LITTERIS
ET
ARTIBUS

Ministry of Education and Science of Ukraine
Lviv Polytechnic National University

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Національний університет "Львівська політехніка"

VII МІЖНАРОДНИЙ
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"LITTERIS ET ARTIBUS"

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23–25 листопада, 2017
Львів, Україна

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ОРГАНІЗАТОРИ ФОРУМУ:

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Наукове товариство студентів, аспірантів, докторантів і молодих вчених

Колегія студентів

Асоціація випускників

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У збірнику опубліковано матеріали наукового форуму, присвяченого проблемам у галузі комп'ютерних наук та інженерії, інформаційних технологій; геодезії, архітектури та будівництва; енергетики та систем керування; гуманітарних та соціальних наук; машинобудування, матеріалознавства, транспорту; економіки та менеджменту; хімії та хімічних технологій; права та психології; екології, природоохоронної діяльності та туризму. Видання призначено для науковців, аспірантів, студентів.

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Rheological Properties of Compositions Based on Modified Polyvinyl Alcohol

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Abstract – developed of a method for producing structured waterproof films based on polyvinyl alcohol (PVA) and montmorillonite-polyvinylpyrrolidone mixture (MPM) to research the impact of borax, pH-environment and MPM content on the rheological properties PVA solutions and water absorption capacity of films based on them. The MPM mixture significantly affects on viscosity the characteristics of the solution polyvinyl alcohol provided their mixing in the ultrasonic field have been established. Composition of traces of sodium tetraborate in the aqueous solution eminent by the highest rates of viscosity. Also, designed compositions considerable influence pH at the viscosity, particularly compositions obtained in weakly alkaline environment with higher values of relative viscosity than compositions obtained in neutral and acidic environments.

Keywords – polyvinyl alcohol, montmorillonite-polyvinylpyrrolidone mixture, modifier, viscosity, exploitation characteristics, borax, heat treatment, film.

I. Introduction

Polyvinyl alcohol (PVA) used in industrial, commercial, healthcare and food sectors and used for the production of many end products such as varnishes, resins, surgical thread and food packaging materials, which are often in contact with food. This polymer is widely used for blending with other polymers to improve the mechanical properties of films obtained through joint structure and hydrophilic properties [1]. PVA is also widely used to produce nanocomposite materials, in particular based on aluminosilicate.

Currently, the focus in the field of layered-silicate nanocomposites of polymer are paying a high level of exfoliation nanoscale particles in a polymer matrix that determines achieve high performance properties. Therefore, the actual problem is the selection of effective organic modifiers layered silicate that provide high adhesion filler with a polymer matrix. In this aspect, considerable interest is the study of the effect of various organic clay of the structure and properties of nanocomposites obtained, the nature of which is not yet fully understood [2]. Identifying these patterns allow to expend control over the structure and predict the properties of composite materials based organic clay.

II. Analysis of recent research

One of the promising directions of polymer science and materials science in recent years is getting organic-inorganic polymer nanocomposites that have a predetermined set of properties [3]. Nanocomposites combine such chemical, physical and mechanical properties that can not be achieved with the introduction of inorganic fillers of macro or microscopic structure.

Intercalation inorganic polymers in laminated materials such as clay minerals – a promising new method of obtaining organic-inorganic nanostructures – supramolecular structures with specific molecular structure [4, 5]. Such an approach causing multifaceted interest. Firstly, there is the practical ability to create layered nanocomposites. Secondly, it is important specificity intercalation and its manifestation in acquiring systems improved physical and chemical properties. Furthermore, the study of these products can provide important information about the nature of chemical interactions in them, specific adsorption of polymers on nanoscale particles and so on. Unfilled polyvinyl alcohol has a glass transition temperature of 70 °C and a melting point of 225 °C. To fully intercalated materials (in which all polymer intercalated in the interlayer space of montmorillonite) based on PVA DSC results do not show any signs of Interphase temperature transitions between 35 °C and 259 °C.

Nanocomposites PVA/MMT has a high light transmission even in the filler content, sufficient for the formation of layered nanocomposites. This is due to the dispersion of particles in a matrix layered silicate cover the nanoscale. Good light transmission allows using nanocomposite materials PVA/MMT for manufacturing paper coating simultaneously with unfilled PVA (which is used now). The presence of MMT particles does not affect the permeability of the composite for the visible spectrum (wavelength 400-700 nm), so there is a high light transmission characteristic of unfilled PVA [6], but significantly increases atmospheric stability.

Previous research has developed a method to obtain water-soluble films based on PVA and and montmorillonite-polyvinylpyrrolidone mixture (MPM), studied their performance properties [6-7]. The aim of this study was to develop a method of producing structured water resistant films based on polyvinyl alcohol (PVA) and montmorillonite-polyvinylpyrrolidone mixture, investigate the impact of borax, MPM content and pH on the rheological properties of PVA solutions.

III. Research Methods

PVA SUNDY 088-20 by Chinese company "Sinopec Sichuan Vinylon Works" (PVA 088-20 – 23 mPa·s) used for obtaining films. Prepared 8% solution of PVA in water and buffer solution with pH 4.4 and 7.9. Dissolution was performed at 60 °C using a magnetic stirrer. To the PVA resulting solution was added MPM in an amount that the ratio of elementary units of PVA to elementary parts PVP system was 16:1, 12:1, 8:1. The resulting mixture was treated with ultrasonic waves of a frequency of 22 kHz on the machine "Volna UZTA 0.4/22 OM" for 3 minutes. Then the mixture was poured into special molds to produce films with plastic lining (to facilitate removal of the finished films form) and air-dried at room temperature. Finished films separated from the form and subjected to heat treatment strove at a temperature of 150 °C for 30 minutes (fig. 1).

Viscosimeterial study of aqueous solutions of PVA was performed using capillary viscometer (capillary diameter – 0.56 mm). Research performed at 25±0,1 °C.
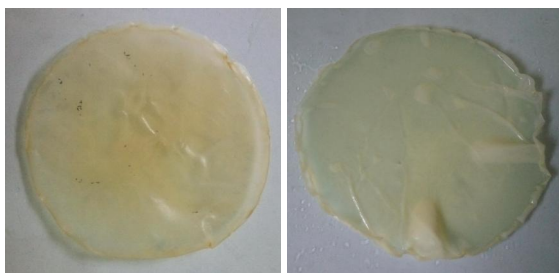
a)   b)

Fig. 1. Samples of films PVA: MPM =12:1
a – after heat treatment at 150 ^{0}C; b – after the extracts in water for 24 hours

IV. Results and discussion

For research were used compositions based on PVA and MPM (PVP:MMT = 5:1) ratio of the number of elementary units of PVA to the number of PVP elementary units in and montmorillonite-polyvinylpyrrolidone mixture as 12:1.

The introduction of modifiers delivered in the processing solutions ultrasonic waves for 3 minutes because this method of mixing ensures satisfactory distribution of particles in the composition.

The lowest values of intrinsic viscosity regardless of environment marked by pure PVA solutions. The introduction of MPM to PVA solution leads to higher viscosity of compositions which can be explained by physical interaction of montmorillonite-polyvinylpyrrolidone mixture of polymer macromolecules in solution under the influence of ultrasound (evidenced by a slight change of color compositions).

It is logical that the highest viscosity solutions are characterized by compositions with traces of sodium tetraborate resulting from the formation of intermolecular chelate compounds by interaction of the -hydroxyl of PVA groups with borate-ions.

Significant effect of pH on the viscosity of the solution of compositions. The lowest values observed intrinsic viscosity of the composition obtained in a neutral environment. Viscosity similar solution compositions in alkaline and acidic environments, virtually the same and is significantly higher.

With aim to determine the permeability and degree of structuring films based on modified PVA investigated their water absorption in cold water. Without treating all the films based on modified PVA dissolved in water independently of pH in which they are received. After heat treatment at 150 ^{0}C for 30 minutes film based on modified PVA only swell in water but not dissolved. From Table 4 we see that the lowest water absorption of film observed PVA:MPM = 12:1, produced in an acidic environment, which correlates well with the results of the mechanical strength of the films [7]. Thus, water absorption of films obtained in acidic medium, 2.5 times lower than the films obtained in a neutral environment. The films based compositions obtained in an alkaline environment also characterized by reduced water absorption, but after treating they slightly yellow, which may indicate partial destruction of PVA. It is also worth noting that films based on PVA modified MPM characterized by lower water absorption than films based on PVA modified pure MMT. So the best environment to produce structured films based on modified PVA is acidic buffer solution, a modifier – MPM ratio PVA:MPM = 12:1 (the number of elementary units of PVA to PVP).

Conclusion

Thus, experimental studies found that montmorillonite-polyvinylpyrrolidone mixture significantly affects the characteristics of the solution viscosity polyvinyl alcohol provided their mixing in the ultrasonic field. Composition of traces of sodium tetraborate in the aqueous solution of the highest rates of viscosity. Also on the viscosity of designed compositions, pH environment commits considerable influence, especially composition obtained in weakly alkaline environment with higher values of relative viscosity than compositions obtained in neutral and acidic environments. Simultaneously, water resistance and mechanical properties of films obtained in an acidic environment is best. The optimal from the standpoint of durability and water resistance is a composition of PVA:MPM=12:1 and depending on the content as MPM and pH characteristics of films based on PVA can be adjusted over a wide range, which would expand the scope..

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Cross-Linked Polymer Hydrogels with Embedded Semiconductor Nanocrystals

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Abstract – Cross-linked hydrogels containing metal cations were synthesized via radical copolymerization of hydrophilic monomers and nanocomposite hydrogels were obtained on their basis using in situ sol-gel synthesis of semiconductor nanocrystals directly in hydrogel matrices. The influence of metal ions onto copolymerization kinetics and hydrogel cross-linking degree was studied. It was shown that nanocrystal size depends to a large extent on the density of hydrogel network.

Keywords – cross-linked hydrogels, copolymers, radical copolymerization, nanocomposites, semiconductor nanocrystals.

I. Introduction

In recent years, nanocomposites based on semiconductor nanoparticles (NP) and polymeric matrices of various nature are attracting many researchers, since they can serve as substitutes for organic substances in optoelectronic devices, biological indicators, etc [1, 2]. Despite the existence of a number of methods for the formation of nanocomposite materials, the development of science and technology requires the creation of simple and accessible methods of obtaining polymer-mineral composites with improved characteristics. Among them, sol-gel methods of synthesis of mineral nanoparticles in conditions of limited growth of crystals in polymer matrices, which allow controlling the shape, size, size distribution of nanoparticles have attracted increasing attention.

II. Experimental

Synthesis of cross-linked hydrogels based on acrylamide (AcAm) and acrylic acid (AA) as polymer matrice was carried out by radical copolymerization in water at 333K in the presence of metal salt $Cd(CH_3COO)_2$. Structural agent N,N'-methylene-bis-acrylamide (MBA) (0.5-2% per monomers) was used to obtain structured hydrogels. The resulting hydrogels were placed in a desiccator over 10% aqueous Na_2S solution for 6 hours at 333 K. Due to the interaction of Cd^{2+} ions incorporated in the hydrogel with the gaseous H_2S CdS nanocrystals (NC) were formed in the hydrogel.

The elastic properties (compression ability) of structured hydrogels were determined as follows: samples of obtained hydrogels (cylinders with a diameter of 9 mm and a height of 10-12 mm) were placed under press. The height of the sample at different loads was measured. Relative deformation was determined by the equation:

$$\varepsilon = ((h_{in} - h_{compr})/h_{in}) \cdot 100\%$$

where h_{in} is the height of a sample of a hydrogel without a load, h_{compr} is the height of the loaded sample.

Optical spectra of nanocomposite hydrogels were obtained using Specord-M40 spectrophotometer. The size of the CdS NC (D, nm) synthesized in the hydrogel was determined from absorption maximum values in optical spectra of samples of hydrogels (cylinders with a diameter of 9 mm and height of 2 mm) using the equation:

$$D = -6,6521 \cdot 10^{-8} \cdot \lambda^3 + 1,9557 \cdot 10^{-4} \cdot \lambda^2 - 9,2352 \cdot 10^{-2} \cdot \lambda + 13,29$$

where λ is the wavelength of the adsorption maximum in the absorption spectrum.

III. Results and Discussion

The results of the study of copolymerization kinetics indicate (Fig. 1) that in the case of introduction of 10% cadmium acetate into reaction mixture the rate of copolymerization of acryl amide with acrylic acid decreased by 30-50%. And further increase of metal salt concentration up to 25% has a little effect on the kinetics of the process.
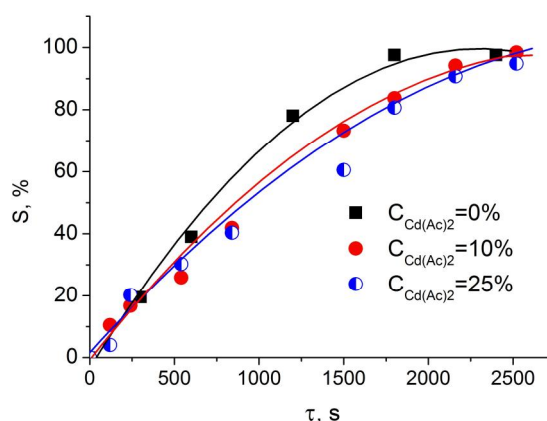
Fig. 1. Kinetics of copolymerization of AcAm with AA at different content of precursor $Cd(Ac)_2$. [AcAm]: [AA] = 90: 10

The gel-fraction value of copolymers obtained in the presence of cadmium acetate was lower than in the case of its absence and was equal to 58-66% depending on MBA content. Taking into account that metal salt introduction decreased copolymerization rate one can conclude that cadmium acetate inhibited radical reaction of polymerization and cross-linking.
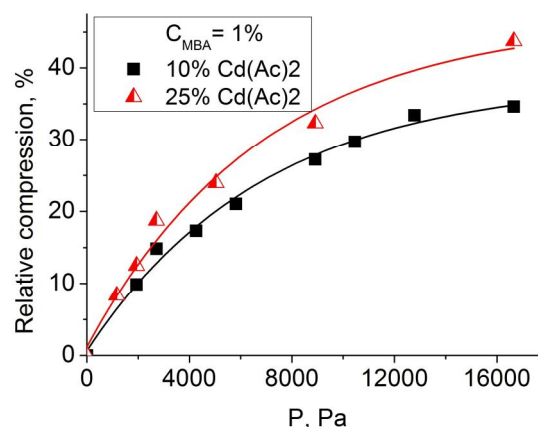
Fig. 2. Dependence of relative compression of p(AcAm-AA) hydrogels containing Cd^{2+} ions on Cd (Ac)$_2$ concentration

The curves of relative compression dependency of hydrogels containing Cd ions on load (Fig. 2) have classic look like those obtained for hydrogels without metal ions. But absolute values are essentially higher and increase with the increase of salt content that witness in favor of assumption about inhibiting influence of $Cd(Ac)_2$ on the process of hydrogel polymer cross-linking

As a result of the treatment of hydrogels containing Cd^{2+} ions with gaseous hydrogen sulfide CdS nanocrystals were formed in the volume of hydrogel that was proved by the change of sample color from colorless to yellow (Fig. 3). The color intensity increased with the growth of the concentration of cadmium acetate in initial reaction mixture

Fig. 3. Samples of structured poly(AcAm-AA) hydrogels filled with CdS nanoparticles ($Cd(Ac)_2 = 25\%$ (left), 10% (right))

Optical spectra of filled hydrogels proved the formation in them of CdS nanocrystals – the absorption bands in the range of 425-460 nm are present in spectra that corresponds to nanocrystal size of 4.3-5.7 nm (Table 1). Besides, with the increase of cross-linking agent concentration (i.e. enhancement of curing degree of hydrogels) we observed hypsochromic shift of absorption. The shift of this peak into the range of higher energies is caused by quantum-size effect of CdS NC and witnesses about the decrease of the size of nanocrystals embedded into hydrogel.

TABLE 1

Dependence of CdS NC size on concentration of cross-linker MBA and Cd(Ac)$_2$ precursor

MBA content, %	$C_{Cd(Ac)2}$, %	λ_{max}, nm	D_{NC}, nm
0,5	10	437,3	4,7
0,5	25	445	5,1
1,0	25	440	4,9
2,0	10	425,4	4,3

The values of relative compression for hydrogel with CdS nanoparticles are essentially higher than that for hydrogels with metal ions only (Fig. 4). On our point of view it can be due to the breaking at the formation of CdS NC of the salt and coordination bonds between Cd^{2+} ions and polar carboxylic groups of acrylic acid which also participate in the formation of 3D network. After breaking of these bonds the rigidity of mesh structure decreased

significantly that caused the ability of hydrogels to compression.
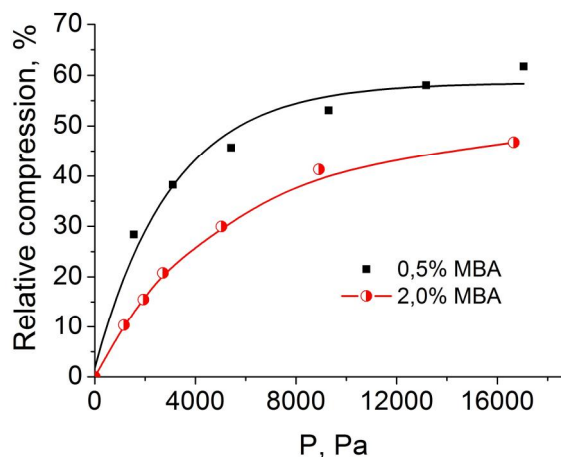
Fig. 4. Dependence of relative compression of p(AcAm-AA) hydrogels containing CdS NC on MBA concentration

But at the same time such samples are elastic and after unloading restored their size and shape (Fig. 5).
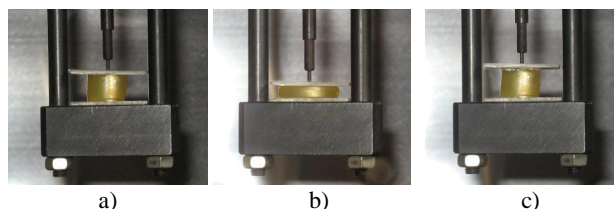
Fig. 5. Samples of p(AcAm-AA) hydrogel with CdS NC before loading (a); under pressure P=16,5 kPa (b), after unloading (c)

Conclusion

Thus, cross-linked nanocomposite hydrogels with embedded semiconductor nanocrystals were obtained via in situ synthesis of CdS nanocrystals in hydrogel polymer matrices. Studies of copolymerization kinetics indicate that the introduction of Cd^{2+} salt into monomer mixture reduces the rate of copolymerization and degree of hydrogel crosslinking. It is shown that the size of semiconductor nanocrystals is largely determined by the density of the hydrogel network. The formation of CdS NC leads to reduction in the stiffness of hydrogels due to the destruction of salt and coordination bonds between Cd^{2+} and the polar functional groups of copolymers.

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Peculiarites of Benzene Decomposition in Cavitation Fields

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Abstract – It is proposed to carry out treatment of wastewaters, containing of aromatic compounds, in particular benzene, in cavitation fields. The results of studies of the cavitational decomposition of benzene under isothermal conditions (at temperatures 303, 313 and 323 K) are presented. The extremal characterof the dependence of the degree of decomposition of benzene from temperature with a minimum of 313 K is established. An abnormal appearance of the dependence is explained by possibility of occurrence of secondary processes , namely the formation of gas bubbles of nanometer sizes (babstons) and their clusters, which have high mechanical resistance and diffusivityy, and also on the basis of the kinetic theory of Frenkel's fluid.Recommendations for the implementation of the benzene decomposition process in cavitation fields are formulated on the basis of the results of experimental studies.

Keywords – cavitation fields, decomposition, benzene, ultrasonic magnetostrictive emitter, stationary treatment mode.

I. Introduction

Benzene and its derivatives (toluene, phenol, etc.), dispersed and emulsified in aqueous media, are the main pollutants of sewage from chemical enterprises and, in particular, petrochemicals. They suppress the respiratory activity of hydrobionts and lead to changes of kind and trophic structure of biogeocoenoses. Processes of oxidation of aromatic compounds are actively used for the treatment of such wastewaters. The effectiveness of oxidation of inorganic (sodium sulfite) and organic (phenol, cresol, toluene) compounds in cavitation fields has been confirmed by numerous studies [1-3]. As a result of the sonolysis of water molecules in cavitation fields, highly reactive compounds (atomic oxygen, hydroxyl radicals, ozone, etc.) are formed which have properties of oxidants-destructors. Thus, it has been established that benzene, which is contained in an aqueous medium, in the presence of atomic Oxygen decomposes with the disclosure of the benzene ring [3].

The purpose of the research was to study the process of decomposition of benzene in cavitation fields under isothermal conditions.

II. Research results

Investigation of the benzene decomposition in cavitation fields under isothermal conditions was carried out on the example of an imitation system of wastewater containing benzene, mol C6H6 / m3 H2Odistilled: for 303 K – 8.37; for 313 K – 7.26; for 323 K – 6.63. Ultrasonic Magnetostrictive Emitter "Ultrasonic Disintegrator UD-20" was used as a cavitation generator. The mode of cavitation treatment is stationary, that means that process parameters, such as the frequency of ultrasonic oscillations and the specific power of the ultrasound generator, are constant over time and equal respectively 22 kHz and 68 kW / m^3. The duration of cavitation treatment was 1800 sec. The concentration of benzene in the imitation of waste water during cavitation treatment was determined by UV / Viz spectroscopy using a SPECORD M40 Carl Zeiss JENA two-beam spectrophotometer with a 10 mm quartz cuvette in the wavelength range of 200-400 nm.

The dependence of the benzene concentration in the imitation (C, mol /m^3) on the duration of cavitation treatment (t, s) under isothermal conditions is shown in Fig. 1.
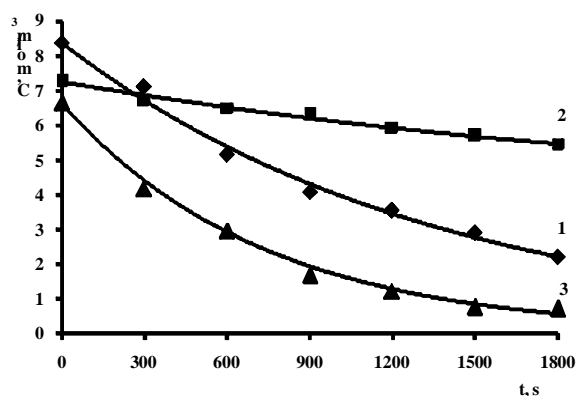
Fig.1. The dependence of the benzene concentration (C, mol / m^3) in the imitation from the duration of cavitation treatment (t, s) under temperature, K:
1 – 303; 2 – 313; 3 – 323

A decrease in the concentration of benzene in the imitation due to cavitation treatment at different temperatures was found, mol / m3: at 303 K – by 6.18 (from 8.37 to 2.19); for 313 K – by 1.8 (from 7.26 to 5.46); for 323 K – by 5.92 (from 6.63 to 0.71). The degree of benzene decomposition is, respectively, %: for 303 K – 73.8; for 313 K – 24.8; for 323 K – 89.3. The nature of the change in the benzene concentration at 303 and 323 K is exponential, and at 313 K − linear.

The minimum degree of benzene decomposition in the cavitation fields and the linear nature of its concentration change at a temperature of 313 K indicate a flow in the system of various secondary processes, which consumes the energy brought to the reaction system. The main process is the formation of babstons – stable gas nano-bubbles. Babstones stability is due to adsorption on their surface of ions with one sign. As a result, there are forces

of Coulomb repulsion that act along the surface of babston. They are compensated by the forces of surface tension, which also contributes to the mechanical balance of the babston. The gas pressure inside the separate babston is equal to the pressure of the gas above the surface of the liquid after achievement of mechanical equilibrium. This provides a diffusion (relative to the gas inside the bobston and gas dissolved in the liquid) stability of the babston. The action of frictional forces, which, of course, are present during cavitation treatment, leads to the appearance of an electric charge on the surface of the babston and the formation of a layer of counterions as a result of the Coulomb attraction. Counterions are result of the sonolysis of water molecules in the cavitation fields. The coagulation of babstons with the formation of bubonet clusters in deeply purified water is confirmed by the method of modulation interference microscopy [4]. The presence of new structural entities (babston clusters) in aqueous media is also indicated by a decrease of sound absorption coefficient in 4 times in the temperature range from 273 to 313 K [5]. The diffusion and mechanical resistance of babston and their clusters prevents their growth with forming of cavitation bubbles capable of spraying with high pressure and temperature gradients, and, hence, the proportion of high reactive compounds, in particular oxidative compounds, decreases. This is also reflected by the results of the cavitation destruction of benzene at 313 K. At further rise of temperature to 323 K, cluster structures are destroyed [5], which facilitates the development of cavitation phenomena and contributes to a significant increase in the degree of decomposition of benzene.

The extreme nature of the change in the degree of decomposition of benzene in cavitation fields with a minimum of 313 K can also be explained on the basis of the kinetic theory of Frenkel's fluid. According to this theory, water in a liquid state exists simultaneously in the form of two equilibrium phases – liquid and quasicrystal by analogy with quasicrystals, whose crystal lattice has axes of symmetry of various orders and which is characterized by orderliness in the mutual arrangement of atoms and molecules. In the region of physiological temperatures of 308-314 K, water reaches a state in which the masses of quasicrystalline and liquid water are the same, and the ability of one structure to pass into another (variability) is maximal [6]. With increasing temperature, the proportion of liquid water, which is characterized by thermal fluctuations of the molecules, increases, and, accordingly, the probability of formation of new cavitation nucleus increases.

Conclusions

Consequently, the process of decomposition of benzene in cavitation fields is highly effective (maximum decomposition rate is 89.3%). The extreme nature of the dependence of the degree of benzene decomposition on the temperature of the reaction system indicates the course of the secondary processes, in particular the formation of gas nanobulls (babstons) and their coalescence with the formation of clusters for which mechanical and diffusion stability is characteristic. Therefore, in order to prevent unproductive expenses of energy, the process of cavitation treatment should be carried out at temperatures lower or higher than 313 K (303 and 323 K in the studied range).

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Modeling of Heterogeneous Catalytic Recovery Process of Ketones

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Abstract – The article considers the mathematical model of the recovery reaction of cyclohexanole by the Meerwein-Ponndorf-Verley mechanism. The activity of the three catalysts in the presence of which the reaction of cyclohexanole recovery took place has been analyzed and selected the most active zeolite for further calculations. With the use of Mathcad 15.0 software the rate constants of investigated reaction has been calculated.

Keywords – Meerwein-Ponndorf-Verley mechanism, inverse problem of kinetics, rate constant, heterogeneous catalysis, zeolites.

I. Introduction

In the catalysis and green chemistry, there is a need for environmentally friendly technologies in order to obtain substances using the heterogeneous catalysts.

In the synthesis of organic substances with a homogeneous catalyst is often necessary to use an additional solvent and restore the catalyst due to its deactivation. These problems considerably complicate the process of obtaining organic compounds.

In contrast to the homogeneous catalyst, the heterogeneous catalyst can be reused and it is much easier to separate this catalyst from the reaction products (with application of mechanical methods of separation) [1].

Promising catalysts of several processes of fine organic synthesis are zeolites which provide a high degree of conversion. Therefore, the development of new catalysts and exploring catalytic properties is a relevant task.

At the Institute of Physical Chemistry of the Ukrainian NAN (Kyiv, Ukraine), the zeolite systems of structural group beta (β), which incorporated ions of metals, were investigated: Sn and Al. The main difference between the given zeolites from those already known is the dual structure of porosity (they have micro- and meso- pores).

The purpose of research is modelling of heterogeneous catalytic recovery process of cyclohexanone and calculation of the reaction rate constants.

To accomplish the set aim, the following tasks were formulated:

– to conduct experimental study of the recovery reaction of cyclohexanone to cyclohexanole in the presence of various zeolite catalysts;
– to process the obtained experimental data and to calculate the rate constants of the examined reactions, using the developed mathematical model in the automated mathematical software package MathCad 15.0 (USA);
– to analyze the received results of calculations and to choose the most efficient catalyst.

II. Mathematical model

Selective recovery of carbonyl compounds to alcohols in the presence of alcoholates is commonly called the restoration of ketones by the Meerwein-Ponndorf-Verley (MPV) mechanism [2].

During carrying out of scientific – research experiment on the recovery of cyclohexanone through the MPV mechanism on SnAl zeolite catalyst it has been obtained the values of conversion degrees (Table 1) of component A in Eq. (1) at different time for three different zeolite catalysts:

– Sn-MgAl($C_4H_{10}O$) (in Table I – Catalyst 1);
– Sn-MgAl(SiO_4) (in Table I – Catalyst 2);
– Sn-MgAl(CO_3) (in Table I – Catalyst 3).

Mechanism of the recovery reaction of cyclohexanone is as follows:

$$A \xrightarrow[{-H_2O}]{+izo\ propanol} B \qquad (1)$$
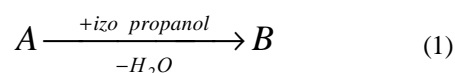
where A – cyclohexanone; B – cyclohexanole.

In Table I by the X, % marked the values of conversion degrees

TABLE 1

CONVERSION OF CYCLOHEXANONE

Catalyst 1		Catalyst 2		Catalyst 3	
t, h	X, %	t, h	X, %	t, h	X, %
0	0	0	0	0	0
0,5	10,75	1	10,09	4	65,46
1,17	20,12	2	16,68	10	89,2
2,25	34,43	4	30,99	-	-
4	44,91	6	38,73	-	-
6	53,54	8	57,55	-	-
8	63,03	10	62,2	-	-
10	67,16	-	-	-	-

As a result the mathematical model of this process has been obtained.

The assumptions that have been nominated in the construction of a mathematical model of the recovery process of the recovery process of cyclohexanone [3]:

– a layer of catalyst is the quasi-homogeneous medium, which is why in a mathematical model the catalyst surface area can be ignored;
– since isopropanol is fed to the reactor in excess, then the change in its concentration can be considered negligible and it can be neglected;
– a layer of catalyst is isothermal;
– the displacement of substance occurs under an ideal agitation mode;
– the transfer of substance along the axial direction is not considered.

Mathematical model of the recovery process of cyclohexanone to cyclohexanole takes the following form Eq. (2).

Initial conditions for mathematical model (2):

– $C_A(0)=0.3$ kmol/m^3 is the starting concentration of component A in reaction Eq. (1);

– $C_B(0)=0$ kmol/m^3 is the starting concentration of component B in reaction Eq. (1).

$$\begin{cases} \dfrac{dCa}{dt} = -k_1 \cdot Ca \\[2mm] \dfrac{dCb}{dt} = k_1 \cdot Ca \end{cases} \quad (2)$$

With using of mathematical model Eq. (2) the rate constant has been calculated.

It should be noted that by performing the rate constants calculation of cyclohexanone recovery reaction by the model Eq. (2) for various catalysts will be obtained different values of rate constants, as well as more effective catalyst, the value of the constant is greater.

In order to calculate the rate constants is necessary to recalculate conversion degree of reaction components to molar concentrations. Fragments of the calculating the concentration of cyclohexanole and cyclohexanone in the MathCad 15.0 software for one of the catalysts are shown in Figure 1.
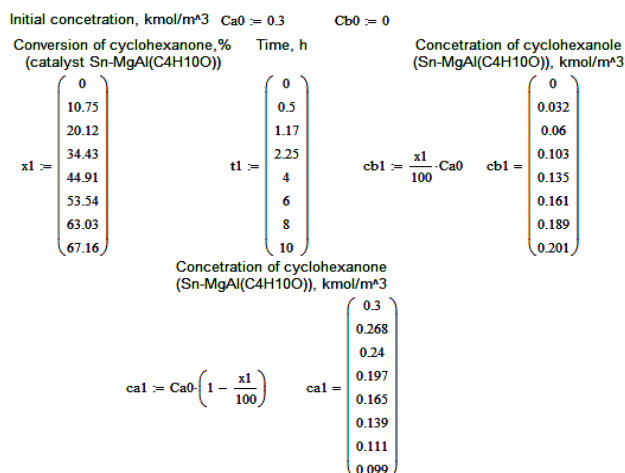
Fig.1 Calculation in the MathCad 15.0 programming environment of the component concentrations for catalyst Sn-MgAl(C$_4$H$_{10}$O).

Data given in Fig.1 were used to calculate the rate constants in the MathCad 15.0 programming environment.

III. Results of rate constants calculation

By using the calculated values of cyclohexanone and cyclohexanole concentrations, given in Table 2, in the MathCad 15.0 programming environment we calculated the rate constants of reaction Eq. (1) for three zeolite catalysts. We employed the listing given in [4] for the calculation. The obtained constants are given in Table 2.

TABLE 2

CALCULATED RATE CONSTANTS

Catalyst	Rate constants, s^{-1}
Sn-MgAl(C$_4$H$_{10}$O)	0,1340
Sn-MgAl(CO$_3$)	0,2544
Sn-MgAl(SiO$_4$)	0,0953

Analysis of the received values of constants is given bellow.

The maximum concentration of the product of reaction (cyclohexanole) is achieved when using the zeolite catalyst Sn-MgAl(CO$_3$). The maximum concentration of cyclohexanole is 0.2676 kmol/m^3. Such value is achieved within 10 hours of the reaction course. The second best in performance is the catalyst Sn-MgAl(C$_4$H$_{10}$O) (the maximum value of concentration of the product of reaction is 0.2015 kmol/m^3. The worst catalyst for this process is the zeolite Sn-MgAl(SiO$_4$).

Finally, the mathematical model Eq. (2) with considering the calculated rate constant (for the Sn-MgAl(CO$_3$) catalyst) will be as follows:

$$\begin{cases} \dfrac{dCa}{dt} = -0{,}24415 \cdot Ca \\[2mm] \dfrac{dCb}{dt} = 0{,}24415 \cdot Ca \end{cases} \quad (3)$$

The adequacy of the mathematical model Eq. (3) has been proved by Fisher's criterion.

Conclusion

We examined the recovery reaction of cyclohexanone to cyclohexanole by the MPV mechanism in the presence of three new zeolite catalysts: Sn-MgAl(C$_4$H$_{10}$O), Sn-MgAl(SiO$_4$), Sn-MgAl(CO$_3$), which have a dual structure of porosity. Experimental data are obtained (conversion degrees of cyclohexanone), which were recalculated into concentrations (kmol/m^3) and used to calculate the rate constants in the MathCad 15.0 programming environment.

The calculated values of the rate constants can be used to solve the direct problem of chemical kinetics, as well as for modelling of chemical reactors.

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Investigation of the Activation Efficiency of Powdered Polyvinylchloride

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Abstract – the purpose of these studies is to determine the mechanical activation characteristics of powdered suspension polyvinylchloride with zinc. The studying method of the powdered polymeric raw material's mechanical activation effectiveness with fine metal powders is developed, according to which the influence of the powdered polyvinyl chloride and finely divided zinc ratio, the time of the mixture treatment, as well as the degree of a ball mill loading on the activation efficiency of the polymer surface has been investigated. The optimal processing time of powdered polyvinyl chloride in a ball mill during the activation of fine zinc has been established.

Keywords – polymer composites, activation, PVC, zinc, ball mill.

I. Introduction

The analysis of trends in the development of promising materials and technologies indicates the widespread use of polymer composites, of which the metal-filled polymeric materials are of particular interest. A wide range of practical use of such materials contributes to its inherent complex of valuable properties.

In the simplest case, the metal-filled polymer composite consists of finely dispersed metal particles that are uniformly distributed in the polymer matrix. Traditionally, metal-filled polymer composites are produced by the following methods:

1. Mechanical mixing of a metal filler with powders, solutions or melting of polymers.

2. Thermal or electrolytic reduction of metals from their compounds, that were previously dispersed in liquid resins, solutions or molten polymers.

3. Impregnation of metal harnesses, fabrics or porous metals with solutions or melting of polymers.

The feature of metal filled polymer composites is that at low concentrations of metal particles, they remain isolated from each other and do not contribute to the conductivity of the system, and at the next increased concentration of the filler, the mechanical properties of the system deteriorate sharply.

The creation of metal filled composite materials with high technological and operational properties requires the development of alternative technological solutions for their obtaining. The main disadvantage of traditional technologies for the production of metal-filled composites is a significant reduction in their mechanical properties, as well as high concentrations of reaching the threshold of percolation. A new technology for the production of metal-filled polymeric composites is proposed by metallization of polymeric raw materials and its subsequent processing directly into products [1-3].

As a result, the process of combining of the components is significantly facilitated and the uniform distribution of the metal filler in the polymer matrix is provided (Fig. 1). This technology relates to highly effective, resource-saving technological processes and is characterized by a reduced production cycle.
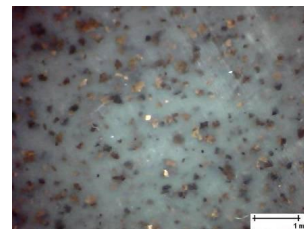
Fig. 1. Microphotography of metal-filled PVC composite (5 mass. % of copper)

II. Powdered PVC activation

The creation of polymeric composites combining good conductive (electrical and thermal conductive) and mechanical properties is a complex task and represents a considerable practical interest. One of the effective methods for solving the problem is the development of new technological solutions for the production of metal-filled polymer composites using a simple technology for activating the polymeric surface.

Powder-like suspension PVC was used for research. Activation of the polymer surface was carried out in a laboratory ball mill with ceramic cylindrical grinding bodies. Suspended PVC and metal activator (zinc powder of the brand PZ-2) was loaded into the mill. During the rotation of the mill there was a metal activator on the polymeric surface.

The use of powdered PVC poses a difficult task for studying of the activation process. Since both the polymer and the metal-activator are powder-like products, it is unclear whether, in the process of processing in a ball mill, there is fixation of metal particles on the polymeric surface (activation), or a mechanical mixture of components is formed.

The formation of a mechanical mixture during processing in a mill is unacceptable, since in this case, during the subsequent metal deposition in chemical recovery solutions [2], there will be no polymeric surface, which eliminates all the advantages of the proposed technology.

Investigation of the activation effectiveness of powdered polymers was carried out using an installation that provides the possibility of transferring the activated polymer powder to a fluidized state with simultaneous vibration exposure (Fig. 2). The need for simultaneous use of vibration and fluidization is caused by the sealing of a powder-like polymer layer due to vibration, which prevents the system from being split into separate density fractions. The transfer of the test mixture to the fluidized state provides the necessary mobility of the components, which contributes to the rapid and maximally complete separation of the system by density.
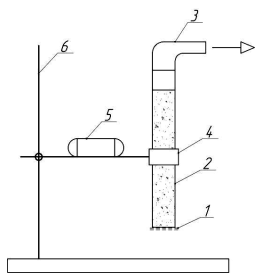
Fig. 2. Installation for separation of the activated
powdered polymer on a density fractions
1 – tissue filter, 2 – separation cylinder, 3 – connection of the
vacuum pump, 4 – holder, 5 – vibrator, 7 – tripod.

Using only fluidization to separate the system by density is also less effective because of the presence of significant circulation flows, which, due to the small size of the metal particles, contributes to the mixing of individual fractions. The velocity of air flowing through the polymer layer should prevent the compaction and provide the required mobility of the components of the system (polymer, metal, polymer with metal) for the possibility of their separation under the action of vibration and does not cause a significant circulation in the layer, resulting in a density equalization the height of the material layer.

The design of the installation also enables the unloading of individual fractions, which are divided in the height of the cylinder by density. After unloading, the percentages of metal in each fraction were determined. The activation efficiency was estimated by the difference in the content of the metal in the upper and lower fractions.

In order to evaluate the activation efficiency of powdered polymeric raw materials, a number of studies has been conducted on the activation of PVC powder with a different amount of finely divided zinc.

It has been established that the activation efficiency increases with an increase in the amount of zinc in the mixture. This can be explained by the fact that at low zinc levels, it is not sufficient for the uniform activation of all polyvinyl chloride. There is a certain amount of pure polymer that is unbound (not activated) with particles of zinc. With an increase in zinc content in the composition, the proportion of such unactivated PVC decreases, which leads to an increase in the activation efficiency.

Microscopic studies, carried out using a scanning electron microscope in the mode of contrast on the average atomic number (Fig. 3), showed the presence of zinc particles on the surface of polyvinylchloride, and can confirm the activation of the polymer surface by zinc powder.
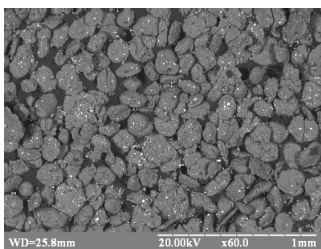
Fig. 3. Microphotographs of zinc activated
suspension PVC surface produced in the mode
of contrast on the average atomic number

In order to intensify the process of suspension PVC activation, the effect of technological activation parameters was investigated. Namely, the speed of rotation in a ball mill, as well as increased loading of grinding balls and a mixture of polymer with metal activator. The speed of rotation in a ball mill is found to have the greatest influence on the activation efficiency in the range of 60-100 rpm, and the subsequent increase in the speed does not significantly affect the activation efficiency.

In the case of an increase in the degree of ball mills loading, as grinding balls, and the initial mixture, the activation efficiency increases slightly. In addition, it should be borne in mind that with a greater degree of load of the mill with a mixture of polymer with metal, the efficiency of the use of equipment and the reduction of energy costs increases.

Conclusions

Thus, the studies confirm that in the process of mechanical activation of suspension polyvinyl chloride with fine zinc in a ball mill there is a strong interaction between the surface of the polymer and the metal-activator. Such interaction is a prerequisite for the next stage of metallization and the production of metal-filled polymer composites with high performance. The activation efficiency is largely determined by the speed, the degree of loading and the ratio of components, which allows to set the optimal parameters for the process.

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Anthraquinonylhydrazones of α-Active Ketones and β-Carbonyl-containing Compunds: Synthesis and Antioxidant Activity

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Abstract − An effective method for the synthesis of 1-anthraquinonyl hydrazones containing the acyl- and/or ethoxycarbonyl, carbo- and heterocyclic fragments in the ylidene moiety has been shown, which are convenient reagents for further chemical transformations. Investigation of the antioxidant activity of hydrazones has allowed to identify promising compounds that can be suggested for further research as antioxidant substances.

Keywords − 9,10-anthraquinone, diazonium salt, hydrazone, α-active ketones, β-carbonylcontaining compunds, antioxidant activity.

I. Introduction

Hydrazones as functional derivatives of the hydrazine are widely used in the synthesis of heterocyclic compounds [1]; some hydrazones exhibit a broad spectrum of biological activity [2]. Compounds of the 9,10-anthraquinone series are known to possess a combination of practically important properties [3]; they have been shown to be promising for various applications, in particular for use as medicinal agents [4]. The anthraquinone ring system is an important scaffold for the design of new biologically active compounds, which strongly stimulates synthesis of new derivatives. Syntheses of anthraquinone hydrazones from the anthrone and its derivatives have been reported in [5–7]. Vorob'eva et al. [8] developed a procedure for the synthesis of ethyl pyruvate anthraquinonylhydrazone via the Japp–Klingemann reaction of 9,10-anthraquione-2-diazonium chloride with ethyl methylacetoacetate in acid medium. However, anthraquinonylhydrazones have not been reported, presumably due to their ability to readily undergo intramolecular cyclization [9].

II. Results and discussion

Herein we propose an efficient method for the synthesis of previously unknown 1-anthraquinonylhydrazones containing in the ylidene moiety acyl and/or ester fragments (Eq. (1)). The reactions of freshly prepared 9,10-dioxo-9,10-dihydroanthracene-1-diazonium hydrogen sulfates **1**, **2** [10] with acetone **3a**, butan-2-one **3b**, acetylacetone **3c**, diethyl malonate **3d**, and ethyl acetoacetate **3e** at a ratio of 1 : 3 in water at 0–5°C in the absence of a base afforded hydrazones **4a–e, 5a-e** in 62–71% yields.

$$1 \ (R_1=H),\ 2 \ (R_1=COOH) \qquad 3a\text{-}e \qquad (1)$$

R$_2$=Me, R$_3$=H (a);
R$_3$=H, R$_2$=Et (b);
R$_2$=Me, R$_3$=C(O)Me (c);
R$_2$=OEt, R$_3$=C(O)OEt (d);
R$_2$=OEt, R$_3$=CN (e)

4a-e (R^l=H), 5a-e (R^l=COOH)
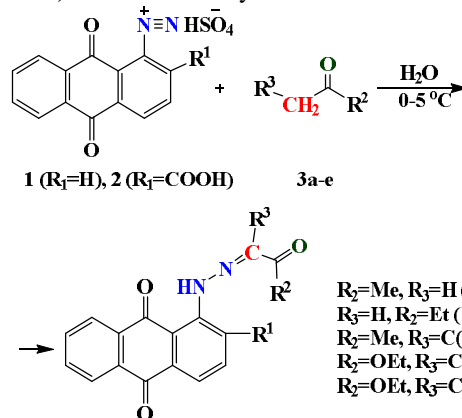
The reaction time depended on the initial carbonyl compound. The reactions with less acidic ketones **3a** and **3b** were completed in 40–45 min, and with 1,3-dicarbonyl compounds **3c**–**3e** in 10–15 min.

The formation of hydrazones **4a-e**, **5a-e** is confirmed by the data of the ^{1}H and ^{13}C NMR spectra, as well as the presence of the corresponding molecular peaks in the LC-MS spectra. The signal of the ylidene proton in compounds **4a,b** and **5a,b** are superimposed with protons of the anthracenedione fragment and are located within the range of 7.71-7.92 ppm. The signal of proton in the amino group of anthraquinonylhydrazones **4a-e**, **5a-e** with acyl substituents in the ylidene moiety is resonated as a broad singlet within the range of 12.29-12.79 ppm, and for compounds **4d,e** the chemical shift increse to the region of the weak field at 14.28-14.48 ppm. In the IR spectra of hydrazons there are absorption bands of the secondary amino group at 3310-3370 cm^{-1}.

In order to modify the anthraquinonylhydrazones by new pharmacophores, in particular, carbonic and heterocyclic fragments, reactions of the 1-amino-9.10-anthracenedione **1** and **2** diazonium salt with cyclic β-di-carbonyl compounds **6a-c** − 5,5-dimethyl-1,3-cyclohexa-nedione, 2,4,6-pyrimidintrione, 2-thioxopyrimidine-4,6-dione (Eq. (2)). The analysis of the ^{1}H and ^{13}C NMR spectra of the obtained hydrazons **7a-c**, **8a-c** allowed to establish the following: the 5,5-dimethyl-1,3-cyclo-hexanedione fragment in anthraquinonyl-hydrazone **7a** in DMSO-d_6 solution exists exclusively in a ketone form. A similar situation is observed for hydrazone **8a**. In the ^{1}H NMR spectra of compounds **7b,c** and **8b,c** in DMSO-d_6, in addition to the NH signal of the hydrazinyl moiety in the weak field, the signals of exchange protons were observed, which is evidence of the formation of keto-enol tautomeric forms.

$$(2)$$

Antioxidant capacity and for inhibitory activities against catalase enzyme using the CUPRAC method. The synthesized compounds 5d, 8a and 8b exhibited better antioxidant capacity than the other compounds. The results revealed that 8b exhibited high CAT inhibition activity compared to the other compounds.
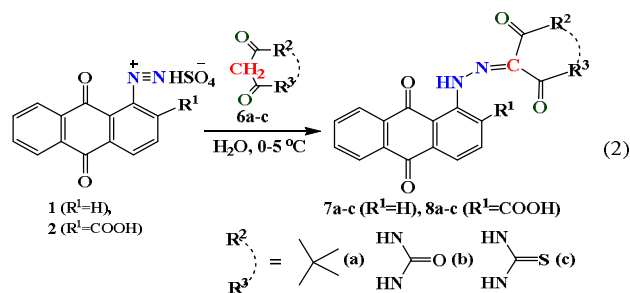
Antioxidant activity

Antioxidant capacity of the synthesized compounds were determined by comparing with Trolox as the standard reference compound using CUPRAC assay (at room temperature) [11]. The CUPRAC molar absorption coefficient (ε) of the tested compound divided by that of TR under the same conditions gave the TEAC-CUPRAC values (Fig. 1).
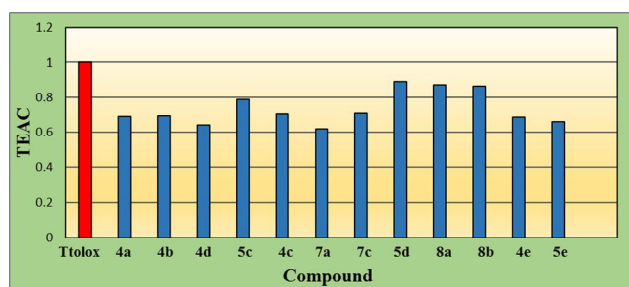
Fig. 1. The TEAC coefficients of the hydrazones with respect to the CUPRAC assay
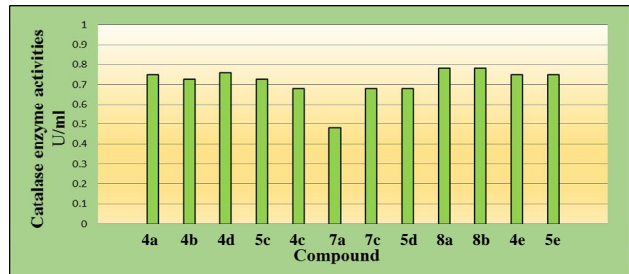
Fig. 2. Catalase enzyme activities (U mL^{-1}) of hydrazones

Amongst the compounds screened for a antioxidant capacity, **5d, 8a** and **8b** exhibited the highest antioxidant capacities and the TEAC coefficients of these compounds were TEAC = 0.86, 0.89, 0.87 (Fig. 1). Also, studies on the effect of catalase activity, which is an integral part of antioxidant protection in cells, were carried out using the CUPRAC method [12]. The results (Fig. 2) showed that the highest activity was characteristic of compound **8b** (0.89 U/ml), and the lowest – hydrazone of dimetidon **7a** (0.48 U/ml).

Conclusion

A convenient way of obtaining a number of new anthraquinonylhydrazones by combining diazonium salt with α-active ketones and β-dicarbonyl compounds in an aqueous medium under mild conditions is proposed. All the synthesized compounds were tested for their

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Influence of the Vibration Source Location on the Modes of Jet Disintegration in the Priller and on Monodispersity of the Finished Product

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Abstract — Influence of the vibration source location on the modes of liquid jets disintegration and obtaining monodisperse droplets and granules of the finished product is theoretically grounded and experimentally confirmed. The experiment was conducted on an experimental stand of industrial granulation equipment.

Keywords — forced perturbations, priller, regular hits, jet disintegration, monodispersity, satellite droplets.

I. Introduction

Currently the use of nitrogen-containing fertilizers is growing every year and further growth is expected according to the investigation conducted by BMI Research.

The most widespread methods of nitrogen fertilizers (ammonium nitrate, carbamide, NPK) production are prilling in towers and granulation (using fluidized bed granulator or drum granulator). Advantages and disadvantages of the listed methods are presented in [1].

Prilling method involves dispersing and cooling of the melt spherical droplets in a free fall and their crystallization in a counterflow of cooling air.

Modern prilling towers are equipped with prillers located at the top of the tower and melt droplets are produced by them (prillers).

The priller has a perforated bottom (bucket) and melt jets are outflowing from its holes and under influence of forced oscillations break up into droplets of a given size [2].

Forced jet disintegration into droplets is a very complex phenomenon, which has a variety of modes and depends on a number of internal and external factors [3].

The main interest of the contemporary scientists is drawn to the monodisperse mode of the jet disintegration into the main droplets without satellite droplets (small droplets) formation.

As one can see from the analysis of the nitrogen fertilizers production process stages, a great deal of fertilizer is lost with the dust emission of the granulated substance (satellite drops) which comes with the cooling air into the atmosphere [2]. In addition to the economic aspects associated with the product loss, this problem has an environmental one which is the pollution of air, surface and ground water; nitrites and nitrates accumulation in plants and reservoirs, which all results in

a load on the ecosystem. Besides European Fertilizer Manufacturers Association stiffened the limit values for dust emissions of the product particles into the air.

The effect of forced oscillations on the modes of the liquid jet disintegration was investigated previously [4].

II. Challenge problem

Providing of continuous operation of the priller (granulator) technological units and maintaining stability of the operation parameters are important issues. Influence of hydrodynamic flows and local mechanical vibrations on the metal structure of the perforated bottom (bucket) lowers elastic properties of the material, which causes its plastic deformation, changing the shape of the discharge holes, and subsequent destruction of the bucket.

There occurs a problem of selecting optimal design parameters of the device for imposing forced oscillations on the melt, to increase duration of the equipment operation and improve quality of the finished product.

Analysis of the study results proved the efficiency of using the disc oscillator as a device for imposing forced oscillations. Disc is not firmly attached to the housing, which allows to reduce negative effect of local vibrations on the device. Oscillations are transmitted through a viscous melt (which under operating conditions can be considered as incompressible fluid) from the source to the bottom. Under this approach, the period of perforated bottom use increases significantly, since there are no local sources of vibration acting directly on the bucket.

As a result of previous theoretical studies of hydrodynamics of liquid jets outflowing from the holes in the bucket of a vibratory granulator, there was obtained a relation between parameters of the disc oscillator and change in the flow pressure by solving the Navier-Stokes system of equations for an axisymmetric liquid jet Eq. 1 [6]:

$$
\begin{aligned}
2r\left(pAf\cos\left(2pft\right)\right)^2 \cdot \Psi + a_1\sin\left(w_1t + c_1\right) &= \\
= p_{amм} - r\big(0.5 \cdot 1/(ptr_o^2)\big(-2Q_{omв} + 2pC_6r_o^2 - \\
-4pC_8r_s^2r_o^2\ln r_o + 2pC_8r_s^2r_o^2 + pC_8r_o^4 - \\
-4pC_3zr_o^2 + 2pC_5r_o^2 + 2pC_{10}r_o^2\big) + 4nC_8\big)
\end{aligned}
\tag{1}
$$

III. Experimental research

Coefficient Ψ depends on the physical and chemical composition of the melt and the device internal design, including distance between the bottom and the source of vibrations. There occurs a problem in determining optimal location of the disc oscillator towards the bucket, to provide monodisperse disintegration of the jets into droplets. Theoretical study of the impulse transmission parameters is hampered by complex internal design of the device; therefore, to obtain more accurate solution, a series of experiments were performed using an experimental setup, shown in Fig. 1.

The experiment was carried out at parameters close to the parameters of a working industrial unit with a similar device design [2]:

• liquid flow in the device V=45 m³/h;

• diameter of the vibratory granulator housing D=0.5 m;
• the number of bucket holes, n = 5850 pcs;
• diameter of the discharge holes d_h=1.2 mm;
• vibration frequency f=375 Hz;
• distance between the bucket bottom and the disc oscillator (h) can be adjusted from 0 to 40mm.
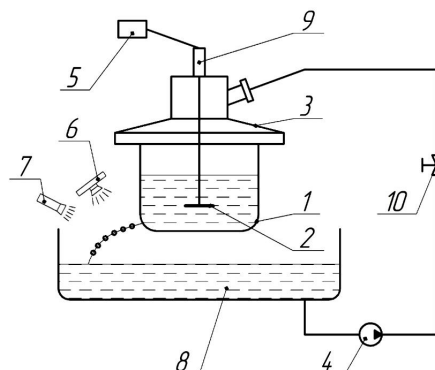
Fig. 1. Scheme of the experimental stand of the vibratory granulator: 1 – replaceable perforated bottom of the granulator; 2 – disc oscillator; 3 – housing; 4 – pump; 5 – vibratory generator; 6 – camera; 7 – stroboscope; 8 – buffer capacity; 9 – electromagnetic vibrator (actuator); 10 – control valve.

To obtain the most accurate data and reduce the overall level of error, a series of photographs was taken for each position of the disc oscillator. The images were analyzed using the method of detecting objects, searching for round figures using the specialized program (Fig. 2).

a)

b)

Fig.2 Determination of droplet sizes by a specialized program: a) photo processing; b) part of the list of measurements

IV. Results

There were constructed graphs of detailed analysis and suitable presentation (discussion) of the results (Fig. 3). In case if the disc oscillator is in contact with the bucket there is observed formation of satellite droplets simultaneously with the main disintegration of jets. It decreases the unit's capacity and negatively affects the environment as well as increases the costs of cleaning the worked-out coolant used to crystallize the melt. Formation of granules of regular spherical shape having maximal diameter occurs when the disc oscillator is placed 15 mm away from the perforated bottom of the vibratory granulator. In this position satellites are not formed and size of the main droplets increase. When the disc oscillator was placed at a distance of more than 30 mm, the number and dimensional scatter of satellite-droplet increased.
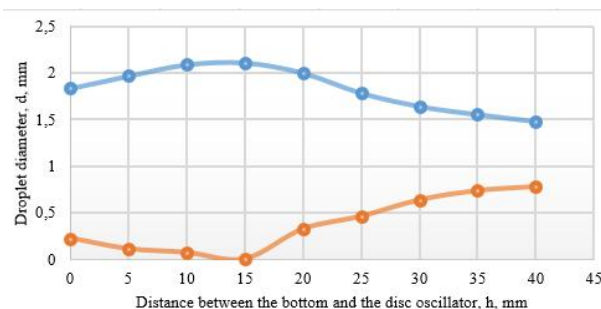
Fig. 3 Graphical dependence of the droplet diameter, formed after jet disintegration, on the distance between the bottom and the disc oscillator

Conclusion

As a result of the conducted studies, one determined influence of the location of forced oscillations source in the inner space of the priller (vibrating granulator) on the diameter of the target droplets and satellite droplets in the process of liquid jets disintegration. This study makes it possible to improve quality of the obtained products and minimize losses of the target product with the exhaust air by controlling position of the disc oscillator. Technology of transmission the oscillations through the liquid melt significantly increases the operation period of assembly parts and components of the vibratory granulator and it increases the general economic indicators of the production.

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Investigation of HgSe Films, Deposited from Aqueous Solutions with Different Complexing Agents

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Abstract – The process of synthesis of mercury selenide (HgSe) thin films by a chemical bath deposition method (CBD) with using different complexing agents (potassium rodanide, potassium iodide and sodium thiosulfate) has been investigated. The phase composition, crystal structure, absorption spectra, surface morphology of HgSe films were studied. The effect of nature of complexing agent on the properties of obtaining coatings was shown. The HgSe films have a sphalerite structure, nearly stoichiometric atomic ratios of mercury to selenium and optical band gaps, which are localized in the ranges 1.38-2.40 eV, depending on the usage of complexing agent.

Key words – mercury selenide, semiconductor films, chemical bath deposition, optical band gap, structure and morphology of thin films.

I. Introduction

Mercury selenide (HgSe) belongs to $A^{II}B^{VI}$ group materials. The mercury chalcogenides can be used in in IR detectors, ultrasonic and gas sensors, catalysts, electrostatic reflective materials and solar cells [1-3]. Also there is great interest in the physical properties of nanometer size semiconductor films, because their properties are often superior to those of conventional coarse-grained polycrystalline materials [4].

Development of chemical synthesis of HgSe films with different complexing agents will allow to study the effects of the ligand nature on the properties of coatings. It will provide new possibilities for wave function engineering and in tailoring optical and optoelectronic properties of semiconductor films.

II. Experimental

The obtaining of HgSe semiconductor films is carried out by many methods. Technologically convenient way to their obtaining is by the method of chemical bath deposition (CBD) [5]. Compared with the other it allows to pursue the deposition at temperatures below 100 °C on the large-sized substrates of different nature and use different combinations of starting substances.

The CBD of thin films of HgSe was conducted with the initial working solution which consisted of mercury nitrate ($Hg(NO_3)_2$), complexing agent, sodium selenosulphate (Na_2SeSO_3) and, if necessary, the pH-regulator. As comlexing agens for mercury were used: potassium rodanide (KSCN), potassium iodide (KI) and sodium thiosulfate ($Na_2S_2O_3$); the pH-regulator – tri-sodium citrate ($Na_3C_6H_5O_7$). The concentration of the $Hg(NO_3)_2$ solutions was equal to 0.05 M; KSCN – 2.0 M; KI – 0.1 M; $Na_2S_2O_3$ – 1.0 M; Na_2SeSO_3 – 0.25 M; $Na_3C_6H_5O_7$ – 1.0 M. Only freshly prepared reagents entered the working solutions for synthesis of HgSe films. The deposition duration and temperature of HgSe films, was 80 min and 20°C (in the case of using KSCN), 10 min and 90°C (in the case of using KI), 220 min and 20°C (in the case of using $Na_2S_2O_3$). The pH-regulator was added only at presense of sodium thiosulfate, because it was necessary to prevent its decomposition with formation of the sulfur. The chemical deposition has carried out on pre-prepared glass substrates with an area of 3.24 cm². After the end of the reaction the substrates were eliminated; the surface was cleaned with a distilled water to take off the remains of working solution and dried in air.

The phase composition of the HgSe films was investigated by X-ray powder diffraction (diffractometer DRON-3.0, Cu*Kα⁻* radiation). Primary processing of the experimental diffraction data in order to identify the phases was made using the PowderCell program [6]. Optimum exposure for each of the samples was selected. Calculation of the cell parameters were done by using the FullProf software package [7]. The investigation of surface morphology of the films was carried out using a raster electron microscope REM-106Y equipped with a system for microanalysis. Absorption optical spectra of HgSe films were obtained with a spectrophotometer XION 500 (Dr.Lange). A comparative signal was passed through glass substrates identical to the substrates, used for the investigated films.

III. Results and discussion

The X-ray analysis of HgSe films has been held. It showed that films are single phase. Peaks that corresponded to the cubic phase of HgSe (sphalerite) (Fig. 1) can be identified on all diffractograms. The lines of theoretical diffractogram of HgSe phase are shown for comparison. The unit cells of HgSe was follows: $a_1 = 0.6055(1)$ nm; $a_2 = 0.6052(2)$ nm and $a_3 = 0.6083(1)$ nm at using KSCN, KI and $Na_2S_2O_3$ respectively.
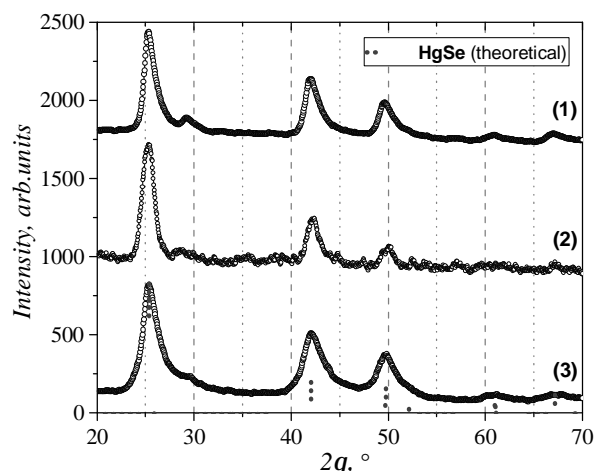
Fig. 1. X-ray diffractograms of HgSe films, deposited with using different complexing agents: 1 – KSCN, 2 – KI, 3 – $Na_2S_2O_3$

The optical absorbtion spectra $A(\lambda)$ of HgSe films were investigated for wavelengths from 340 to 900 nm (Fig. 2). The HgSe films, deposited with using $Na_2S_2O_3$, has the biggest light absorbtion. Using KI makes this value averages. The lowest absorbtion of HgSe films was observed with use of KSCN. The decrease of the light absorbtion can be seen in all cases near 400 nm wavelengths region, which corresponds to mercury selenide and confirms the results of the phase analysis by X-ray diffraction. The spectral dependences in $(\alpha \cdot h\nu)^2$ vs. $h\nu$ coordinates allow determining the fundamental absorption edges. The optical band gaps of the films are localized in the ranges 1.38-2.40 eV, depending on the usage of complexing agent. These values corresponds to the literary data [8-10].
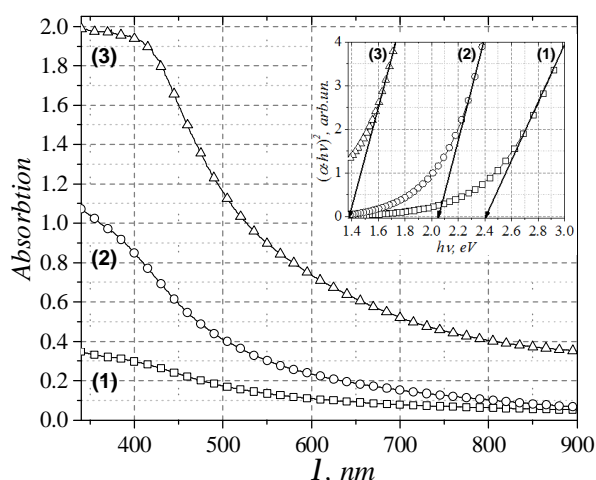
Fig. 2. The spectral dependences of optical absorbtion of HgSe films, deposited with using different complexing agents: 1 – KSCN, 2 – KI, 3 – $Na_2S_2O_3$ (inset – $(\alpha \cdot h\nu)^2$ vs. $h\nu$ dependense)

Investigation of HgSe surface morphology at x5000 magnification (Fig. 3) showed that the films are homogeneous and solid, with small amounts of surface defects. The spherical particles are seen on the surface of the film at the case of using potassium rodanide.
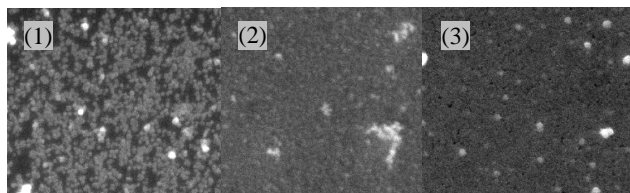
Fig. 3. Surface morphology of HgSe films, deposited with using different complexing agents: 1 – KSCN, 2 – KI, 3 – $Na_2S_2O_3$

The microanalysis of the surface of the HgSe films shows nearly stoichiometric atomic ratios of mercury to selenium with a slight excess of mercury atoms (at using of potassium iodide) or a slight excess of selenium atoms (at using of potassium rodanide and sodium thiosulfate).

Conclusion

The HgSe thin films were synthesized by the CBD method. The possibility of using different complexing agents was shown. The phase composition of obtained HgSe samples was determined. The optical absorption spectra, surface morphology of HgSe films were investigated. According to the results of microanalysis the elemental composition of coatings were studied. From the obtained data, the most suitable complexing reagent can be selected. The positive research results of obtained HgSe films allows to assuming that the chemical bath deposition method can be used to produce optical materials based on this coatings.

Acknowledgement

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Changes in the Thermal Stability of Mineral Motor Oils After its Using in Diesel Engine

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Abstract ─ It is studied the process of thermal stability of the fresh and waste mineral motor oils for the diesel engine. Based on the results of the research it's been established that the chemical composition of mineral motor oisl after their exploitation depends primarily on the type of engine and its service conditions. It is shown that thermal stability of the studied petroleum motor oils under the same conditions is not the same, due to a change in the chemical composition and the uneven wear and tear additive package.

Keywords: waste motor oils, thermogram, mass loss, thermolisys, chemical composition

The motor oil is important element in the internal combustion engine construction, because it has considerable influence on the reliability of its work. The ability of oil to counteract thermal, mechanical and chemical effects is a guarantee of a long duration of the engine operating. The main factor affects the motor oil source is a temperature on the friction surface and heated parts. Accordingly, the thermal stability of the oil is primary indicator at its selection for engines with different degrees of capacity. At the same time temperature has influence on oxidation processes and processes of additives destruction and fundamental basis of the oil[1,2]. The temperature method of testing lubricating layers helps to get the data about the thermal stability at the friction of any lubricants.

I. The starting materials

For investigation we selected M-10DM mineral motor oil. The samples before using in the augmented diesel engine and after finishing standard service life (approximately 350 motor hours) of oil were studied. For virgin M-10DM motor oil, it was found: kinematic viscosity $v_{50} = 60,13$ mm^2/s, $v_{100} = 11,40$ mm^2/s; viscosity index (VI) 95; density 889 kg/m^3; acid number (AN) 1,30 mg KOH/g; base number (BN) 5,83 mg KOH/g; flash point 230 °C; freezing point -20 °C.

For used M-10DM motor oil it was found: kinematic viscosity $v_{50} = 51,65$ mm^2/s, $v_{100} = 10,22$ mm^2/s; viscosity index (VI) 88; density 884 kg/m^3; acid number (AN) 2,71 mg KOH/g; base number (BN) is absent; flash point 215 °C; freezing point -19 °C.

II. The studying of mineral motor oils thermal stability

Group hydrocarbon composition was studied by a chromatography. The silica alumina gel of ASK type was used as an adsorbent. Fractions of hydrocarbons were washed out by petroleum ether and benzene, and asphalt-resinous substances were desorbed by alcohol-benzene mixture[3].

The widespread thermal analysis methods are thermogravimetric and differential-thermal.

One of the varieties of the differential-thermal method is derivatographic analysis. The fundamental principle of it is a comparison of thermal properties of testing substance sample and thermally-inert substance of the ethanol. Derivatographic method allows combining derivatographic thermal analysis and thermogravimetric analysis, what enables to determine thermal stability and thermal effect in compound simultaneously.

Investigation of thermal stability of oil samples was performed on a derivatograph Q-1500D (Paulik-Paulik-Erdey system) with the registration of the analytical signal of mass loss and heat effects using a computer[4]. The samples were analyzed under a dynamic mode with a heating rate of 10°/min in the air. The weight of the samples was 100 mg. The reference substance was aluminum oxide.

III. Results and Discussion

If we analyze the changes in the group composition (Table 1), we observe the decrease in the amount of paraffin-naphthenic hydrocarbons and increase of monocyclic aromatics and tarry asphaltene substances for the used oil. It means that during operation the destruction of paraffin hydrocarbons, dehydration of naphthenic hydrocarbons and condensation of aromatic hydrocarbons take place leading to the formation of tarry asphaltene substances.

TABLE 1

GROUP COMPOSITION OF M-10DM OIL

Group	Virgin oil	Used oil
Paraffin-naphthenic Hydrocarbons	75,2	71,0
Aromatic monocyclic hydrocarbons	5,6	10,7
Aromatic bicyclic hydrocarbons	15,7	14,2
Aromatic polycyclic hydrocarbons	1,9	1,2
Tarry asphatene substancs	1,6	2,9

To establish the change in thermal stability of M-10DM we carried out derivatographic investigations before and after engine operation. According to the results of thermogravimetry (TG), differential thermogravimetry (DTG) and differential thermal analysis (DTA) of the virgin and used oils the thermolysis takes place over two or three stages, respectively (Figs. 1-2).

Thermolysis of the virgin oil (Fig. 1) takes place over three stages. The first stage, when the sample looses the

main mass (Dm = 87.20 %) is within the temperature range of 20–390 °C. This stage is accompanied by the appearance of intense exothermal effect on DTA curve with the maximum at 347 °C and corresponds to a thermooxidative destruction of hydrocarbons and their partial combustion. The second stage is within the range of 390–577 °C. It is accompanied by the appearance of the next exothermal effect on DTA curve with the maximum at 494 °C and corresponds to the combustion of pyrolytic residue (Dm = 11.45 %). At the third stage of thermolysis within 577-725 °C the combustion of carbonized residue takes place. This process is accompanied by a slight mass loss (Dm = 1.35 %) and appearance of the third exothermal effect on DTA curve with the maximum at 640 °C.
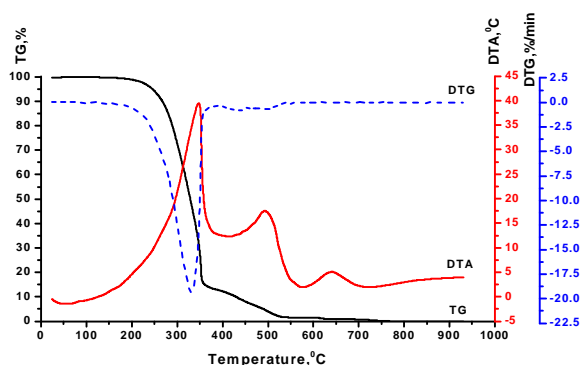
Fig.1. Thermogram of the virgin oil
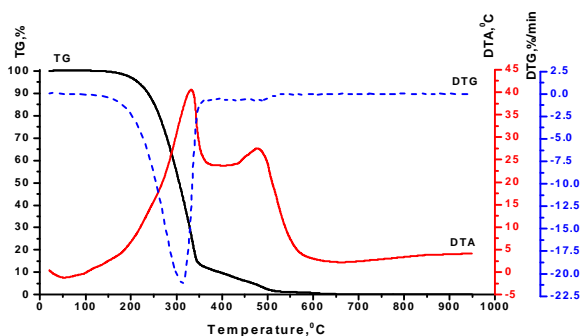
Fig.2. Thermogram of the used oil

Thermolysis of the used oil (Fig. 2) takes place over two stages. The first stage corresponds to the thermooxidative destruction of the sample and partial combustion of destruction products (D*m* = 89.47 %, temperature range 20–387 °C). The first exothermal effect appears on DTA curve with the maximum at 331 °C. At the second stage within 387–650 °C the complete combustion of pyrolytic residue takes place (D*m* = 10.53 %) and the second exothermal effect has the maximum at 479 °C.

It should be noted that the used oil has a lower thermal stability compared with that of the virgin oil. The reason is the decrease in additives amount. While heating the used oil loses its mass more intensive than the virgin oil (Fig. 4) and maxima of its exothermal effects are shifted to the area of lower temperatures (Fig. 5). The combustion of pyrolytic residue takes place over one stage for the used oil and is accompanied by the appearance of only one exothermal effect.
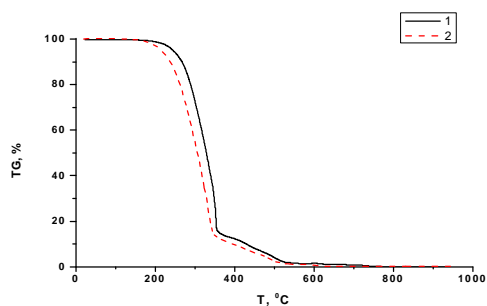
Fig.3. TG curves of M-10DM: virgin oil (1); used oil (2)

The combustion of pyrolytic residue of the virgin oil takes place over two stages within wider temperature range (390–725 °C). Two exothermal effects appear on DTA curve.
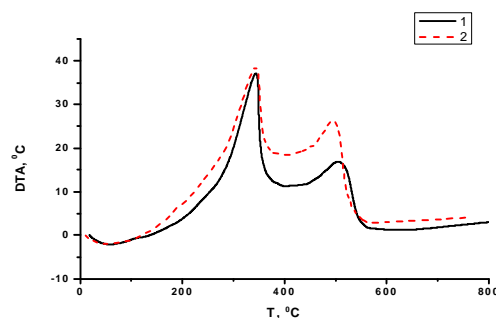
Fig.4. DTA curves of M-10DM: virgin oil (1); used oil (2)

Conclusion

It has been studied the thermal stability of fresh and waste mineral motor oil M-10DM for diesel engines. With the help of derivatographic research, it has been established that waste oil M-10DM differs in lower thermal resistance in comparison to the fresh oil. The waste mineral oil is characterized by lower thermal stability in comparison to the fresh oil, what is caused by the change of chemical composition and wear and tear the additives package while operating.

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Sedimentation of Silver and Palladium on the Silicon Surface by Galvanic Replacement

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Abstract − *The results of investigations of the process of precipitation of micro- and nanosized particles of silver and palladium on the surface of silicon by electroplating substitution are presented. The conditions of the process, in which a nanosized precipitate is formed in the environment of organic aprotic solvents, is established. The influence of the concentration of metal ions in the solution, temperature and duration of galvanic substitution on the morphology of the modified surface, the geometry of the sediment particles and their distribution in size have been studied.*

Keywords − galvanic replacement, nanoparticles, silver, palladium, silicon surface, aprotic solvents.

I. Introduction

In the last decade, great attention is paid to modifications of the surface of silicon by micro- and nanosized particles of metals by galvanic substitution [1-6]. This method is easy to implement and in providing equipment [7].

The process of galvanic substitution on the surface of silicon occurs by the electrochemical mechanism and therefore it is characterized by the same electrode processes, as in electrodeposition:

$$\text{microanode: } Si + 6\,F^- \rightarrow SiF_6^{2-} + 4\ e;$$
$$\text{microcatode: } Me^{n+} + n\ e \rightarrow Me;$$
$$\sum: nSi + 4\ Me^{n+} \leftrightarrow nSi^{4+} + 4\ Me.$$

However, the spontaneity of the electroplating substitution process makes it difficult to obtain nanoparticles with given characteristics – geometry, size distribution, component content. Therefore, it is important to establish the basic parameters that affect these characteristics. This will be the basis for the creation of scientific principles for controlled synthesis of nanomaterials by electroplating substitution.

The purpose of the research was to study the process of depositing micro- and nanosized particles Pd and Ag on the surface of silicon by galvanic substitution in an environment of organic aprotic solvents.

II. Research results

Deposition of silver and palladium on the surface of silicon in solutions of organic aprotic solvents DMSO and DMF was investigated. Such environment, as shown by the authors [8-9], prevents the course of a number of side chemical processes. This ensures a uniform distribution of particles of deposited metal by size on the floor of the substrate. In addition, high-donor properties of such solvents cause the formation of surface complexes on the embryos of recovered metals, which also positively affects the sediment nanostructure.

Relatively simple composition of the solution ($AgNO_3$ + DMF; Pd $(NO_3)_2$ + DMSO) was used to obtain nanosized particles. It is shown that nanosized particles of silver and palladium (Fig. 1, a-b) are formed on the surface of silicon in a wide range of ions of reducing metals.

Fig.1 SEM image of the surface of silicon deposited with silver (a), palladium (b) by galvanic replacement in solutions of 0.01M $AgNO_3$ in DMF, 0.004M $Pd(NO_3)_2$ in DMSO.

The concentration of the corresponding metal ions, temperature and duration of galvanic substitution are the main factors influencing the sediment morphology and the size of its structural particles.

The tendency to decrease of the size of deposited particles of silver and palladium with a decrease in the concentration of the corresponding metal ions in solutions of organic aprotic solvents DMSO and DMF was found.

As the temperature increases due to cathodic depolarization, the particle size increases. At the same time, there is a tendency to 3D growth of sediment. Moreover, 2D growth prevails, which contributes to the uniform filling of the substrate (Fig. 2, a-b).

Fig.2 SEM – an image of silver deposited with a galvanic substitution from the solution 0.01M $AgNO_3$ + 3% HF in DMF on the silicon surface for 1 min at a temperature 23(a), 40(b) ^{0}C.

As the length of the galvanic substitution process increases, the size of the particles of the recovered metals increases. This is due to nucleation almost exclusively in the initial period, that is, during the formation of microcatodes and microanodes on the substrate surface. In the future there is only their growth. Consequently, the long process of galvanic substitution causes the formation of a sintered sediment with a large particle size distribution.

Conclusions

1. The main factors influencing the sediment morphology and the size of its structural particles are the composition of the solution, the temperature and the duration of galvanic substitution.

2. In the environment of organic aprotic solvents DMSO and DMF galvanic substitution on the silicon surface passes without any side processes. This contributes to the formation of nanoparticles of silver and palladium of uniform size and uniformity of their distribution on the surface.

3. The size of the particles of the recovered metals increases with increasing of temperature and duration of the electroplating process on the silicon surface.

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Synthesis of Microcapsules with Encapsulated Magnetic Nanoparticles for α-amylase Immobilization

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Abstract – Polymeric microcapsules with paraffin core containing magnetite nanoparticles modified by oleic acid and functional polymeric shell were synthesized using the technique of "extraction-coacervation" microencapsulation. The influence of process parameters onto colloidal chemical properties (size, dispersity index, surface porosity) of synthesized microcapsules was studied. It was shown that the use of heterofunctional copolymer as microcapsule shell allows the possibility of irreversible immobilization of α-amylase and provide its participation in the reaction of starch catalytic decomposition.

Keywords − magnetite, acrylate copolymer, heterofunctional copolymer, magnetic nanoparticles, encapsulation, microcapsules, enzyme immobilization.

I. Introduction

In past decade, magnetic nanoparticles (MN) with definite size distribution and structure are of a wide attention due their unique physical and chemical properties [1]. Their use as the carriers of diverse bioactive moieties is of special interest due to their unique properties such as superparamagnetism, high surface area, large surface-to-volume ratio, easy separation under external magnetic fields [2]. Compared to porous carriers, such non-porous nanoparticles have no external diffusion problems, making them more competitive especially for large scale industrial usage in solid–liquid systems (e.g., precipitated protein) [3]. However, unmodified magnetite nanoparticles often have high reactivity and easily undergo degradation upon direct exposing to certain environment, leading to poor stability. Hence, the elaboration of the method of obtaining polymeric microcapsules (MC) with functional shell and encapsulated MN is the important scientific and practical problem.

Therefore the aim of this work is to study the processes of obtaining and properties of functionalized polymer microcapsules with paraffin core filled with MN for immobilization of α-amylase enzymes.

II. Experimental part

Heterofunctional tetrapolymer (HFP) – copolymer of acrylonitrile (AN), butyl methacrylate (BMA), styrene (ST) and maleic anhydride (MA), the composition and properties of HFP are presented in Table 1. IR analysis of synthesized HFP proved the presence of corresponding functional groups in HFP structure: 2240 cm^{-1} – valent vibration νC≡N of AN nitrile group; 1856 and 1780 cm^{-1} – νC=O vibrations of MA anhydride groups; 1728 cm^{-1} – νC=O vibrations and 1220 cm^{-1} – νC–O vibrations of ester group in BMA;

3030 cm^{-1} – νC–H vibrations, 1600, 1580, 1460 cm^{-1} – skeleton vibrations of aromatic C–C bonds; 760 and 700 cm^{-1} – δC–H deformation vibrations of ST phenyl groups.

TABLE 1

COMPOSITION AND PROPERTIES OF HFP

COPOLYMER COMPOSITION, % MOLE				M_N	M_W	DISPERSITY INDEX (M_W/M_N)	T_G, K
AN	BMA	ST	MA				
50.2	27.9	14.3	7.6	28602	53013	1.85	356±1

The method of synthesis of magnetite nanoparticles. The synthesis of Fe$_3$O$_4$ nanoparticles modified with oleic acid (OA) was carried out using modified co-precipitation technique [4]. The difference of our modified method from the original technique was that in this case was used crystalline FeSO$_4$·7H2O, and the final product synthesis was prepared as a suspension in ethyl acetate.

The technique of MN microencapsulation. In this work we applied "extraction-coacervation" method of MN encapsulation described in [4].

The technique of immobilization of α-amylase onto microcapsules surface. In order to carry out the immobilization of α-amylase onto MC surface we prepared phosphate saline buffer solution (pH=6). This solution (100 ml) with 500 mg of α-amylase enzyme previously solved in it was added to the synthesized MC. The glass with obtained suspension was placed onto water bath with stirring during 3 hours. After that the enzyme solution was separated from MC containing Fe$_3$O$_4$ nanoparticles via magnetic separation. Modified MC were washed three times by 0.01% solution of Tween 20 in water.

Methods of analysis of modified MN and MC with encapsulated MN.

Thermogravimetric analysis (TGA) was carried out using TG 209 F1/Iris device at dynamic mode in air atmosphere and differential-scanning calorimetry (DSC) was performed using DSC 204 F1 Phoenix. Electron microscopic studies were performed using Selmi REM-106I scanning electron microscope (SEM).

Using the results of statistical treatment of the size measurements of 400-500 particles differential curves of MC size distribution were built and number-average (d_n), weight-average (d_w) sizes as well as dispersity indexes (k_p) of synthesized MC were calculated.

III. Results and discussion

Synthesis and modification of MN. At the first stage we have synthesized magnetic nanoparticles with simultaneous their modification by oleic acid. The curves of TGA and DSC of synthesized Fe$_3$O$_4$ nanoparticles are presented in Fig. 1. For unmodified magnetite nanoparticles we observed sharp weight decrease in the range from 25 ^{o}C to 100 ^{o}C that was not observed for modified MN. This is evidently caused due to the elimination of adsorbed water because MN modified by oleic acid have hydrophobic surface and do not adsorb water molecules. Besides, for the sample of modified MN

the sharp weight decrease is observed in the range 250-400 °C (close to the boiling point for oleic acid) that can be explained by elimination of unbonded oleic acid.
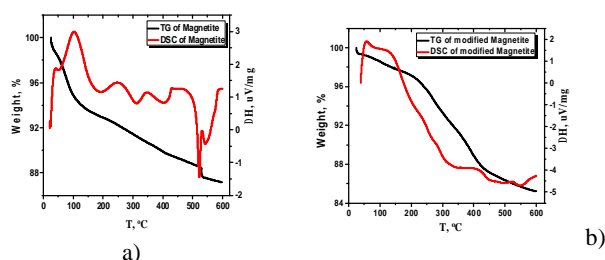
Fig. 1 The curves of TGA and DSC of magnetite samples: unmodified (a) and modified by oleic acid (b)

MN microencapsulation. The next step of the work was the MN encapsulation in microcapsules with paraffin core and functional polymer shell and the study of dependences of colloidal-chemical properties of synthesized MC, namely of number-average, weight-average sizes as well as polydispersity indexes on the process parameters (Table 2).

TABLE 2

MC FORMATION CONDITIONS AND CHARACTERISTICS
(MN TO PARAFFIN RATIO IS 1:22 WEIGHT PARTS, DISPERGATION RATE – 400 RPM)

SAMPLE	PVA CONTENT, %	T, K	D_N, μM	D_W, μM	K_P
MC1	1.0	328	47.9	78.1	1.63
MC2	2.0	328	37.5	69.6	1.86
MC3	3.0	328	28.3	63.5	2.24

According to obtained data (Table 2) one can conclude that the increase of PVA concentration in stabilizing solution causes the decrease of number-average and weight-average size of MC. At the same time the value of polydispersity index increases.

One can see (Fig. 2), that as a result of encapsulation of magnetic nanoparticles of magnetite microcapsules with regular spherical shape were obtained and agglomeration of particles was not observed.
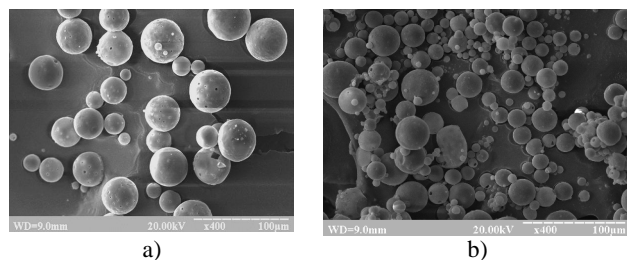
Fig. 2 Microcapsules of sample MC 1 (a), MC 3 (b).

As one can see the porosity of the surface of microcapsules obtained with 3% of PVA in stabilizing solution is less as compare with microcapsules synthesized at the PVA concentration of 1%. It is caused by the fact that greater concentration of PVA leads to the increase of solution viscosity. As a result, during the stage of water addition extraction of ethyl acetate into water

phase proceeds slower and the microcapsule surface is formed smoother with less amount of pores. It is necessary to note that obtained MC are rather stable even in acidic medium. After their deposition into 1.5% solution of HCl during one month they keep magnetic properties, that witnesses in favor of dense encapsulation of modified magnetic nanoparticles in the paraffin core.

The next step of the work was the immobilization of α-amylase enzyme onto MC surface using the technique described above. To prove α-amylase immobilization the obtained MC were placed into vial with 5% starch solution
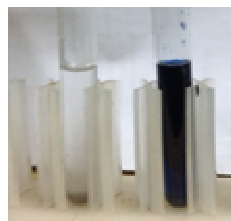
Fig. 3 The vials with MC containing immobilized α-amylase (left) and without MC (right).

(1 ml) and phosphate buffer solution (5 ml). To another vial the same solutions were added but without MC. These vials were deposited into thermostat at 40 °C during 20 hours. After that 1 drop of iodine were added to each vial. In the vial that did not contain MC the appearance of intensive color was observed while the solution in the vial containing MC remained colorless (Fig.3). The test was repeated a few times. Obtained result proves the catalytic action of immobilized α-amylase in the reaction of starch decomposition.

Conclusion

The results of performed studies witness that the method proposed allows to obtain microcapsules with paraffin core containing magnetic nanoparticles and functionalized polymeric shell. The influence of process parameters onto colloidal-chemical properties of synthesized microcapsules has been studied. It was shown that MC size and polymeric shell porosity decreases with the increase of polyvinyl alcohol concentration in the stabilizing solution. The presence of functional groups in MC shell structure allows irreversibly immobilization of enzymes that can be used as biocatalysts for industrial application.

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The Features of Fruits Drying in the Production of Natural Chips

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Abstract – The objective of research was determination of the optimum heat treatment conditions before drying fruits and stage-wise dehydration modes. The optimal stage-wise regimes of apples drying in the production of fruit chips are presented in the article. The drying curves apples and organoleptic properties apple chips are analyzed.

The obtained results were used in the development of energy-efficient technology for the production of fruit chips using the convection drying method, and the technical conditions were developed and approved. The developed technology increases the energy efficiency of the process by 15 %.

Keywords – fruit and vegetable chips, apple chips, thermal and humidity parameters of the drying agent, stage-wise drying, energy efficiency.

I. Introduction

A new form of dried products for Ukrainian consumers is fruit and vegetable chips. These include chips from apples, pears, persimmons, quinces, bananas, beets, carrots, white roots, etc.

Fruit and vegetable chips are natural sweet product with high dietary and taste properties with natural taste and they have a color that inherent in the feedstock and they had been dried to a low residual moisture content.

Special distinction of chips is:
- no roasting process, cholesterol, carcinogens;
- low calorie;
- ease of use;
- duration of storage.

Daily consumption of chips provide the body's need for natural vitamins, trace elements and other vital substances.

Scientific development technologies drying chips are involved in many countries (USA, China, Korea, Thailand, Serbia, Poland, Hungary, Russia and Belarus), but Ukraine does not pay enough attention to such studies.

Various methods of dehydration such as sublimation, vacuum, convective, infrared, as well as their combination are used in the production of chips. Most technologies for chips involve the use of different flavors, stabilizers, spices, on the preparation of raw materials and the final stage [1 – 4]. This increases the cost of the final product, fruit and vegetable chips lose their naturalness, become more calorie and less dietary.

The development of energy-efficient technology for the production of fruit chips is an urgent task because there is no mass production of chips in Ukraine.

II. Objective of the work

The plant materials may be separated into groups differing in certain predominant features. For example, such plant products as apples are characterized by high content of pectin substances. Therefore the drying process for such pectin-containing materials should proceed under such thermal and moisture conditions which would provide maximal retention of pectin.

Bearing this in mind, we performed a complex of experimental studies whose results served for optimization of the convection drying parameters and development of the technology for processing of plant products into dried products. This technology is based on the technique of fast drying of pretreated raw material. This technology is also characterized by small energy consumption.

III. Objects and methods of research

Objects of research were Reinette Simirenko apples. Apples dehydration was carried out by the method of convective drying to a residual moisture content of no more than 8 %.

The duration of the apples' stay in a medium of a certain temperature and moisture content was monitored; the apples temperature in the course of drying process did not exceed the maximum permissible temperature for thermally unstable pectin-containing materials.

Drying experiments and the evaluation of apples quality were performed according to standard procedures.

III. Results of experimental investigations and discussion

The results of our experimental investigations show that elevated content of pectin substances (which bind and retain moisture) hampers the drying process and limits the material temperature in the course of this process. To obtain a high-quality final product with high degree of retention of pectin and other bioactive substances, it is necessary that the material temperature in the course of drying process remain below its critical value. For this purpose, the drying agent parameters should vary in the course of the drying process in accordance with the regularities of heat and moisture transfer in the dry-out material [5].

Taking into account specificity of the dehydrated objects, one has to conclude that hygrothermal processing of parenchyma (resulting in transition of insoluble pectin into its soluble form and increase of jellying ability of dried products) is the mandatory requirement when processing the pectin-containing materials into dried products. In the course of hygrothermal processing, cell permeability is increased and moisture removal is intensified. In addition, such processing leads to better preservation of dried pectin-containing products, due to reduction of their absorbability and inactivation of the enzyme system.

Different methods of preliminary processing of raw materials for drying were carried out (steam treatment, processing in solutions of citric acid and sugar syrup).

Analysis of modes and methods of pretreatment of raw materials on drying kinetics and the organoleptic finished product showed that examined treatments provide a high degree of color preservation of raw materials and accelerating the kinetics compared to untreated samples.

Steam treatment shortens the drying process by 20...30 % than the raw fruit dehydration, Fig. 1. Steam treatment stabilizes color and taste range of source material. The effect of preliminary processing on color of raw materials and finished product are given in Table 1. Steam treatment helps preserve vitamins and helps destruction of oxidative enzymes.
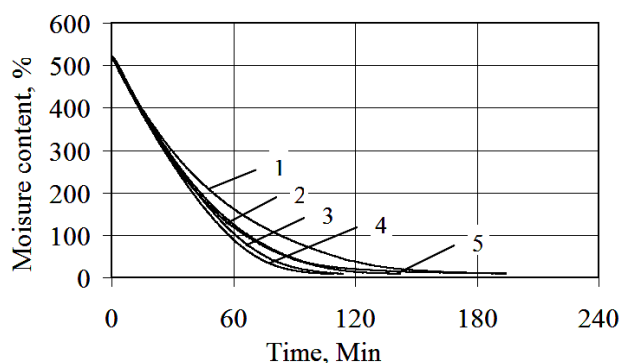
Fig. 1 The effect of preliminary heat treatment on apples drying at t=80…60 ℃, V=1,5 m/s, d=10 g/kg of dry agent: 1 – fresh apples, 2 – 10 % solution of sugar syrup, 3 – 0.1 % lemon solution acid, 4 – 1 % lemon solution acid, 5 – steam-thermal treatment.

TABLE 1

THE EFFECT OF PRELIMINARY PROCESSING ON COLOR OF RAW MATERIALS AND FINISHED PRODUCT

The type of processing	The change the color of the raw material	The color of the chips
fresh apples	darkening of the sample from 3 to 35 minutes, depen-ding on the variety	light brown color
steam-thermal treatment	color stable saturated	light cream color
processing in 0.1% and 1 % lemon solution acid	color saturated	light yellow color
treatment in 10 % solution of sugar syrup	color saturated	cream color

We studied the effect of drying agent medium parameters such as temperature and flow rate on the drying process. We also studied the effect of stage-wise dehydration modes of apples, Fig. 2.

Based on experimentally determined drying curves and drying rate curves it was found that drying time is mainly affected by initial flow rate of drying agent and temperature. We offer the optimal stage-wise regimes of apples drying are with thermal and humidity of the drying agent parameters: temperature t=80...60 ℃, speed of V=1.5...2 m/s, moisture content of d=10 g/kg of dry agent.
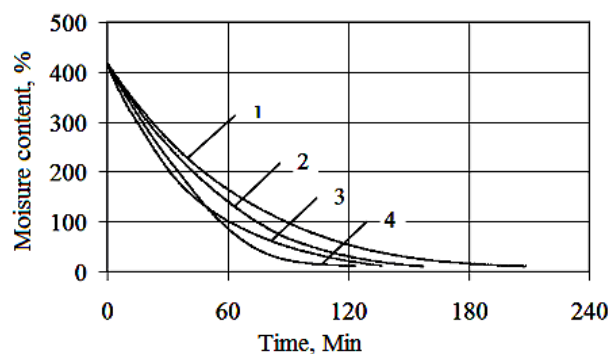
Fig. 2 The stage-wise apples dehydration modes at V=1,5 m/s, d=10 g/ kg of dry agent: 1 – t=60 ℃, 2 – t=70…65…60 ℃, 3 – t=90…70…60 ℃, 4 – t=80…60 ℃.

Conclusions

Considering the above set of requirements to the drying process, we determined the optimal parameters of the drying agent and developed the stage-wise dehydration modes resulting in 20…30 % reduction of process duration and 15 % saving of energy carriers and providing high degree of preservation of pectin and bioactive substances.

The obtained results were used in the development of energy-efficient technology for the production of fruit chips using the convection drying method. In a basis production technology of fruit chips is the method of convective drying in modes of multistage dehydration pre-prepared materials. In the process does not use any flavoring ingredients, preservatives, it is undoubtedly worth of chips and provides their naturalness, low calorie, stability, organoleptic characteristics during storage. The developed technology allows to intensify the process and reduce time of the fruit chips production, to preserve the natural feedstock comprising: vitamins, amino acids, carbohydrate, organic acid, pectin and other biologicallyactive substance. As a result, natural fruit chips are obtained containing no outside chemical agents used as fillers in chips prodused abroad.

The technical conditions of "Chips fruit, vegetable" were developed and approved. Technology is protected by 9 patents of Ukraine.

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The Mechanochemical Influence on the Physico-chemical Properties of CeO$_2$-MoO$_3$ System

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Abstract – Oxide system CeO$_2$-MoO$_3$ with atomic ratio Ce/Mo = 15:85, 25:75, 50:50 and 75:25 was modified by mechanochemical treatment (MChT) during 2, 4 and 8 hours in air. Obtained samples were studied by means of XRD, BET, TEM, sorption from the solution methods. It was shown, that mechanochemical modification leads to change of oxides crystalline structure, their surface morphology, porous structure and sorption ability to safranin-T dye.

Keywords – mechanochemistry, composition, cerium and molybdenum oxides.

I. Introduction

It is known that CeO$_2$-MoO$_3$ system is widely used in catalysis branch, namely is an effective selective reduction catalyst to remove nitrogen oxides (NO$_x$) [1], presentes high activity towards CO oxidation [2] and high photocatalytic ability in degrade process of organic dyes [3].

The preparation of oxide cerium-molybdenum system by traditional methods (solid phase synthesis, precipitation, hydrothermal synthesis etc.) is characterised have some drawbacks and the creation of new preparation methods of these compounds is very actual. It is found that mechanochemical treatment permits to obtain the nanocompositions with larger specific surface area, the structure with specific planes and other properties, reduce the production stages, realize the energy consumption, and prepare the catalysts in metastable state. In this communication the results of MChT on properties of CeO$_2$-MoO$_3$ system are reported.

II. Experimental

Cerium-molybdenum oxide system with a molar ratio of CeO$_2$/MoO$_3$ = 15:85, 25:75, 50:50 and 75:25 was prepared by mixing. Milling of samples was carried out in the planetary ball mill Pulverisette-6 (Fritsch) during 2, 4 and 8 hours in air. The rotation frequency was 550 rpm with the reverse after 30 min treatment. The vial (200 cm^3) and balls (5 mm in diameter) were made of ZrO$_2$. The ball-to-powder weight ratio (BPR) was 10:1.

The physico-chemical properties of investigated system before and after modification were studied by the following methods: XRD, BET, TEM and sorption from the solution.

III. Results

The X-ray data show that in initial mixture CeO$_2$-MoO$_3$= 50:50 all reflexes characteristic for simple oxides (Fig. 1, *1*) with significant domination reflex of α-MoO$_3$ from the plane (020). It is found, that MChT leads to decrease of intensity all reflexes that is caused by decrease of particle size of initial oxides.
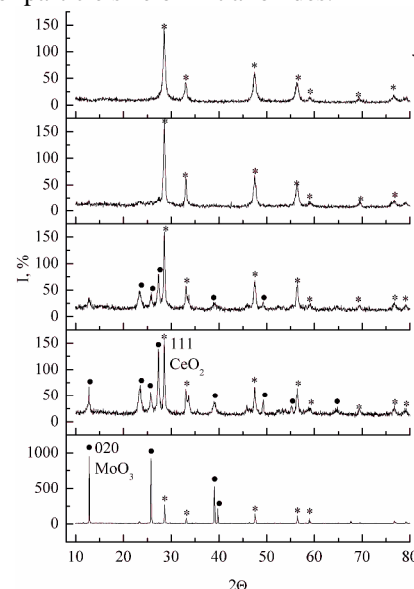
Fig.1 Diffractogram of system CeO$_2$/MoO$_3$: initial Ce/Mo=50:50 – *1*, after MChT of Ce/Mo=15:85 – 2, 25:75 – 3, 50:50 – 4, 75:25 – 5

It is shown, that in samples Ce/Mo= 50:50 and 75:25 after 2 hours treatment the reflexes α-MoO$_3$ are disappear that is connected with the amorphization process of this phase and simultaneously the dominance of phase CeO$_2$ from the plane (111) is observed.

The results of crystallite size (L) calculated by Scherer equation presented in Table I.

TABLE 1

XRD AND BET RESULTS OF SYSTEM CeO$_2$/MoO$_3$ SYSTEM

Atomic ratio Ce/Mo	Time processing, h	L, nm		S$_{BET}$, m^2/g	V$_\Sigma \times 10^{-2}$, cm^3/g
		MoO$_3$ (020)	CeO$_2$ (111)		
15:85	0	89	64	1,3	1,0
	2	47	36	11,6	11
	4	59	33	12,4	12
	8	50	28	13,0	12
25:75	0	96	55	1,1	2,0
	2	56	26	1,4	5,0
	4	44	25	4,6	5,0
	8	72	22	9,5	9,0
50:50	0	93	53	1,7	3,0
	2	-	21	2,7	3,0
	4	-	18	3,0	3,0
	8	-	15	4,7	6,0
75:25	0	-	48	6	4,0
	2	-	17	5,2	6,0
	4	-	16	6,4	6,0
	8	-	16	7,2	8,0

The studies of porous structure show that mechanochemical modification accompanied by increase of specific surface area and total pore volume (Table 1). Thus, the change of type isotherm from II to IV (IUPAC classification) for Ce/Mo=15:85 and 25:75 after treatment is observed that is connected with mesopores formation. The

modification of Ce/Mo=50:50 composition accompanied only increase of S_{BET} while the MChT of Ce/Mo=75:25 leads to formation of macropores from the the mesoporous structure as indicate the total pore volume (98-130 nm) and change type isotherm (from IV to II).

Results of transmission electron microscopy of mechanochemical treated samples of composition Ce/Mo=50:50 showed the formation of nanosized particles of cerium and molybdenum oxides. There are two types of initial oxide particles: big crystals 200-300 nm (MoO_3) and small crystals – 50-70 nm (CeO_2) (fig.2 a).
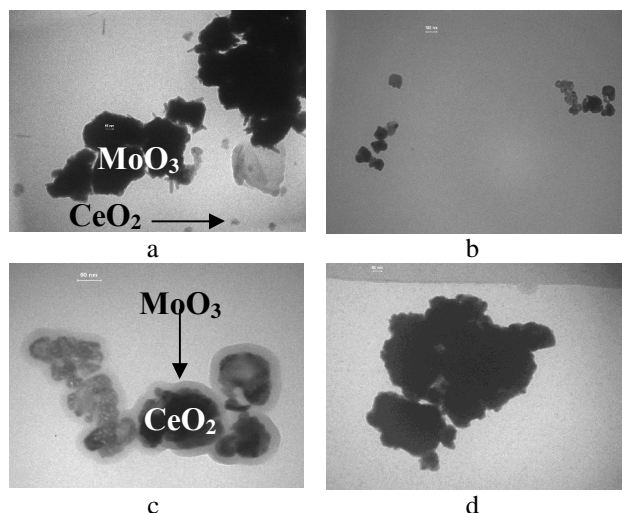
Fig.2 TEM microphotographies of initial composition Ce/Mo=50:50 – a and ater its treatment during 2h – b, 4h – c, 8h – d

The decrease of particles size to 20-40 nm after 2 hours treatment is shown from the fig.2 b. The modification of this sample during 4 hours accompanied by a formation of nanodispersed structure "core-shell" (fig.2 c), when after 8 hours this structure is destroyed with agglomerates formation (fig.2 d).

The studies of composition Ce/Mo=50:50 catalytic properties in ethanol selective oxidation reaction showed that the acetic aldehyde is major reaction product and the selective formation of ethen as collateral product is insignificant (3%).
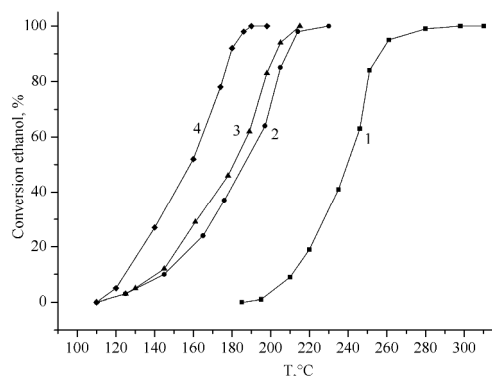
Fig.3 Depending ethanol conversion on the temperature for Ce/Mo=50:50 samples: 1- initial, after MChT during 2h – 2, 4h – 3, 8h – 4.

Such changes can be connected with icrease specific surface area for modified samples.

The comparative analysis of sorption properties of mechanochemical modified composition Ce/Mo=50:50 showed that type of kinetic curves changes from H2 to H1 (agree with classification to C.Giles). Efficiency of dye removal from water solution by materials modified during 2, 4 and 8 hours are 72, 78 and 87 % respectively, when this indicator for initial sample is only 50 %.
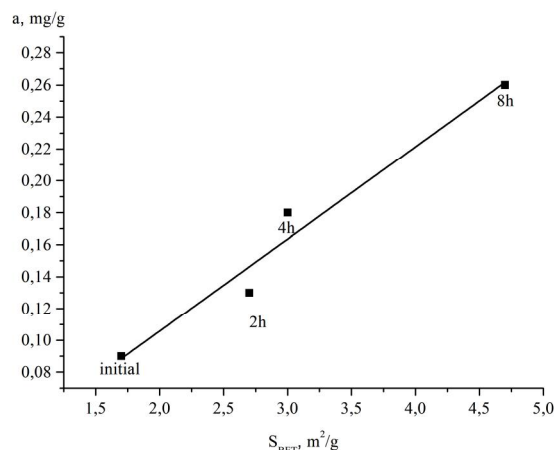
Fig.4 Graph of the adsorption dependence of safarin T on the specific surface of a mechanically activated composition Ce/Mo = 50:50

Obtained results testify about dependent of sorption ability from the specific surface area because with an increase in S_{BET} in 1,6-2,8 times the dye adsorption increases in 1,4-2,8 times (fig. 4).

Conclusion

This study has shown that mechanochemical treatment of CeO_2-MoO_3 system leads to decrease crystalline size, change of porous structure and direct dependence the sorption capacity from the specific surface area.

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Acknowledgments

Photodegradation of Aqueous Solution of Benzene and Phenol Using Nitrogen Doped TiO$_2$ Supported on Silica Gel

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Abstract – The photocatalytic decomposition of benzene and phenol was carried out on TiO$_2$N/SiO$_2$ catalysts. TiO$_2$ supported on SiO$_2$ was synthesized using TiCl$_4$ and silica gel as raw materials. In the process of deposition, the samples were modified with urea and ammonia for introducing nitrogen atoms into the matrix TiO$_2$. The effect of annealing temperature was investigated. According to IR spectroscopy, the nitrogen doped TiO$_2$/SiO$_2$ consisted of nitrogen atoms. The band gaps of nitrogen doped TiO$_2$ and pure TiO$_2$(P-25) were estimated from UV-Vis spectroscopy data to be 2.7 and 3.3 eV, respectively. From the comparison of photocatalytic activity of TiO$_2$N/SiO$_2$ samples prepared by different annealing temperature, it was found that sample annealed at 500°C was the most active.

Keywords – photodegradation, TiO$_2$N/SiO$_2$ catalysts.

I. Introduction

Photocatalytic degradation is considered a favored, promising, cleaner, and greener technology for the removal of toxic organic and inorganic pollutants from water and air. Titanium dioxide (TiO$_2$), as a chemically stable, nontoxic, highly efficient, and relatively inexpensive photocatalyst, has been widely used for water and air purification. However, the TiO$_2$ photocatalyst has not been applied widely in the field of environmental pollution control, since its large band gap energy considerably limits the utilization of visible light. Band gap narrowing by the introduction of nonmetal anions (N, S, C and F) into TiO$_2$ was recently found to be more efficient than the traditional methods to yield catalyst with high catalytic activity under visible light irradiation [1].

While the TiO$_2$ suspension has been employed in most of the studies, the supported TiO$_2$ on a stationary support is more likely to be used in any commercial application of this technique because of its easier recovery of TiO$_2$ particles from the purified effluents. Silica gel has been selected as a unique support since it has been used widely in industry and does not possess a charged framework, but a moderate hydrophobicity.

II. Experimental

Synthesis of nitrogen-doped TiO$_2$ supported on silica gel was prepared according to the procedure [2]. 2 ml solution of 5.6 M TiCl$_4$ was slowly added to 20 ml water. Taking into account that the reaction of hydrolysis of titanium chloride is exothermic, the process was carried out in an ice bath. To prevent the formation of orthotitanic acid, 10 ml of acetic acid was added. Then 40 ml saturated solution of urea and 50 g silica gel were added to reaction solution under vigorous stirring for 30 min. Deposition of TiO$_2$ was carried out using 25% ammonia solution. After this, the samples were dried at 110 ° C and calcined for 5 hours at 400, 500 and 600 ° C.

Photocatalytic experiments were carried out under the influence of radiation of 70W sodium and 125 W mercury lamps of high pressure. As a substrate, aqueous solutions of phenol or benzene at concentrations of 50 MPC (maximum permissible concentration) were used. The reaction products were analyzed on a gas chromatograph with a PID on a 1m column filled with Porapak-Q (for analysis of benzene content) and 3m filled with silica gel with a polymeric siloxane deposited on its surface (for phenol analysis). As a photocatalytic installation, a system of serially connected quartz tubes, filled with supported samples, was placed around the thermostated radiation source. The reaction mixture circulation and cooling of the reactor were provided by a peristaltic pump with parallel channels.

III. Results

As a result of gravimetric studies, it was found that the amount of TiO$_2$ deposited irrespective of the heating temperature is about 0.9%. From the structural-sorption data it is clear that the application of silica gel to the surface of both pure and nitrogen-containing TiO$_2$, calcined at various temperatures, practically does not affect the structural and sorption properties of the support.

Fig. 1 shows IR-spectra of nitrogen doped TiO$_2$ supported on silica gel samples.
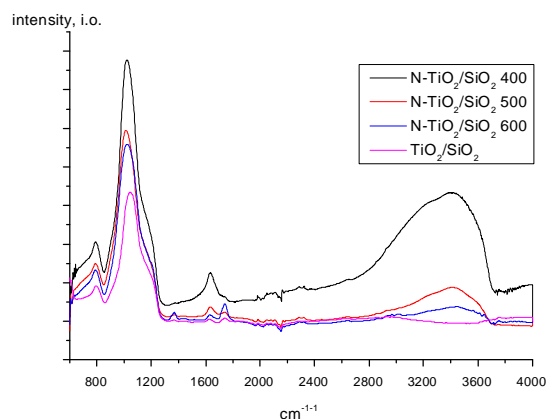
Fig.1 IR-spectra of TiO$_2$/SiO$_2$ and N-doped TiO$_2$/SiO$_2$

In the IR range all samples have similar bands. It demonstrates the bands that are positioned at 3300-3500 cm^{-1}, assigned to hydroxyl for both the dissociated water and the molecularly adsorbed water and at 1623 cm^{-1}, for the molecular water [3]. An intense bands within 1020-1050 cm^{-1} can be attributed to the nitrogen atoms embedded in the titanium dioxide matrix [4]. Also bands at 1740 cm^{-1} correspond to oxygen-containing particles of nitrogen (N$_x$O$_y$) [5].

The band gaps of nitrogen doped TiO$_2$ and pure TiO$_2$ (P-25) were estimated from UV-Vis spectroscopy data to be 2.7 and 3.3 eV, respectively.

The activity of synthesized samples was investigated in the reactions of photodegradation of aqueous solutions of benzene and phenol (50 MPC) under UV and visible light.

a   b
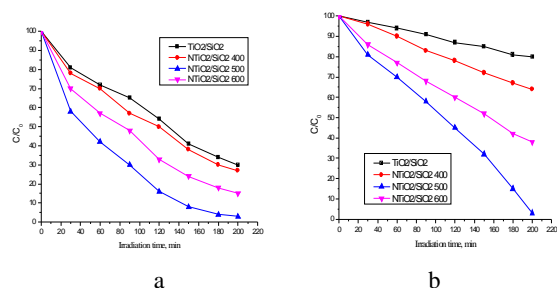
Fig. 2 The photodestruction of aqueous solutions of benzene (50 MPC) under (a) UV and (b) visible light.

From the comparison of photocatalytic activity of TiO_2N/SiO_2 samples prepared by different annealing temperature, it was found that sample annealed at 500°C was the most active. A two-fold decrease in the content of benzene in the solution with irradiation with a mercury lamp was achieved in less than 60 minutes, while at irradiation with a sodium lamp in just two hours (Figure 2).

Somewhat lesser activity was observed in the photodestruction of phenol aqueous solution (Fig. 3).

a   b
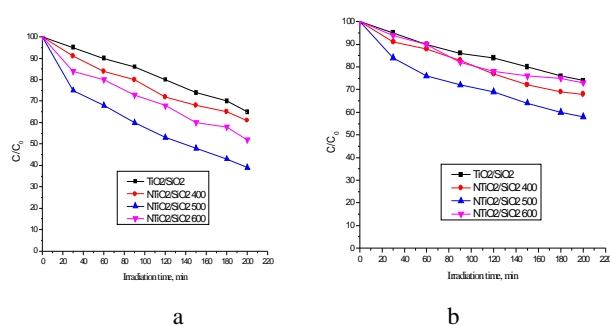
Fig. 3 The photodestruction of aqueous solutions of phenol (50 MPC) under (a) UV and (b) visible light.

In the visible range of radiation, the activity of the samples did not exceed 40%, and when irradiated with a mercury lamp – 60%.

Conclusion

The preparation of nitrogen doped TiO_2 resulting in a desired band gap narrowing and an enhancement in the photocatalytic activity under visible light. Thus, among all synthesized and modified samples, only in the case of nitrogen doped titanium dioxide supported on silica gel, it was possible to obtain samples that are active in the visible range of radiation.

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Acknowledgments

Synthesis, Properties and Application of Amphiphilic Copolymers Based on Poly(fluoroalkylmethacrylate)s With Terminal Peroxide Group

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Abstract − Polymers with terminal peroxide fragment were synrhesized via radical polymerization of fluoroalkyl methacrylates. Amphiphilic block-copolymers with hydrophilic block of different structure were synthesized by usage of obtained polymers with terminal peroxide group as macroinitiators. Kinethic peculiarities of polymerization were studied on both stages. The strucrure of polymers were confirmed by IR- and NMR-spectroscopy.

Keywords − fluoroalkyle methacrylate, peroxide group, radical polymerization, controlled synthesis.

I. Introduction

Polymeric materials are widely prevalence in all spheres of human life. However, the field of application of such materials is determined by their properties which in turn depend on the structure of macromolecule.

Control of polymeric structure can be done by regulation of the lengths of side- and main chains of macromolecule. The nature of polymeric fragments is also affects the polymeric properties. Thus, amphiphilicity of polymeric backbone possible to provide by combining fragments with different solubility in polar environment.

Unique properties of fluorine contained polymers led to the rapid growth of the number of their studies in different areas. Polymers with fluorine fragments are use as components of contact lenses [1], additives for surface modification [2] and semiconcuctors [3]. In additions, perfluorinated lengths in the structure of surfactant are most hydrophobic in comparison with their hydrocarbon counterparts [4]. This properties is interesting for increation of molecular amphiphilic character. Amphiphilic copolymers with fluorinated segments studied as carriers for nucleic acid delivery and marking and detection of biological objects [5-7].

In order to provide effective control of macromolecular structure and properties is important establishment of kinetic regularities of homo- and block-copolymers with controlled lengths and nature of side chains and blocks.

In this paper are presented research of synthesis of poly(fluoroalkyle methacrylate)s with terminal peroxide fragments and amphiphilic block/comb-like copolymers based on obtained polymers with peroxide group.

II. Synthesis of F-contained polymers with terminal peroxide group

Comb-like fluorine-contained homopolymers with terminal peroxide fragments were synthesized by free radical polymerization of fluoromethacrylates in presence of peroxide contained chain transfer agent – monoperoxine (MP). General scheme of polymerization are shown in fig. 1.
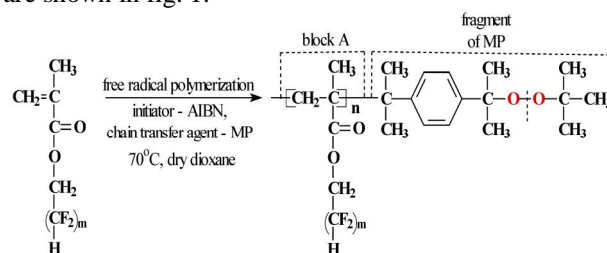
Fig. 1 General scheme of polymerization of poly(fluoroalkyl methacrylate)-MP

Kinetic peculiarities of polymerization were studied. Influence of polymerization parameters on the length of macromolecular backbone was established.

Structure of comb-like polymers confirmed by IR- and NMR-spectroscopy. The results of gas-liquid chromatography confirmed entrance of peroxide group to macromolecular structure.

Control of molecular-weight characteristics was carried out by addition of monoperoxine. Terminal peroxide group allows to use obtained polymers as macroinitiators on the next stage of synthesis.

III. Synthesis and properties of amphiphilic copolymers based on prepared macroinitiators

Amphiphilic block-copolymers with fixed size of side chains and blocks were synthesized by free radical polymerization of hydrophilic monomers initiated by obtained poly(fluoroalkyl methacrylate)s. Block/comb-like copolymers obtained with different structure of hydrophobic (block A) and hydrophilic block (block B) (fig. 2). Thus, we changed the lengths of blocks and nature of hydrophilic blocks. Cumen and epoxide-contained derivative of cumen (KGE) were used for narrowing the molecular-weight distribution. The general scheme of synthesis of block/comb-like copolymers with amphiphilic character are shown on fig. 2.

Fig. 2 General sqheme of synthesis of block/comb-like amphiphilic copolymers based on poly (fluoroalkyl methacrylate)-MP

Kinetic parameters of synthesis of hydrophilic block B were studied. The dependencies of molecular-weight characteristics from the length of block A, nature of the solvent, amount of chain transfer agent and macroinitiator were established.

Structure of amphiphilic copolymers was confirmed by IR- and NMR-spectroscopy and results of elemental analysis.

Including of hydrophilic part in the structure of macromolecule also confirmed by ability to dissolving of amphiphilic copolymers in water.

Colloidal-chemical properties of amphiphilic copolymers were studied. The avaibility of inflection point on obtained isotherms confirmed surface tentions properties of amphiphilic copolymers. The sizes of polymeric micellar structures were studied by results of dynamic light scattering (DLS). Influence of the length of blocks on CMC value and sizes of micellar structures were established.

IV. Perspective of practical application of amphiphilic copolymers

The changing of nature of hydrophilic block or terminal group determine specifics of block-copolymers usage.

Thus, polymers with polyelectrolyte block B can form complexes with nucleic acids (called polyplexes). Such polymers are described at literature as nonviral vectors for nucleic acid/genes delivery. Well known [7], that fluoritated fragments in structure of nonviral vecrors prevent of interactions between delivery system and proteins. Furthermore, such components facilitate penetration of polyplex through cell membrane.

From the other way, terminal epoxy group was introduced for the purpose of binding polymeric macromolecule and biologically active components, for example oligonucleotides. Moreover, nonionic nature of block B are provide selective oligonucleotide binding with terminal group.

Proposed methods of synthesis block/comb-like copolymers are interesting for research, development and implementation of novel approaches to therapy for cancer and genetic diseases.

Conclusion

In present work are described kinethic perculiarities of poly(fluoroalkyl methacrylate)s with terminal peroxide groupe and amphiphilic copolymers based on obtained macroinitiator. Colloidal-chemical properties of amphiphilic copolymers were studied. Perspective of practical usage of copolymers are shown.

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Esterification of Dextrine by the N-derivatives of Glutamic Acid Using Steglich Reaction

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Abstract – Was investigated the esterification of dextrin using Steglich reaction. Such modification allows obtaining a functional product with an extensive structure of macromolecules, capable to form self-stabilized dispersions in an aqueous environment. To ensure the branching, the modification was performed using the functional agents – N-derivatives of glutamic acid. The substitute in the N-position provides the introduction of the required function.

Keywords – dextrin, glutamic acid, cross-link, Steglich esterification, modification of polysaccharides.

I. Introduction

A number of natural properties of the polysaccharides do not allow their direct use for medical and biomedical purposes.

To create biomaterials based on them they need to be modified. Very often modification is made by controlled cross-linking of the polysaccharides macromolecules [1]. But, despite the modification, should not forget the advantages of this natural polymer. The materials, obtained by the modification, should stay polysaccharides and preserve the property of being tolerant to the human body.

Steglich reaction takes place in mild conditions, and the obtained polyester, as shown by the relevant studies, is non-toxic, depyrogenized and biodegradable material. It is also important fact that the products of decomposition of the polymer in the live organism are also non-toxic. [2, 3]

In light of this, the considerable interest represents the modification of polysaccharides by N-derived of dicarboxylic acid using Steglich reaction to produce polymer materials for medical and biomedical purposes.

II. Dextrine modification

In general, the interactions between the hydroxyl group of dextrin and carbonyl group of 2-(stearoylamino) pentane dicarboxylic acid (Glu(St)) can display the Fig. 2.

The degree of substitution of hydroxyl groups determined by the efficiency (selectivity) of the reaction and by the ratio between the reagents. Because the Glu(St) is a dicarboxylic acid, it is possible the cross-linking reaction between dextrin macromolecules, under conditions of sufficient process efficiency, in any ratio of the reagents. This process is reflected on the Fig. 3.

With moderate increase of quantities of cross-links will be formed modified dextrin with significantly increase of molecular weight and a dendrite structure of macromolecules. The modified product, with the dendrite structure of macromolecules, should not lose solubility in water and, by introducing the residues of Glu(St) and the formation of ester group must obtain the ability to dissolve in some organic solvents, particularly in methanol.

On the other side, the formation of a significant amount of cross-links between the macromolecules of dextrin should lead to the formation of spatial net. The modified dextrin, which macromolecules formed cross-linked spatial nets, loses its ability to dissolve in solvents, including water, and it can only restricted swell. Furthermore, if to the process of creating a three-dimensional net will be involved a critical amount of macromolecules of dextrin it will lead to the gel formation, which, observed with a rapid increase of the viscosity of the environment.

Confirmation, that in the investigated system observed the progress of described above processes, can be seen on Fig. 1, which shows the change of viscosity of the reaction mixture during the process at the ratio of carboxyl groups of Glu (St) to the hydroxyl groups of dextrin as 1 to 1. As it can be seen from the curve, the viscosity of the mixture increases during the whole process of the reaction and when the process reach a certain conversion, occurs its rapid magnification and the reaction environment transformed into the gel. The processes of structuring passes during all the time of the reaction, and when it reached a certain molecular weight, at the point of percolation, it begins a mass interaction between the cross-linked macromolecules, leading to the formation of the gel. Chemical processes of structuring also occur and after percolation point.
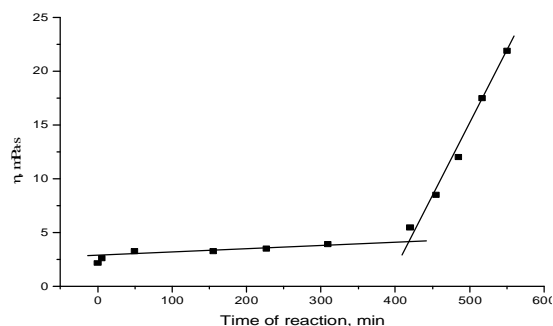
Fig 1. The change of viscosity over time.

Time of the percolation point achievement depends from the ratio of the reagents and from the conversion. The percolation point is observed at $6,5 \div 7,5$ hour after beginning of the process, which corresponds to approximately $80 \div 90$ % conversion.

Conducted research showed that the ratio, provided to the achieving of the $92 \div 95$% conversion, is the determining factor for obtaining modified products of the different molecular weight and composition.

The investigation of the structure and composition of significantly structured product, that was obtained after percolation point, is complicated by the loss of its solubility. Therefore, within this work, conducted studies
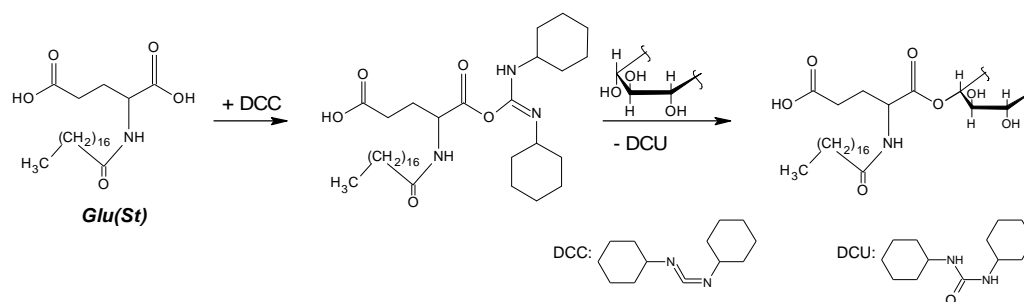
Fig. 2. Schematic image of the interaction between Glu(St) and dextrin by the Steglich reaction.
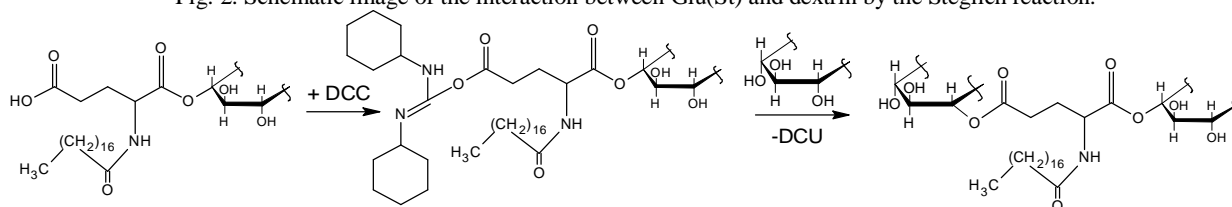
Fig. 3. Cross-linking of the dextrin macromolecules.

of modified dextrin, that formed before percolation point was reached, but under the condition of high conversion.

According to the methodology of the research, the resulting product was separated by extraction of samples with methanol and distinguished the product soluble in methanol and insoluble in it. Several additional observations such as swelling of methanol separated products in a variety of solvents showed that the fraction that soluble in methanol endlessly swells in DMF and product that insoluble in methanol has a limited swelling in some solvents. We can conclude that in the methanol dissolved the modified and heavily branched product, and insoluble in methanol fraction is a cross-linked product that during modifications forms the spatial net.

Fig. 4 shows the NMR spectrum of methanol soluble fraction of the product with referring of basic signals. This spectrum confirms the reaction of grafting Glu (St) to dextrin macromolecules.
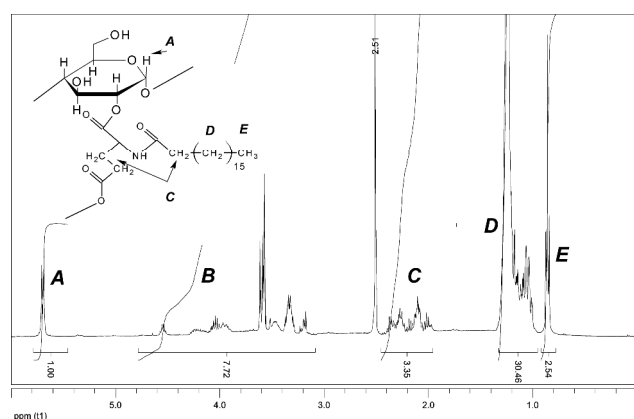
Fig 4. NMR spectrum of the dextrin esterification product.

The resulting products were tested for the ability to form in water environments polymer dispersions. These studies have shown that modified dextrin with a dendrite structure of macromolecule formed in an aqueous environment, a self-stabilized dispersion with particles of nanometric size.

Conclusions

As a result of conducted studies was found that modification of the dextrin, by N-derivatives of the glutamic acid using the Steglich reaction, proceeds with high efficiency and provide the substitution of 50 to 75% of the hydroxyl groups from possible, at a given proportion of reagents. As a result of the modification it is formed the products with branched and cross-linked structure of macromolecules. These products can be separated and the ratio between them determined by the ratio of reagents at the stage of synthesis. The practical interest represents the product with branched structure of macromolecules, as it is able to form the self-stabilized aqueous dispersion, stable in time, with nano- and micrometric size of the particles.

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Influence of the Deposition Time on the Structure and Optical Properties of Indium Sulfide Films (In$_2$S$_3$)

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Abstract – The process of synthesis of indium sulphide (In$_2$S$_3$) semiconductor thin films by a chemical synthesis method was done. The acetic acid has been used as a complexing agent. Ivestigations of thin films properties were carried out by using X-ray powder diffraction, scanning eletron microscopy, optical spectroscopy. The phase composition, optical transmission and absorption spectra of In$_2$S$_3$ films were studied. The value of bang gap energy has been experimentally determined from spectral dependences of optical transmission of In$_2$S$_3$ films, and ranges from 2,31 to 2,55 eV.

Key words – indium sulfide, chemical deposition, semiconductor films, thin films, structure and morphology of thin films.

I. Introduction

Mass production of thin-film devices are allowed only when the methods for their preparation are technologically simple, low-cost, flexible in managing properties with high reproducibility obtained materials.

Increased interest is observed in semiconductor materials of the group A^{3}B^6 with their subsequent application in the optoelectronic, photoelectric industry and photoelectrochemical solar cells [1,2]. One of the promising candidates for replacing cadmium sulfide is chemically deposited films of sulfide indium. In$_2$S$_3$ – n-type semiconductor with bandgap width (2.0-2.8 eV) [2,3], which is a non-toxic material and can be used as a buffer layer in Cadmium-Indium Sulfide (CIS) solar cells.

II. Experimental

The working solution for synthesis In$_2$S$_3$ films was prepared by mixing indium sulfate (C(In$_2$(SO$_4$)$_3$) = 0,01 M), acetic acid (C(CH$_3$COOH) = 0,1 M), as a complexing agent and thioacetamide (C(CH$_3$CSNH$_2$) = 0,2 M), as sulphating agent [3-8]. Deposition time was from 10 to 45 min.; temperature – 65 ^{o}C. As substrates, pre-prepared plates 18 × 18 mm from an optically homogeneous glass with a thickness of 0.2 mm were used. The resulting films were solid.

The investigation of surface morphology of the films was carried out using a raster electron microscope REM-106Y equipped with a system for microanalysis The optical transmission spectra of In$_2$S$_3$ films were obtained for wavelengths from 340 to 900 nm on spectrophotometer Xion 500 «Dr. Lange». A comparative signal was passed through glass substrates identical to the substrates, used for the investigated films. The phase composition of the In$_2$S$_3$ films and structures was investigated by X-ray powder diffraction (diffractometer DRON-3.0, CoKα-radiation). Primary processing of the experimental diffraction data in order to identify the phases was made using the PowderCell program [4]. Optimum exposure for each of the samples was selected.

III. Results and discussion

According to the results of X-ray diffraction analysis of samples In$_2$S$_3$ films obtained at a temperature of 65 ° C., was established that all samples consist of α-In$_2$S$_3$, β-In$_2$S$_3$, or their mixture. That's because their theoretical difractograms are similar.
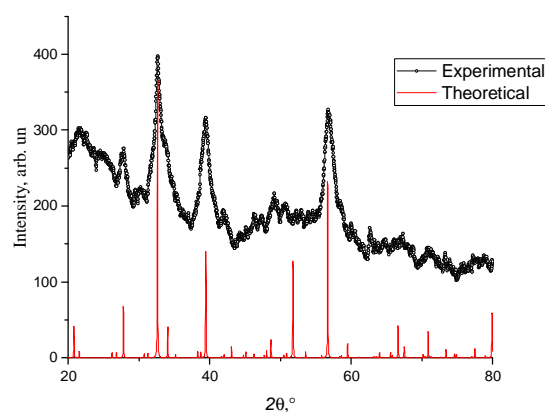
Fig. 1 X-ray diffractogram of In$_2$S$_3$ film.

The optical spectrum of light transmission T (λ) of In$_2$S$_3$ film for wavelengths from 340 to 900 nm was investigated (Fig. 2). The growth of light transmission begins in the area 360-380 nm. With increasing in the duration of the synthesis of light transmittance gradually decreases due to an increase in their thickness. The spectral dependences of the absorption of the In$_2$S$_3$ in $(\alpha \cdot h\nu)^2$ vs. $h\nu$ coordinates allow determining the fundamental absorption edges.
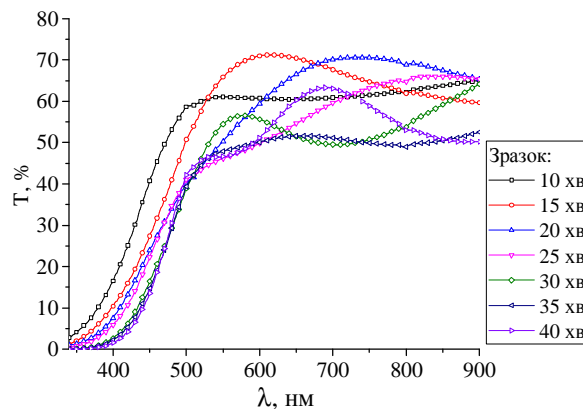
Fig. 2 The spectral dependences of optical transmission of In$_2$S$_3$ films.
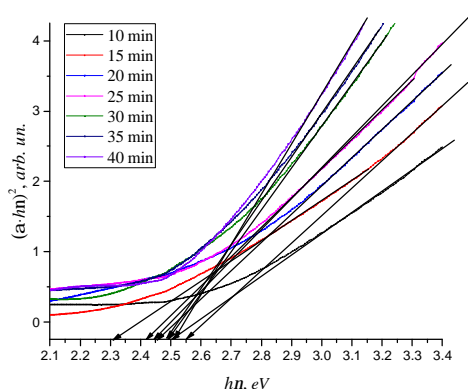
Fig. 3 Plot of $(\alpha \cdot h\nu)^2$ vs. $h\nu$ (b).

The optical band gaps of the films (Fig. 3) are localized in the ranges 2,31-2,55 eV, which is in good agreement with literature data for films of indium sulfide, deposited by chemical methods. [3,4].

TABLE 1

RESULTS OF THIN FILMS MICROANALYSIS

Deposition time, min.	Content In, at.%	Content S, at.%	In/S
10	43.812	56.188	1.283
15	40.125	59.875	1.492
20	41.891	58.109	1.387
25	41.844	58.156	1.390
30	41.734	58.266	1.396
35	42.013	57.987	1.380
40	43.052	56.948	1.323

The surface of In_2S_3 films (Fig.4 a – d) is smooth and homogeneous, solid, completely covering the surface of the substrate. With the increase duration of synthesis there is a change in color from yellow lemon to orange. The duration of the process also affects the thickness and thickness defects obtained films. More inclusions of approximately the same color, the number of which increases over time.
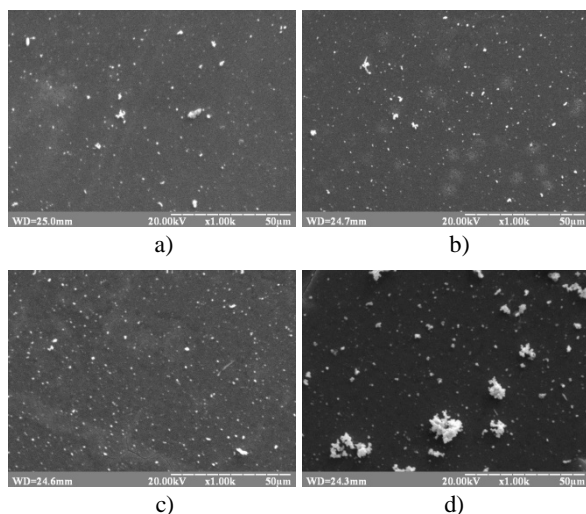
Fig. 4 Surface morphology of the In_2S_3 films, deposited for a) 10 min; b) 20 min; c) 30 min; d) 40 min.

Conclusion

The possibility of the synthesis of films by chemical precipitation using acetate acid, as complexing, indium sulfate, as a donor of Indium ions and thioacetamide as a sulfating agent [1-4, 5-9], has been confirmed. In this paper, the synthesis and properties of thin films of indium sulfide were studied.

The influence of the deposition time on the surface morphology and the coefficients of light transmission has been investigated. The value of bang gap energy has been experimentally determined (2,31-2,55 eV). The atomic composition and phase composition of films are determined. It has been established that the quality of films is very dependent on mixing and constant temperature control. At low mixing speed, a precipitate is formed on the substrate surface.

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New Heterocyclic Scaffolds with Thiophene and 1,2,4-triazole Rings

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Abstract – Some chemical modifications of the Gewald 2-amino-thiophenes and 3-aminothiophenes were established. A number of new substituted thienotriazolopyrimidines, thienotriazoles and thiophenyl-triazolothiadiazine were obtained. This study provides new approaches to the construction of substituted 1H-1,2,4-triazoles bearing thiophene core and allows to use data in medical chemistry for further drug discovery.

Keywords – 2-aminothiophene, 3-aminothiophene, 1,2,4-triazoles, aminohydrazones, thienotriazolopyrimidines, triazolothiadiazines.

I. Introduction

Recently, special attention is paid to the research in medicine, particularly to the synthetic drugs development for the treatment of serious diseases such as cancer. Fused heterocyclic derivatives with thiophene core continue to attract considerable attention because of their great practical usefulness, primarily, due to a very wide spectrum of biological activities. In particular, thiophenes have been reported to possess anticancer activity [1]. Among all heterocycles, the heterocycle-fused 1,2,4-triazole scaffold has been identified as one of the privileged structures in drug discovery. New literature data suggest that compounds with both: thiophene and 1,2,4-triasole rings are actively investigated for anticancer activity [2]. Among them thieno[3,2-*e*][1,2,4]triazolo[4,3-*a*]pyrimidines [3], thieno[3,2-*d*][1,2,4]triazolo[1,5-*a*]pyrimidines [4] and [1,2,4]triazolo[3,4-*b*][1,3,4]thiadiazines [5] are predisposed to antitumor activity.

Therefore, based on the combination of both thiophene and 1,2,4 triazole rings, an extended structure-activity investigation focusing on drug-like properties should be performed and the development of new efficient and mild syntheses of such compounds is a useful task, particularly when versatile procedures from readily available reagents can be employed.

II. Results and discussion

Synthesis of diverse heterocyclic molecules from the readily available starting materials in a cost and time-effective manner is an enduring challenge for organic chemists. Thus, functionalized Gewald 2-aminothiophenes and 3-aminothiophenes were used as starting material for this research.

In order to obtain 1*H*-1,2,4-triazole derivatives aminothiophenes **1a-c** were transformed at first into reactive thienyl clorohydrazones **3a-c** in high yields

through the diazotation reaction. Obtained chlorohydrazones with active chlorine atom could easily react with ammonia giving corresponding aminohydrazones in quantitative yields. It should be mentioned, that in case of Gewald aminothiophene, the diazotization step was carried out in the sulfate acid, since the use of concentrated hydrochloric acid leads to a rapid decomposition of such labile diazosalts.
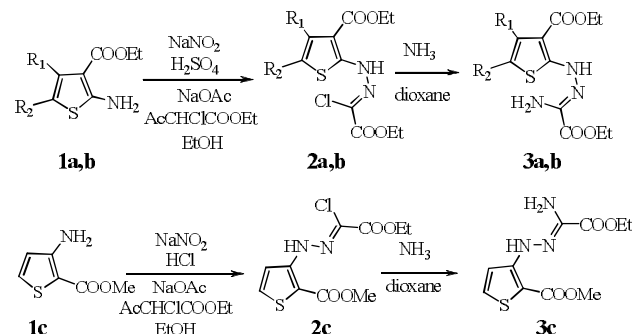
Fig. 1 Synthesis of thienyl aminohydrazones 3 a-c

Aminohydrazones **3** as a versatile reagents with several nucleophilic centers were studied in the cyclization reactions. Special attention was paid to the formation of 1*H*-1,2,4-triazole derivatives. We found that aminoethenylhydrazones **3a-c** do not react with carbodiimidazole, even with prolonged heating and excess of reagents. Cyclic derivative **6** was obtained only during prolonged heating of aminohydrazones with acetic anhydride in moderate yield. The cyclization reaction is most easily achieved by the formation of similar thienyl triazoles **5a,c** while heating aminohydrazones **3** with orthoester in acetic acid using toluenesulphonic acid as a catalyst. The target product is formed with a good yield.
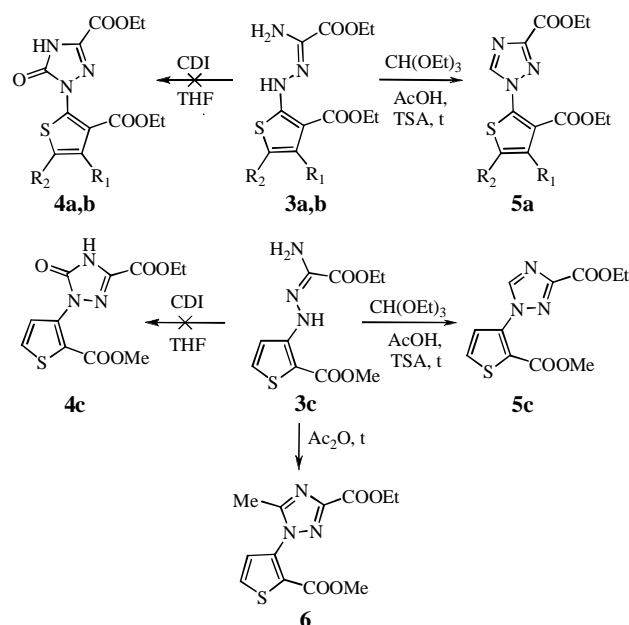
Fig. 2 Transformation of thienyl aminohydrazones 3 a-c

The etyl thiophene-3-carboxylate **7**, formed in Gewald aminothiophene deamination reaction, was converted to

4-amino-[1,2,4]triazole-3-thiol **8** according to the well-known method [6]. Alkylation of the compound **8** with chloroacetamide **9** and subsequent cyclization of the product in excess of POCl₃ resulted in the previously unknown thienyl substituted [1,2,4]triazolo[3,4-*b*][1,3,4] thiadiazine **11**.
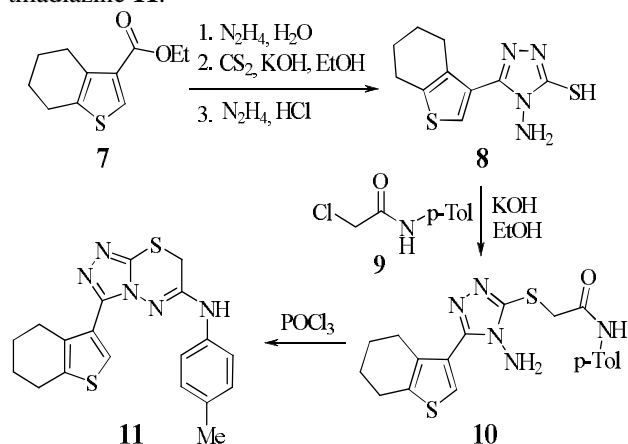
Fig. 3 Synthesis of triazolothiadiazine **11**.

Moreover, Gewald's aminothiophenes were studied in a three-component reaction with hydrazides and orthoester. Thus, 2-aminothiophene **12** reacting with triethylorthoformiate forms an appropriate ethoxymethylene-aminothiophene, which undergoes an attack by the nucleophilic nitrogen atom of the hydrazide molecule. Further cascade cyclization lead to the formation of thieno[2,3-*e*][1,2,4]triazolo[1,5-*c*] pyrimidine **14a-e**.
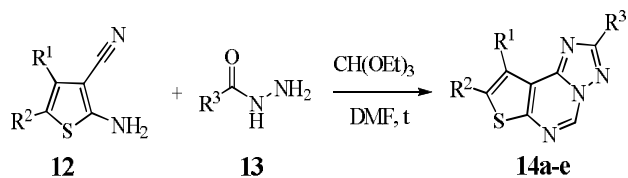
Fig. 4 Synthesis of thienotriazolopyrimidines **14a-e**.

The method has been tested on a number of hydrazides and allows to obtain large combinatorial libraries of the not enough studied tricyclic fused systems of thiophene. Yields of compounds **14a-e** are shown in Table 1.

TABLE 1

Yields Of Thienotriazolopyrimidines **14a-e**.

	R^1, R^2	R^3	YIELD, %
14a	R^1+ R^2= -(CH₂)-	Ph	81
14b	R^1= R^2=Me	4-NO₂-C₆H₄	84
14c	R^1= R^2=Me	3-Me-C₆H₄	80
14d	R^1= R^2=Me	CH₂CN	79
14e	R^1+ R^2= -(CH₂)-	CH₂CN	79

Investigating the properties of previously obtained by us thienopyrimidines [7], we found that when heating a mixture of 2,3-diaminothieno[2,3-*d*]pyrimidine **15** with benzaldehyde and sulfur in DMF, a thieno[2,3-*d*][1,2,4]

triazolo[1,5-*a*]pyrimidine **17** is formed. This result opens the way for the synthesis of isomeric thienotriazolopyrimidines.
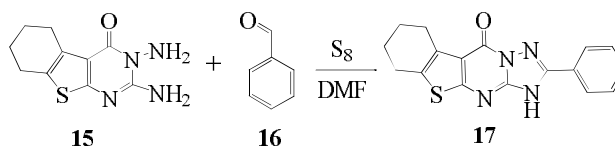
Fig 5. Synthesis of thienotriazolopyrimidine **17**.

Conclusion

A number of new substituted thienyl 1,2,4-triazoles, 3-(thiopen-3-yl)-triazolo[3,4-*b*][1,3,4]thiadiazines, thieno [2,3-*e*][1,2,4]triazolo[1,5-*c*]pyrimidines, thieno[2,3-*d*] [1,2,4]triazolo[1,5-*a*]pyrimidine were obtained. The resulting compounds have significant potential for biological research, in particular, to find new anticancer drugs.

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Effectiveness of Fenton Reagent in Oxidation Process of Methyl Violet Dye

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Abstract − Decoloration methyl violet dye by Fenton reagent was investigated spectrophotometrically. Reagents concentration, pH value, and metal ion were varied. It was shown that substrate oxidation rate depends non-linearly on dye concentration, Fe^{n+}, H_2O_2, and pH value. The composition of the reaction mixture providing maximum oxidation rate and MV conversion is proposed.

Keywords − kinetics, oxidation, Fenton reaction, dye, methyl violet, hydrogen peroxide, UV/Vis-spectroscopy.

I. Introduction

Dyes are a common model in the studying of water purification processes. Oxidation of dyes is not only a methodological but also a practical interest, since it is of great importance for reducing the impact of textile, paper, food, and pharmaceutical industry wastes on the environment. Fenton reagent may be effectively used as oxidizing agent because it is environmentally friendly and rather cheap. In classical Fenton system, Fe(II) ions are used for the catalytic decomposition of hydrogen peroxide [1]. Fenton reaction produces Fe(III) and hydroxyl radical, the latter initiates radical-chain oxidation process. It is known that this process consists of number of stages, including oxidation–reduction reactions. Some authors showed that Fe(III) could also be used in Fenton-like systems instead of Fe(II) [2]. The goal of this work was investigation of regularities of oxidation reaction of organic compounds with both classical Fenton reagent and H_2O_2/Fe(III) system under different conditions using methyl violet dye as the substrate.

II. Experimental part

Methylene violet (MV), $FeSO_4 \cdot 7H_2O$, $FeCl_3 \cdot 6H_2O$, H_2O_2 (60 % w/v), H_2SO_4, were all G.R. grades and used as received. All solutions were made in distilled water. The pH value of the $FeSO_4$ solution was adjusted using 0.25 M H_2SO_4.

The kinetics of dye decoloration was studied using SPEKOL® 1500 UV/Vis spectrophotometer (Analytik Jena AG, Germany) at 585 nm. Digital pH-meter was used for pH measurements. The experiments were carried out at 21±2 °C.

It was shown that in the range $1.2 \cdot 10^{-5}$–$2.7 \cdot 10^{-5}$ M, the absorbance of methyl violet solution at 585 nm versus concentration plots were linear (r ~ 0.99) with zero intercept for both Fenton systems.

III. Results and discussion

The kinetics of oxidative destruction of methyl violet (MV) by hydrogen peroxide in the presence of Fe(II) or Fe(III) ions was investigated. It was shown that such Fenton-like reactions could be effectively controlled by initial concentrations of dye, Fe^{n+}, H_2O_2, and pH value of the reaction media.

Analysis of kinetic curves demonstrated that the decoloration of MV solution by Fenton reagent occurs in two stages (Figs. 1 and 2). The first stage is faster (1–2 min or less), and the second one is ~4 times slower, regardless Fe^{n+} ion used. The rate of each stage essentially depends on the concentration of the components of the reaction mixture. It has been shown that the initial rate of the oxidative destruction of dye and process duration depends on each component concentration (substrate, hydrogen peroxide, Fe^{n+}). It should be noted that type of metal ion used is also important – change of Fe^{2+} in classical Fenton system to Fe^{3+} results in changes of kinetic curves form (see Figs. 1 and 2). The duration of the fist faster stage is much shorter for $Fe^{3+} + H_2O_2$ system.
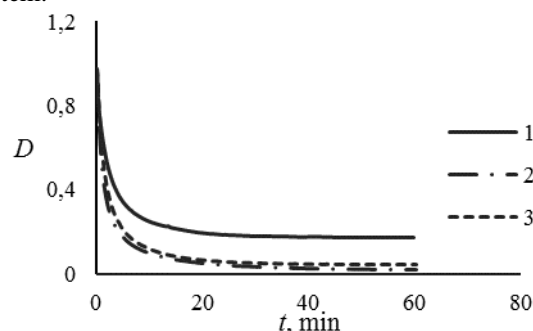
Fig. 1 Change in optical density (D) at different $[H_2O_2]_0$: (*1*) –$1.15 \cdot 10^{-4}$ M; (*2*) – $2.28 \cdot 10^{-4}$ M; (*3*) – $4.57 \cdot 10^{-4}$ M; $[MV]_0 = 1.75 \cdot 10^{-5}$ M; $[Fe^{2+}]_0 = 1.0 \cdot 10^{-4}$ M; pH = 3.
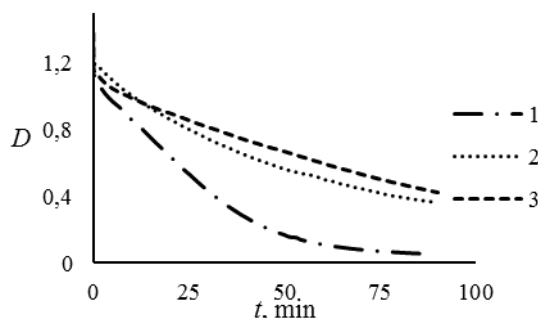
Fig. 2 Change in optical density (D) at different $[H_2O_2]_0$: (*1*) – $0.99 \cdot 10^{-3}$ M; (*2*) – $2.01 \cdot 10^{-3}$ M; (*3*) – $3.99 \cdot 10^{-3}$ M; $[MV]_0 = 1.75 \cdot 10^{-5}$ M; $[Fe^{3+}]_0 = 1.0 \cdot 10^{-4}$ M; pH = 3.

To investigate the effect of hydrogen peroxide concentration on dye degradation kinetics, experiments were conducted at different H_2O_2 concentrations. From Figs. 1 and 2 it can be seen that change of H_2O_2 concentration significantly influences the initial rate of

dye oxidation reaction. At comparatively low concentrations of H_2O_2, relatively high initial rates are observed. When the concentration of H_2O_2 increased significantly (0,02 M) (not given), the form of the kinetic curve has changed: the initial rate decreased, but remained almost constant throughout the measurement period. This may indicate a nonproductive decomposition (in terms of the formation of •OH radicals, which are essential in the degradation of the dye) of hydrogen peroxide in such conditions. The analysis of the received dependences demonstrated that the initial rate of dye decomposition (V_0) and substrate conversion depended non-linearly on H_2O_2 concentration. V_0 reached maximum values at $[H_2O_2]_0 = 5,7\cdot10^{-4}$ M for $Fe^{2+} + H_2O_2$, and $[H_2O_2]_0 = 6,02\cdot10^{-3}$ M for $Fe^{3+} + H_2O_2$.

Fig. 3 demonstrates the kinetic curves of MV decoloration by H_2O_2 in the presence of Fe^{2+}. At high Fe^{2+} concentrations gradual decrease in the initial rate of dye destruction process is observed. The possible explanaton is the growth of hydrogen peroxide decomposition rate, which means that the concentration of reactive $OH^•$ radicals in the system decreases: $2Fe^{2+} + H_2O_2 + 2H^+ \rightarrow 2Fe^{3+} + 2H_2O$. As for system $Fe^{3+} + H_2O_2$, larger concentrations of reagents should be taken to achieve similar results (Fig. 4).
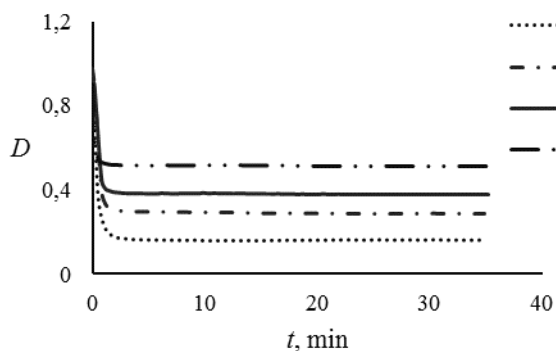
Fig. 3 Change in optical density (D) at different $[Fe^{2+}]_0$: (1) – $0.91\cdot10^{-4}$ M; (2) – $1.82\cdot10^{-4}$ M; (3) – $22.8\cdot10^{-4}$ M; (4) – $27.4\cdot10^{-4}$ M; $[MV]_0 = 1.75\cdot10^{-5}$ M; $[H_2O_2]_0 = 4.0\cdot10^{-4}$ M; pH = 3.
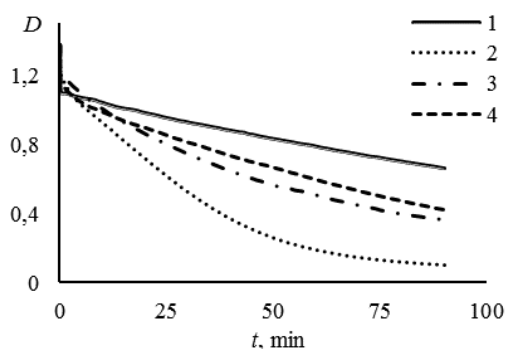
Fig. 4 Change in optical density (D) at different $[Fe^{3+}]_0$: (1) – $1.0\cdot10^{-3}$ M, (2) – $1.85\cdot10^{-3}$ M, (3) – $2.0\cdot10^{-3}$M, (4) – $4.0\cdot10^{-3}$ M; $[H_2O_2]_0 = 1\cdot10^{-3}$ M; $[MV]_0 = 2\cdot10^{-5}$ M; pH = 3.

In the presence of only Fe^{3+} ions and hydrogen peroxide, significantly slowly reaction takes place:

$$Fe^{3+} + HOOH \rightarrow Fe^{3+} + {}^•OOH + H^+.$$
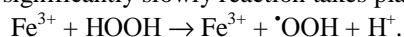
Generated •OOH radical is less active than hydroxy radicals, therefore, they react with MV much more slowly. For the investigated concentrations range initial decoloration rate shows non-linear dependence: maximum initial rate of decoloration and dye conversion was observed at $[Fe^{3+}]_0 = 1.85\cdot10^{-3}$ M.

Additional experiments were made to determine the influence of pH value on the studied process. It was established for $Fe^{2+} + H_2O_2$ system, that maximum conversion and rate of dye decomposition was observed for pH 2.2–3.

In order to determine the optimum ratio of $[Fe^{n+}]/[H_2O_2]$ for dye degradation, experiments were conducted by varying the Fe^{n+} and H_2O_2 concentrations, keeping the dye concentration fixed. The results of the experiments are listed in Table 1.

TABLE 1

COMPARISON OF THE INITIAL RATES OF MV OXIDATION (V_0) BY FENTON SYSTEMS DEPENDING ON $[Fe^{n+}]/[H_2O_2]$ RATIO AND METAL ION USED ($[MV]_0 = 2\cdot10^{-5}$ M)

$[Fe^{n+}]/[H_2O_2]$	$V_0\cdot10^7$, mol·l⁻¹·min⁻¹	
	Fe^{2+}	Fe^{3+}
2/1	1.8	1.0
3/1	1.5	4.9
4/1	1.3	3.4
6/1	0.9	2.9

It can be seen from the Table that for Fe^{2+} as the catalyst maximum initial oxidation rate is observed at $[Fe^{2+}]/[H_2O_2] = 2/1$, while for $[Fe^{3+}]/[H_2O_2] = 3/1$. The higher the concentration of Fe^{n+} the lower the V_0 value is observed.

Conclusion

The oxidation of methylene violet dye by Fenton reagent at ambient temperature was studied spectrophotometrically. The effects of the initial concentrations of dye, Fe^{2+} (Fe^{3+}), and H_2O_2, pH of the solution on dye decoloration reaction were established. It was shown that the initial rate of dye decoloration changes non-linearly with concentration of hydrogen peroxide and Fe^{n+}. Substitution of classical $Fe^{2+} + H_2O_2$ system to $Fe^{3+} + H_2O_2$ showed lower efficiency. In order to reach similar effect in dye conversion and reaction rate the concentrations of reagents should be increased approximately by order of magnitude. It was shown That the higher the concentration of Fe^{n+} in the system compared to H_2O_2 the lower the dye decoloration rate was observed.

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Effect of Oxidant Composition on Obtaining Raw Material for Pulverized Coal Production from High-sulfuric Low Grade Coal

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Abstract – The effect of the water steam on the sulphur removal degree and conversion level of coal organic matter has been determined. Sulfur content, as well as ash content and volatiles yield depend on the mentioned values. The optimal the content of water steam in oxidants to realize the oxidative desulphurization process has been found with the aim of obtaining raw material for pulverized coal production.

Keywords – water steam, oxidative desulfurization, coal organic matter, pulverized coal.

I. Introduction

It is well know, that to improve technical and economic indicators of the metallurgy industry can be used pulverized fuel. It considerably decreases the expenses of the imported natural gas and coke, and cheapens the process of steelmaking.

The requirements to the raw stuff of pulverized fuel are rigid enough. It primarily concerns the sulfur content, as it shouldn't accede 1.5%. The balance reserves of Ukrainian coal is considerable, approximately 33873 millions ton., it`s 3,8% of word stocks. However, the exploitation of Ukrainian coal for production of raw stuff for pulverized fuel is impossible because of high sulfur content.

To extend the sources of raw materials for PCI technology it is proposed [4] to use oxidative desulphurization of the coal, i.e. selective oxidation of pyrite sulphur, which is the main sulphur in coal, by an oxidant (air or air-steam mixture – ASM) to the sulphur(IV) oxide. The influence of the oxidant composition on the process of oxidative dehydration to get the raw materials for pulverized fuel production hasn't been study. The study of the influence of this parameter is considered in the work.

II. Initial Material

Low-rank coal from "Belorechenskaya" mine (Donetsk coal basin, Ukraine) was used for the experiments. It was grinded and fractions of 0.1-0,25mm were chosen. The characteristic of the initial coal coal is given in Tab 1-2.

TABLE 1

CHARACTERISTICS OF THE INITIAL MATERIAL

Moisture conten, W^A, wt %	Ash content, A^D, wt %	Volatiles yield, V^{DAF}, wt %
3.91	8.15	38.08

As can be seen from Tab. 1 the investigated coal is high-sulphuric coal with the pyrite form forming the bulk of coal sulfur.

TABLE 2

SULPHUR CONTENT IN INITIAL MATERIAL

Sulphur content relative to the dry mass, wt %			
total (S_t^d)	Pyrite (S_p^d)	organic (S_o^d)	sulphate ($S_{SO_4}^d$)
3.29	1.67	1.25	0.37

III. Experimental

The process conditions under which the effect of the water steam on the oxidative desulphurization is studied are presented in Table 3.

TABLE 3

OXIDATIVE DESULPHURIZATION CONDITIONS

Parameter	Values
Time, min	15
Temperature, K	698
Oxidant linear velocity, m/s	0.044
OFR, m³/h·kg,	4.8

As a result of the experiments was defined that in a case of water vapor increasing in steam-air mixture, boost the yield of the distilled coal (fig.1). The matter is that the water vapor slows down the reaction of the coal organic part burning. And total amount of the solid desulphuration products output increases.
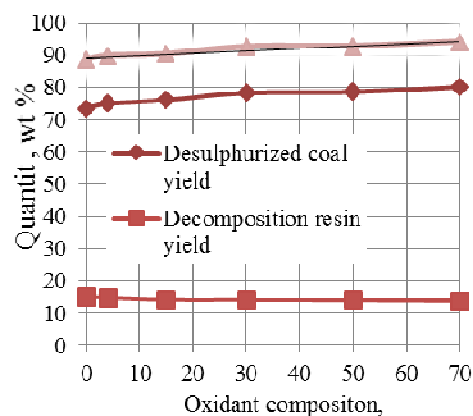
Fig. 1 Desulphurized coal yield; decomposition resin yield; solid products yield *vs*. oxidant composition.

It is shown in the table 4 that at the increasing of the water vapor content in the steam-air mixture decreases the ash level of desulphuriziting coal in a result of reaction impairing of OMD burning.

At the increasing of water vapor in the oxidant the amount of pyrite and total sulfur in coal develop through the minimum (tab.5). The addition of first dosage of water vapor, not only slows the process of organic and mineral depositions burning, but intensifies the process of pyrite

oxidation. The enrichment of sulfur content in the desulphuriziting coal after getting the maximum is explained by the lack of oxygen in the reagent (reduction of its concentration in reactive capacity).

TABLE 4

DEPENDENCE OF DESULPHURIZED COAL PROPERTIES
ON OXIDANT COMPOSITION

Water steam content in oxidant,vol %	Moisture content,W^A, wt %	Ash content, A^D, wt %	volatiles yield, vdaf, wt %
0	0,98	12,24	31,28
4,5	1,08	11,88	32,10
15	1,13	10,98	33,23
30	1,17	10,13	37,66
50	1,25	8,99	38,59
70	1,32	8,67	39,46

.

TABLE 5

SULPHUR CONTENT IN DESULPHRIZED COAL

Water steam content in oxidant, vol %	Sulphur content, wt %			
	total (S_t^d)	pyrite (S_p^d)	organic (S_o^d)	sulphate ($S_{SO_4}^d$)
0	2,74	1,24	0,30	1,19
4,5	2,43	1,01	0,28	1,13
15	1,92	0,86	0,26	0,80
30	1,36	0,28	0,22	0,85
50	1,52	0,39	0,23	0,89
70	2,25	0,94	0,27	1,03

In the fig.2 is depicted the areas of water vapor content in the steam-air mixture, what helps to obtain the suitable characteristics of the desulphuriziting coal, which meet the requirements of the raw stuff for PVP (Polyvinylpyrrolidone).

As we can see the fig.2 presents a wide range of the water vapor content values in the oxidant (32,3–42,7 % vol.), in consequence of the oxidative desulfurization of the low-metamorphosed coal, can be obtained the raw materials for PVP production, it meets the requirements of the coal brands №3–4 [2]. It is worth mentioning that at the given parameters of the water vapor content in the oxidant, is observed considerably high yield of the solid desulfurization products, near 92,5 % wt.
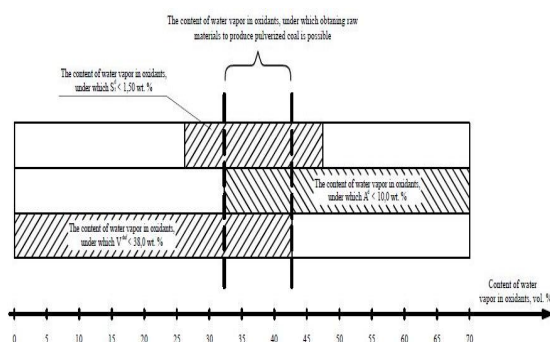
Fig. 2 Contents water steam values, under which the raw material for PCI may be obtained

Conclusion

The conducted experimental research made it possible to determine the water vapor influence in an oxidant on the process of receiving of the raw materials for pulverized coal fuel from high-sulfur low-grade metamorphozed coal by means of its oxidation desulfurization. The increase of water vapor quantity in an air-vapor mixture has the following general influence on the research procedure: yield of sulfur-free coal grows, yield of tar from disintegrated coal becomes slightly reduced, ash content in sulfur-free coal decreases, the number of volatile matters increases, the amount of pyritic and general sulfur goes through a minimum.

The duration of the process is 15 min., the temperature 698 K and OFR 4,8 m^3/h·kg, however, an optimal interval of the value of water vapor quantity in an oxidant is 32-43 % wt. (sulfur-free coal receiving is provided, which can be classified, due to its characteristic features, as a raw material for pulverized coal fuel production)

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Diffusion-transport Properties of Hydrogel Membranes Based on Copolymers of 2-hydroxyethyl Methacrylate with Polyvinylpyrrolidone

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Abstract − The results of researches of dialysis permeability hydrogel films on the basis of copolymers of 2-hydroxyethyl methacrylate with polyvinylpyrrolidone dependently on their composition and modes of dialysis have been carried out. Possibility of synthesized hydrogels applying as the diffusion dialysis membranes has been confirmed.

Keywords − hydrogel, copolymer, polyvinylpyrrolidone, films membranes, dialyze, permeability.

I. Introduction

The creation of biologically compatible polymer membranes which able selectively skip one or other substances not only for the molecules size, but also depending on their nature and membrane process conditions – is an actual problem [1]. Perspective in this direction are grafted copolymers of methacrylates and polyvinylpyrrolidone (PVP). Such copolymers are effectively applied in medicine, in particular, for making contact lenses, film medical materials, drugs controlled release systems etc. [2-4]. In the work the correlation of hydrogel membranes permeability based on cross-linked copolymers of 2-hydroxyethyl methacrylate (HEMA) and PVP with its composition and dialysis process parameters has been studied. The aim of the work was to determine the main kinetic regularities of diffusion permeability of hydrogel membranes based on HEMA/PVP copolymers while dialysis and ground the capabilities of its practical application.

II. Material and Methods

Hydrogen membranes were obtained by copolymerization of HEMA with PVP compositions in the water at mass ratio of the monomer phase and water equal to 1:1. The potassium persulfate in an amount of 0,3 wt. % per polymer-monomer composition has been applied as the initiator. Polymerization of compositions were conducted in forms of silicate glass in dry-air thermostat in the following mode: 60 °C – 2,5 hr; 75 °C – 3 hr.

To increase the mechanical strength the hydrogel was reinforced with a polyamide grid of cell dimensions $1,5 \times 1,5 \times 10^{-4}$ m. The reinforcement was carried out during molding.

Obtained hydrogel membranes were hydrated in distilled water for 24 hr and stored prior to the research start in a hydrated state.

Diffusion properties of hydrogel films were studied in dynamic mode (flow velocity of liquid $V_d = 2...4$ dm^3/hr) during water solutions dialysis of a model substance (sodium chloride). The laboratory dialyzer which contains a flowable dialysis cell by area of $1,9 \cdot 10^{-3}$ m^2 and peristaltic pump has been utilize. The research was carried out in accordance with the developed methodology [5]. The film's permeability was determined by change in the electrical conductivity of the water solution of electrolyte during dialysis applying measuring bridge P-5010 using platinum electrodes of comparison. Dialysis permeability was estimated by the amount of electrolyte which has diffused through the studied film membrane.

III. Result and Discussion

The influence of copolymer composition of synthesized hydrogel films on the diffusion rate of NaCl in the initial stage (Fig. 1) has been researched.

It was defined that permeability of film hydrogel membranes based on HEMA/PVP copolymers is significantly determined by the hydrogel composition. With increase of PVP amount in the initial composition the diffusion velocity increases, however, increase of PVP content in polymer-monomer composition over 20 wt. % doesn't lead to a proportional increase of NaCl diffusion velocity. Taking into account the above as well as that fact that increase of PVP content is the reason of deterioration of hydrogel films mechanical strength [3], for further research the hydrogel membranes containing PVP in the composition to 20 wt. % by weight have been applied.
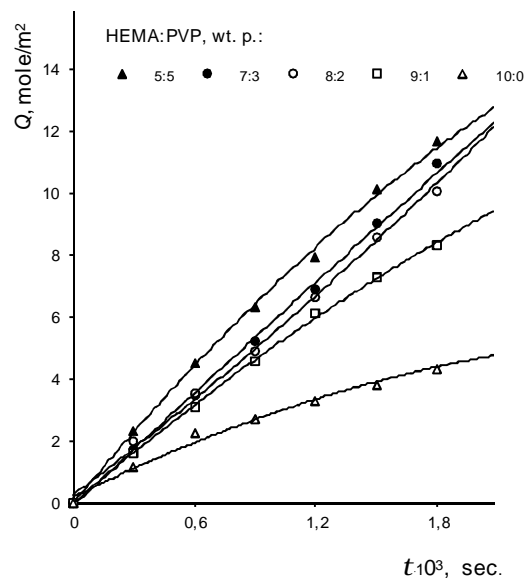
Fig.1 Kinetic curves of dialysis permeability (Q) HEMA/PVP membranes for NaCl ($d = 200$ μm): NaCl = 0,154 mole/dm^3; $V_d = 3$ dm^3/hr; $T_d = 20$ °C.

The dependence of dialysis permeability of the synthesized membranes on liquid flow velocity has been researched. It is determined that with increasing of flow rate of liquid from 3 to 4 dm/hr NaCl diffusion velocity through the HEMA/PVP membrane increases almost twice (Fig. 2).
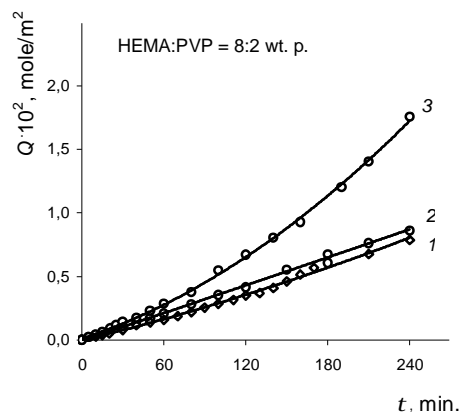
Fig.2 Kinetic curves of dialysis permeability (Q) HEMA/PVP membranes for NaCl ($d = 200$ μm): $C_{NaCl} = 0,154$ mole/dm^3; $T_d = 20$ °C; V_d, dm^3/hr: $1 - 2$; $2 - 3$; $3 - 4$.
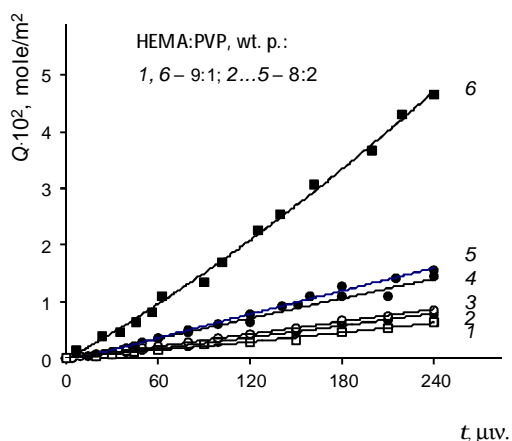
Fig.3 Kinetic curves of dialysis permeability (Q) HEMA/PVP membranes for NaCl ($d = 200$ μm): $C_{NaCl} = 0,154$ mole/dm^3; $V_d = 3$ dm^3/hr; T_d, °C: $1...3 - 20$; $4, 6 - 37$; $5 - 50$; $2, 4, 5$ – reinforced films.

In order to determine the practical application of hydrogel membranes the influence of temperature dialysis effect on their permeability were investigated. It is determined that the diffusion rate of NaCl significantly increases with increasing of dialysis temperature (Fig.3, curves 1, 6), but such a membrane will be significantly strain through of their high elasticity. Reinforcement of

hydrogel film with polyamide grid reduces their elasticity and increases strength, however effective area of the membrane working surface decreases by almost 40%. It was defined that reinforcement slightly affects dialysis permeability of hydrogel membranes (Fig.3, curves 2, 3). Also NaCl diffusion velocity for reinforced films increases much less with increasing of dialysis temperature (Fig.3, curves 2, 4, 5) than for non-reinforced films. The reason of mentioned is their elasticity reduce.

Conclusion

The kinetic regularities of the dialysis permeability of hydrogel films based on cross-linked HEMA/PVP copolymers have been researched. The dependences of their permeability on hydrogel composition, reinforcement, and also conditions of dialysis of sodium chloride water solutions have been determined. The possibility of application of HEMA/PVP copolymer hydrogel films of as the diffusion dialysis membranes is confirmed.

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Composite Hydrogel Materials of Biomedical Application with Fungibactericidal Properties

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Abstract ‒ The new porous compositions on the basis of hydroxyapatite filled copolymers of methacrylic esters and polyvinylpyrrolidone, which containing silver nanoparticles in the structure, were synthesized. Effect of pores forming agent nature, polyvinylpyrrolidone and hydroxyapatite amount on the composite properties was observed. In the composite structure silver nanoparticles are obtained via silver nitrate reduction by tertiary nitrogen of polyvinylpyrrolidone. The synthesized silver-containing composites possesses bactericidal properties .

Keywords – porous composition , polyvinylpyrrolidone, silver nanoparticles, bactericidal properties, porosity.

I. Introduction

Modern medicine and biotechnology pays great attention to research that focused on the development of new osteoplastic materials. These materials should provide effective regeneration of bone tissue after various kinds of operations, particularly in orthopedics and maxillofacial surgery. These applications require materials that can be produced on the basis of non-organic matrix of cattle natural bone tissue which contains chemical elements in the same form as in vital organism. Hydroxyapatite (HA) is the main mineral component of bone, tooth, enamel and dentin that plays an important role in many physiological processes. As potentially the most biologically compatible and active replacement of bone tissue the hydroxyapatite attracted great attention from scientific society [1]. Hydroxyapatite may be stable in contact with body fluids and become essentially integrated with the bone [2]. However, this material is brittle and its poor mechanical properties, such as compressive strength, elastic modulus and some fracture toughness, cannot be entirely compared to unique mechanical features of cortical and cancellous human bones [3]. The possibly most benefitial way to overcome this disadvantage is to design porous polymer-mineral composites [4,5] synthesized from calcium-phosphate materials (which have their composition similar to bone) and biocompatible polymeric matrix, mainly on the basis of 2-hydroxyethylmethacrylate (HEMA) with polyvinylpyrrolidone (PVP) copolymers.

The aim of the present work is to develop new compositions with antiseptic and antibacterial properties based on (co)polymers of HEMA with PVP capable being applied in medicine (in osteogenesis) and to investigate the effect of composition structure on the regulations of composites formation and properties.

II. Material and Methods

2-Hydroxyethylmethacrylate (Bisomer) were vacuum distilled before use; polyvinylpyrrolidone (M_W=28·10³, AppliChem CmbH); hydroxyapatite ($Ca_{10-x}(PO_4)_6(OH)_2$) with the particles size of 0,05…1,25 mm was synthesized at the Department of Silicates Technology of Lviv Polytechnic National University.

The average diameter of pores (d_p) and polydispersivity index (*PDI*) were determined by size measuring of at least 200 pores using MBS-9 microscope. The structure of the composites was studied using transmission electron microscope (TEM) JEOL JEM 200 CX. The total porosity and composites density were determined using a Manehold method described in [6].

The compression strength was determined by the standard method using testing machine "Kimura" type RT-601U. UV spectroscopic studies was carried out on the Perkin-Elmer Lambda 20 UV-VIS spectrometer.

III. Result and Discussion

One of the main bioplastics requirements is the presence of through porous structure with controlled micro- and macropores sizes necessary for implant composite growth by bone tissue. Therefore, at first we studied the effect of nature of potential pores forming agents on the porous structure formation and composites conditional density. The basic polymer-monomer composition was the composition [HEMA]:[PVP] = 7:3 wt. p. with high reactivity and without demand of high curing temperature [7]. The pores forming agents were compounds of organic and inorganic nature: chloroform, methylene chloride, cyclopentane, hexane, calcium chloride, ammonium and potassium carbonate. The organic agents form pores at evaporation, calcium chloride – after its washing by water from a ready composite, ammonium and potassium carbonates – due to the decomposition and release of carbon dioxide at composite heating. Porous material is not formed only in the case of hexane. Concerning the inorganic forming agents (calcium chloride and ammonium carbonate), the high-porous composites were obtained with fine pores, the size of which does not exceed 0,4 mm. While using organic ones: chloroform, methylene chloride and cyclopentane the materials with satisfied size of pores (0,8…1,3 mm) are formed.

The value of porosity considerably depends on the components ratio. Porosity increases from 37 % for polyHEMA to 67…70 % for copolymer HEMA-PVP with PVP content of 30 wt. %. This fact reveals that PVP positively affects not only the kinetics of composite curing but pores forming as well. $AgNO_3$ do not affect the general porosity, though the polydispersivity index increases with the increase of their amount.

Photographs of the composites filled with HA are represented at Fig.1. They confirm the presence of developed micro- and macroporous structure favoring the effective growth of the composite by bone tissue. Composites, which incorporates contain more PVP, have greater porosity value (Fig.1a).
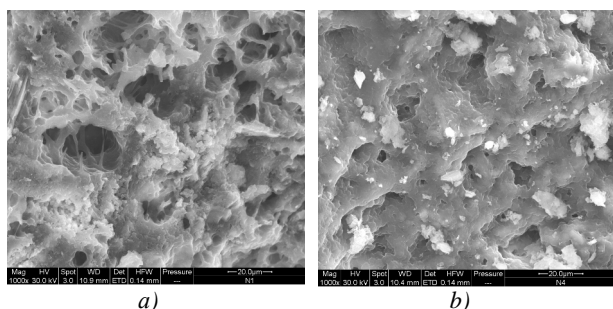
Fig.1 Photographs of microporous structure
of hydroxyapatite filled HEMA-PVP composites:
[HEMA]:[PVP]:[HA], wt. p.: *a* – 6:4:7, *b* – 9:1:7.

The amount of the filler also affects the composite formation and its properties. The porous composite structure is not formed without HA or its content not exceeding 25% even at the optimum amount of pores forming agent. To our mind, foaming takes place before the composition curing. At the same time in the investigated range the decrease of material porosity is observed with the increase of filler amount. The most homogeneous porous material with the least conditional density is formed with HA amount of 70 wt. %.

In order to obtain silver nanoparticles and to provide the composites with antibacterial properties the reaction of silver recovery by interaction of its salts with tertiary nitrogen of PVP was investigated. The formation of silver by this reaction is confirmed with the presence of peak (420...430 nm) at UV spectra of products of interaction between $AgNO_3$ and PVP and with the results of the chemical analysis of reaction products.

The results of electron microscopy studies have shown that Argentum nitrate forms silver nanoparticles in the shape of different size polyhedrons. The size of nanoparticles depends on the nature of the reaction medium. In aqueous solution there are formed silver particles with an average diameter of 40...60 nm, whereas in mixtures of water with ethanol – 10...30 nm.

Reaction of Argentum reduction by interaction of its salts with tertiary nitrogen of PVP was used to provide antibacterial properties of composites during the composite formation. Temperature conditions of composites synthesis were justified on the basis of kinetic studies of polymerization [7]. The polymerization was initiated by BPO (1 wt. %).

During the synthesis composites with PVP and argentums salts change their color from weak-yellow to brown. It is also the indirect confirmation of silver nanoparticles formation while interaction between argentum nitrate and PVP tertiary nitrogen. This method has irrefutable advantages over other known methods when nanoparticles and hydrogels are prepared separately or when hydrogel is saturated with argentum salts or when silver nanoparticles are obtained via its reduction by amino-containing methacrylic monomer followed by its copolymerization with other monomers. Moreover, there is no necessity in toxic amino-containing reducers.

To confirm the possible practical application of the developed silver-containing composites in biomedical research industry their bactericidal and fungicidal properties were investigated. The research results are presented in Table 1.

TABLE 1

FUNGIBACTERICIDAL ACTIVITY OF SILVER-CONTAINING COMPOSITE (HEMA:PVP:HA:AgNO$_3$ = 7:3:7:0,6 WT. P., DIAMETER OF THE COMPOSITE SAMPLES 15 MM)

Diameter of the growth retardation zone, mm (%)		
E. coli	*S. aureus*	*A. niger*
24,4 (60)	26,0 (73)	20,0 (33)

As a result of comparative analysis of bactericidal and fungicidal properties of the obtained HEMA-PVP composites that contain silver nanoparticles and non-silver-containing composites on microorganisms it was found that the composites, containing silver nanoparticles, block the growth of bacteria, showing bactericidal activity.

Conclusion

Thus, new porous composites on the basis of hydroxyapatite filled copolymers of methacrylic esters and PVP were synthesized. The possibility of silver nanoparticles obtained during formation of the composite was confirmed. It is expected that these composites will possess antibacterial properties. The effect of origin and ratio of the initial components on the properties of porous filled composites was determined. These results will be used for optimization of compound ratio of the material for osteogenesis and its further investigations including medical and biological treatments.

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Bitumen Modified by Phenol-Cresol-Formaldehyde Resins Obtained From Coking By-products

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Abstract − Resins were synthesized via phenol polycondensation with formaldehyde from the coal coking by-product, phenol fraction namely. Phenol-cresol-formaldehyde resins were obtained from the fractions b.b.–185 °C (PhCFR-1) and "raw" phenol obtained from the fraction b.b.–185 °C (PhCFR-2). It was established that the resulting resins may be used as modifiers of road bitumen.

Keywords − modified bitumen, «raw» phenol, phenol-cresol-formaldehyde resin.

I. Introduction

Approximately 85% of oil bitumen is used as an astringent in the ways of asphalt stacking: pavements, highways, airports etc. It`s a basic binding agent that is used for highway engineering. There are some difficulties in using of the road bitumen, but the most essential problem is that the adhesion properties of the bitumen commodities are not high enough (even if it meets the requirements of the normative documents) [1].

One of the ways of the problem solution is the modification of the commercial road bitumen. For road bitumen modification usually are used the block copolymers of styrene SBS type, it is caused not only its ability to improve the bitumen strength but also to provide a polymer-bitumen elastic compositions, even in a low temperature [2-4].

The main drawback is high price, what moderates the growth rate of modified by the thermoelastoplasts bitumen (price is higher in 1,5-2,5 times rather than non modified [5]).

It is important to find inexpensive substances which improve the operating characteristics of bitumen, first of all adhesive.

The experiments of getting relatively cheaper and effective oil bitumen modifiers from the by-products of coking coal are conducted at the department of Chemical Technology of oil and gas processing, Lviv Polytechnic National University [6-8].

It is known [2-4], while modifying the oil bitumen quite effective modifiers are phenol-formaldehyde resins. But resins got from the phenol, is not widely used as polymer modifiers because of its high price. On the other hand, one of the coke-chemical enterprises products is phenol fraction with the output of 1,5 – 2,5 % wt on fresh coal, there is a considerable part of phenol and cresol (around 65 %) form in the coking process. The cost of the coal tar

phenol fraction contains 35-50% wt of the phenol, it is in 35-40 times lower than cost of the synthetic phenol [9]. The purpose of the experiments was to show the possibility of the oil bitumen modification by the phenol-formaldehyde resins, got from the by-products of the coking coal process

II. Experimental

The phenol fraction was used for synthesis, selected on JSC Zaporizhkoks.

The scheme of experiments performing is in the fig.1. In order to separate phenol and cresols mixtures was performed the distillation of phenol fraction on two fractions – b.b. fraction – 185 and 185-e.b. fraction °C (the temperature of phenol boiling is 182 °C, cresols -- 191-202 °C). Then from the b.b. fr. – 185 °C the phenol was concentrated («raw» phenol was got). The phenol disengagement from the b.b. fr.-185°C was performed by 10% NaOH solution, with phenol it forms water soluble phenolates, conversion into phenol was made by the concentrated hydrochloric acid. (Fig.1)
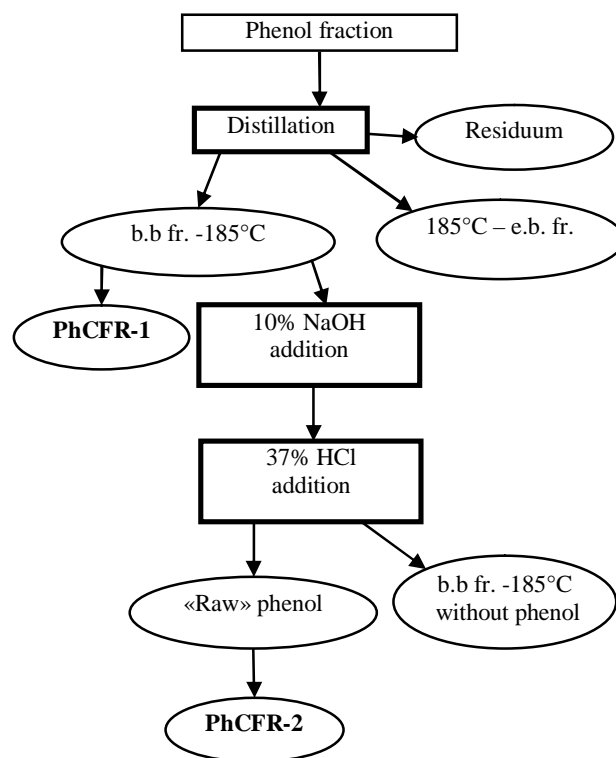
Fig.1 Scheme of research.

The material balance of distillation is given in the Table 1

TABLE 1

THE MATERIAL BALANCE OF PHENOL FRACTION DISTILLATION

Article / Value	fresh, % wt
b. b.fr.-185 °C (phenol concentrate)	50,60
fr. 185-e. b. °C (cresol concentrate)	46,77
Residuum	2,63
Total	100,00

The method of phenol polycondensation with formaldehyde was used to synthesize resins from the b.b. fraction. -185 °C (PhCFR-1). The yield of «raw» phenol is 28,8 % wt for b.b.fr. .-185 °C.

III. Result

The conditions of PhCFR-1 and PhCFR-2 are in the Table 2 [10].

TABLE 2

THE CONDITIONS OF PHENOL – FORMALDEHYDE RESINS SYNTHESIS

Parameter	Value
Molar relation phenol / formaldehyde	1,42
Catalyst content (conc. HCl), % wt on phenol	0,1
Temperature,°C	100
Process duration, min.	60

The yields of the resins are in the Table 3.

TABLE 3

THE YIELDS OF PHENOL – CRESOL – FORMALDEHYDE RESINS

Resin	b.b. fr.-185, % wt
PhCFR-1	24,3
PhCFR-2	26,1

The oil bitumen was modified at 110 and 190 °C by the phenol-formaldehyde resins. The characteristics of the bitumen-polymer mixtures are in the Table 4.

TABLE 4

THE CONDITIONS OF PREPARING AND CHARACTERISTICS OF BITUMEN MODIFIED BY THE POLYMER

Indicators	Output bitumen	Modification temperature, °C			
		2,5 % wt PhCFR-1 the bitumen output		2,5 % wt PhCFR-2 the bitumen output	
		110	190	110	190
Softening temperature (ball & ring method) (°C)	45	48	48	–	48
Penetration at 25 °C (0,1 mm)	67	62	42	–	52
Ductility at 25 °C (cm)	>90	>90	>90	–	>90
Adhesion to glass (%)	49,5	90,2	87,4	–	94,5
Homogeneity	+	+	+	non-homogeneous	+

Conclusion

Compare the data given in the table 4, it is clear that loading into bitumen phenol-formaldehyde resins – 2,5% wt, increases the melting temperature and adhesion of oil bitumen. Modification of PhCFR-1 of oil bitumen should be conducted at 110 °C, because at 190 °C the modified bitumen becomes less plastic; phenol-formaldehyde resins 2 – at 190°C, because at 110 °C it is modified bitumen what doesn't meet the requirements of homogeneity.

Also the results show (Table 3) the yield of of phenol PhCFR-2 is much higher than PhCFR-1. So, it is more expedient to get the phenol-formaldehyde resins from «raw» phenol.

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Emulsion Co-oligomerization of Hydrocarbon Fraction C₉ With the Polyvinylchloride Production Waste as a Dispersion Medium

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Abstract −The main raw materials for co-oligomers synthesis are waste and by-products of ethylene production, first of all □ a liquid pyrolysis products which contain aliphatic and aromatic hydrocarbons. The main part of these products is C₉ fraction. Emulsion co-oligomerization of hydrocarbon fraction C₉ allows for the maximum degree of processing liquid pyrolysis by-products, improve ecological production of ethylene, lower power inputs on the stage of the synthesis and release of co-oligomers compared to existing methods.

The process of emulsion co-oligomerization with "emulsion water" (by-product of the suspension polyvinylchloride production) as a dispersion medium – have been investigated.

Keywords − emulsion co-oligomerization, C₉ fraction, initiator, co-oligomer, "emulsion water".

I. Introduction

In today's industrial development question of qualified use of by-products appears as ethylene production amount increases annually, leading to increasing of the amount of liquid by-products of pyrolysis (LBPP). The rational way of LBPP recycling is obtaining cooligomers on their basis. The features of industrial methods of initiated oligomerization: high reaction temperature (453 – 473 K), high reaction time (6 – 8 hrs.), complexity of the selection of target products, high enough color (40 – 100 mg I₂/100 ml) which significantly affects not only properties, but also the oligomers cost.

Since the initiated co-oligomerization produces a cyclopentadiene-styrenic co-oligomers, a low-temperature technology of hydrocarbon fraction C₉ emulsion co-oligomerization of the is proposed. The peculiarity of co-oligomerization in an emulsion is the low temperature of the process (323 K), its insignificant duration (down to 3 hours), and the possibility of obtaining high-molecular weight and low color-coding co-oligomers. The emulsion mixture contains: a monomer (hydrocarbon fraction), water, emulsifier and initiator. The initiators are soluble both in the disperse phase (benzoyl peroxide) and in the dispersion medium (peroxides, persulfates). Emulsifiers are a variety of soaps: oleates, stearates, salt sulfocytes of paraffinic high boiling carbohydrates, castor oil. The concentration of the emulsifier in the system ranges from 0.1 to 2.0 wt% (relative to the dispersion medium). Emulsifiers quantitative of a certain nature depends on the value of their critical concentrations of micelles (CCM).

Suspension polyvinylchloride (PVC) manufactured in "Karpatnaftokhim" (Ukraine, Kalush city), a significant amount of "emulsion water" is obtained as a by-product. "Emulsion water" (EW) is a solution of residues of the emulsifier E-30 and a mixture of the initiator's decomposition products (bis (2-ethylhexyl) peroxydicarbonate, (Trigonox EHP-W60), dilauyl peroxide (Laurox W40), 2,4,4-trimethylpentyl 2- peroxidecanoate (Trigonox 423-W50)), in the amount of 0.1 – 0.2wt% (relative to the monomers weight).

The study of co-oligomers obtaining by emulsion co-oligomerisation with "emulsion water" as a dispersion medium is appropriate.

II. Experiments

As raw material for oligomerization (dispersion phase) fraction C₉ of liquid by-products of diesel pyrolysis is used: density – 936 kg/m³; bromine number – 68 g Br₂/100 g, molecular weight – 102, the content of unsaturated compounds to 45% including styrene 17,85% viniltoluols 6,99%, 18,00% dicyclopentadiene, indene 1,25 %.

The initiator – water-soluble potassium persulfate (PC) with the content of the main product 99.0%. The emulsifier – E-30, a mixture of linear alkanesulfonates. The general formula R-SO3Na, where R – corresponds to a carbon chain with an average length of C₁₅.

Under the conditions of the process the main reactive monomers are styrene and its derivatives with a low boiling point. Selectivity observed in the reactivity of unsaturated hydrocarbons C₉ fraction as the maximum product yield is comparable with the amount of styrene in the raw material.

III. Results and Discussion

For the results comparison of "emulsion water" and tap water (TW) as a dispersion medium surface tension has been determined. The results of the study are shown in Fig.1.
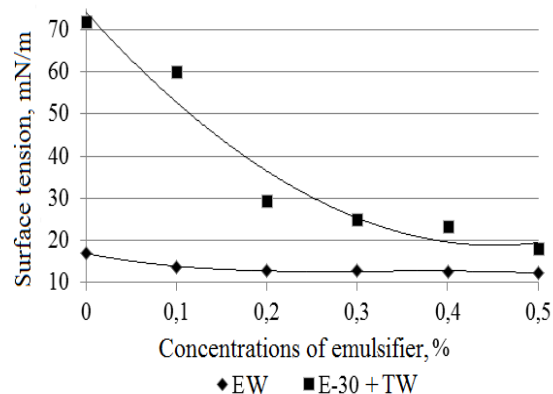
Fig.1 Isotherm of surface tension of "emulsion water" and tap water at different concentrations of emulsifier E-30.

It was determined that an increase in the amount of emulsifier E-30 in "emulsion water" only by 0.1% contributes to reducing the surface tension from 17.0 to 13.6 mN/m. An increase in the concentration of emulsifier above 0.1% has lesser effect on the surface tension.

"Emulsion water" is used as a dispersion medium in the process of the C_9 fraction unsaturated hydrocarbons emulsion co-oligomerization. Co-oligomers synthesis of was carried out under the following conditions: reaction temperature 323 K; volumetric phase ratio [fraction C_9]:[emulsion water] = 1: 1 ÷ 1: 3; reaction time 180 minutes.

For comparison, to the "emulsion water", an initiator of potassium persulfate was added in an amount of 0.1% by weight. (relative to the amount of fraction C_9), and an emulsifier E-30 with a concentration of 0.1% by weight (relative to the amount of water phase). The results of the research are shown in Fig.2.
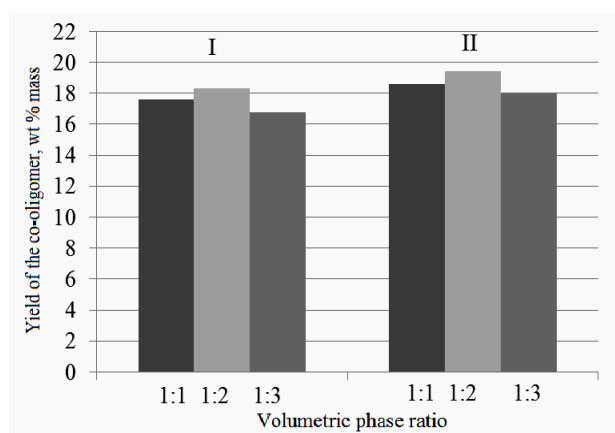
Fig.2 The volume phase ratio effect [fraction C_9] : [EW] on the yield of the co-oligomer
I – without emulsifier and initiator;
II – emulsifier (E – 30) = 0.1 wt%,initiator (PC) = 0.1 wt% mass, τ = 180 min)

The results of the study indicate that the use of "emulsion water" as a dispersion medium in the process of emulsion co-oligomerisation of fraction C_9 is appropriate. As a result, a co-oligomer with a maximum yield of 19.4% by weight was obtained. (with the ratio [fraction C_9] : [EW] = 1 : 2) and good parameters (molecular weight – 860, softening temperature – 350 K).

The maximum yield of the product (19.4% by weight) was obtained at the ratio [fraction C_9] : [EW] = 1 : 2 (concenation of the emulsifier and initiator 0.1% by weight), average molecular weight 860, softening temperature 350 K .

The results of the study are shown at Table 1.

The dependence of the product yield on the phase ratio for the dispersion medium of "emulsion water" is compatible with the dependence for co-oligomerization using as a dispersion medium of tap water.

TABLE 1

THE DEPENDENCE OF THE COOLIGOMER CHARACTERISTICS FROM THE EMULSION SYSTEMS COMPOSITION

Characteristics	[C$_9$ fraction]:[EW]			[C$_9$ fraction]:[EW] (C$_I$=0,1 wt%; C$_{E(E-30)}$=0,1wt%)		
Volumetric phase ratio	1:1	1:2	1:3	1:1	1:2	1:3
Bromine number, g Br$_2$/100 g	34,5	34,0	36,8	33,3	29,3	34,5
Softening temperature, K	346	348	344	348	350	349
The average molecular weight	755	760	755	810	860	815
Color, mg I$_2$/100 ml	40	40	40	40	40	40

Conclusion

The possibility of using – a by-product of the of suspension polyvinylchloride production – "emulsion water" (EW) for the synthesis of co-oligomers in the emulsion has been established. The results of the study indicate that the use of "emulsion water" as a dispersion medium in the process of emulsion co-oligomerisation of fraction C_9 is appropriate. As a result, a cooligomer with a maximum yield (19.4% by weight) was obtained at the ratio [fraction C_9] : [EW] – [1:2] and the following physical and chemical parameters: molecular weight – 860, softening temperature – 350 K. The proposed technology allows the rational use of petrochemical industrie by-products.

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Influence of the Nature of Metal-Containing Polymer-silicate Filler on the Physico-mechanical Properties of Polypropylene

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Abstract − The influence of Ni-containing polymer-silicate filler modified by polyvinyl alcohol on the physico-mechanical (surface hardness, strength at breaking, elastic modulus, coefficient of structure) properties of thermoplastic composites based on polypropylene has been found.

Keywords − metal-containing polymer-silicate fillers, polypropylene, physico -mechanical properties.

I. Introduction

Today, for the development of modern technologies and their effective implementation it is necessary to use the innovative materials with specific required properties. The increased attention have thermoplastic and thermoset polymer-inorganic (nano-)composites based on inorganic fillers including silicates, which have the required for a particular application unique set of operating and technological characteristics.

Usually the inorganic fillers are previously modified for enhancing the technological compatibility with the polymer matrix and directional adjustment of technological and exploitation properties of polymer composites. Among the methods of modifying of silicate fillers physico-chemical method, based on coprecipitation of water-soluble silicates and functionality surface-active polymers modifiers under the influence inorganic acids and (or) salts of metals is effective and ensures even distribution of the modifier on the surface and in the structure of the filler. The functional-active water-soluble polymer – polyvinyl alcohol (PVA), which has a high surface activity and is able to intermolecular and interfacial interactions is advisable to use for modification. Polypropylene (PP) occupy a special place among the wide range of polymer matrices used for development of new composite materials.

II. Experimental

To filling polypropylene and polyester resin was used metal-containing modified silicate fillers that was obtained due to coprecipitation of sodium silicate and polymer modifier – polyvinyl alcohol under the influence of metals chlorides of different nature [1]. The developed method of coprecipitation are provided the obtaining of silicate filler with a specific active surface area of the within 60-76 m^2/g and the number of active sites on it 77-99 · 10^6 mol/g and reduced of water absorption value by 40-60% and even distribution of the modifier on surface and in silicon-oxygen skeleton.

To create a polymer composite materials as a polymer matrix were used – polypropylene Moplen HF501N («LyondellBasell» Netherlands). For polymer composites based on PP with Ni-containing silicate filler, which are modified by polyvinyl alcohol (Ni-PVA-SF), was pre-mixing the bulk components in the desired ratio in the mixer drum (applying powder of silicate filler on granular of thermoplastic polymer). After receiving mechanical mixture carry out drying and homogenization of components by mixing in viscous state on extruder Cellier followed by squeezing material in the form of rods.

Production of standard samples from granular material for future research carry out in injection molding machine mark 25 KUASY 32/2. Filler content – 10% by weight.Physical-mechanical properties of samples: ultimate tensile strength at breaking, border fluidity during stretching, the relative elongation during tearing was determined according to ISO 527-1, -2.

Research elastic-deformation properties of obtained materials carried on consistometers of Hepler at 293 K by indentation of conical indenter under load of 120 N and determine the characteristics of the module and deformation by calculation according to the methodology.

The surface hardness by conical point of fluidity determined on consistometers of Hepler at 293 K indentation in the polymer sample steel cone with an angle sharpening 58^0 08' under load of 50 N for 60 s

III. Results and Discussion

The performance properties of composite materials based on thermoplastic polymers, including polypropylene differ significantly from unfilled thermoplastics. For polymeric composition materials these properties over a wide range can be adjusted by physical condition and nature of the initial components, the nature of the distribution of the ingredients in the bulk material, heat treatment, technological parameters of processing and more. In this regard, considerable interest is the study of basic physical, mechanical and thermophysical properties of materials based on PP filled with modified Ni-containing silicate filler.

Physicomechanical properties of the composites are one of the most important performance properties and largely determine the field and terms of the products in their basis. Mechanical testing under static loads by using stress-elongation curve can determine the key indicators of strength during stretching.

Stretching curves of developed polymer composites are typical for crystalline polymers. In particular, there are areas that meet certain state of supramolecular structure of the material under the applied load. Because the elastic deformation, which is fully reversible, meaning tension in the material initially is proportional elongation that is similar to a crystalline solid bodies and significant restructuring of the crystallites happens [2]. The basis of curves defined border tension strength (σ_b) and relative elongation (ε_b). These characteristics and surface hardness values before (F) and after (F_T) heat treatment shown in table. 1.

TABLE 1

PHYSICOMECHANICAL PROPERTIES OF COMPOSITES BASED ON PP

No.	Filler	σ_b, MPa	ε_b, %	F, MPa	F_T, MPa
1	Without filler	41,2	66	195,7	213,4
2	Ni-SF	43,4	30	190,2	228,7
3	Ni-PVA-SF	45,6	40	231,7	240,94

The composites based on filled PP the ultimate tensile strength values is higher compared to unfilled materials, which is obviously due to the higher degree of crystallinity. Thus, the largest value σ_b is observed during use as Ni-PVA-SF – 45,6 MPa. This feature is associated with the creation of more favorable conditions for crystallization of PP with the direct participation of the modified filler.

As a result of intermolecular interactions (mostly hydrophobic character) filler with macromolecules of PP occur changes in interphase layers that lead to some relative orientation of macromolecules to form denser supramolecular structures, resulting is increases a surface hardness of the composites.

For polymer composite of constructive and thermotechnical appointment are important resilient, highly elastic and plastic properties. The study of deformation properties of composites based on PP are essential for understanding the behavior of a material under load different types (static or dynamic, short or long, etc.) and the correct choice of the application. The elastic-deformation properties for composites based on PP are shown in table. 2.

TABLE 2

ELASTIC-DEFORMATION PROPERTIES OF COMPOSITES BASED ON PP

No.	Parameter	Filler		
		–	Ni-SF	Ni-PVA-SF
1	Module strain E_g, MPa	512	614	677
2	The equilibrium modulus E_m, MPa	1248	1568	1677
3	Conditionally instantaneous modulus E_0, MPa	1727	2169	2165
4	Highelasticity module E_h, MPa	4496	5662	7446
5	Proportion of the elastic component in the overall deformation ε_e,	0,296	0,283	0,313
6	Proportion of the highelasticity component in the overall deformation ε_h	0,113	0,108	0,09
7	Proportion of the plastic component in the overall deformation ε_p	0,589	0,608	0,596
8	Coefficient of plasticity K_p	0,092	0,089	0,085
9	Coefficient of structure K_s	5,66	5,7	5,71

Modulus (E_m) that defined by a small displacement of atoms, changing the interatomic and intermolecular distances and bond angles of the investigated PP material increases with the introduction of Ni-containing silicate filler, modified by polyvinyl alcohol. That demonstrates the reinforcing effect of polymer-modified silicate filler because of orienting influence of active centers filler and modifier on macromolecule PP, which results in limiting their mobility and the formation in a force field around fine particles of adsorbed layers of ordered supramolecular structures. This effect of filler involves a reduction in the number of possible conformations of macromolecules in these layers, the growth medium of relaxation times, increased relaxation spectra and density packing of macromolecules. High elastic deformation (E_h) that associated with conformational changes of macromolecules somewhat reduced due to the using of modified filler, that is associated by additional intermolecular interactions filler-modifier-polymer matrix. The increase in the overall deformation proportion of plastic deformation (ε_p) that was caused irreversible movement of macromolecules for filled materials, also reflects the influence of the filler on the formation of tighter structure of the polymer, which is unable to inverse deformation. The established of module strain shows that derived materials can be attributed to low deformability materials, which are characterized mainly strong inverse deformation and elastic aftereffect. At the same time, the introduction of filler leads to increase of the coefficient of structure, which is characteristic of spatial fluctuation network

Conclusion

Composites based on polypropylene and metal-containing polymer-silicate filler due to equitable distribution of modifier, directed influence on the surface properties of the filler and high technological compatibility between components have the value of ultimate tensile strength at breaking of composites is increased by 5-10%, modulus – by 20-30%, surface hardness by 10-15%. Increased mechanical, elastic-deformational, thermal and technological properties of developed composites provide their effectiveness for use in the production of materials for constructional purposes.

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The Effect of Poly (vinyl chloride) and Filler on Technological Properties of Polyester Composites

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Abstract – The paper determines the influence of polymer modifier (poly (vinyl chloride)) and finely dispersed inorganic filler on the elastic-deformation and thermophysical properties of polyester materials. The research discovers the change of deformation modulus, elasticity modulus, high elasticity modulus, surface hardness, Vica heat resistance, and technological shrinkage of modified polyester composites filled with calcium carbonate and aluminum oxide.

Keywords – polyester, compositions, filler, modification, poly(vinyl chloride).

I. Introduction

Unsaturated polyester resins are technologically compatible with polymers and fillers different by nature. That enables them to provide a complex of essential properties. Among technologically and economically feasible methods of modification of polyester resins are physical methods based on the combination of polyester oligomers with oligomers of a different nature, and macromolecular compounds. Their application provides materials with the necessary complex of technological and operational properties.

Adding inorganic fine fillers, in particular, $CaCO_3$ and Al_2O_3 into polyester composition, along with the impact on technological and operational properties of the modified materials, will regulate the process of binder structuring through the formation of interfacial layers with different characteristics and formation of physical and chemical bonds between the filler surface and molecules of the polymer matrix [1].

II. Experimental

The unsaturated polyester resin (UPR) marked Estromal A023 was used for obtaining polyester composites. Unsaturated polyester resin curing was conducted in the presence of 1.5-2.0 pts.wt. initiator Metox-50 (methyl ethyl ketone peroxide solution in dimethyl phthalate) and 0.2-0.4 pts.wt. accelerator of cobalt naphthenate at room temperature.

Poly (vinyl chloride) (PVC) of brand Lacovyl PB1156 was used as polymer modifier. We also used the calcium carbonate ($CaCO_3$) and aluminum oxide (Al_2O_3) as fine disspersed inorganic fillers. Additionally, the composition was filled with diesterphtalate plasticizer of dibutyl phthalate (DBP) which is compatible with poly (vinyl chloride). It also functioned both as a solvent and plasticizer for the unsaturated polyester resin and polyvinyl chloride.

The research of elastic-deformation properties of modified polyester materials was carried out with the application of Hepler Consistometer at 293 K. The method is based on indentation of conical indenter under the load of 120 N and determination of characteristics by the modulus and deformation calculation according to the methodology.

Vica heat resistance of the investigated materials was determined in accordance with ISO 306:2013, the loading was 50 N.

The surface hardness of conical fluidity point was determined on Hepler Consistometer at 293 K by indentation of steel cone in the polymer sample with a sharpening angle of 58°08' under the load of 50 N for 60 s. Shrinkage of polyester material was measured according to ISO 2577:2007, comparing the size of the obtained sample with the size of a form.

III. Results and Discussion

Unfilled unsaturated polyester resin is characterized by high values of deformational modulus and modulus of elasticity. Apparently, it is caused by structural features of cross-linked polymers, such as presence of chemical knots of the grid which practically are not destroyed under static loads. Herewith, high density of grid reduces the segmental mobility, as evidenced by the high values of High elasticity modulus.

Adding finely dispersed $CaCO_3$ filler in UPR increases the value of deformation modulus of composite that decreases its ability to deformation under static loads. The value of the equilibrium modulus, characterized by interatomic distances change in the chains of macromolecules, as well as bond angles deformation, significantly increases during the process of $CaCO_3$ adding. It is obviously caused by the decrease of mobility of structured polyester resin segments due to interphase interactions with the surface of finely dispersed filler. Along with this, there is a substantial increase of high elasticity modulus for polyester composites.

Adding PVC modifier to the polymer composition leads to increasing of elasticity and plasticity of the composite material. It is evidenced by the increasing of the elastic modulus and decreasing of the value of high elasticity modulus as in the case of unfilled and filled materials.

Adding plasticizer dibutyl phthalate in filled composition results in increased strength characteristics of the material (deformation modulus and elastic modulus are increased). These special features are caused by decrease defects of polyester grid owing to the interaction of plasticizer molecules with solid filler surface and change of interphase characteristics of the system polyester matrix – filler [2].

In the case of applying Al_2O_3 as a filler of unmodified polyester compositions, we could observe the similar to $CaCO_3$ effect on deformation modulus and high elasticity modulus (these values increase).

However, the deformation modulus decreases in the materials which except the filler contain 20 weight part of PVC. It shows that the modified composite is less rigid and hard compared to the unmodified one.

Influence of the filler nature and polymer modifier on structure coefficient K of the polyester materials are shown in Fig. 1.

Adding poly (vinyl chloride) in unfilled composition increases the coefficient of the composite structure, which apparently is a consequence of the formation of partly interpenetrated grid of structured polyester resin and PVC macromolecules.
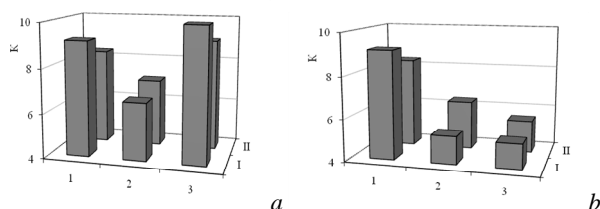
Fig. 1 Influence of filler nature and PVC polymer modifier on structure coefficient K of polyester composites:
a) UPR:CaCO$_3$:DBP, wt. p.: 1 – 100:0:0; 2 – 100:235:0;
3 – 100:235:3; PVC content, wt. p. I – 20, II – 0.
b) UPR:Al$_2$O$_3$:DBP wt. p.: 1 – 100:0:0; 2 – 100:150:0;
3 – 100:150:3; PVC content, wt. p.: I – 20, II – 0

It is found out that the addition of inorganic filler, irrespective of its nature, reduces the composite structure coefficient due to the influence of surface filler on the process of oligomers structuring in the studied systems. This may form a three-dimensional grid with less knots integrity. Adding poly (vinyl chloride) and inorganic finely disspersed fillers to the polyester compositions allows predetermining the process of structuring polyester binder through the formation of boundary layer on the border of filler-polymer matrix [3]. Therefore, it affects the thermal and physicomechanical properties of the obtained composite.

TABLE 1

The impact of modifier content and nature filler on technological properties of polyester materials

№	Composition content		Shrin-kage, %	Vica heat resistance K	Surface hard-ness, MPa
	Filler	PVC content, wt. p.			
1	-	-	8,64	582,3	30
2		20	7,82	522,2	26
3	CaCO$_3$	-	7,08	643,0	48
4		20	5,65	599,3	34
5*		20	6,87	589,5	36
6	Al$_2$O$_3$	-	7,45	638,9	44
7		20	5,82	579,4	33
8*		20	7,15	594,6	33

* In the presence of 3 wt. p. of DBP.

The impact of the polymer modifier and nature of finely dispersed inorganic filler on thermal and physico-mechanical properties of polyester materials is presented in Table.1.

It is determined that the modified polyester materials containing finely dispersed inorganic fillers, are characterized by various principles of change of the values of surface hardness and Vica heat resistance compared to the unfilled materials. Adding finely dispersed inorganic fillers, for instance CaCO$_3$ and Al$_2$O$_3$ in polyester matrix allows adjusting strength properties of the material. It is found out that adding finely dispersed inorganic fillers leads to higher values of surface hardness.

These features of polyester material could be explained by the different nature of interactions between polyester resin and filler. It leads to significant changes in the structure of supramolecular polyester matrix and to the change of properties of polyester composite.

Technological shrinkage of polyester material depends on the nature of the filler, modifier content, and also on the ratio of the reagents in the composition. It is found out that adding finely dispersed inorganic filler and poly (vinyl chloride) polymer modifier in the polyester matrix causes the reduction of technology shrinkage of the material by 30-35%.

Conclusion

The study discovers that the nature and content of finely dispersed inorganic filler calcium carbonate and alumi-num oxide substantially affect the elastic-deformation, thermal and technological properties of modified poly (vinyl chloride) polyester materials.

Highly filled modified polyester composites are characterized by the increased values of Vica heat resistance, hardness, modulus of elasticity and reduced values of technological shrinkage.

Adding poly (vinyl chloride) leads to increases of highly elastic features of polyester composites. Evidently, it is due to the formation of partly interpenetrated grid involving structured polyesters and poly (vinyl chloride) macromolecules.

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The Influence of the Nature of the Gas into the Cavitation Destruction Organic and Biological Contanination of Wastewater from Brewing Industry

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Abstract – The influence of the nature of the gas (oxygen, nitrogen, a mixture of nitrogen and oxygen in the ration of 1:1) on the efficiency of ultrasound treatment has been investigated . The degrees of the destruction of organic substances and the degrees of water disinfection have been calculated.

Keywords – ultrasound cavitation, the degree of the destruction of organic substances, the degree of water disinfection, wastewater treatment, the nature of the gas.

I. Introduction

One of the important problem of the modern water purification is insufficient level of wastewater treatment without damage to the environment and people's health. Small amount of fresh water causes the reuse of wastewater for technological purposes. However, this cannot always be done, because modern technologies of water purification, mostly,do not provide the appropriate level of purification. So, it is necessary to modernize them and introduce new technologies of water purification.

One of the new methods is ultrasounds water purification. Ultrasound has a destroying effect into organic and biological contaminants, which are the basic components of wastewater from biotechnology production [1].

II. Experimental part

The process rate and the degree of the purification of polluted water under ultrasound action depends on the conditionals of the process. The experiments were carried out at the constant parameters, means frequency of 22 kHz, temperature of 298 K, pressure of 1 • 105 Pa, process duration of 1-120 min.,the nature of the gas being the only variable . We use oxygen, nitrogen and a mixture of nitrogen and oxygen in the ration of 1:1. The object of the study was the wastewater of «Brewery Kumpel ».

The main indexes in determining the influence of ultrasound to the wastewater treatment of «Brewery Kumpel » are chemical oxygen consumption and microbial number. Based on the obtained experimental data chemical oxygen consumption and microbial number the calculation of the degrees of the destruction of organic substances and the degrees of water disinfection under the influence of various gases on the water purification process have been conducted.

The degrees of the water purification have been calculated for the final value chemical oxygen consumption and microbial number (in the 120 min of ultrasound effect to these samples of water).

Comparing obtained results of the destruction of organic substances during bubbling the gases of different nature (fig.1) the lowest degree of water purification has been achieved during oxygen bubbling -7,5 %. Better result has been obtained during nitrogen bubbling -11,67 %. The highest degree of the destruction of organic substances has been observed during common action of nitrogen and oxygen – 35,29 %. Exposing the wastewater under ultrasound action during 120 min have obtained the degree of purification 47,37 % has been obtained, which is 1,3 times higher, than during the action of the most efficient gas – mixture of oxygen and nitrogen in the ration of 1:1.
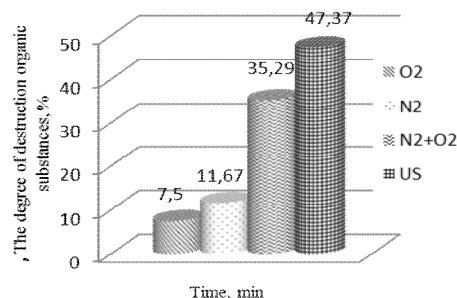
Fig. 1 Dependence of the degree of destruction of organic substances on the influence of gases of different nature

Conducting similar comparison of influence the nature of the bubbling gas to the degree of water disinfection from biological contaminants (fig.2), we can observe the lowest degree of water disinfection during bubbling nitrogen – 26,22%. Oxygen bubbling and the action of the ultrasound itself has shown close values of the degree of the water disinfection – 39,34 % for oxygen and 40,76 % for ultrasound. The highest value has been achieved during bubbling the mixture of oxygen and nitrogen in the ration of 1:1 – 41,58 %.
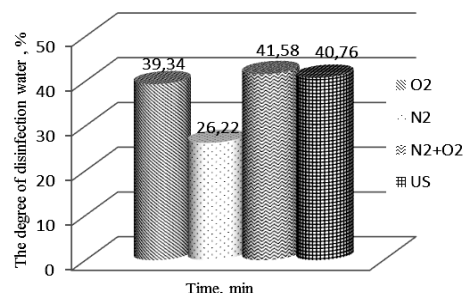
Fig. 2 Dependence of the degree of water disinfection from the influence of gases of different nature

In further research it is advisable to consider the action of the separate gas to the water purification process from organic and biological contaminants, exactly nitrogen. Under different conditions of the process,exactly when we use the action of the ultrasound itself, bubbling gas and common action ultrasound with gase, we can observe

a certain regularity for the degree of the destruction of organic substances (fig.3.) and for the degree of water disinfection (fig.4.). The lowest results in both cases have been achieved during bubbling the nitrogen itself, the degree of the destruction of organic substances is 11,67 % and the degree of water disinfection is 26,22%.

Average results have been achieved under the action of ultrasound itself. For the degree of the destruction of organic substances it is 47,37% and for the degrees of water disinfection it is 40,76 %.
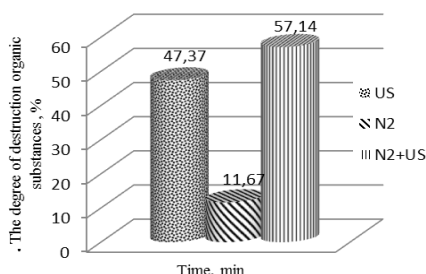
Fig. 3 Dependence the degree of the destruction of organic substances from the conditianals of the process

The deepest purification from organic and micro-biological contaminants has been observed during the common action of ultrasound with nitrogen. The degree of the destruction of organic substances is 57,14%,which is five times higher,than the action of the gas itself and 1,3 times higher than the action of ultrasound itself. The degree of water disinfection is 86,93%, which is 3,3 times higher than the action of the nitrogen itself and 2,1 times higher than sounding water, which confirms again the expediency of the common usage of ultrasound and nitrogen.
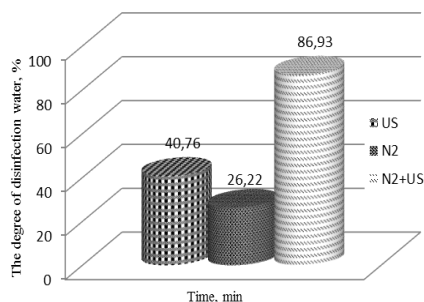
Fig. 4 Dependence the degree of water disinfection from the conditianals of the process

Comparing the effect of all gases (oxygen, nitrogen, a mixture of nitrogen and oxygen in the ration of 1:1) in cavitation conditionals with the effect of the ultrasound itself (fig.5.) has been established that in ultasound field the least expedient is the common action of ultrasound and the mixture of nitrogen and oxygen in the ration of 1:1 (the degree of the destruction of organic substances is 16,67 %). The degree of the destruction of organic substances during oxygen bubbling is average – 31,25 %. The effect of ultrasoun itself is better, than its common action with oxygen and with the mixture of nitrogen and oxygen (the degree of the destruction of organic

substances is 47,37 %), but less effective than sounding of wastewater in an atmosphere of nitrogen (the degree of the destruction of organic substances is 57,14 %, which is 3,4 times better than using ultrasound with mixture of nitrogen and oxygen in the ration of 1:1.
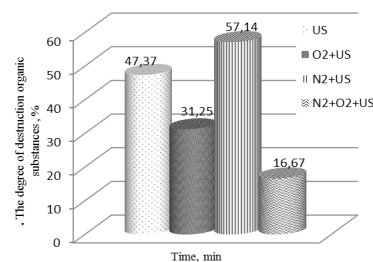
Fig. 5 Dependence the degree of the destruction of organic substances from the nature of the gases into the cavitation conditianals

For desinfection wastewater into cavitation conditionals (fig.6.) bubbling the mixture of the gases and the action of ultrasound itself have shown close values (38,16% and 40,76% accordingly). The common action of ultrasound and oxygen is more effective, we have reached the degree of water disinfection 81,05%, which is 2 times higher than the action of ultrasound itself and bubbling the mixtures of the gases. But the most expedient is the common action of nitrogen and ultrasound, the degree of the destruction of organic substances is 86,93 %.
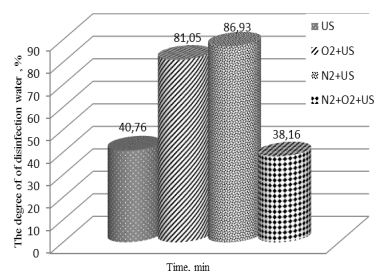
Fig. 6 Dependence the degree of of disinfection water from the nature of the gases into the cavitation conditianals

Conclusion

The degrees of the destruction of organic substances and the degrees of water disinfection has been calculated. Has been proved that the ultrasound cavitation destroy organic compounds and has negative effect to biological contamination, which are contained in wastewater. Has been determined that the common action ultrasound with gases are more effective than the effect from the gases itself. The highest purification effect has been achieved during the common action of ultrasound and nitrogen. The highest degree of the destruction of organic substances is 57,14 % and the highest degree of water disinfection is 86,93 %.

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Catalysts of Aldol Condensation of Acetic Acid with Formaldehyde

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Abstract – it had been demonstrated that mechanochemical and hydrothermal treatment of support allows increasing activity and selectivity of the catalyst in the studied process. Hydrothermal treatment (HTT) of silica increases mechanical strength of silica gel granules subjected to hydrothermal treatment, also reduction of coke formation takes place, as well as prolongation of the catalysts life. Similarly, the same approaches allow to optimize the pore structure of titanium phosphates.

Keywords − acrylic acid, aldol condensation, mechanochemical treatment, hydrothermal treatment, porous structure.

I. Introduction

Acrylic acid (AA) is a valuable substance in the industry of organic synthesis and is widely used in the production of high-quality paint and varnish, organic glass, as an auxiliary substance in the textile industry, in the production of superabsorbents, in medicine [1-4]. World production of AA amounts to over 5 million tons per annum, and according to analytical studies, the market of acrylate monomers has a steady upward trend [5]. One of the most promising methods of AA production is aldol condensation of acetic acid (AcA) with formaldehyde (FA) [6]. The production of AA by aldol condensation is not implemented in industry because of comparably low efficiency of known catalysts and short working life due to coke formation on catalysts' surface [7].

The key for successful implementation of AA production based on AcA and FA is effective catalyst for this process. It is known that the reactions of aldol condensation may proceed through both base and acidic catalysis. We have synthesized the catalysts of both types and found that acid catalysts have higher activity and efficiency than the base ones [8,9]. Also the correlation between the strength of acid sites of the catalysts and their selectivity was found [10]. But despite of some success in the catalysts development, the desirable level of their efficiency isn't still achieved.

It is well known that porous structure of solid catalysts has a huge effect on their catalytic properties. So we decided to continue our developments of catalytic systems for aldol condensation reaction and to apply different kinds of treatment of the catalysts in order to modify their crystal structure, activate surface and, as a result, change their catalytic properties [11]. This kind of modification also allows to vary parameters of porous structure (specific surface area (S), pore size (d) and pore size distribution (PSD)) in wide limits [12].

II. Results and Discussion

It is well known that efficiency of catalysts of aldol condensation reactions depends on many physical and chemical characteristics, namely specific surface area, porous and crystal structure, surface acidity. So, different kinds of catalysts were tested in this process: acid and basic type catalysts, supported and bulk solid catalysts, the catalysts with various carriers. Recently using of structured carriers for aldol condensation catalysts was reported as well as the huge effect of porous structure of catalysts on their chemical properties. So in this context, application of different kinds of catalysts treatment (hydrothermal, microwave and mechanochemical), which are able to vary the physical and chemical characteristics of catalysts within wide limits, can be considered as the alternative method for porous structure regulation and optimization of the catalytic properties [12]. Therefore, the goal of present work is to study the efficiency of hydrothermal methods for the regulation of porous structure of the catalysts for aldol condensation reaction as well as optimization of their catalytic performance in acrylic acid synthesis, for which we tested the effect of hydrothermal treatment of $B_2O_3–P_2O_5–WO_3–V_2O_5/SiO_2$ and hydrothermal and mechanochemica treatments of $TiPO_4$ catalysts which are moderately efficient in gas-phase acrylic acid synthesis via aldol condensation.

It has been found that hydrothermal treatment (HTT) of silica support of B–P–V–W–O_x catalyst at 150 °C allows increasing the one-pass yield of acrylic acid synthesis from 58 % to 68 % at acrylic acid selectivity of 91 %. In addition to increase of mechanical strength of silica gel granules subjected to hydrothermal treatment, reduction of coke formation takes place, as well as prolongation of the catalysts life.
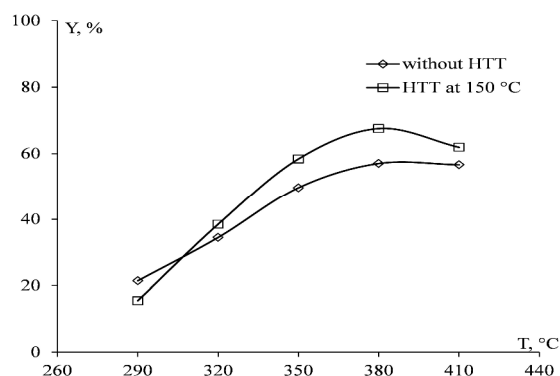
Fig.1 The effect of HTT temperature on Acrylic Acid yield (Y, %) at different reaction temperatures.

As expected, mechanochemical and hydrothermal treatment of TiPO4 catalyst also modifies its porous structure (Table 1). But in this case specific surface area changes are insignificantly.

As for catalytic properties in aldol condensation reaction of AcA with FA, the formation of AA on pure $TiPO_4$ was negligible (Fig. 2).

Catalysts	Porous Structure			
	SSA, m^2/g	V_{Σ}, cm^3/g	d, nm	Total acidity, mmol/g
$TiPO_4$ (Initial)	109	1.60	32; 52	0.434
$TiPO_4$ (MChT)	86	1.23	9.0	0.080
$TiPO_4$ (HTT)	107	1,72	3.7; 49	0.510

SSA – specific surface area, V_{Σ} – total pore volume, d – pore size

Mechanochemical and hydrothermal treatment of titanium phosphate dramatically changes its catalytic properties in test reaction. Thus both mechanochemically and hydrothermally treated catalysts exhibit much better catalytic performance. On the treated by MChT catalyst AA yield increases to 14 %, and on the treated by HTT catalyst AA yield reaches maximum value 61 % at 623 K.
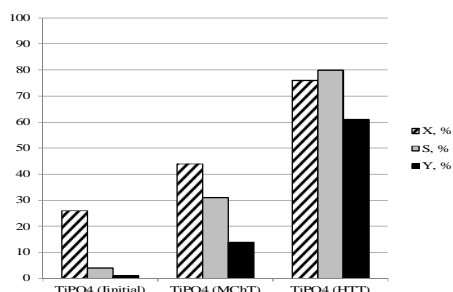
Fig. 2 Catalytic properties of initial titanium phosphate and titanium phosphates after MChT and HTT at 623 K, residence time 8s.

Conclusion

It had been demonstrated that mechanochemical and hydrothermal treatment of support allows increasing activity and selectivity of the catalyst in the studied process. Hydrothermal treatment (HTT) of silica support of B–P–V–W–O_x catalyst at 150 °C allows increasing the one-pass yield of acrylic acid synthesis from 58 % to 68 % at acrylic acid selectivity of 91 %. In addition to increase of mechanical strength of silica gel granules subjected to hydrothermal treatment, reduction of coke formation takes place, as well as prolongation of the catalysts life. Similarly, the same approaches allow to optimize the pore structure of titanium phosphates. On the treated by MChT catalyst AA yield increases to 14 %, and on the treated by HTT catalyst AA yield reaches maximum value 61 % at 623 K.

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Kinetics of Polymer Dispersion Drying dy the Conduction Method

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Abstract – The effects of conduction heating at the drying surface temperatures ranging from 50• to 90•C for thin layer conduction drying of polymer dispersion were studied.

Results show that polymer dispersion at 52 percent initial moisture contants dried initially under constant rate period for a very short time and then dried under falling rate period.

The empirical drying equations, developed before for the above drying conditions can be used to predict the drying time with fairly good accuracy.

Keywords – contact drying, drying rate, drying time, drying kinetics, polymer dispersion

I. Introduction

The drying of materials is often the final operation in a manufacturing process and the drying operation often follows evaporation, filtration and crystallisation.

Heat transfer and mass transfer are critical aspects in drying processes. Heat is transferred to the product to evaporate liquid, and mass is transferred as a vapor into the surrounding gas. The drying rate is determined by the set of factors that affect heat and mass transfer.

The conduction method is of considerable interest for the understanding drying kinetyc. According to this method, the total drying time of a thin film material form (50-150 μm) can be calculated.

II. Materials and methods

Typically convection approach to define the drying kinetic can be used. The mass transfer at atmospheric pressure can be modeled using Crank's model [1].

Another approach can be used for conductive drying. A conduction dryer experiment is made on a metal-walled, heat-jacked arrangement that is either stationary or rotating. Accoding to this conditions removal of vaporized water is independent of the heating medium. It depend from heat surfase temperature and more other factors such as structure and material properties, heat transfer, operation pressure. The polymethylmethacrylate-polystyrene water dispersion was investigated under contact drying conditions. The physical properties of the polymer dispersion are given in Table 1.

TABLE 1

THE PHYSICAL PROPERTIES OF THE DISPERSION

Solid phase content	47-48%
Particle size	0.2-0.4 μm
Viscosity at 25^0C	200 – 500 mPa·s
Density of dispersion	1108 kg / m^3
Film formation	93 ^{0}C
Sintering temperature	104 ^{0}C

III. Results and discussions

The surface temperature was 50, 75, and 92°C. The diagram in Fig. 1 shows that the process consists of two periods.
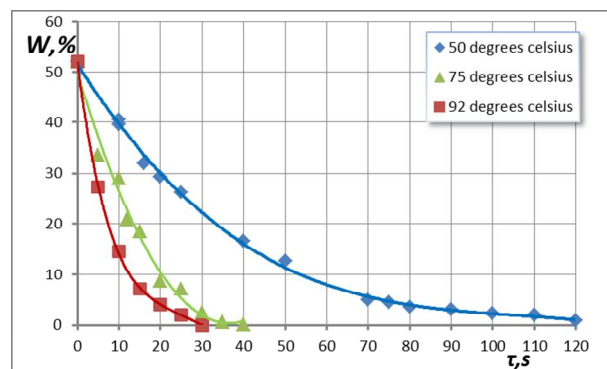
Fig. 1 The polymer dispertion drying curve

The instantaneous moisture content during the first period of drying can be determined from the equation:

$$W = W_i - N t_1 \qquad (1)$$

where W_i is the initial moisture content, %; N the rate of drying in the first period, %/sec; and τ, the drying time, sec.

The moisture content in the second falling rate period can be determined from the equation:

$$W - W_E = (W_{cr_1} - W_e)\exp(-2{,}3X_1 N t_2) \qquad (2)$$

where τ_2 is the time elapsed from the start of the second period, sec; X- the relative coefficient of drying, 1/% and W_e the equilibrium moisture content, %.

According Eqs. (1)-(3) taken into account gave the following equation of the total drying time:

$$t_{total} = \frac{1}{N}(W_i - W_{cr_1} + \frac{1}{X_1}\lg\frac{W_{cr_1} - W_e}{W_u - W_e}) \qquad (3)$$

where W_u is the ultimate moisture content. [2]

Conclusion

The rate of water loss during contact drying of polymer dispertion was directly related to the temperature.

The process time to attain a We water loss can be predicted using the proposed model when the model parameters are known.

The rate of drying in the first period N and relative coefficient of drying X obtained from the experimet data ranged from 0.038 to 0.141 s^{-1} and from 0.023 to 0.06, to temperature ranged from 50 to 90 °C, respectively.

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Rheological Investigation of Sol-Gel Systems Based on 3-Methacryl-Oxypropyl Trimethoxysilane

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Abstract. The influence of various factors (temperature, concentration of starting substances and catalyst of sol-gel process) on the rheological behavior of sol-gel systems on the basis of the organic-inorganic precursor – 3-methacryloxypropyl trimethoxysilane – was investigated by viscosimetry. The elastic and friction components of viscosity were estimated from the gradient dependence measurements using the optimization method. The integral activation energy of the gelation process in the studied sol-gel systems was calculated.

Keywords – sol-gel system, 3-methacryloxypropyl trimethoxysilane, dynamic viscosity, gradient dependence of viscosity, activation energy

I. Introduction

Membrane science and technology are of great interest for many researchers and are constantly considered as one of the priority scientific and technical directions. Membranes are widely used in alternative energy, electrodialysis, ion-exchange processes, etc.

A lot of membranes are synthesized on the basis of hybrid organic-inorganic materials, what ensures the achievement of desired properties. Sol-gel technology has a number of advantages in comparison with other methods of synthesis: simplicity, eco-friendliness, possibility of modification of material properties by introducing modifying substances at the synthesis stage.

One way of obtaining hybrid organic-inorganic membranes with the use of sol-gel technology is to form them from organic-inorganic precursors that contain organic functional groups and inorganic alkoxysilane groups undergoing sol-gel transformation.

3-methacryloxypropyl trimethoxysilane (MAPTMS)

$$\text{H}_3\text{CO}-\overset{\overset{\displaystyle \text{OCH}_3}{|}}{\underset{\underset{\displaystyle \text{OCH}_3}{|}}{\text{Si}}}-\text{CH}_2\text{CH}_2\text{CH}_2-\text{O}-\overset{\overset{\displaystyle \text{O}}{\|}}{\text{C}}-\overset{\underset{\displaystyle \text{CH}_3}{|}}{\text{C}}=\text{CH}_2 \qquad (1)$$
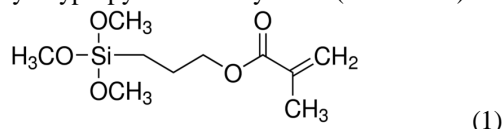
is one of the promising starting materials for such syntheses because it contains methacrylic fragments capable to form C-C bonds in polymerization process and alkoxysilane groups near Si atom that can form siloxane chains in sol-gel process [1, 2].

MAPTMS is often used together with the other alkoxysilane – tetraethoxysilane (TEOS), which is the most commonly used alcoxysilane in sol-gel synthesis. When added to sol-gel system based on TEOS, MAPTMS acts as a structural modifier. As a result of the modifier influence, the final siloxane network acquires the necessary properties (for example, hydrophobicity, flexibility). Thus, in [3] a mixture of MAPTMS and TEOS was used in a molar ratio of 4: 1. Hydrolysis of a mixture of precursors was carried out in a solution ethanol – water. Investigation of sol-gel process of alkoxysilanes mixture by ^{29}Si NMR and FTIR allowed to optimize the duration of hydrolysis of both components and subsequently to prepare organic-inorganic hybrid materials – sol-gel coatings for metallic surfaces.

For the wider use of precursor MAPTMS in sol-gel processes, it is necessary to study its rheological behavior under different conditions.

II. Experimental

Solutions of sol-gel precursors were prepared by mixing TEOS, MPTMS, ethanol, water and phosphoric acid in appropriate ratios, at constant stirring on a magnetic stirrer (500 rpm) at different temperatures. The rheological behavior of these systems was investigated using the rotary viscosimeter RHEOTEST 2.1 (VEB MLW, GDR).

For sol-gel precursors the dependence between the shear stress τ and the shear rate D_r was established. Dynamic viscosity was determined by the ratio: $\eta = \tau / D_r$, where η is the dynamic viscosity (Pa • s); τ is shear stress (Pa); D_r is the shear rate (s^{-1}).

III. Results and discussion

The percolation point corresponds to such concentration of macromolecules and their conformational size, at which the conformational volumes of macromolecules begin to overlap leading to a sharp increase in viscosity of sol-gel system. Consequently, the state of gelation can be estimated by monitoring the changes in viscosity of the system in time.

Dynamics of viscosity of sol-gel systems was investigated at high angular speeds of rotation of the working cylinder (ω = 4.05 rps). We obtained the dependencies of viscosity:

- on temperature for 5 sol-gel systems of different compositions;
- on MAPTMS content;
- on the content of sol-gel process catalyst – orthophosphoric acid. The exaple of measured dependencies is presented in Fig. 1.
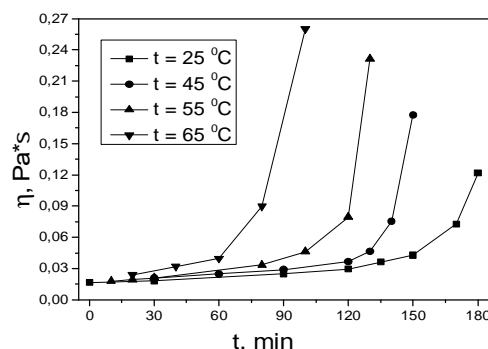
Fig. 1. Viscosity change in time for sol-gel system MAPTMS:
TEOS: C_2H_5OH: H_3PO_4: H_2O =
= 0.25: 0.75: 4: 1.2: 4 (mol) at different temperatures

From obtained dependencies the time of achievement of percolation point t_g, which corresponds to the beginning of gelation process, was determined. The obtained data are summarized in Table. 1.

TABLE 1

DYNAMICS OF SOL-GEL SYSTEMS STRUCTURING

System composition (mol)	H$_3$PO$_4$ (mol)	Temp° C	t_g min
MAPTMS:TEOS:C$_2$H$_5$OH:H$_3$PO$_4$:H$_2$O = = 0,4:0,6:4:X:4	1,2	25	300
MAPTMS:TEOS:C$_2$H$_5$OH: :H$_3$PO$_4$:H$_2$O = = 0,25:0,75:4:X:4	1,2	25	150
		45	130
		55	100
		65	70
	1,8	45	130
		65	120
TEOS:C$_2$H$_5$OH:H$_3$PO$_4$: :H$_2$O = 1:4:X:4	1,2	25	100
		45	30
		55	10
		65	5
	1,8	45	30
		65	7

The temperature dependence of the gelation time can be described by the Arrhenius equation: $\ln (t_g) = A + E / RT$, where E is activation energy of the gelation process.
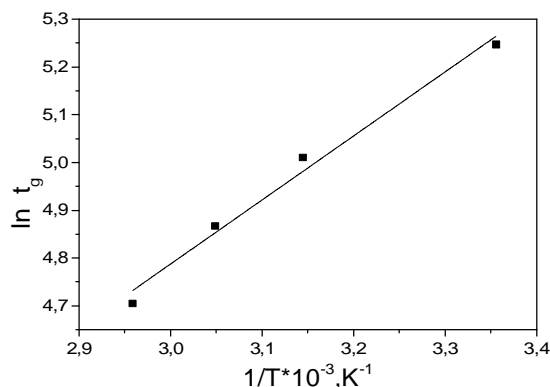
Fig. 2. Temperature dependence of gelation time in sol-gel system MAPTMS: TEOS: C$_2$H$_5$OH: H$_3$PO$_4$: H$_2$O = = 0.25: 0.75: 4: 1.2: 4 (mol*)*

Experimentally determined activation energy of gelation process is 22.5 kJ/mol for the system MAPTMS: TEOS: C$_2$H$_5$OH: H$_3$PO$_4$: H$_2$O = 0.5: 0.75: 4: 1.2: 4 (mol) and 44.9 kJ/mol for the system TEOS : C$_2$H$_5$OH: H$_3$PO$_4$: H$_2$O = 1: 4: 1.2: 4 (mol).

The gradient dependence of sol-gel system viscosity was measured in the range of speeds of the working cylinder of 0.5 – 243 rpm (Fig. 3). The frictional and elastic components of viscosity and coefficient b, which characterizes the segmental motion of macromolecules, for each sol-gel system at different conditions were calculated using the optimization method in ORIGIN 5.0 program.
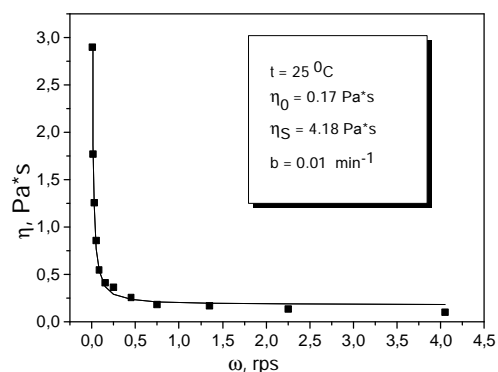
Fig. 3. Gradient dependence of viscosity of the system MAPTMS: TEOS: C$_2$H$_5$OH: H$_3$PO$_4$: H$_2$O = = 0.4: 0.6: 4: 1.2: 4 (mol)

Calculated values of viscisity parameters show their dependence on the system composition, temperature and the catalyst content. In all cases, the elastic component of the viscosity is greater than the frictional one, which indicates a significant contribution to viscosity of the segmental motion of macromolecules. With increasing temperature, we observe the growth of viscosity, and the elastic component changes more significantly.

Conclusion

Investigation of sol-gel systems viscosity of various composition based on precursors TEOS and MAPTMS allowed to determine the effect of temperature, composition of the system, the catalyst concentration on the time of achievement of percolation point, when gelation occurs. These results are of practical importance for synthesis of organic-inorganic composites using sol-gel process. It was established that the replacement of TEOS by MAPTMS slows down the gelation process. Studying of the gradient dependence of viscosity of sol-gel systems allowed to determine the frictional η_o and elastic η_s components of viscosity depending on temperature and the initial composition of the system.

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The Simulation of Cavitation Process Using the Engineering Analysis Methods

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Abstract – The expediency of analysis and evaluation of the cavitation process by methods on the CAE software complexes have been shown.

Keywords – CAE, engineering analysis, simulation, cavitation, SolidWorks.

I. Introduction

Cavitation is a process of formation of cavities in fluids filled with gas, vapor or a mixture of them (so-called cavitation bubbles or cavities) [1]. Cavitation bubbles are formed in those places where the liquid pressure reaches a certain critical value of P_{cr}. The sharp collapse of the generated gas cavities creates a very sharp sudden increase in local pressure creating rapid change in pressure and hydrodynamical properties of current volume [2]. In the order to a low amount of the engineering researches of this process, CAE investigation of the cavitation has been conducted.

II. Experimental part

For engineering modeling of the process, the series of experiments with a model mixture on a vibration cavitator (Fig. 2) were conducted. A model water solution of isopropyl alcohol with concetration $1,2 \times 10^{-3}$ mol/l. Series of indicative measurements of chemical oxygen demand were done to analyse amout of oxidizable pollutants. Analytical analysis was conducted due to recommendations [3].

The Dichromate Chemical Oxygen Demand (COD) test measures the oxygen equivalent of the amount of organic matter oxidizable by potassium dichromate in a 50% sulfuric acid solution. End products are carbon dioxide, water, and various states of the chromium ion. After the oxidation step is completed, the amount of dichromate consumed is determined titrimetrically or colorimetrically. Either the amount of reduced chromium (chromic ion), or the amount of unreacted dichromate, can be measured. If the latter method is chosen, the analyst must know the precise amount of dichromate added.

$$2\ K_2Cr_2O_7 + 8H_2SO_4 + 3C \rightarrow 2\ K_2\ SO_4 + 2\ Cr_2(SO_4)_3 +$$
$$+3\ CO_2\uparrow + 8H_2O\ [4]$$
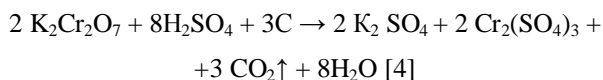
Chemical oxygen demand results are usually expressed by the amount of oxygen consumed during the oxidation of organic matter. When oxygen is used as the primary oxidant in the oxidation of potassium acid phthalate, the equation above describes the reaction.

The results of the researches are shown in the Table 1 and Fig. 1.

TABLE 1

RESULT OF THE COD ANALYSIS.

Frequency, hz	30	35	40	45	50
O₂ demand, mg/ml	4,48	8,64	18,24	29,44	29,44
	10,88	13,44	24,64	31,04	32,64
	16	27,52	30,08	39,04	36,48
	21,12	32,64	35,84	39,04	40,64
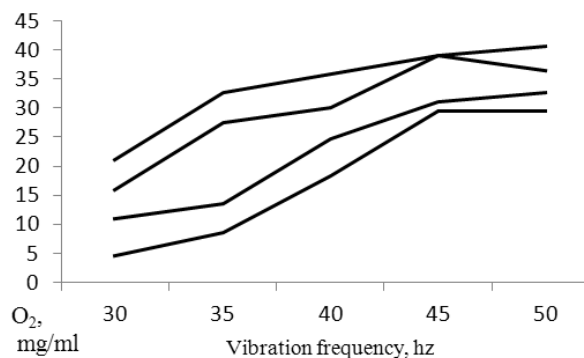
Fig. 1 The relation between COD frequency values.

III. Model of the laboratory device

For experimental investigations the compact laboratory electromagnetic vibration cavitator (Fig.2) has been used [4].
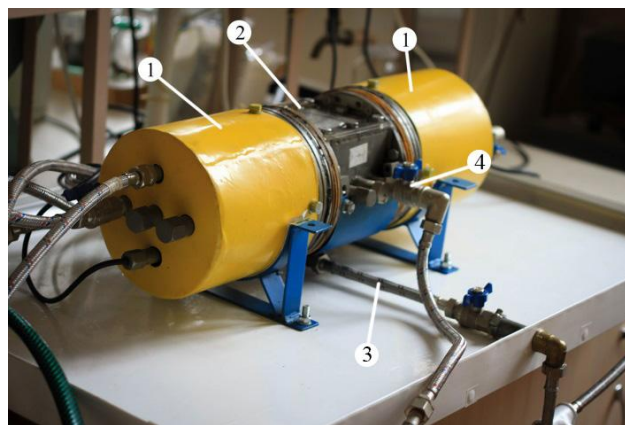
Fig.2 The laboratory electromagnetic vibration cavitator: 1 – electromagnetic vibration drives, 2 – operational chamber with three cavitation disks, 3 – liquid outlet , 4 – liquid inlet

Cavitation disks are moving in X-axis, creating distortion of the mixture wich follows the cavitation process.

For the analysis of hydrodynamics and cavitation process a solid model of the laboratory cavitator has been created in the CAD/CAE software complex of SolidWorks 2016 Educational Edition [5].

The solid model of the operational chamber with three cavitation disks is shown in the Fig. 2.
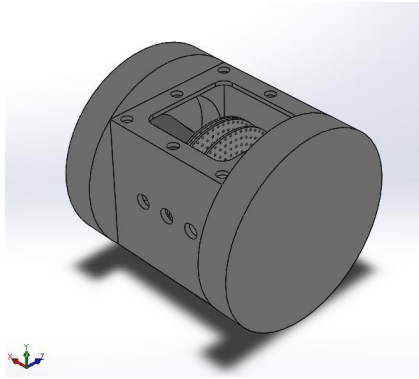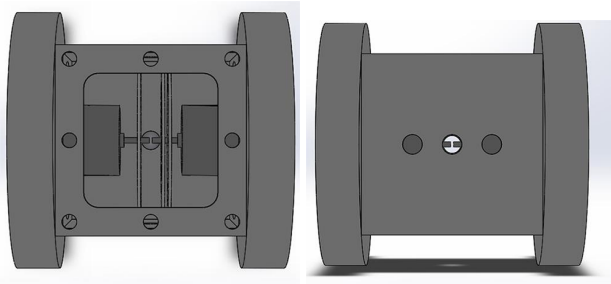
Fig.3 The solid model of the vibration cavitator created in SolidWorks 2016 Educational Edition.

Conclusions

The research results will be published. The results are going to show simulation of the cavitation process, which has a wide use in various industrial processes. That will help in the research of the practical process using.

Acknowledgment

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Activation of Alcohol Yeast

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Abstract − The influence of alcoholic yeast treatment with electrochemically activated water (EAW) on their enzymatic activity in the fermentation and generation, improve their physiological state was investigated. The obtained results showed that catholyte has the greatest effect on alcoholic yeast activity. The use of electrochemically activated water in alcohol production can reduce the duration of the biotechnological process and increase the finished product yield.

Keywords − yeast, enzymatic activity, alcoholic fermentation, electrochemically activated water, catholyte, anolyte.

I. Introduction

Production of ethyl alcohol from grain raw materials includes the biotechnological process – fermentation. Yeast *Saccharomyces cerevisiae* is a source of alcohol fermentation. The intensity of this biotechnological process depends on their physiological state. Biosynthetic, fermentation activity, the number of cells with kidneys, with glycogen, dead cells affect the rate of fermentation, the concentration of alcohol in the digestible medium, the yield of the finished product. One of the ways of ethanol production intensification is to stimulate the activity of industrial yeast strains.

Different methods are used to increase the activity of yeast. These include: the effect of the magnetic field on aqueous solutions, ultrasound, shaking, thermal treatment of water (heating, cooling, freezing and subsequent thawing) and electrochemical activation (EA). Activated by these methods water receives new properties. These properties have an influence on the kinetics of reactions occurring in it, the change in solubility of substances, biological activity.

The analysis of scientific literature on the use of electrochemically activated water showed that today there are no stable patterns of the influence of catholyte and anolyte on biological objects, in particular microorganisms. Electrochemical activation of water occurs in an electroslider – a device consisting of a capacitance and two electrodes. In a container, which is separated by a semipermeable membrane, electrodes (cathode and anode) are on both sides. In the volume of water through these membranes under the action of an electric field passes an electric current, due to which the electrolyte creates a potential difference and the transfer of ions and electrons through the membrane occurs. The cathode forms in a cathode chamber. Anolyte is obtained in the anode chamber due to electrochemical activation. In the simplified form, the basic processes that occur in an electrolyzer can be represented as follows:

1) oxidation of water in the anode:
$$2H_2O - 4e− \rightarrow 4H^+ + O_2;$$
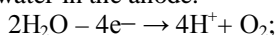
2) water recovery on cathode:
$$2H_2O + 2e− \rightarrow H_2 + 2OH^-;$$
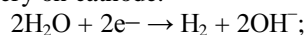
3) formation of gaseous chlorine at an anode:
$$2Cl^- -2e− \rightarrow Cl_2;$$
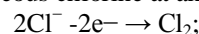
4) formation of highly active oxidants in the anode chamber:
$$Cl_2O, ClO_2, ClO^-, HClO, Cl^{\bullet}, O_2^{\bullet}, O_3, OH^{\bullet};$$

5) production in the cathode chamber of high-level reducing agents:
$$OH^-, H_2, HO_2^{\bullet}, HO_2^-, O_2^-.$$
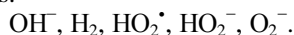
Many scientists have noticed the biological activity of electrochemically activated water (EAW). It has been established that the catholyte exhibits antioxidant properties [1-2]. It inhibits the processes of oxidative phosphorylation and respiration of its tissues. It was investigated that electrochemically activated water with negative AFP is easily digested and restores the lost and charged cells with charge and energy, while avoiding pathologies [3-5].

Therefore, the study of electrochemically activated water effect on the yeast fermentation activity to reduce process time and increase the yield of ethanol is very urgent.

II. Methods and Techniques

The research material was yeast Deltaferm AL-18, which was made in Germany. Electrochemically activated water was obtained using "Ekovod-3K" device. (Ukraine). To prepare wheat wort the enzymes Amelex 3T (alpha-amylase) and Diazyme SSF (glucoamylase) were used. Wheat wort with 22-24% of dry matters was fermented by Deltaferm AL-18 seed yeast kept in EAW, as well as by control samples. The "fermentation test" was carried out in conical flasks with gauge filled with a sulfuric acid solution at 33 °C for 72 hours. Evolved CO_2 was controlled by gravimetric method. In fermented wash the content of ethanol was determined by bottle method, non-fermented sugars – by photoelectrocolorimetric method, the number of yeast cells – using Goryaev chamber.

III. Results and Discussion

Stimulation of yeast cells to produce seed active culture for wheat wort fermentation was performed by treating Deltaferm AL-18 dry alcohol yeast with EAW, namely catholyte, anolyte, catholyte/anolyte mixture with the ratio of 1:1. Yeast kept in sterile tap water, which was used to prepare EAW, were used as the control samples. Previous studies showed that EAW has a positive effect on yeast biosynthetic activity.

The dynamics of carbon dioxide accumulation during the fermentation indicates that the largest mass of evolved gas (17.4 g CO_2/200 cm^3 mash) is observed in mash obtained using seed yeast kept in catholyte (fig 1). Yeast, which were treated before fermentation with anolyte and catholyte/anolyte mixture (1:1), generated more CO_2 in fermented wort in comparison with the control samples. It should be noted that fermentation time can be reduced to 64 hours under seed yeast stimulation by EAW, because after this period the mass of evolved carbon dioxide actually is not changed.
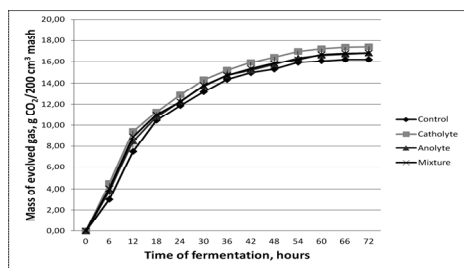
Fig. 1 The dynamics of carbon dioxide accumulation during the fermentation.

Analysis of alcoholic mash obtained using yeast kept in sterile tap water (control – option 1) and treated by catholyte (option 2), anolyte (option 3) and catholyte/anolyte mixture (option 4) shows the highest alcohol content for the option 2. According to the results obtained, the yield of alcohol was maximum in option 2 (fig. 2, a). However, both anolyte and mixture also stimulate fermentation activity of yeast, because alcohol content in mash is higher as compared with the control sample.

An important indicator of yeast fermentation activity is the concentration of non-fermented sugars in mash. Fig. 2, b shows the lowest content of sugars in mash obtained seed yeast kept in catholyte. The high alcohol content in this sample confirms this fact.
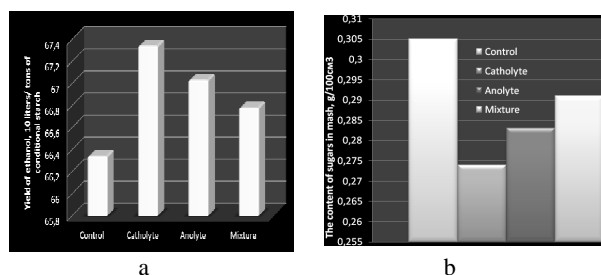
Fig. 2 a – yield of ethanol; b – lowest content of sugars in mash.

Changes in yeast cells concentration during fermentation (Fig. 3) indicate unequal effect of catholyte, anolyte and mixture on cells activity. Catholyte has the greatest effect.
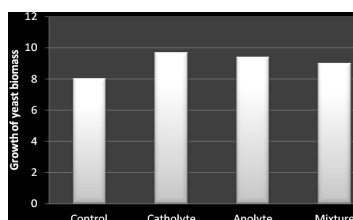
Fig. 3 Growth of yeast biomass.

Despite the fact that anolyte has antiseptic properties, yeast treatment by it causes stimulation of yeast activity that requires further research and explanation.

Conclusion

In this work, the results demonstrated that alcohol yeast treatment with electrochemically activated water stimulates their biosynthetic and fermentative activity, which leads to the increase in the yield of alcohol, the decrease in concentration of non-fermented sugars and insoluble in mash starch and reduction of the fermentation time.

The use of electrochemically activated water can be offered in alcohol production as an effective way of activating industrial yeast.

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Comparison of the Bacteria Destruction with and Without Gas Action and Cavitation

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Abstract — Various branches of petroleum, chemical and food industries cause significant damage to natural reservoir; outdated and imperfect technology forms a substantial amount of harmful waste and wastewater to the environment. Mostly businesses these industries consume large amounts of water, which in some cases used directly for manufacturing processes, while others – for the support and maintenance of technology, ie for treatment products and semi-finished products, washing packing container and equipment etc.

Key words – cavitation, water disinfection, microorganisms, gas bubbling, bacteria aggregates.

I. Introduction

Number of works is dedicated to the investigation of cavitation effect in water by the indicating of its high efficiency in the viruses, protozoa etc. But at the same time, the researchers have noticed, that cavitation is highly effective nonchemical ecological method of water purification from organic and microbial components. It is clear that the need for a long disinfecting processing doubted the feasibility of using ultrasound for industrial conditions. Obviously, it is due to the result of an inadequate study of complex phenomena, which is accompanying with the cavitation effect, together with the ignorance of basic laws of the studied process that characterize the interaction of the components of water available to it specific organisms, the impact of additional gas supplied by the action of cavitation, etc.

II. Methodology

We have conducted complex of microbiology research of natural water from the lake in the Lviv region. In this water the *Diplococcus, Pseudomonas fluorescens, Bacillus cereus, Sarcina lutea* bacterias were detected. The bacteria *Bacillus cereus* was available in a huge number that is why it was chosen as the data to create model environment. The basis was to identify not only microscopy preparations like a "crushed drop", with the fixed preparations of cells to study their morphological criteria, including Gram staining, but the study of culture and physiological reaction (oxygen) microorganisms (MO) properties identified in the examined water.

The determination of the total number of MO in the water for the purpose of bacteriological study of universal culture medium used – meat peptone agar.

Cultivation was carried investigated by the MO depth method. MO was grown in an incubator at a constant temperature (37 °C) with the duration of 48 hours.

To investigate the impact of natural gas to the cavitation effectiveness of water treatment experiments performed under argon, helium, oxygen, carbon dioxide in the ultrasound field at atmospheric pressure, temperature of 298 K, ultrasound frequency – 22 kHz. Processing time 1-120 min. US oscillation frequency of 22 kHz low-frequency generator UZDN-2T (power 90 W) transmitted via magnetostriction emitter immersed in water volume study of the initial value of the number of known microorganisms (NM). Outputs NM machining water samples were in the range $NM_0 = 820 – 2090$ CFU/cm^3.

III. Description

The further research aimed at studying the simultaneous effect of gas and cavitation perturbed by the rod-shaped bacteria of *Bacillus cereus* family *Bacillaceae* an insignificant microbial contamination of water ($NM_0 = 8*10^2$ CFU/cm^3). In the short-term action of the acoustic field under argon, oxygen, helium and carbon dioxide gas ($t_{gas/US} = 60 \div 180$ s) there was a sharp increase NM. Availability of simultaneous action of carbon dioxide and ultrasound led growth in order NM ($2.4*10^3$ CFU/cm^3) in the first three minutes of the experiment. The further steps of gas/ultrasound processes in all cases leads to a sharp reduction of NM throughout the whole treatment process.

For detailed studying of this phenomenon the microscopy of water samples before and after the joint gas/ultrasonic action was made. As the result, in the control water samples a large number of microbial units was revealed, while after t = 180 s system was dominated mostly by the separated cells. We can therefore say that the accumulation of microbial cells on the stage of the process and due process of disaggregation. Obviously, increasing the value of NM directly proportional to the number of cells in units identified in the initial samples of water, and may affect the process of disaggregation nature of the bubbling gas. The growth of NM in the presence of carbon dioxide by 1600 CFU/cm^3, in contrast to the growth in the presence of argon (only 100 CFU/cm^3) may have an impact on the final value of the NM.

Thus, when cutting in the ultrasound field water in which existing microbial aggregates is disaggregation dominant process in the presence bubbling gases, which in turn, is characterized by a determining influence on the overall efficiency of water disinfection. Therefore, the studying of the process of disaggregation would make the process without bubbling gases only in acoustic terms.

To study the process of disaggregation, the real natural water from lake was selected in the Lviv region. Samples of water were taken during the summer period (June and July), as the water temperature is the highest and the water level is the lowest, when the oscillations of NM are maximal.

The number of MO ranged $820 \div 2090$ CFU/cm^3, depending on many physical and chemical factors: temperature regime of a reservoir, which influences on the growth of MO, the concentration of dissolved oxygen in water, the value of pH of water and redox potential, and also temperature of the air, quantity of the atmospheric precipitations, hydrodynamic regime of the reservoir, etc.

Investigating a joint action of gas/US on the example of bacteria *Bacillus cereus* at $NM_0 = 800$ CFU/cm^3, and the influence of acoustic cavitation on the natural water from the lake in the Lviv region with an increased content of bacteria *Bacillus cereus* at $NM_{01} = 820$ CFU/cm^3 and $NM_{02} = 2090$ CFU/cm^3, it was found a pattern of growth of NM at the first stage of acoustic cavitation process. The difference was only at the time of sound treatment, at which the maximal values of NM were observed.

The abrupt increase of NM was observed during a short-term action of acoustic field on the bacteria *Bacillus cereus* in atmosphere of carbon dioxide during the first 60÷180 s of experiment. At the joint action of cavitation and argon or helium, although there was observed an increase in NM at the beginning of the experiment, but with much lower maxima than at the joint action of carbon dioxide and cavitation. The exception was the action of oxygen, where the increase of NM was not observed.

When lake water is treated by a sound, NM reaches its maximal value after 1800 s of experiment in the absence of gas bubbling. By microscopic examination of the water, it was discovered the aggregates of MO of different types, while the number of single cells was negligible. Energy of acoustic cavitation at this stage was spent mostly on the breaking of the aggregates to the single cells, and the dying occurs more slowly than disaggregation. A similar picture was observed during the action of acoustic cavitation on the clusters of detected bacteria aggregates *Bacillus cereus* under atmosphere of argon, oxygen, helium and carbon dioxide. The decrease of the time spent on the breaking of aggregates in the water environment, is likely due to saturation of one or another gas, because in their absence only dissolved oxygen is available in aqueous solutions.

the obtained experimental data on disinfection of aqueous solutions from bacteria *Bacillus cereus* demonstrate the effectivity of simultaneous bubbling of gases and the action of US waves on the studied water environment. The presence of a gas decreases the accumulation period of the number of MO comparing with the water treated by a sound without gases in 10 times. Thus, for the water sample 1 $NM_{max} = 1500$ CFU/cm^3 for 1800 s without gas bubbling; and for the sample of water with a pure culture of bacteria *Bacillus cereus* with the same initial value NM, it increased accordingly: $NM_{max} = 1100$ CFU/cm^3 for helium, $NM_{max} = 850$ CFU/cm^3 for argon, and $NM_{max} = 2400$ CFU/cm^3 for carbon dioxide within 60÷180 s of the experiment. As it was found that the increase of the value NM is proportional to the number of cells in the aggregates, found in the initial water samples. Thus, the process of disaggregation is also affected by the nature of bubbling gas. In the atmosphere of argon, it was achieved the highest value of the sonochemical effective death rate constant of MO $k_d = 8.92*10^{-4}$ s^{-1}, comparing with $k_d = 7.47*10^{-4}$ s^{-1} for oxygen, in the presence of which the increase of NM was never observed. In the atmosphere of carbon dioxide, where the highest value of NM_{max} was observed, the process of water disinfection from bacteria Bacillus cereus proceeds the most slowly, at the value of $k_d = 6.99*10^{-4}$ s^{-1}. Calculation of the sonochemical effective death rate constants of MO once again confirms the expediency of the gas usage (in particular, argon) to disinfect the water from bacteria *Bacillus cereus*, compared with the use of only cavitation. Without bubbling of gases under the action of cavitation waves on water samples 1 and 2, only dissolved oxygen is available in the reaction medium, the amount of which is insufficient for the formation of additional centers of cavitation nucleations.

Conclusion

It was proved that the supply of gas in the first three minutes of the process promotes acceleration of breaking of bacterial aggregates in 10 times in the water environment at acoustic conditions, comparing with the process run in the absence of gas supply, where a similar process occurs after 30 minutes, due to a formation of additional cavitation nucleations during gas supply.

Development of the Forming Technology of Combined Membranes Based on Hydrogel and Polycaproamide

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Abstract – The technology of forming of composite polymer membranes by modifying the surface of hydrogels thru thin layer of polymer has been developed. The physical, mechanical properties and surface adsorption of composite membranes are determined. It was established that via variation of composite structures of hydrogel and modifying layers of composite membranes can be directed regulating of their physical and mechanical properties and surface adsorption of the obtained composite membranes.

Keywords – combined membranes, hydrogels, polycapro-amide, polyvinylpyrrolidone, 2-hydroxyethylmethacrylate, modification solution.

I. Introduction

The modern research and development in field of polymer and membrane technologies are focused on innovations making it possible to improve properties of known synthetic membranes. The leading place in the above mentioned studies belong to the production of the latest composite or hybrid membranes wich contain functional polymer hydrogels. Polymer hydrogels are three-dimensionally crosslinked polymer systems that, due to its porous structure possess selective permeability for various chemical and biological molecules. Also described polymer hydrogels have good sorption properties, biocompatibility and are capable for biodegradation [1]. Besides numerous advantages the polymer hydrogels also have disadvantages. Their porous structure makes it possible to absob solutions, while at the same time making them vulnerable to mechanical stress [2]. Insufficient strength of hydrogels caused insecurity in their use at high pressures and loads, and therefore narrowed the fields of their application.

There are various methods of membranes modification with organic and inorganic fillers [3] which are directed to increase the strength of existing membranes based on polymer hydrogels [4], etc. A successful combination of various materials makes it possible to create composite materials with unique properties. Therefore, it is advisable to create composite polymer materials by modifying them with compatible polymers to improve their working characteristics.

Currently, the search for strengthening material and its bonding with hydrogel is an actual as well as the development of an effective method for the modification of polymer hydrogels and membranes with strengthening material, which would retain the selectively permeable characteristics of the hydrogel.

Formation of composite polymer membranes is associated with two technological processes: the creating of a porous base and the application of thin fine-porous selective layer on it [5, 6].

One of the most productive directions in the development of polymer membranes is the creation of composite membranes of a heterogeneous structure. In such membranes, porous substrates can be considered as modified ones by thin and ultra-thin layers of porous synthetic material. The laying on of thin polymer films by precipitation from solutions is an effective method for modifying the surface of polymer membranes, which makes it possible to consider this technology as promising for the creation of specially designed membranes.

For surface modification of membranes with thin hetero-layers the multicomponent polymer solutions are applied.[5, 7]. The method of film deposition from solutions makes it possible to form thin films of definite structure, uniform in thickness and distribution of functional groups. Also it allows in wide ranges to vary both qualitative and quantitative composition of the modifying layer, while giving for the composition membranes additional special properties.

II. Formation of combined membranes

In order to develop a technology for the formation of composite polymer membranes of high strength the films based on aqueous solutions of hydrogels from copolymers of polyvinylpyrrolidone (PVP) and 2-hydroxyethyl methacrylate (HEMA) [8] were synthesized and applied on their surface microporous films based on the interpolymer complex of polycaproamide (PA-6)/PVP. The thin strengthening modifying layer was applied by precipitation diffusion of PA-6/PVP polymer blend from the formiate solution due to the contact of the hydrogel sample surface with the solution surface.

The working out the technology of obtaining of composite polymer membranes was conducted by research the influence of the concentration of PA-6/PVP in formic acid, the concentration of formic acid, the time of laying on of the film, the temperature and time of evaporation of the acid from the composite film on the amount of surface adsorption and, consequently, on the physical and chemical properties of the obtained membranes.

The influence of combined membranes on the adsorption properties of hydrogel has been investigated. Simultaneously the conditions for the formation of the hydrogel substrate were studied, namely the ratio of the polymer aqueous phase, the replacement of part of the water phase with water soluble additives, in particular glycerol, formic acid, as well as the temperature mode of the matrices hardening (three stages of temperature increase) and the stage of hydration of the obtained hydrogel films of thickness 0,35 mm and 0,5 mm.

The dependence of the amount of the obtained hardened layer on the researched conditions was studied. It was determined that the optimum concentration of formiate

solution is 7 % by weight, the time of its laying on to the hydrogel (modification time) is 5 minutes, the evaporation temperature is 75...80 °C and the time of solvent evaporation is 30 min. Hydration of the obtained combined membranes was carried out in three stages: 1,5% aqueous solution of sodium bicarbonate (50 °C), distilled water (50 °C), distilled water (25 °C) – 2 hours.
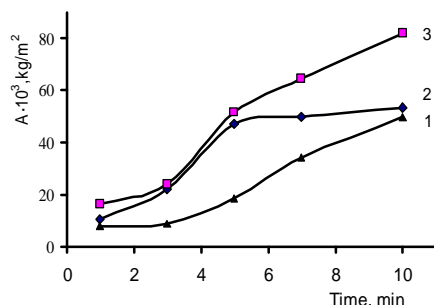
Fig. 1 Dependence of surface adsorption (A, kg/m^2) of combined membranes on time of modification.
HEMA : PVP: H$_2$O = 48 : 12 : 40 wt. h.,
HEMA : PVP = 8 : 2 wt. h., PA-6 : PVP = 95 : 5 % by weight,
PA-6/PVP : HCOOH, mass %: 1,2 – 7 : 93, 3-10 : 90,
Initial concentration [HCOOH] = 80 % by weight,
δ, mm: 1 – 0,35 mm, 2 – 0,5 mm.

The ressearch have determined that surface adsorption increases with the modification time of the combined membranes increase and also with the increase of the formiate solution concentration (Fig. 1). It is shown that while increasing the thickness of the hydrogel layer the surface adsorption is slightly higher (Fig. 1)
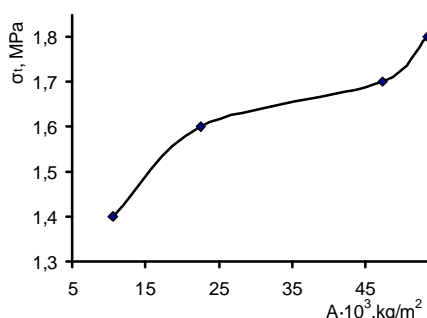
Fig. 2 Dependence of the strength (σt, MPa) of the combined membranes on the surface adsorption.
HEMA : PVP : H$_2$O = 48 : 12 : 40 wt. h.,
HEMA : PVP = 8 : 2 wt. h.,
PA-6/PVP : HCOOH = 7 : 93,% by mass,
Initial concentration [HCOOH] = 80% by weight,
PA-6 : PVP = 95 : 5 % by mass, δ = 0,5 mm.

As we can see from Fig. 2 with increasing of modification time of hydrogel membranes, the strength increases with an increase of the adsorption of polymer layer based on PA-6/PVP.

The influence of the additives on the structure of hydrogel is determined. The conformation of chains of mentioned hydrogel substantially changes (rectified in glycerine and twisted and packed in formiate acid). An increase in the amount of water in the initial composition causes the formation of diluted hydrogel with reduced strength and deteriorated optical properties.

Conclusion

Consequently, we developed the technology of forming of combined hydrogel membranes based on 2-hydro-xyethylmethacrylate copolymers with polyvinyl-pyrrolidone, which were strengthened with nano-layer made of PA-6/PVP polymer blends, and the dependence of their physical and mechanical properties on the surface adsorption was studied.

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Compounded and Raw Rubbers for Bitumen Modification

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Abstract — the analysis of petroleum bitumen characteristics used in road building is presented. The inflence of crumb rubber derived from waste tires on the bitumen properties has been investigated. The modification residual bitumen polymer latexes Butonal NS 198 and Butonal NS 104 and the analysis of modified bitumen. Using the above-mentioned products it is possible to omprove bitumen properties

Keywords — bitumen, rubber-bitumen blinder rubber crumb, bitumen modification, swelling.

I. Introduction

Bitumen consists of carbon and hydrogen in liquid, semisolid or solid state and contains small amounts of sulphur, nitrogen and oxygen. Bitumen production is one of the priority directions in oil refining. Petroleum bitumen is one of the main engineering-building compounds widely used for the production of roofing and waterproofing materials but the road-building is its main consumer [1]. Recently the demand for bitumen quality became stricter, especially for mechanical and deformational properties [2].

The modern road-building makes increased demands for road-building materials, namely for bitumen of asphalt concrete. Usual asphalt concrete based on bitumen cannot provide necessary physico-mechanical properties of the coatings and their durability. The bitumen modification by fillers, surface-active substances, sulphur, polymeric additives, etc. stands first among the methods of coatings life increase [3].

Latexes, compounded and raw rubbers take a special place in bitumen modification. The bitumen-polymeric product obtained due to the modification by above-mentioned compounds possesses higher elasticity, greater resistance for cracking, and wider temperature range of serviceability. Moreover, it is more durable during repeated dynamic effects in the area of low temperatures. While changing plasticizer and polymer content we may control the quality indexes of the finished product [4-5]. Rubber powder which is obtained during used tires processing may be also used as bitumen modifier [6]. Such usage allows to save money and solve the ecological problem.

The aim of this work is to obtain the commercial bitumen via its modification by rubber crumb and latexes of butonal type.

II. Experimental

For modification we used residual bitumen of Orhovits oil and polymeric latexes Butonal NS 198 and Butonal NS 104. These types of modifiers are widely used in the industry to increase the bitumen ductility and elasticity (Table 1).

TABLE 1

DEPENDENCE OF MODIFIED BITUMEN PROPERTIES ON BUTONAL NS 198 QUANTITY AND MODIFICATION TIME

Modifica-tion time, hrs	Penetration at 25°C, 0.1 mm at Butonal NS 198 content of		Softening temperature, °C at Butonal NS 198 content of		Elasticity, % at Butonal NS 198 content of	
	2 wt %	4 wt %	2 wt %	4 wt %	2 wt %	4 wt %
0	106	106	37	37	31	31
1	101	96	44	45	65	73
2	97	90	47	49	71	75
4	89	83	48	52	72	76
6	77	74	49	54	73	77

We introduced 2-3 wt % of Butonal NS 104 or Butonal NS 198 into the residue of Orhovits oil, stirred the mixture at 180°C for 2–6 hrs and obtained the bitumen meeting the requirements of BND-60/90 bitumen according to the standard DSTU 4044-2001. Thus, polymeric latexes of Butonal type may be used not only to increase the bitumen elasticity but to provide the necessary ratio softening temperature/penetration.

In spite of latexes advantages, their great shortcoming is high cost. On the other hand, there are many waste rubber products, namely used tires. Therefore we investigated modification of BND 90/130 bitumen by rubber wastes, i.e. by used crumbled tires.

Using the laboratory plant we investigated the effect of rubber crumb granulometric composition, its content in bitumen, temperature and mixing time on the quality of obtained product. The plant consists of a reactor, equipped with heater and temperature control, and mixing unit. The process was carried out within 373–473 K for 250–350 min. Since the rubber crumb is not completely solved in bitumen, we extracted the insoluble part from the mixture by means of metal sieve to make the analysis results more objective.

The samples of modified bitumen were analyzed to determine their elasticity, penetration at 25°C, and softening temperature by "ring and ball" method. The experimental results are represented in Table 2.

TABLE 2
CHARACTERISTICS OF ROAD BITUMEN MODIFIED BY RUBBER CRUMB

Mixing time 250 min								
Quality indexes	Rubber crumb content $d = 0.6$–0.8 mm				Rubber crumb content $d = 0.8$–1.0 mm			
	0%	5%	10%	15%	0%	5%	10%	15%
Elasticity,%	89	86	82	81	89	85	81	81
Penetration at 25°C, 0.1 mm	115	95	75	50	115	91	71	48
Softening temperature, °C	49	59	64	66	49	57	62	65
Mixing time 350 min								
Quality indexes	Rubber crumb content $d = 0.6$–0.8 mm				Rubber crumb content $d = 0.8$–1.0 mm			
	0%	5%	10%	15%	0%	5%	10%	15%
Elasticity,%	89	87	83	81	89	86	81	81
Penetration at 25°C, 0.1 mm	115	100	80	60	115	90	70	46
Softening temperature, °C	49	58	63	65	49	55	60	63

III. Result

The obtained results show that the increase of rubber crumb by more than 15 wt % increases the viscosity of rubber-bitumen blinder.

The optimum temperature is 433 K. At lower temperatures the time of rubber-bitumen blinder preparation increases from 250-350 min to 500-700 min. At 453 K and higher temperatures the bitumen colloid structure is destroyed and all quality indexes of rubber-bitumen blinder sharply become worse.

Concerning the optimum size of rubber crumb granules, it was found that bitumen modification by the fraction 0.8–1.0 mm and 0.6–0.8 mm shows the best results relative to all quality indexes. Application of smaller granules is useless. Rubber-bitumen blinder prepared by using fraction of above 1 mm does not meet requirements for such composites.

There is no necessity to completely solve rubber crumb in bitumen. It is enough to carry out the surface devulcanization of rubber crumb.

Our investigations show that minimal modification time is 4 hrs. The shorter mixing time leads to the partial disintegration of bitumen-rubber crumb system. It is impermissibly. The increase in mixing time does not essentially change the quality indexes; therefore it is to no purpose to increase the time.

Conclusion

We showed the possibility to use rubber crumb in bitumen production. The addition of rubber crumb has a positive effect on main properties of bitumen: elasticity, penetration, softening temperature. It also allows to exchange the expensive commercial elastomers for cheaper ones to obtain polymeric asphalt concrete. While adding rubber crumb in amount of 5-12 wt % the rubber-bitumen blinder which satisfying the standard demands is produced [7]. Taking into account the decrease in bitumen cost and partial solving of the used tires problem, the proposed method may be used in the industry.

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Effect of the Reactants Molar Ratio on the Kinetics of Cycloaddition of 2,3-Dimethylbuta-1,3-diene to methylacrylate

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Abstract – The cycloaddition reaction between 2,3-dimethylbuta-1,3-diene and methylacrylate proceeds by the second order kinetics. The rate constants increase with the increase in the excess of one of the reactants. The change in the effective rate constants is described by the Michaelis–Menten equation indicating that the reaction proceeds through the initial equilibrium stage of formation of an intermediate complex which then transforms into the product. The effective rate constants, the equilibrium constants of formation of the intermediate complex, and the rate constant of its transformation into the reaction product were determined, as well as the thermodynamic parameters of the formation of the intermediate complex and the activation parameters of the transformation of the intermediate complex into the product. The limiting stage of the reaction is established and its mechanism is suggested.

Keywords − 2,3-dimethylbuta-1,3-diene, methylacrylate, methyl-3,4-dimethylcyclohex-3-ene-1-carboxylate, cycloaddition reaction, Michaelis–Menten equation, effective rate constants, intermediate complex, limiting stage.

Introduction

Alkylcyclohexene carboxylates are starting materials for drugs, as well as modifiers, plasticizers, epoxyresins, and co-monomers [1]. They are used to create lotions, body emulsions, shampoos, day and night creams, perfumes, and food flavors [2]. In this work we studied the kinetics of interaction between 2,3-dimethylbuta-1,3-diene (DMB) with methylacrylate (MA) to optimize the process of producing methyl-3,4-dimethylcyclohex-3-ene-1-carboxylate (1).

$$H_3C \quad \text{--} \quad C\text{--}O\text{--}CH_3 \qquad (1)$$
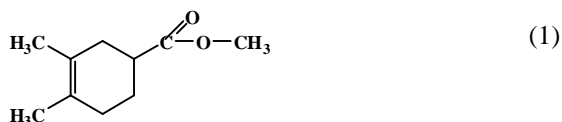
II. Experiment

Kinetic studies were performed in temperature-controlled sealed glass ampules according to the method described in [3], in the temperature range 403-433K. To the 10 cm^3 ampules were charged methylacrylate and 2,3-dimethylbuta-1,3-diene in the molar ratios from 1:1 to 1:1.75 and some hydroquinone, the ampules were sealed and placed in a thermostat. At regular intervals, an ampule was removed from the thermostat, quickly cooled, opened, and the reaction mixture was analyzed by gas–liquid chromatography on a SELMI CHROM-1 apparatus. The quantitative analysis was performed with internal normalization. The accuracy of chromatographic analysis in multiple parallel determinations did not exceed 3% [4].

The investigated reaction proceeds according to the second-order kinetics. The values of effective rate constants are listed in Table 1. We found that the values of the effective secondorder constants increase with the increasing ratio 2,3-dimethylbuta-1,3-diene : methylacrylate. The difference is more pronounced at higher temperatures. It was appropriate to examine in more detail the mechanism of this reaction. Note that the mechanism of the [4 +2]-cycloaddition reaction today is still controversial [5].

Two concerted mechanism are suggested: a single-step (sinchronous) and a two-step, in which the first step is the limiting one [6]. The Arrhenius equation described satisfactorily the dependence of the effective rate constants on temperature for different ratios (Fig. 1), which allowed us the calculation of the formal activation energy and other activation parameters of the overall process (Table 1).

TABLE 1
EFFECTIVE RATE CONSTANTS AND ACTIVATION PARAMETERS OF THE CYCLOADDITION REACTION BETWEEN 2,3-DIMETHYLBUTA-1,3-DIENE AND METHYLACRYLATE

AMA : DMB	$(K_{EFF} \pm \Delta K) \times 10^6$, L MOL^{-1} S^{-1}				E_{EFF}, KJ MOL^{-1}	ΔH_{EFF}, KJ MOL^{-1}	ΔS_{EFF}, J MOL^{-1} K^{-1}
	403K	413K	423K	433K			
1:1	2.6±0.2	6.2±0.2	9.9±0.3	11.9±0.5	72.5	56.4	-160.2
1:1.25	3.5±0.2	7.1±0.3	11.2±0.4	16.7±0.5	73.6	64.3	-155.1
1:1.4	4.0±0.2	8.5±0.3	13.4±0.4	19.3±0.5	74.8	68.2	-152.5
1:1.5	4.9±0.2	10.3±0.3	16.9±0.5	23.9±0.7	75.9	74.6	-148.2
1:1.6	5.8±0.2	12.3±0.3	19.6±0.5	28.9±0.7	76.4	78.5	-145.6
1:1.75	7.2±0.2	14.4±0.3	25.5±0.5	36.0±0.7	78.1	87.2	-139.9

The correlation coefficient was satisfactory in all cases ($R^2 > 0.95$). The analysis of the parameters maid it possible to establish that upon increase in the 2,3-dimethylbuta-1,3-diene excess and the accompanying increase in the values of k_{eff} a systematic increase was observed in the effective energy (ΔE_{eff}) and the effective activation enthalpy (ΔH_{eff}). Simultaneously, the value of the effective activation entropy ($-\Delta S_{eff}$) also increased.

For all ratios of reagents an isokinetic relationship was observed with a high degree of correlation ($R^2 = 0.99$) between the effective entropy and enthalpy of reaction, which allowed the calculation of the isokinetic temperature $T_{iso} = 287$ K (Fig. 2) that was far from the investigated temperature range.
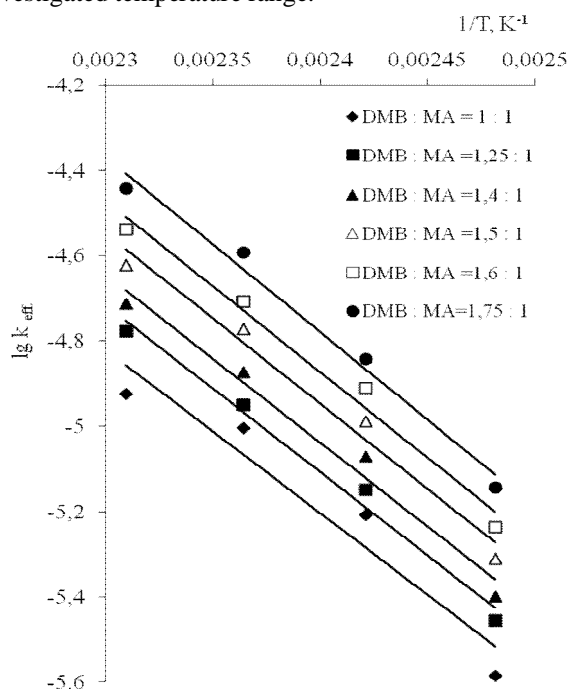
Fig. 1 Dependence of the effective rate constant of cycloaddition between 2,3-dimethylbuta-1,3-diene and methylacrylate on temperature for different ratios of reactants: 2,3-dimethylbuta-1,3-diene : methylacrylate
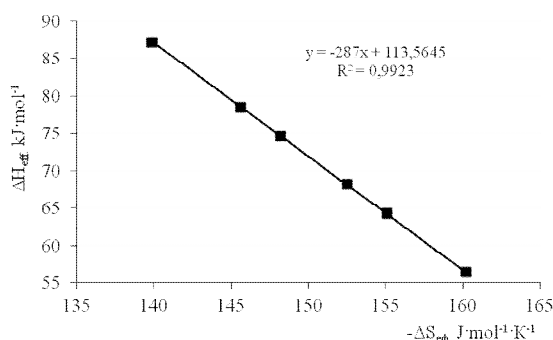
Fig. 2 Dependence of the effective activation entropy on the effective activation enthalpy of the cycloaddition between 2,3-dimethylbuta-1,3-diene and methylacrylate.

The increase in E_{eff} and ΔHe_{ff} with increasing excess of 2,3-dimethylbuta-1,3-diene and a simultaneous increase in ΔS_{eff} indicate the increasing steric hindrances in the reaction course. This finding suggests also that the reaction mechanism is unique in the studied range of the reagents ratio. Such a systematic change in the rate constants with an increase in excess of one of the reactants is typical of the reactions that include the formation of the charge transfer complex (CTC by the reagents) [7]. A similar reaction course has been proved also for several cases, including the alcoholysis of alcohols [7], where the formation of charge-transfer complexes was confirmed by the methods of physicochemical and spectral analyses.

For these reactions the effective second-order rate constant does not remain constant at the change in the reagent ratio, and the kinetics of the process is described by the Michaelis–Menten equation:

$$A + B \xrightarrow{K_{eq}} [A:B] \xrightarrow{k_{conv}} \text{Product}$$

$$\frac{1}{k_{eff}} = \frac{1}{k_{conv}} + \frac{K_{eq}C_A}{k_{conv}} \qquad (2)$$
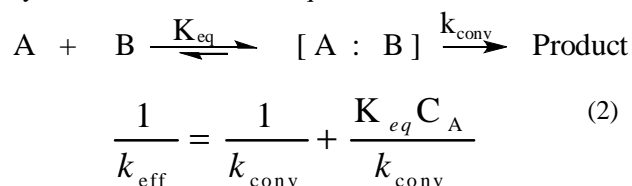
where k_{eff} is experimentally determined effective second order rate constant (l mol^{-1} s^{-1}) for each reagent ratio,

K_{eq} is the equilibrium constant (l mol^{-1}) for the intermediate complex formation,

k_{conv} is the rate constant (s^{-1}) of the intermediate complex conversion into the reaction product,

C_A is the molar concentration (M) of the substance taken in excess.

III. Results and Discussion

In our case, the change in the effective rate constants of the 2,3-dimethylbuta-1,3-diene cycloaddition to methylacrylate as a dependence on the ratio of reactants is also satisfactorily described by the Michaelis–Menten equation (2). This fact suggests that the cycloaddition reaction between 2,3-dimethylbuta-1,3-diene and methylacrylate proceeds through a stage of equilibrium with the formation of an intermediate complex followed by its conversion into the reaction product [Eq. (3)].

From the dependences shown in Fig. 3 for four temperatures, we obtained the following linear equations:

403K: $1/k_{eff.} = -331500 C_A + 708910$, ($R^2 = 0.990$) (4)
413K: $1/k_{eff.} = -131591 C_A + 297689$, ($R^2 = 0.976$) (5)
423K: $1/k_{eff.} = -87327 C_A + 192769$, ($R^2 = 0.971$) (6)
433K: $1/k_{eff.} = -75758 C_A + 157315$, ($R^2 = 0.986$) (7)

(3)
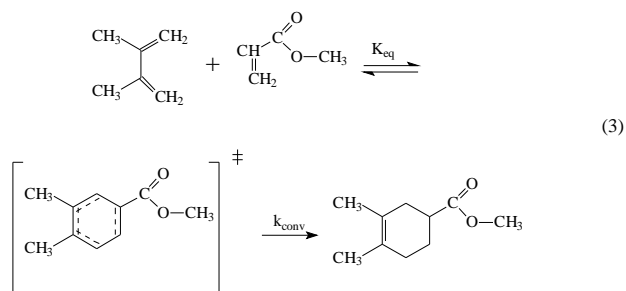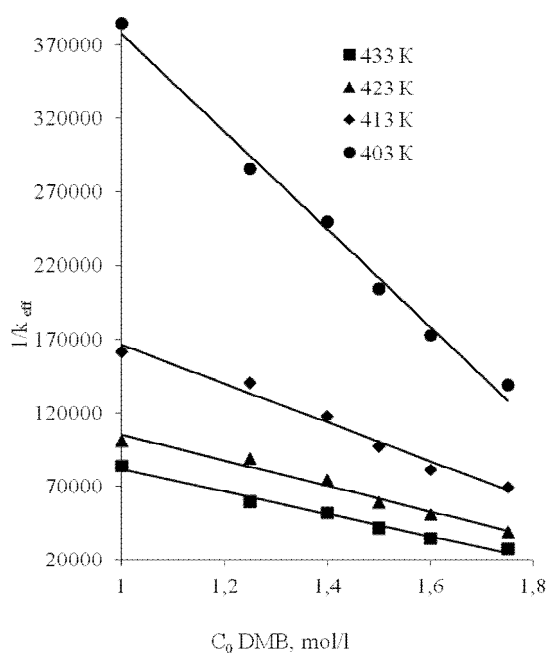
Fig. 3 Dependence of the effective rate constant of cycloaddition between 2,3-dimethylbuta-1,3-diene and methylacrylate on the molar ratio of reagents in the temperature range 403-433K.

The slope of the obtained straight lines gives the rate constants of the conversion of the intermediate complex in the reaction product (k_{conv}). The values of the intercepts on the ordinate axis give the equilibrium constants of the complex formation (Table 2) according to the expression $K_{eq} = 1/(k_{eff} k_{conv})$.

The dependence of the equilibrium constant (K_{eq}) of the intermediate complex formation is described by the isobar (Fig. 4, $R^2 = 0.993$). The dependence of the rate constants of conversion (k_{conv}) on temperature is described by the Arrhenius equation (Fig. 5, $R^2 = 0.999$), which allows the calculation of the activation parameters of the intermediate complex conversion in the reaction product (Table 2).
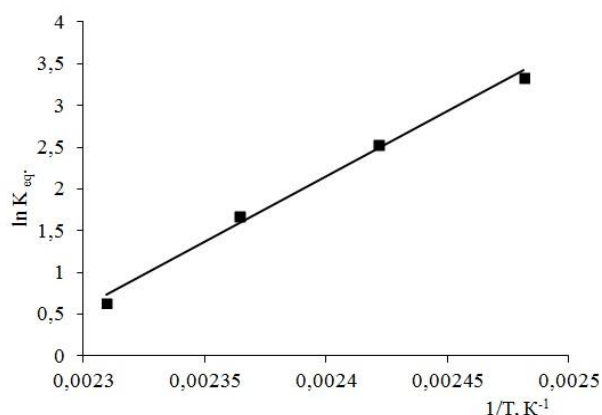
Fig. 4 Dependence of the equilibrium constant of the formation of intermediate complex on the temperature.

TABLE 2

EQUILIBRIUM CONSTANTS (K_{EQ}) AND THERMODYNAMIC PARAMETERS OF FORMATION OF THE INTERMEDIATE COMPLEX, THE RATE CONSTANTS (k_{CONV}) AND ACTIVATION PARAMETERS OF ITS TRANSFORMATION INTO A PRODUCT OF THE REACTION

CONSTANTS	403K	413K	423K	433K	ΔH_{EQ}, KJ MOL⁻¹	ΔS_{EQ}, J MOL⁻¹ K⁻¹	ΔG_{EQ}, KJ MOL⁻¹
					8.4	-228.5	98.2
$K_{eq}\cdot10^1$, l·mol⁻¹	4.67	4.42	4.54	4.77	E_{conv}, kJ mol⁻¹	$\Delta H^{\#}_{conv}$, kJ mol⁻¹	$\Delta S^{\#}_{conv}$, J mol⁻¹ K⁻¹
$k_{conv}\cdot10^6$, c⁻¹	1.41	3.36	5.19	6.36	72.3	44.5	-168.1
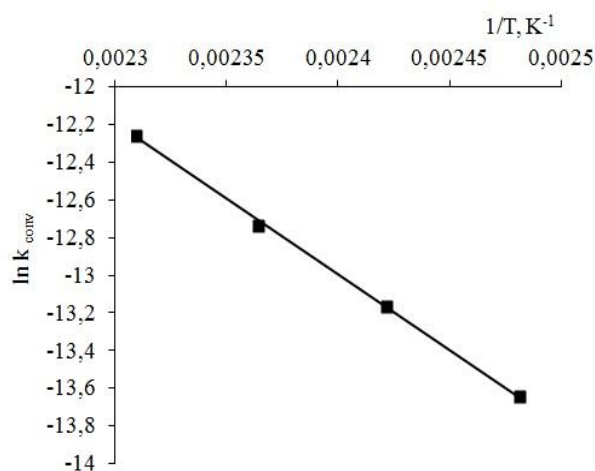
Fig. 5 Dependence of the rate constants of conversion of the intermediate complex in the reaction product on the temperature.

The found positive ΔG_{eq} and negative ΔS_{eq} values indicate the energy advantage of the intermediate complex formation. At the same time a relatively fast decomposition of the intermediate complex suggests that its formation is the limiting stage of the process. Thus, we established for the first time that the kinetics of the investigated process obeyed Michaelis–Menten equation, which was valid in the case of the reaction course through the stage of the associative equilibrium. It is an argument in favor of this reaction to proceed by the mechanism of concerted cycloaddition. However, the nature of the interaction of the components should be studied in more detail.

It is known that the addition of a diene molecule to the dienophile double bond originates from a certain deficiency

of the electron density on this double bond due to its interactions with the other active groups, and the stronger conjugation with them, the easier the diene addition. Indeed, when k_{eff} of 2,3-dimethylbuta-1,3-diene interaction with methylacrylate at 353K is 0.74×10^{-6} mol l^{-1} s^{-1} (determined graphically), the k_{eff} for the interaction of 2,3-dimethylbuta-1,3-diene with 1,4-naphthoquinone, where the π-bond interacts with two C=O groups, is 0.14×10^{-5} mol l^{-1} s^{-1} (in hexane) [8], and with its 5-substituted derivatives it is even two orders of magnitude higher, 1.5×10^{-3} mol l^{-1} s^{-1} [9]. The accelerating effect of electronegative substituents, like cyano group or halogen, on the cycloaddition reaction is even more pronounced. Thus, in the interaction of cyclopentadiene with methyl acrylate at 303K in dioxane k_{eff} is 2.8×10^{-5} mol l^{-1} s^{-1}, with fumaric acid dinitrile, 155×10^{-5} mol l^{-1} s^{-1}, and with tetracyanoethylene, 10200×10^{-5} mol l^{-1} s^{-1}. In such cases it is reasonable to assume that a relatively strong donor–acceptor bond arises between the reagents [9].

Conclusion

The results of the study of kinetic regularities in the process of synthesis of methyl-3,4-dimethylcyclohexa-3-ene-1-carboxylate and the study of the mechanism of this reaction showing its corresondence to the Michaelis–Menten equation confirm the formation of an intermediate complex between the reagents, 2,3-dimethylbuta-1,3-diene and methylacrylate. The study of thermodynamic parameters of formation of the intermediate complex suggests that the limiting stage is the slow formation of an intermediate complex, the activation parameters of the transformation of the intermediate complex in the product indicates that the conversion of the intermediate complex in the product occurs rapidly and spontaneously.

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Investigation of Kinetic Regularities of Rice Drying Process

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Abstract – Place here short abstract in English (please do not exceed 100 words, use Abstract style). The abstract should briefly present the purpose, principal results and novelty of your research.

Keywords – conference, conference proceedings, paper layout, paper sample, research paper (you should add from 5 to 10 keywords, use Index Terms style). The index terms should represent the whole paper content.

I. Introduction

Rice is considered to be the second largest collection of grain in the world. For half of humankind, rice processing products are the main ones in daily nutrition. Rice cereals – the main food product of more than 3 billion people. Rice grains are found in 112 countries on an area of 155.5 million hectares, and annual grain production in the world is about 600 million tons [1-3].

Rice contains vitamins E, B_1, B_4, B_5, B_6, B_9, PP and minerals K, Zn, Mg, P, Mn, Fe, which are necessary for normal physiological activity of the human body. Vitamin B_5 and Mn help improve metabolism in the body, Zn and P stimulate the brain and improve memory and vision. Vitamins E and PP improve the condition of the skin and hair, minerals K, Mg – normalize blood pressure, strengthen muscles. Vitamins B_1, B_4, B_6, B_9 support the health of the cardiovascular system [2].

II. Scientific aspects

Rice grain has a reduced moisture output due to the presence of air gap under the fruit membranes. In addition, low protein content in it causes large fractures, which is revealed even when the maturation of grain in the field, requiring mild drying conditions. The temperature mode should be differentiated depending on the initial moisture content of the grain: at a moisture content of 18% dried in one pass at the temperature of the coolant 65 – 70°C and the heating of grain is not higher than 40°C. At a humidity of about 20%, apply a two-stage mode (at first degree, the temperature of the coolant 60°C, with the second 70°C), allowing the heating of the grain to 35 and 40° C. The productivity of dryers during drying of rice grain is low.

In practice, almost always apply a few hours grate (2 – 3 hours) of grain between the first and second stages of drying. The length of the detachment depends on the amount of moisture evaporating during drying at one time: 3% – not less than 4 hours, 2% – not less than 3 hours, 1% – up to 2 hours.

Note that in the grain of dry rice, the moisture of the embryo is 2 – 3% lower, but moist, on the contrary.

Therefore, in order to prevent the rapid self-heating due to the high level of respiration, grain of rice must be brought to a state of dryness [4].

III. The laboratory equipment and its description

Theoretical and experimental research of regularities of filtration drying of grain of rice is carried out. The results of experimental studies of the influence of the temperature of the thermal agent have been found that increasing its temperature increases the rate of filtration drying of grain of rice.

The effect of temperature of the thermal agent was investigated in the range from 40 to 70 ºC and the height of the material layer in the range from 0.05 m to 0.1 m on the kinetics of filtration drying. The chosen parameters of the heat agent were selected taking into account that the grain of rice was a thermolabial material, the rate of filtration of the heat agent was selected taking into account the productivity of the industrial fans and based on the fact that in industrial installations the total area of the drying zone can be 4 – 6 m^2. The height of the stationary layer of grain of rice was chosen for reasons of providing the maximum possible uniform heating of the layer and the final moisture.

To perform experimental studies of filtration drying of rice grain, an experimental laboratory plant was used, the general appearance of which is depicted in Fig.1 [5-6]. It makes it possible to carry out complex studies of grain drying under variable conditions: the speed and temperature of the drying agent, the height of the grain material layer, its moisture and the angle of inclination of the drying zone.
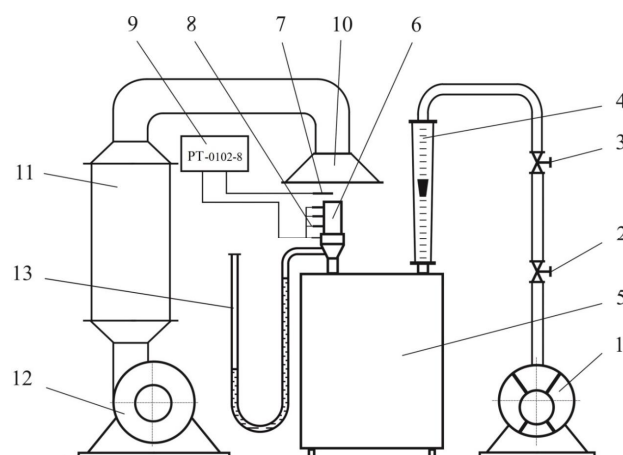
Fig.1 Scheme of the experimental installation: 1 – a water-ring vacuum pump; 2, 3 – shut-off and regulating valves; 4 – rotameters; 5 – the receiver; 6 – container; 7, 8 – thermocouples; 9 – control and measuring device PT – 108; 10 – diffuser; 11 – electric heater; 12 – fan; 13 – U-shaped gauge.

The installation shown in Fig. 1 consists of a circulator vacuum pump 1, which through regulating 2 (for controlling the flow of the thermal agent) and the shut-off valve 3 and the rotameter 4 are connected to the receiver 5 to which the container 6 is installed. Over the container 6 is a thermocouple 7 that controls the temperature at the

input to the container and a system of thermocouples 8 that measure the temperature in the layer of dispersed material and which are connected to an intelligent measuring transducer. Above the container 6 is a diffuser 10 of the air-cooled electric-cooler 11, which is connected to the fan 12. To measure the pressure loss values, a U-shaped gauge 13 is attached to the material layer.

For experiments the grain of rice was pre-moistened to the given moisture content. The initial moisture content of grain material was determined by an electric digital meter of moisture content of grain and seeds of VSP-100 (Fig. 2).

Fig. 2 The hydrometer VSP-100

The required grain moisture content of rice and its calculation were obtained according to the stepwise humidification of the grain material in accordance with the procedure given in [1]. Having determined the initial moisture content of rice grain samples, we calculated the mass of water W needed to obtain the grain of rice of the required moisture, according to the eq. 1:

$$W = G_n \cdot \frac{w_\kappa - w_n}{100 - w_\kappa} \qquad (1)$$

where G_n- mass of grain at initial humidity, kg; w_κ , w_n – humidity, respectively, before and after the addition of water,% of the total mass of grain.

The calculated amount of water W was added to the grain material in small portions, mixing it well. After that, the rice grain was stored in the desiccator for 2 ... 3 days, stirring periodically. Before the experiment began, the hydrometer content of the grain was checked using the VSP-100 moisture.

The fans and heaters were switched on, after reaching the set temperature, which was measured using the electronic thermostat PT-0102 (accuracy of measurement ± 0.5 ℃), included a vacuum pump and a damp material container mounted on the receiver. At certain intervals, the weight of the container was fixed with a weight of AXSIS-3000 with an accuracy of 0.01 g. The time of the weighing of the container was 60, 120 and 180s. To exclude the cooling and evaporation of moisture from rice grain, the container was covered with a lid.

Conclusion

According to the results of the research, the dependences of the temperature change of the thermal agent on the height of the material layer were determined. It was established that the increase in the height of the wet material layer does not change the nature of the filtration drying process of grain of rice. On the basis of the study of the kinetics of the process, the rate of filtration drying of rice grain at a different height of the layer, and at different temperatures of the thermal agent, is determined. It has been found that the rate of filtration drying increases with the growth of the temperature of the heat agent and the decrease in the height of the grain material layer.

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Simultaneous Filtration of Liquid and Solid Aerosols on Fibrous Filters

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Abstract − The subject area of this work refers to filtration process by using fibrous filters made by modified melt-blown technique during simultaneous exposition to contaminated gas by solid particles and liquid microdroplets. The paper consists a characteristics of deposition of aerosols with different morphology and influence for pressure drops for separation solid, liquid and mixed aerosols on fibres. In this research a filtration test set-up was modified to allow to generate and put into airstream simultaneously both particles and droplets.

Keywords − aerosol deposition; fibrous filter; filtration efficiency; melt-blown technique; mixed aerosols.

I. Introduction

Nowadays gas purification process is one of the most significant step in the processing of various substances and is widely used in many industrial processes for humen and nature protection. Harmful and unwanted particles must be removed from the waste gases before there could be released to the atmosphere. This allows us to minimize a negative impact on the environment. New generation of high efficiency fibrous polymer filters can be used for capture and removal from air pollutants in wide range of size diameter [1, 2].

In the literature of subject, mainly removal of solid [3,4] or liquid particles [5,6] separately has been reported. Very rare are informations about simultaneous occurrence of these two types of aerosols, they interaction with each others and with the surface of the collector. However, in real conditions of filtration process these two type pollutants often occur in air. It has affected for the actual lifetime of the filter materials. Hence, there is a big need for a better understanding of the simultaneous filtration of mixed aerosols.

In the paper [4], it have been shown phenomena, which occur during the filtration of solid particles. In the first step, the particles settle on the surfaces of the clean fibers. During the filtration process the particles starts to forming a dendritic structures. As a results, they reduce pores of onwoven and we could observe that filtration efficiency and airflow resistance increase.

The separation of aerosols with liquid droplets was investigated in [4]. In the first part of process, the droplets deposited on the surface of the filter fibers and create thin film layer . In this step of process we could observed a slight increase in pressure drop. After some time oil starts fill almost the entire space between the filter fibers forming numerous liquid bridges what results in an exponential increase of airflow resistance. Later on when this resistance reaches a maximal value the pressure drop and particle penetration are nearly constant. This is due to the balance between loading, dripping and redistribution of droplets.

In case of solid particles dendritic structures are formed which are hardly to tear down. As a result of coalescence, droplets create the liquid bridges and oil may flow on the fibres [4]. In the case where the filter contains particles of both types, the nature of the interaction between them and between them and the fibers has changed. It affects directly in the filtration efficiency, nature of the deposition as a result of additional interactions and forces (e.g. capillary forces) [7]. Furthermore, it makes a difference in the pressure resistance characteristics during the filtration process.

The framework of our investigation includes the measurement of pressure drop across the filter and analysis of deposits formed on the surface of the fibers after the filtration process by using scanning electron microscope (SEM).

II. Materials and methods

As a filtration medium, fibrous filters made by means of modified melt-blown technique were used [1]. Non-woven filtrating media contains packed fibres formed into layers with irregular structure and polydisperse diameter distribution of fibres. The filters were made from polypropylene. This polymer has high value of Melt Flow Index that allows to obtain filters with thin average fibres diameter. In this studies the mean fiber diameter was 7.186 μm, porosity of filters was 97.02% and mean thickness of a filter was 5.059 mm.

The tests of filtration process were carried out at the modified MFP 1000 set-up (PALAS® GmbH). This is a set-up specially designed for testing flat filtrating materials. The main components of the test bench are: solid particle generator, nebulizer – liquid particle generator, charge neutralizer, spectrometer particle counter and vacuum pump used to suck the sample into the particles counter probe.

The appropriate equipment and materials were used to generate dispersed phases. In the case of solid particles, it was the RBG 1000 generator and synthetic silica dust the "Arizona fine test dust". To generate the droplets the PLG 1000 generator and DEHS (Di-Ethyl-Hexyl-Sebacat) oil were used.

During the tests, the test bench was modified to allow simultaneously put into filtrating chamber solid and liquid particles. The particles size distributions of generated aerosols are shown in Fig.1.
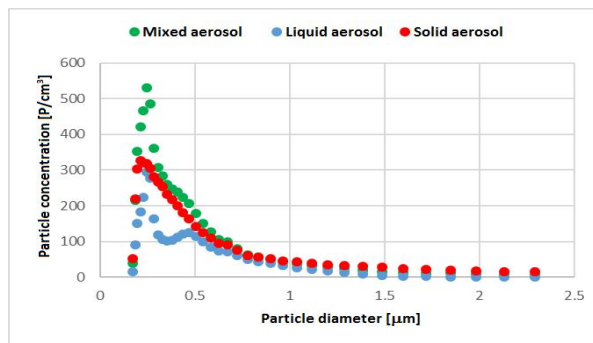
Fig.1 Particle size distribution of generated aerosols.

The total concentration of generated silica dust was 4996 [P/cm^3], for oil droplets it was 2956 [P/cm^3] and for mixed aerosol it was 5810 [P/cm^3]. It can be notice that the total amount of particles for mixed aerosol was less than the sum of solids and liquids (7952 [P/cm^3]) more than 25%. This may be due to collisions of particles in the filtration chamber and particles deposition mixing jets.

III. Results

It was noted that during the simultaneous loading of the filter by mixed aerosol we observed that pressure drop on filter increase much more slower than in the case of solid particles separation and increase only a little bit faster in compared with the oil droplet separation. This is due to the reorganization of dendritic structure deposits, which occur under the influence of a thin layer of liquid formed on fibres and particles. Due to the presence of oil on the fibers, solid particles firstly create dense layer throughout their lengths. On the next step of process particles start to form larger clusters which cause that flow resistance is increasing slowly. This type of structure makes less resistance to the flow of air then solid particles dendrites structure. The changes of pressure drop during 7h filtering process are shown in Fig.2.
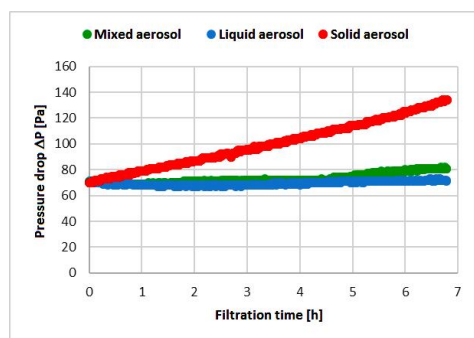
Fig.2 Changes of pressure drop under continuous loading by different types of aerosols.

A series of photos was taken to see the morphology of deposits on fibers (see Fig.3). There is considerable difference between deposits of solid, liquid and mixed aerosol. Dendritic structures are clearly visible for solid particles and liquid bridges for oil droplets. However, the most interesting is the appearance of fibers with both types of particles. It is easy to see how the fibers were loaded by dust and oil. The presence of creates dense compact structures.

Conclusion

During the loading of non-wowen filters there may be observed huge differences between filtration deposits, depending on the form of particles (solid, liquid or mixed). Mixed (solid and liquid) particles form characteristic compact structures. This is caused by the presence of oil, which disturbs to form dendritic structures and spreads dust along the whole length fibers and makes dense structures. Moreover, there were observed changes in the trends of the pressure drop across the filters. During a filtration of mixed aerosol the flow resistance grows only a little more quickly than during the filtration of oil droplets.
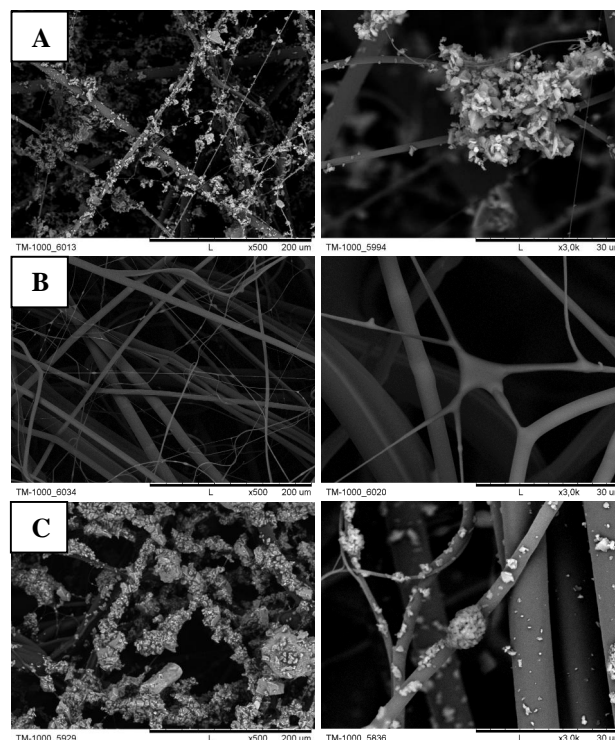
Fig.3 SEM images of filters after filtration of (A) solid particles (B) liquid droplets (C) mixed aerosol.

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Dissolution of solid polydisperse materials during pneumatic mixing

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The thesis investigates dissolution of solid polydisperse materials during pneumatic mixing. In particular, a study of kinetics regularities of dissolution of C_6H_5COOH in water. The methods of experimentations are described. It has been experimentally established that with increasing air flow, the duration of the dissolution process is reduced. The influence of mixing applications on the dissolution process is described. The advantages of the dissolution process during the pneumatic mixing of the solution are analyzed.

Keywords: dissolution, pneumatic mixing, benzoic acid, polydisperse phase, mixing applications.

I. Analysis of recent research and publications

The dissolution belongs to one of the most widely used mass transfer processes, which are widely used in industry. It is known that the investigation of the dissolution process is thoroughly investigated, mainly for single particles of spherical form [1]. The main attention during the study of the dissolution of single particles was given to determining the coefficient of mass transfer experimentally and the presentation of experimental data theoretically by the method of generalized variables. In particular, the dissolution of single particles of benzoic acid in a spherical form is also described in Garner and Hoffmann's work [5].

In spite of the fact that the study of the dissolution of single particles has been given a lot of attention by different researchers, the industry usually dissolves polydisperse systems consisting of many particles of irregular shape. The dissolution in a layer of solid material is given in works [6-7]. Dissolution is a transition phase to a solid solution and can be accompanied by the complete disappearance of the solid phase. Dissolution is a complex process that can occur in diffusion, kinetic or mixed areas. Widespread use of dissolving was determined in halurhiya during the process of natural salts refinery [2].

Reducing costs associated with the intensification of the process of dissolution. There are many ways of intensification of this process, mechanical and pneumatic mixing, creating a fluidized bed, ripple motion of fluid, cavitation and ultrasound sparks [3]. A known method for intensifying reaction and mass transfer processes in heterogeneous systems is realized in a device for dissolving solid particles in a liquid in which a liquid carrying solid particles moves along a pipe having a variable cross section throughout its length [4]. However, the disadvantage of this method is the large dimensions of the installation, loss of pressure in the variable cross sections, and also possible erosion of the walls of the pipe.

Most of the methods of intensification characterized by high energy costs, flexible design of mixing devices, so we investigated the method by intensifying creation the pneumatic mixing in the device with compressed air.

In the technological process, the concentration of the target component should be high and approach to the concentration of saturation.

Therefore, the study and establishment of the laws of the process of dissolution of polydisperse mixtures is an urgent task.

II. The aim of the work

The aim is to study the kinetics of dissolution process of polydisperse solid phase of benzoic acid in water during the air mixing and described the influence of mixing applications on the dissolution process .

III. Experimental study and its analysis.

Experimental study of dissolution polydisperse solid phase was conducted in a pneumatic stirring apparatus.

To carry out the dissolution process, the apparatus for pneumatic mixing was filled with distilled water, where the initial concentration of acid was $C_0 = 0$. The compressor was switched on. The regulator was exposed to the required pressure and air flow rate. The acid was lit and the stopwatch was switched on too.

We analyzed the process on the following parameters. Concentration of saturation C = 2.63 g/l. The volume of the solution was V = 1.5 l. The weight of benzoic acid (BA) in the experiments was m = 4.5 g. The average size of the fraction was d = 1.5 mm. The air consumption was also unchanged and was $V = 2.67 \text{ m}^3/\text{h}$. Ambient temperature was 15 ± 0.5 C.

Through samplers were taken 5 ml of the analyzed solution at intervals of 10 minutes until completion of the dissolution process. The dissolved C_m content was determined from the titrimetric analysis by titrating the sample with a 0.01-normal solution of NaOH in the presence of a phenolphthalein indicator.

On the basis of the calculated data, the dependence of the change of the concentration of benzoic acid in the solution from the time $C = f(\tau)$, which is presented in Fig. 1:

C, g/l

τ, min.
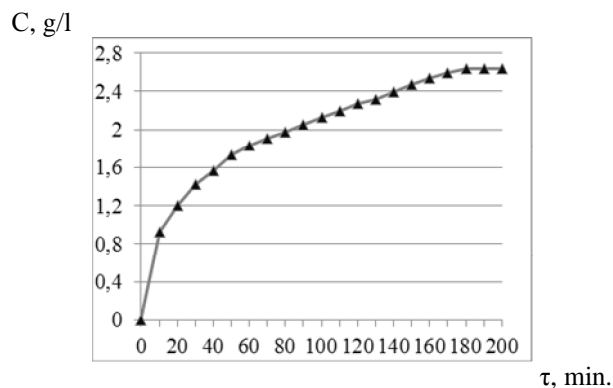
Fig.1 The dependence of the concentration of benzoic acid on the duration of the dissolution process.

The main disadvantage of the dissolution process when pneumatically stirred is the formation of foam, which is accompanied by the removal of solid particles of the soluble material outside the zone of intensive mass transfer and, thus, increasing the duration of the dissolution process to a given concentration.

The kinetics of the dissolution process is determined by the speed of reaching the concentration of saturation by the target component. We investigated the influence of solid particles of various forms, made from chemically inert to benzoic acid materials, on the pneumatic mixing process and, accordingly, on the kinetics of dissolution of benzoic acid in water. This influence is shown in Figure 2.

The amount of the introduction of mixing solutions in the solution should be as small as possible to exclude their effect on the dissolution of polydisperse particles, but only to prevent the rendering of the solid phase in the foam.
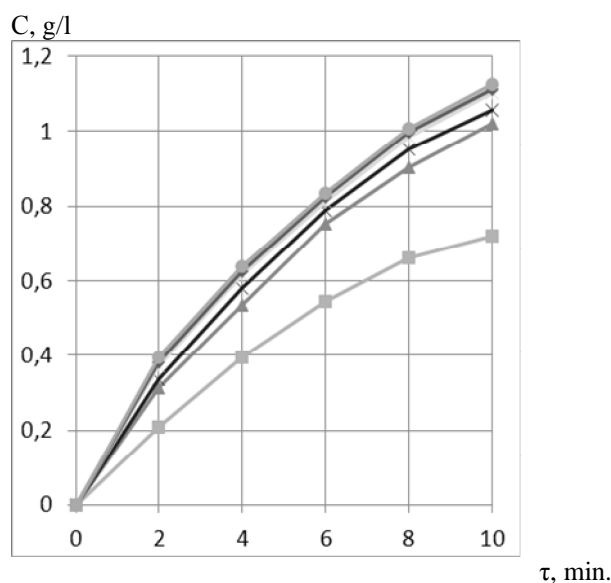
Fig.2 Effect of the number of mixing balls on the kinetics of the dissolution process.
■- M_b=0 g; ▲- M_b=12.9 g; **x**- M_b=37.4 g; ♦- M_b=70 g;
●- M_b=100 g.

As a result of experimental studies it was found that the addition of chemically inert balls significantly improves the kinetics of the dissolution process, reducing its duration and, accordingly, energy consumption. The addition of mixing balls prevents the solid phase from solids from the zone of intense mass transfer to the foam layer, there by providing continuous washing of particles with water, increasing the surface of the mass return.

We also investigated the effect of increasing the air flow rate on the speed. It is established that the increase in air flow rate above 4.5 m^3/h significantly increases the foam height, which hovers about 80% of solid particles, which negatively affects the dissolution intensity, reducing the size of the zone of intensive mass transfer. That's why, this air flow was the limit in our research.

The choice of the dissolution process when pneumatically stirred is due to a number of advantages over other methods. Pneumatic mixing devices have a simplified internal construction, since they don't have mixing devices. The absence of these devices eliminates the need for their maintenance, as well as prevents contamination of the target product, eliminating the possibility of reaction between the material of the mixing device and the solution, which is very important in the food and pharmaceutical industry. The use of bubbling air provides a constant temperature of the solution, bringing out the heat released during dissolution, outside, with the bubbles. The main advantage of using such mixing is the uniform and intense mass transfer between the solid phase and the liquid. The simple design of pneumatic mixing machines allows you to significantly reduce the cost of their service.

Conclusions

The dissolution of polydispersed benzoic acid particles in a pneumatic mixing apparatus has been experimentally investigated. The dissolution of polydispersed benzoic acid particles in a pneumatic mixing machine has been experimentally investigated. The method of conducting experiments is described. The dependence of the mass concentration of the dissolved substance on the duration of the process and the plot is constructed. The influence of the side effect of foam formation on the dissolution process is considered. The influence of inert mixing applications on the process of pneumatic dissolution is established and we have also built graphical dependence of the effect of the number of mixing balls on the kinetics of the dissolution process. It has been experimentally established that with increasing air flow, the duration of the dissolution process is reduced. The advantages of the dissolution process during the pneumatic mixing of the solution are analyzed.

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Preparation of Highly Hydrophobic Cellulose Based Surfaces by Silica Particles and Fluorosiloxane Deposition

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Abstract − This work is focused on modification of cellulose filters surface in order to hydrophobise a material and decrease water drop adhesion to its surface. Proposed modification methods include deposition of silica particles to obtain desired material roughness and coating material with 1H,1H,2H,2H-perfluorooctyl triethoxysilane (FOTS) to decrease its surface energy.

Keywords − cellulose filter media, silica particles, 1H,1H,2H,2H-perfluorooctyl triethoxysilane (FOTS), roughness, hydrophobicity.

I. Introduction

The purpose of this work is to improve the performance of modified cellulose filters dedicated to purifying diesel fuel from emulsified water and solid particles. The removal of these contaminants is essential due to the negative impact of the above mentioned impurities on engines and injection systems. Developing new methods of cellulose hydrophobisation is particularly relevant due to low-sulphur fuels containing biocomponents introduced into market in recent years. These types of fuel usually have a relatively low value of interfacial tension with water, which results in formation of stable emulsions and a more difficult separation of water.

The wettability of water droplets on solid surfaces is governed by two parameters: chemical composition of surface and its microstructure in a submicron scale. Due to this fact, techniques of preparation superhydrophobic surfaces comprise two steps: manufacturing a rough surface with a nanoparticles and its coating with a low surface energy component [1].

In presented research silica particles were deposited on cellulose fibers to increase their surface roughness and subsequent chemical modification with fluorosiloxane was carried out to decrease surface energy.

II. Materials and characterization methods

The commercial filter material from Ahlstrom used in this research consists of the main cellulose filtration layer laid onto two polyester layers applied as a support. The material was modified to increase its hydrophobicity and to attenuate the adhesion of water to the surface. The original unmodified material was used as a reference to verify effects of modification.

To characterize the properties of separation materials, measurements of static contact angle (CA) and sliding angle for water droplets were carried out using the goniometer Dataphysics OCA 25 equipped with a tilting base. The sliding angles were measured for water droplet volume equal to 50 μl. These parameters define the ability of the filter material to repel water and thus prevent its accumulation on the surface. Moreover, the structure of modified material surface was verified using Scanning Electron Microscopy (SEM).

III. Modification of the cellulose surface

In the first step of modification the monodisperse and spherical silica particles were deposited on cellulose fibers to increase fiber roughness. The silica particles were synthesized utilizing Stober reaction which involves the sol-gel process of aqueous alcohol solution of tetraetoxysilane (TEOS) with addition of ammonia as a catalyst [2]. The silica particles synthesis was carried out in 40°C for 90 minutes, where TEOS (14 ml) was added gradually to continuously mixed solution of ethanol (100 ml) and ammonia (11 ml). The obtained colloidal silica particles were diluted with isopropanol (1:1 volume ratio) and deposited on material via dip coating method, without previous particles drying nor separation.

To reverse the negative charge and enable efficient coating the reference cellulose was immersed in solution of 1% wt of PDDA (positive electrolyte) in aqueous 0.5 M solution of NaCl for 15 minutes.

To hydrophobize the surface, in the second step of the modification the materal was exposed to the 1H,1H,2H,2H-perfluorooctyl triethoxysilane (FOTS) solution in ethanol with addition of water (the volume ratio of used components FOTS:EtOH:H$_2$O was equal to 1:100:2). The treatment was conducted by immersing the silica coated cellulose in the solution for 6 hours at ambient temperature. At the end of treatment the material was dried in oven at 120°C for 2 hours [3]. The scheme of the cellulose surface modification and chemical structure of fluorosiloxane is given in Fig. 1.
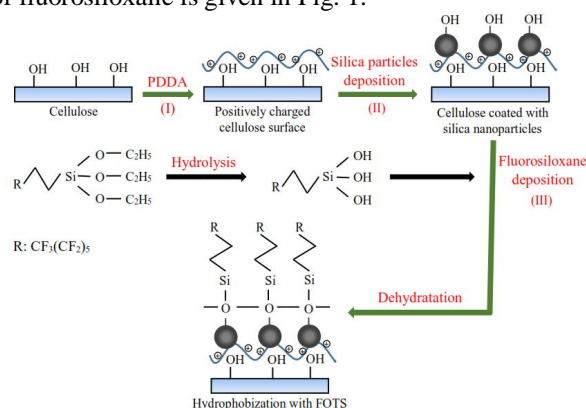
Fig.1 Scheme of cellulose surface modification: (I) changing the cellulose surface charge, (II) deposition of silica particles, (III) bonding fluorosiloxane on inorganic surface.

IV. Results and discussion

As a result of Stober reaction a stable suspension of colloidal silica spheres was obtained. The concentration of particles was about 34 mg/cm^3 and their zeta potencial at pH=9 was −49.1±1.5 mV, which confirms stability of colloidal system. In the Fig. 2 the SEM image of synthesized silica particles (after solvent evaporation) is presented.
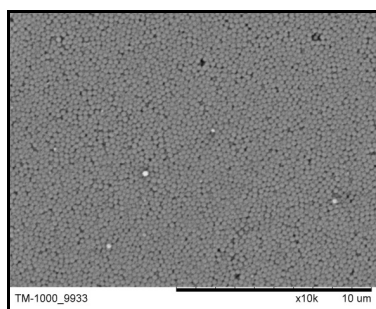
Fig.2 SEM image of silica particles with average size of 301.6±1.4 nm (by number).

In the modification procedure the hydroxyl groups of cellulose play an important role in adhering of silica nanoparticles. They create interfacial C-O-Si bonds with the Si-O groups of silica formed as a result of TEOS hydrolysis. However, the deposition of fluorosiloxane deposition directly onto cellulose was possible due to self-condensation of siloxane followed by hydrolysis (black arrows path in Fig. 1). The different morphologies of cellulose fibres after modification are shown in Fig. 3.
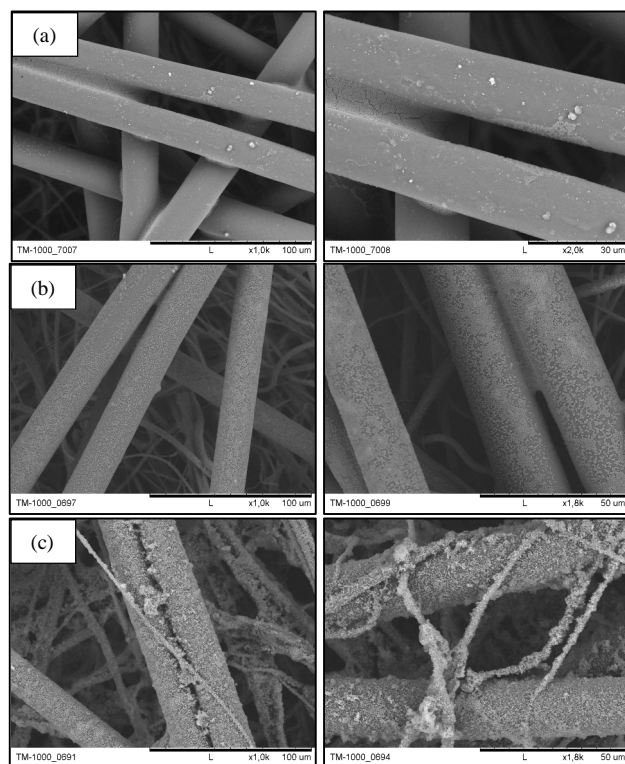
Fig.3 SEM images showing the surface morphology of cellulose fibers: (a) without changing negative charge of cellulose, (b) and (c) single or twice repeated deposition procedure of silica particles respectively, with previous changing surface charge of cellulose for positive (magnification: 1000x i 1500x).

The small amount of silica particles (Fig. 3a) is due to skipping the step of changing cellulose charge in modification procedure. In such case repulsive forces between negatively charged silica particles and the cellulose surface hindered the fiber coating process.

In Fig. 3b and 3c the silica particles appear well dispersed at the cellulose surface, which makes its roughness rather homogeneous. When the particle deposition procedure was repeated, the higher amount of silica particles on cellulose fibers was present, as shown in the Fig. 3c . However, no multilayer coating has been observed.

In Table I results of wettability expressed by values of contact angles and sliding angles of water for obtained materials after modification are presented.

TABLE 1

CHARACTERIZATION OF SURFACE PROPERTIES
OF TESTED MATERIALS

Material	Water contact angle (CA), °	Water sliding angle ($\alpha 50$), °
Cellulose, without modification	125.5±5.1	44.0±1.8
Cellulose + FOTS	134.0±4.1	45.5±2.4
Cellulose + silica particles 1x + FOTS	136.8±6.2	44.7±2.1
Cellulose + silica particles 2x + FOTS	139.3±4.3	47.4±6.2

The significatnt increase of water contact angle as a result of fluorosiloxane deposition was noticed. However, introducing the silica particles lead to an increase of water contact angle only by few degrees.The reduction of water sliding angle of water was not achieved in this case. Obtained results can be explained by application of silica particle with a very uniform size, which did not allow to create a hierarchical structure. In literature the best results of surface roughness were obtained for silica particles diameter about 600 nm [3], where sodium silicate layers were applied to create hierarchical roughness.

Conclusion

The presented approach constitutes a promising method to increase hydrophobictity of cellulose material. The best results were obtained for the filter covered with silica particles (procedure repeated twice) and fluorosiloxane (FOTS) comparing to the reference structure (before modification). Additionally, the necessity of changing cellulose surface charge before silica deposition step was confirmed to be critical to obtain an effective and uniform coating.

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The simulation of the heat transfer equipment using methods of engineering analysis

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The expediency of analysis and evaluation of the heat exchange process by methods on the CAE software complexes have been shown.

Keywords – CAE, engineering analysis, simulation, heat transfer, SolidWorks.

I. Introduction

Energy costs for production constitute a very large part of the cost price of the final product. In the order to the high cost of energy sources, optimizing the work of heat-exchange equipment is an important application problem. Using the modern engineering analysis software we are able to analyze the work of existing devices and make adjustments to their optimization and for the next reducing of the energy costs.

II. Model of the laboratory device

The heat transfer eguipment is used in the most industrial processes. To properly design the device, we shoul devaluate the important parameters: heat load, hydraulic data, physical and chemical properties of the material, temperature values (starting and ending), flow chart, heat loss, degree of resistance of materials used and etc.

Using the software, is's possible to set all the necessary parameters for the process of the corresponding model of the device (Fig.1) and watch the change of these parameters with time. The substance passes through the tube, and the coolant is fed into the intertubular area. Thus, go on the process of heat exchange between the coolant and the substance.

Fig.1. The laboratory «pipe-in-pipe» heat exchanger installation:
1 – the pipe for the cool agent, 2 – the pipe for a heat agent.

For research and further modeling of the heat transfer process, experimental pilot studies have been conducted on a laboratory «pipe-in-pipe» heat exchanger installation (Fig. 1).

A solid model of the laboratory installation has been created in the CAD/CAE software complex of SolidWorks 2016 Educational Edition [1].

The solid model of the modeled «pipe-in-pipe» heat exchanger is shown in the Fig. 2.
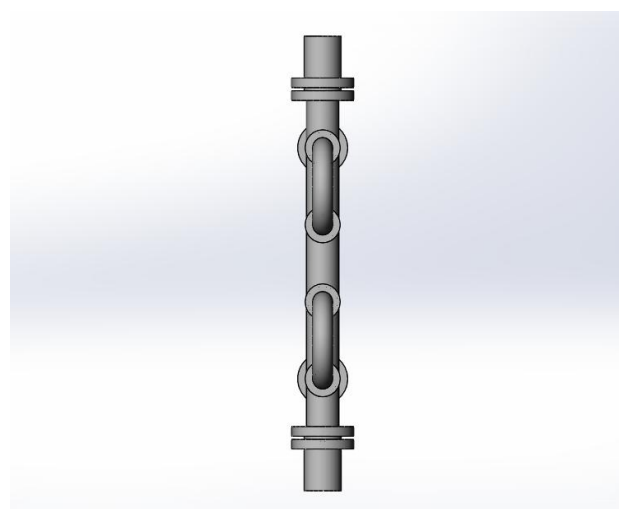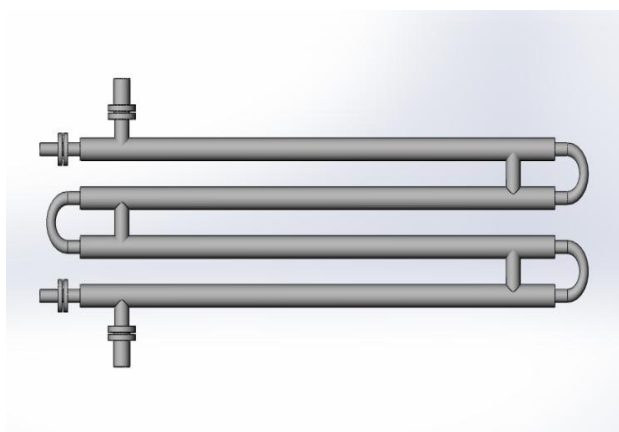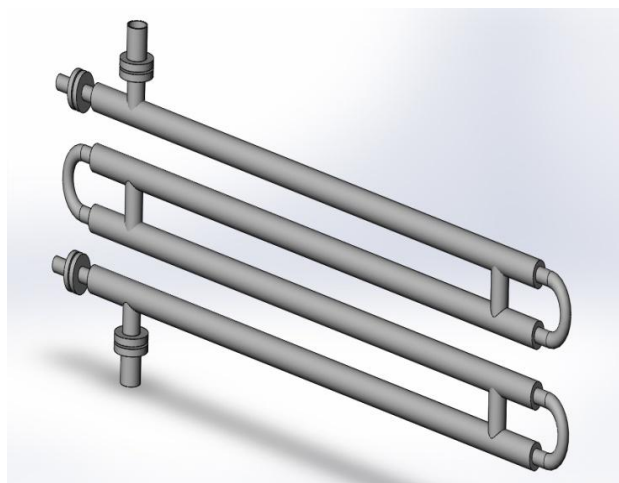
Fig.2. The «pipe-in-pipe» heat exchanger created
in SolidWorks 2016 Educational Edition.

III. Experimental part

According to the results of the test, the temperature of the cold coolant changed from 12°C to 17°C, and the hot coolant decreased from 42°C to 27°C.

By using the methods of engineering analysis the experimental data have been analyzed in the software Solidworks Flow Simulation 2016 Educational Edition.

The research results are presented in Fig. 3.
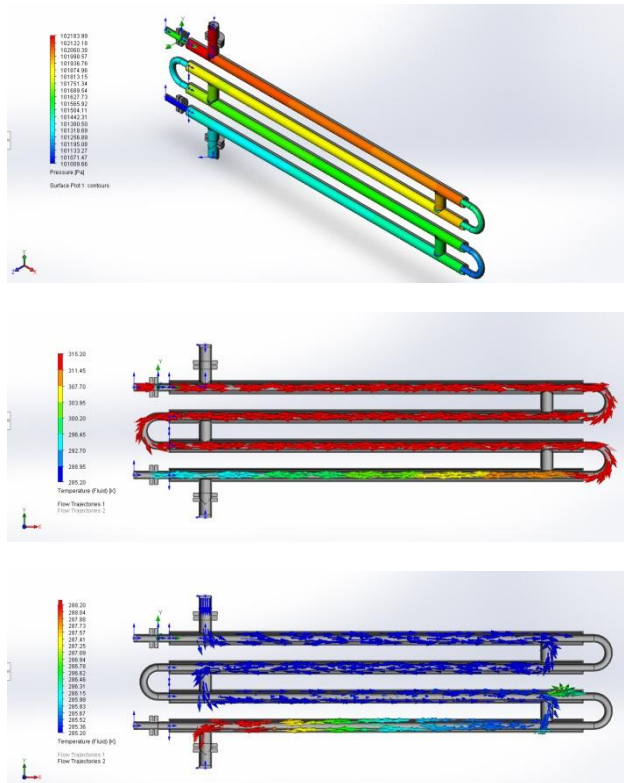
Fig.3. The analysis of the «pipe-in-pipe» heat exchanger work created in SolidWorks Flow Simulation 2016 Educational Edition.
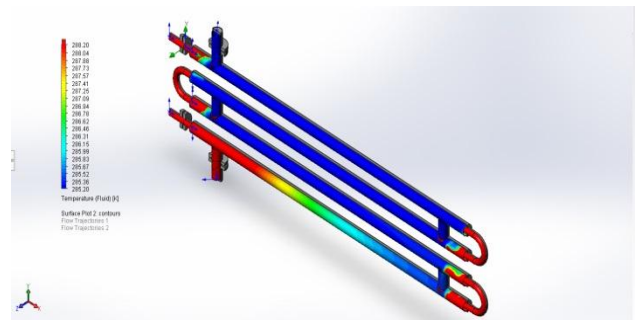
Fig.3. The analysis of the «pipe-in-pipe» heat exchanger work created in SolidWorks Flow Simulation 2016 Educational Edition.

With the help of engineering analysis methods, the practical solutions can be proposed for optimizing the existing heat exchange equipment depending on the specific needs to a particular technological process.

Conclusions

The next research results will be published. The results are going to show simulation of the heat transfer process, which has a wide use in various industrial processes. That will help in the research of the practical process using and reducing the price on the final product.

Acknowledgment

The authors are expressing the gratitude to the company «Intersed-Ukraine», the official representative of SolidWorks Corp. in Ukraine.

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The heat transfer during the filtration drying of the grinded sunflower stems

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Abstract – The stems of sunflowers can be successfully used as a raw material for solid fuel production due to their ingredients: cellulose, hemicellulose and lignin. The high concentration of above-mentioned compounds defines high calorific power of biofuel (about 20.6 MJ/kg) made from plant raw material. The fate of the costs of drying in the cost of manufacture of solid biofuels from grinded sunflower stems are large, which increases the cost of the finished product. The application of the filtration method for drying of the grinded sunflower stems makes it possible to intensify the dehydration process and to reduce energy costs.

Keywords – grinded sunflower stalks, the heat transfer, filtration drying, the thermal agent, the heat transfer coefficients

I. Introduction

Solid fuel production from waste agricultural products makes it possible to reduce energy costs, reduce land fill volumes and contribute to reductions in GHG emissions. The solid fuel product, an alternative to propane, oil and natural gas, provides a feed supply for thermal heat systems for generation of hot water, steam and producer gas applications. Studies have shown that the stems of sunflowers can be successfully used as a raw material for solid fuel production due to their ingredients: cellulose, hemicellulose and lignin. The high concentration of above-mentioned compounds defines high calorific power of biofuel made from plant raw material. The average highest calorific value of sunflower dry matter is about 20.6 MJ/kg. The technology of solid fuel production from this type of material provides stages of preliminary grinding and drying to humidity of 4□12 % favorable for sustainable briquetting and quality characteristics of received briquettes. Each particle of grinded sunflower stems may be examined as a system formed by a great number of cells with intracellular space. Cell wall together with plasma membrane form semipermeable confined space of the cell containing liquid. The intracellular space is also filled by liquid. The initial average moisture content of the investigated sunflower stalks is 60%. The fate of the costs of drying in the cost of manufacture of solid biofuels from grinded sunflower stems are large, which increases the cost of the finished product. The application of the filtration method for drying of the grinded sunflower stems makes it possible to intensify the dehydration process and to reduce energy costs. Filtration drying of dispersed materials, in particular grinded rough-stalked matter, is a complex process involving mass and heat transfer. During the filtration drying process, the thermal agent moves in the direction from the surface of the material to the perforated partition through the curvilinear channels formed by the spaces between the particles of the polydisperse material. Numerous studies have shown zonal mechanism during the filtration drying, that is characterized by periods of full and partial saturation of the thermal agent with moisture [1-3]. The zone of heat and mass transfer moves in the same direction that the heat agent, that's why both dry and wet materials are presenting at the same time in the layer.

II. The aim of the work

The determination of the heat transfer coefficients from the heat agent to the particles of the grinded sunflower stems and the obtaining of the equation that allows to calculate theoretically the heat transfer coefficients.

III. Experimental study and its analysis

To intensify the filtration drying process of the grinded sunflower stems, the experiments for the heat transfer coefficients determination were carried out. Heat agent with the constant velocity and temperature was filtered through the sample layer in each experiment. Heat agent with the velocities of 0,68; 1,02; 1,3; 1,7 and 2,05 m/s was filtered through the sample layer. The temperature was controlled and measured by RT-0102-08 thermoregulator. The recorded values of the thermal agent temperatures at the output of the material layer are represented in Fig. 1.
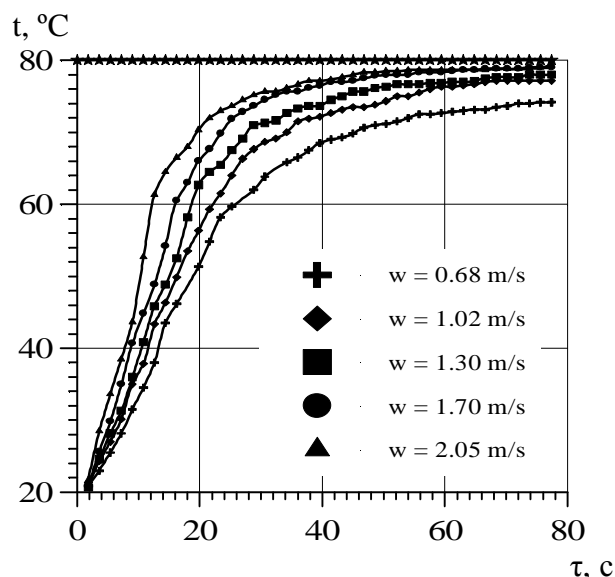
Fig. 1. The recorded values of the thermal agent temperatures at the output of the material layer at different velocities.

As we can see, increasing of the thermal agent velocity leads to the intensification of the heat transfer process, because of greater amount of heat which is introduced into the material layer by the thermal agent over a certain period of time.

The calculation of heat transfer coefficients was carried out according to the dependence:

$$a = \frac{\Delta Q}{F \cdot (t - T_n) \cdot \Delta T} \qquad (1)$$

The values of the heat transfer coefficients at different thermal agent velocities are represented in Table 1.

THE VALUES OF THE HEAT TRANSFER COEFFICIENTS AT DIFFERENT THERMAL AGENT VELOCITIES.

$w, \dfrac{m}{s}$	1	1,5	2	2,5	3
$a, \dfrac{W}{(m^2 \cdot K)}$	300	445	540	620	750

The generalization of experimental results was carried out according to the dependence:

$$Nu = A \cdot Re^n \cdot Pr^m \qquad (2)$$

Where $Nu = \dfrac{(a \cdot d_e)}{1}$, $Pr = \dfrac{v}{a}$.
Where $Nu = \dfrac{(a \cdot d_e)}{1}$, $Pr = \dfrac{v}{a}$.

Taking into account that the physical parameters of the thermal agent changed in the narrow range $Nu \sim Pr^{0,33}$, that's why index m = 0,33. Presenting the experimental results as the dependence $\dfrac{Nu}{Pr^{0,33}} = f(Re)$ we determined the coefficient A = 0,14 and the index n = 0,9.

Conclusions

The heat transfer coefficients were determined for the grinded sunflower stalks during filtration drying at different thermal agent velocities. As the result of research studies, the equation $Nu = 0,14 \cdot Re_e^{0,9} \cdot Pr^{0,33}$ was obtained. The deduced equation allows to calculate the heat transfer coefficients theoretically according to the modes of movement and the physical parametres the heat agent, that is important for forecasting the heat energy costs at the drying equipment design stage.

The heat transfer during the filtration drying of the grinded sunflower stems has been studied. The heat transfer coefficients have been determined for the grinded sunflower stalks during filtration drying at different thermal agent velocities. The deduced equation allows to calculate the heat transfer coefficients theoretically according to the modes of movement and the physical parametres the heat agent, that is important for forecasting the heat energy costs at the drying equipment design stage.

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Research of the process of regeneration of activated carbon during filtration drying

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Abstract – Heat-mass exchange processes during drying of regenerated activated carbon was to study and determine minimum height of heat-mass exchange zone and time of termination of hot heating agent supply based on criterion equations and heat balance calculations.

Keywords – adsorbent, adsorption-desorption processes, heat-mass exchange, heating agent

I. Introduction

In chemical technology considerable part of technological processes proceeds in fixed bed of disperse material. Such processes include adsorption-desorption processes widely used in chemical, food, pharmaceutical and other industries.

Regeneration of adsorbent can be carried out by steaming with saturated water vapor or by treatment with hot water [1]; by electrical [2] and electrochemical methods [3]; by SHF irradiation [4]; by thermal [5], chemical [6] or ultrasonic methods [7]; by means of catalyst addition [8].

In consideration of the fact that much more energy is consumed by adsorbent regeneration process compared to the adsorption process itself, theoretical and experimental studies of drying and cooling processes are very urgent.

In industry adsorbents are multiple use materials. After adsorbent saturation with an adsorbate adsorption process is stopped and the adsorbent used is regenerated with the aim of removing the components adsorbed. Water steam or hot water with temperature 100°C are most often used as desorbing agents, and regeneration of the adsorbents without their consequent drying leads to considerable decrease of their adsorption capacity. According to [10], adsorbent regeneration consists of the following stages:
– heating of the bed by hot air;
– steaming of the bed by saturated water vapor;
– drying of the adsorbent;
– cooling of the adsorbent bed to 20°C.

It is stated in [11] that after finishing the adsorbent drying its adsorption capacity can become equal to the capacity of fresh adsorbent. Such phenomena depend on size of pores and capillaries and on the amount of moisture condensed in them.

II. Experimental

Activated carbon, used in this study as the research object, supplied by Sigma–Aldrich, was Carbotrap Adsorbent matrix, 20-40 meshgrade.

Activated carbon, was loaded into a cylindrical container (fig. 1). The research container made of thermal insulating material (Polytetrafluoroethylene (PTFE), film, thickness 0.005 mm, L 0.1 m, coil width 450 mm was purchased from Sigma–Aldrich), consists of six 30 mm high sections with perforated bottoms. Thermocouples were put into each section. Another two thermocouples was used to measure temperature in the inlet and the outlet of the container. Temperature was registered by eight-way thermoelectric transducer ПТ-108 (by CEM R&D, China) capable of displaying measured values on computer after 1.8 s. Change of mass of the container filled with activated carbon during drying was measured by electronic balance AXIS-3000 (by AXIS, Poland) to within 0.01 g. Gas flow rate was measured by rotameter PM–II (PM-02-0,016ZhUZ by Arzamas instrument-making plant, Russia).
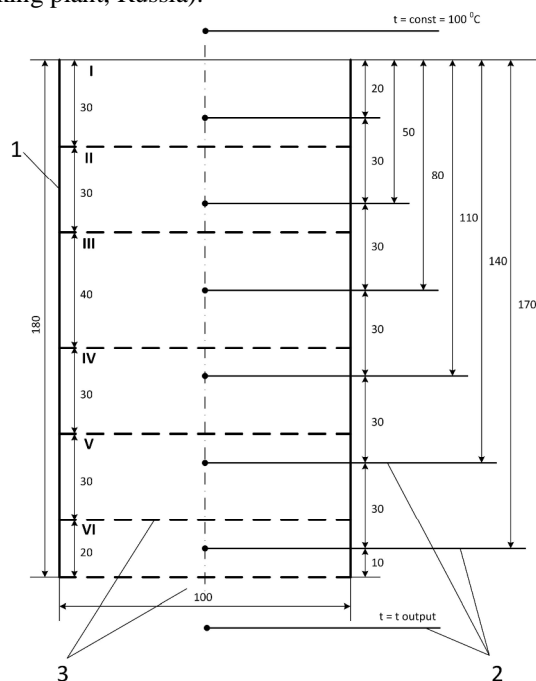
Fig.1. Arrangement of thermocouples mounting into sections of container for disperse adsorbent:
1 – container, 2 – thermocouples, 3 – perforated partitions.

The research was carried out as follows. Wet adsorbent, regenerated by steaming with saturated water vapor, with temperature 100°C was loaded into six sections of the cylindrical container (fig. 1). Total height of the adsorbent bed in the container is 180 mm. The heating agent was filtered through the bed at rate of 2 m/s. Researches were carried out at the heating agent temperature equal to 100°C, which was kept constant in the container inlet. Time change of heating agent temperature across the adsorbent layer height during filtration drying was registered by thermocouples situated in the middle of each section and in the container outlet.

Mass of the container with activated carbon was measured with fixed time intervals (30 s). If mass of the container with adsorbent remained constant for 120-180 s and if the heating agent temperature in the container

outlet was 100 K, the experiment was stopped. Mass of dry carbon after drying was 640 g.

III. Results and Discussion

So, the experimental data show, that heat-mass exchange zone moves in heating agent flow direction. After certain time intervals there appears an adsorbent layer, which does not take part in heat-mass exchange process and accumulates heat energy in itself.

Thaking this into consideration, it is reasonable to use the energy accumulated by dried layer to dry remaining wet material by filtration of cold air through hot dried layer. Thus, due to such organization of the process part of heat energy can be saved and total duration of the adsorbent regeneration can be reduced.

New concept of regeneration of a layer of activated carbon grade is suggested in the paper. The essence of the concept consists in drying of hot layer of adsorbent with temperature 100°C by heating agent with the same temperature. The driving force in this case is difference of partial pressures of saturated water vapor on the adsorbent particles surface and in the heating agent.

The mechanism of suggested method is as follows: because of pressure difference the moisture from the activated carbon particles is evaporated and moved out by the flow of the heating agent. Complex heat-mass exchange process proceeds during this. The activated carbon particles are cooled because of moisture evaporation and, at the same time, heated up by the heating agent. So, the temperature of the first layer in heating agent flow direction is kept constant and equal to 100°C.

Further heat-mass exchange proceeds only because of cooling of wet particles of lower layers of the adsorbent. Due to the heating agent cooling and its saturation with moisture the evaporation intensity steadily decreases in the heating agent flow direction until its complete saturation with moisture. Thus, the mass exchange zone is expanded. After complete saturation of the heating agent with moisture corresponding its temperature at certain height h_{min}, it is heated up when filtrating through wet layer of the adsorbent with temperature 100°C. Thus, heated heating agent "gets its second wind", so its extra saturation of water vapors becomes possible. Moisture content of the heating agent when coming out from the adsorbent layer is determined by its temperature.

Conclusions

Based on experimental researches and grounded drying mechanism, the reasonability of using the energy accumulated by dried layer for drying the remaining wet material by filtration cold air through it, has been demonstrated.

Minimum time of the hot heating agent supply termination τ , as well as minimum height of hot layer h_{min} , energy of which would be enough to dry the lower wet layers, have been determined based on experimental data and criterion equations.

Exact time of the hot heating agent supply termination has been calculated based on heat balance, and under the experimental conditions is equal to 540 s.

Amount of energy consumed for conventional process of adsorbent regeneration and amount of energy consumed for the regeneration process suggested in the paper have been calculated.

It has been proved that suggested regeneration method allows to reduce the amount of consumed specific energy by 1066.95 kJ/kg $_{of\ dry\ adsorbent}$.

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Pr-, Nd-, and Eu-Containing Heteropoly Tungstates With Peacock–Weakley Anion: Synthesis From Aqueous-Acetone Media, FT-IR Spectroscopy, and Surface Micromorphology

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Abstract − The conditions for the synthesis of pure inorganic sodium heteropoly decatungstometalates (III) – $Na_9[Pr(W_5O_{18})_2]\cdot34.25H_2O$, $Na_9[Nd(W_5O_{18})_2]\cdot34H_2O$, and $Na_9[Eu(W_5O_{18})_2]\cdot34H_2O$, from the aqueous solution of sodium tungstate acidified to Z=0.80 with a ratio v(Ln):v(W)=1:10 and with acetone admixture were established. Isolated salts were analyzed using Elemental Analysis, FT-IR spectroscopy, and Scanning Electron Microscopy

Keywords − Praseodymium, Neodymium, Europium, polyoxotungstate, heteropoly anion, Peacock-Weakley structure.

I. Introduction

The precis presents the results of synthesis of heteropoly compound with Peacock-Weakley [1] type anion $Na_9[Ln(W_5O_{18})_2]\cdot nH_2O$, which was carried out by the self-assembly from WO_4^{2-} and Ln^{3+} (Ln=Pr, Nd, Eu) in an acidify aqueous solutions; it also studies its structures by FT-IR spectroscopy, and surface micromorphologies by Scanning Electron Microscopy.

II. Experimental Part

In the study, $Na_2WO_4\cdot2H_2O$, HNO_3, $Pr(NO_3)_3\cdot6H_2O$, $Nd(NO_3)_3\cdot6H_2O$, Eu_2O_3 (all are ACS reagent grade) aqueous solutions were used. The $Eu(NO_3)_3$ solution was prepared by dissolving Eu_2O_3 in HNO_3. Excess amount of HNO_3 was removed by two-fold evaporation until wet residue was formed, which then was dissolved in distilled water.

The synthesis of $Na_9[Ln(W_5O_{18})_2]\cdot nH_2O$ was carried out as following. Sodium tungstate solution was added to distilled water, and then HNO_3 solution was added dropwise with vigorous stirring. After that $Ln(NO_3)_3$ solution was added dropwise very slowly with vigorous stirring. It bears mentioning that each next drop of $Ln(NO_3)_3$ was added only after the disappearance of opalescence from the previous drop. The volume of the final aqueous solution amounted to 100 mL. Adding of reactants corresponds to the stoichiometry of the reaction,

during which heteropoly decatungstolanthanidate(III) anions are formed [2]:

$$Ln^{3+} + 10WO_4^{2-} + 8H^+ \leftrightarrows [Ln(W_5O_{18})_2]^{9-} + 4H_2O,$$
$$Z = \nu(H^+)/\nu(WO_4^{2-}) = 0.80.$$
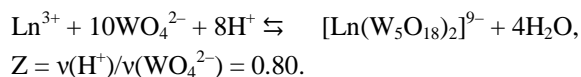
In order to isolate salt with the resulting anion as a crystalline precipitate, 100 mL of acetone was added to the solution. Then, the resulting product was sealed and stored for 3 days at $6\,^0C$ that led to the formation of needle-like (or plate in case of a salt with Europium) crystalline precipitate.

Instrumental methods of analysis.

FT-IR spectroscopy. FT-IR spectroscopy was used to identify anion in the synthesized salt. FT-IR spectra of the air-dry samples of salts were recorded on FTIR Spectrum BXII (Perkin-Elmer), within the wavenumber range of $400–4000\ cm^{-1}$. For this, a weighed amount of salts (0.0030 g) were triturated with crystalline KBr (0.6000 g) and compressed into a thin disk.

Microscopic analysis. Microscopic study was conducted by scanning electron microscopy (SEM) with microscope JSM–6490LV (JEOL). Air-dry samples deposited on a conductive graphite scotch tape were studied in backscattered electron (BEC) mode used for the elemental analysis of phases being the parts of the sample, and in secondary electron (SEI) mode used to study the surface of the resulting salts. Elemental analysis during the microscopic studies were performed with energy-dispersive X-ray spectrometer INCA PentaFETx3 (OXFORD Instruments).

III. Results and their Discussion

Acidity $Z = 0.80$ in the presence of stoichiometric amounts of reactive ions corresponds to the formation of heteropoly decatungstometalate(III) anions:

$$Ln^{3+} + 10WO_4^{2-} + 8H^+ \leftrightarrows [Ln(W_5O_{18})_2]^{9-} + 4H_2O$$
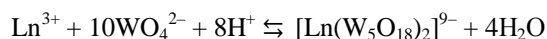
(Ln – Yttrium or lanthanides).

To isolate such particles with Pr(III), Nd(III), and Eu(III) ions-heteroatoms, sodium tungstate solutions (C_W=0.1 mol/L) acidified to Z = 0.80 were used, to which $Ln(NO_3)_3$ solutions were added with vigorous stirring. After mixing of the components in a stoichiometric ratio of X:W=1:10, acetone were added to the systems (up to 50 vol. %) and formation of needle-like (or plate in case of a salt with Europium) crystalline precipitates were observed. Products yield were ~90%; loss amounting to ~10% were lost likely caused by the solubility of salt when washing the precipitate with water-acetone mixture (1:1) during its separation from the mother liquor. According to the results of the chemical analysis and EDX the isolated precipitates were assigned formulas $Na_9[Pr(W_5O_{18})_2]\cdot34.25H_2O$, $Na_9[Nd(W_5O_{18})_2]\cdot34H_2O$, and $Na_9[Eu(W_5O_{18})_2]\cdot34H_2O$.

Nature of stretch and deformation vibrations in the tungsten-oxygen framework within FTIR spectra of air-dry samples of salts (Fig. 1) also indicates to the presence of Peacock-Weakley heteropoly anion of 10th row in them.
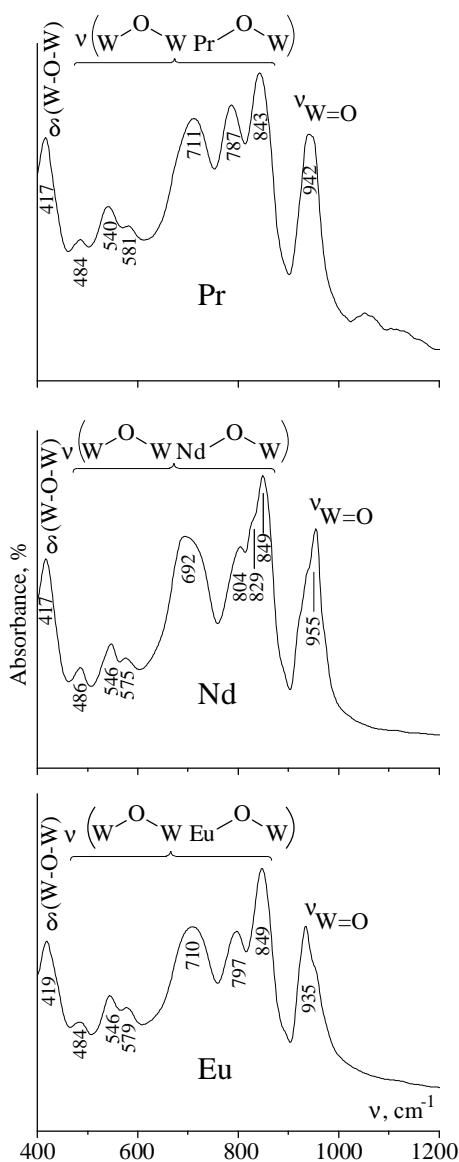
Fig. 1. FT-IR spectra of cristalline salts with $[Ln(W_5O_{18})_2]^{9-}$ anion.

Fig. 2. SEM image of $Na_9[Eu(W_5O_{18})_2] \cdot 34H_2O$ powder surface.

Fig. 3. SEM-image of $Na_9[Eu(W_5O_{18})_2] \cdot 34H_2O$ powder surface in backscattered electron mode ($\times$ 50 times)

Conclusion

The conditions for the synthesis of a new pure inorganic heteropoly tungstates $Na_9[Ln(W_5O_{18})_2] \cdot nH_2O$ (Ln = Pr (n=34.25), Nd (n=34), Eu (n=34)) from the aqueous solution, acidified to $Z=\nu(H^+)/\nu(WO_4^{2-})=0.80$ with acetone adding, were determined. FT-IR spectroscopy was used to show that the anion within the synthesized salt has a Peacock-Weakley structure. Scanning electron microscopy confirmed the single-phaseness of the synthesized salts.

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In this anion, two lacunar tetradentate pentatungstate-anions $[W_5O_{18}]^{6-}$ are coordinated to Ln-heteroatom, thus forming a coordination polyhedron in the shape of a square antiprism.

Microscopic analysis showed that the surface of grains in the isolated salts has fuzzy blurred edges. The size of the grains for the triturated in agate mortar sample of $Na_9[Ln(W_5O_{18})_2] \cdot 34H_2O$ is within the range of 200–400 nm (Fig. 2).

Uniform surface contrast in backscattered electron (BEC) mode points to single-phaseness of the isolated salt (Fig. 3).

On the micrographs of the salt powder in characteristic X-ray emission there are no regions with different surface morphology, and there is an even distribution of Ln (Pr or Nd or Eu), Na, W, O, without segregations and eliquations. These clearly indicate the formation of single-phase samples.

Application Of Oil And Fat Industrial Wastes For Modification Of The Fillers

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Abstract − After the execution of this work were derived polymer composite materials (PCM) based on polystyrene and PVC. In the course of this work were obtained with PCM modified and unmodified fillers: chalk, kaolin, aerosil, titanium dioxide, aluminum oxide.

It kinetics modifications fat-containing waste mineral fillers of "Novovolyns`ky oil and fat factory", thermomechanical properties, tensile strength and toughness obtained of PCM. The synthesized composites can be used in various industries, such as engineering, aviation, production of packaging materials and more.

Keywords − polymer composites, polystyrene, polyvinyl chloride, modified mineral filler.

I. Introduction

Oil and fat industry of Ukraine produces a wide range of edible fats and oils for various purposes. In this case, fat contained wastes are formed that can not be used for food purposes. Because of this, the problem of finding new ways to use such wastes is relevant. At the same time, modern industry requires the appearance of new ones, including polymer, composite materials. The generally accepted approach for creating such materials is the use of modified mineral fillers. An interesting attempt is made to jointly address these two problems, that is, the study of the possibility of using the waste oils of the fat and oil industry to modify the surface of dispersion mineral fillers, which can be used with their subsequent use to create new polymer composite materials.

The aim of the work is finding the possibility of fat and oil production waste using for the modification of dispersed mineral fillers and studying the influence of such fillers on the physical and mechanical properties of polymer composite materials.

II. Experimental part

In the present work, fat-containing wastes of «Novovolynskyi oil and fat industrial complex» have been used for modification of mineral fillers: chalk, kaolin, titanium dioxide, aerosil, aluminum oxide

In a 150 ml glass, filler and fat in a ratio of 10:1 and distilled water in a ratio of 25:1 against filler were placed. The suspension was constantly stirred with a magnetic stirrer to a temperature of 50°C and held for a certain time (0.5; 1; 1.5; 2 hours). The resulting mixture was filtered using filter paper and dried at 80°C for 4-5 hours. The degree of modification of the filler was determined by gravimetric method, after burning the modified samples at a temperature of 500˚C to constant weight. Previously,

unconfined samples determined the moisture content that was not evaporated at a temperature of 80°C.

Styrene, which was purified by distillation under vacuum, was used to make polymer by polymer filling. A mixture of styrene with a filler (in the ratio of styrene: filler = 1:2.5) was loaded into a glass vial, which, after cooling, was sealed. The composite was obtained by thermal polymerization of styrene at a temperature of 120°C for 3 days, after which the ampule was broken down and the composite was extracted. In order to determine the influence of the modification of fillers on the properties of composites, rods with modified and unmodified fillers were produced in parallel.

When performing thermomechanical tests, parts of the rods were used in the form of tablets 3-4 mm in length and 6 mm in diameter. The thermomechanical investigations were performed on a FVW R7/90 apparatus.

III. Main material

The modification process can be managed by changing the modification time. In this case, fillers with varying degrees of modification are obtained. At the same time, by increasing the speed of modification fillers can be placed in a row: aerosil – kaolin – titanium dioxide – aluminum oxide – chalk. Such a difference in the rates of modification probably can be explained by the influence of the surface of the filler.

Composites with the same degree of filling were filled with modified and unmodified fillers. Degree of modification of the filler is 5%. The thermomechanical curves of the resulting composites are shown in Fig. 1,2.
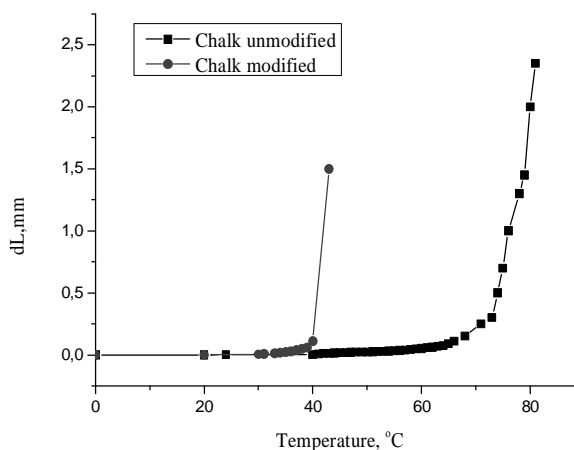
Fig. 1. Thermomechanical curves of polymer composite
based on polystyrene filled with unmodified
and modified chalk.

In order to compare the properties of samples of materials based on polyvinyl chloride with modified and non-modified fillers, thermomechanical studies were conducted.

Fig. 3. Thermomechanical curves of modified and unmodified by titanium dioxide PVC-based composites.

Figures 3, 4 shows comparative curves of modified and unmodified samples of aluminum oxide and titanium dioxide.
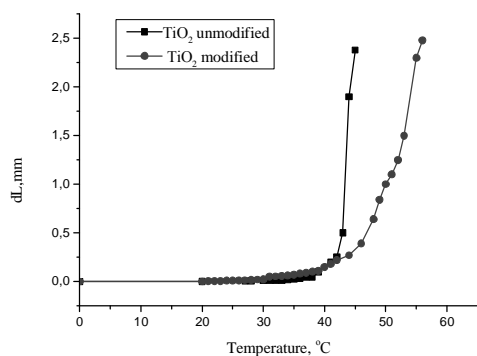
Fig. 2. Thermomechanical curves of polymer composite based on styrene filled with unmodified and modified titanium dioxide.
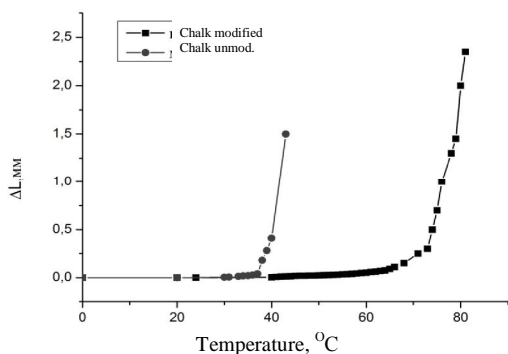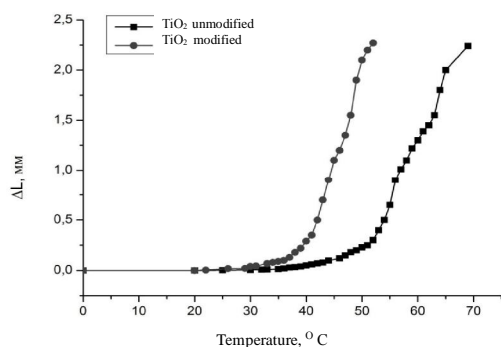
Fig. 4. Thermomechanical curves of modified and unmodified by chalk PVC-based composites.

PVC-based composites with modified and non-modified fillers were investigated on the Tira Test 2200 apparatus. Their breaking strength and relative elongation were determined. The results are shown in Table 1.

As can be seen from the data given in Table 1, the use of modified fillers leads to a significant improvement in the strength of composites. The breaking strength in the application of various fillers increases by 34 – 214%.

Determination of impact strength was carried out for polystyrene-based composites with the following mineral fillers: chalk, aerosil, aluminum oxide. The results of the studies are presented in Table 2.

TABLE 1

Tensile strength of polyvinyl chloride composite

Filler	Breaking strength, kH/m^2	Strength increase, %	Relative elongation, %
Chalk unmodified	267	-	25
Chalk modified	838	214	26
kaolin unmodified	447	-	10
kaolin modified	943	122	37
Titanium dioxide unmodified	706	-	29
Titanium dioxide modified	943	34	50
Aluminum oxide unmodified	396	-	16
Aluminum oxide modified	783	97	34
Aerosil unmodified	1141	-	23
Aerosil modified	2123	86	32

TABLE 2.

Impact strength of polystyrene composite

Filler	Impact strength, kJ/m^2	Increase, %
Chalk unmodified	0.0073	-
Chalk modified	0.0150	109
aerosil unmodified	0.0069	-
aerosil modified	0.0074	6.2
Al_2O_3 unmodified	0.0121	-
Al_2O_3 modified	0.0154	26

As can be seen from Table 2, the highest impact strength indicators was shown by samples of composites filled with modified chalk and modified aluminum oxide. Toughening is greatest in chalk, and the smallest in aerosil.

Conclusion

Thus, as a result of the performed research, the possibility of modification of dispersed mineral fillers was first explored: chalk, aerosil, kaolin, titanium dioxide and aluminum oxide with fat contained waste from the fatand oil industry, for the use of modified fillers for polymer composite materials. In the study of kinetics of modification it has been shown that complete sorption of fat on the filler at a temperature of 50°C occurs in 2-3 hours. The degree of updating of the filler can be adjusted by changing the time of the process. Thermochemical studies show the difference in the properties of polymer composite materials based on polystyrene and polyvinyl chloride filled with modified fillers compared to unmodified ones. For a number of polymer compositions, the thermomechanical curves are shifted toward higher temperatures, i. e., products made from such composites can be used at higher temperatures without losing their mechanical properties. It has been shown that the use of such modified fillers improves the physical and mechanical properties of composites, by increasing their impact strength, relative elongation and breaking strength
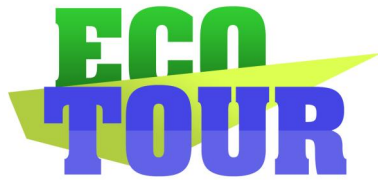
**4th INTERNATIONAL ACADEMIC CONFERENCE
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Measuring the Awareness Level of Local Tourists in Their Tourism and Environment Relations: A Research in Tarsus

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Abstract – the purpose of the research is to determine the differences in the level of awareness on the tourism and environmental relations of local tourists traveling to Tarsus from different regions of Turkey and to determine whether these differences differ according to the demographic characteristics of the tourists participating in the research (gender, age, education, living city etc.)The sample of the research is composed of 110 local tourists visiting different touristic destinations of Tarsus town.The survey method was used to reach the data.The questionnaire, consisting of 21 questions, was filled by the participants in face-to-face negotiations.

Keywords: Tourism, Environment, Local Tourist, Tarsus

I. Introduction

Developed and developing countries are faced with the noise, stress, traffic and environmental pollution caused by industrialization and rapid urbanization.Having these problems increasing day by day may cause people to requests more entertainment, traveling, resting etc. and may increase the demand towards tourism activity.In recent years tourism has become one of the largest sectors of the world.Nine tenth of employers throughout the world is employed in tourism sector and the incomes obtained from tourism constitute approximately 6% of the global gross national product (Demirel,2010).

The development of tourism contributes to the development of the social and cultural development processes while enabling the national economy to develop nationally and internationally (Kuter ve Ünal, 2009:146).The high number of tourists participating in tourism activities causes natural-cultural and historical environments in touristic regions to get damaged. The understanding of the coupling relationship between tourism and the environment is important due to the complex interaction in environmental effects induced by tourism (Tang, 2015:11).

These losses can be a social, economic and environmental damages.The unconscious use of tourism resources leads to destruction of natural resources, increase of tourism activities and environmental pollution and damage of marine pollution in coastal areas, destruction of forests and destruction of cultural and historical structures resulting from travels with groups (Ayaş, 2007: 61). The tourism sector, which creates positive effects on economic, cultural and social areas, causes extreme natural resources usage, wrong place selection, destruction of natural areas which are touristic products, destruction of coastal and historical values (Mansuroğlu, 2006: 36).

Increasing pressure of tourism on the society, increasing mass tourism in coastal regions, alternative tourism types and places become more attractive by tourists, natural and rural areas are preferred more.Alternative forms of tourism provide protection of the natural and cultural environment, protection of local people and income from tourism.Alternative forms of tourism are a form of tourism that is in harmony with the environment (Kervankiran, 2014: 134).

II. Literature review

Tourism and Environment Awareness. The tourism sector has become one of the largest income sources of developed and developing countries in the 21st century. The positive and negative effects that it creates are now the subject of researches. One of the most important effects of tourism is undoubtedly its negative impact on the environment. The relationship of tourism with the environment is important for the continuity of the sector. With mass tourism, people move in groups and cause natural cultural and historical sites to be destroyed. The protection and development of the environment is important in terms of maintaining the existence of the human generation (Gündüz, 1999: 10).

After the 1960s, problems that are damaging environment began coming on the agenda; and the measures and policies towards environment problems started being determined (Çınar, 2001; Sencar, 2007: 53).Mass tourism has made it possible for tourists in coastal areas to spend money on leisure activities such as holiday villages, accommodation, eating and drinking, entertainment, etc., and reveals their usages of the enterprises in the region exceeding their capacities.

This touristic process, which is mainly focused on consumption revealed itself as:

• Visual pollution due to concretization in terms of construction,

• Environmental pollution in terms of distribution, density, resource use in ecological environment,

• Pollution-related species losses and degradation of ecological balance,

• Socio-cultural differences and cultural disruption in anticipation of incompatibility.

Today, the developed world countries have developed various types of tourism to provide more respect for the

natural environment, protection and sustainability in order to overcome the problems created by mass tourism, which is focused on consumption. These types of tourism are ecotourism, sustainable tourism and environmental tourism (Kısa Ovalı, 2007).

Sustainable tourism is defined as a development type that provides the protection of the environment with which the human being is in interaction, without getting damaged and changed and that maintains the cultural integrity, ecologic processes, biological diversity and systems that maintain the life as well as where all natural resources are managed in a way to meet the economic, social and aesthetic needs of humans and tourists as well as the needs of the next generations visiting the place (Okşaşoğlu, 2006: 97).The concept of sustainable tourism suggests that the relationship between environment and tourism is interrelated (Gündüz, 1999: 26-27).

Tourism and Green Marketing Concept. The concept of green marketing was discussed for the first time in the 'ecological marketing' seminar that the American marketing union was organized in 1975, and so took part in the literature (Giritlioğlu, 2015: 179).Green or environmental marketing is, as a concept, environmental and nature-protecting marketing activities aimed at meeting consumer needs and desires (Seyhan and Yılmaz, 2010: 54).According to another definition, green marketing is a type of marketing designed to meet people's desires and needs while at the same time aiming at minimizing harm to the natural environment while meeting these demands and needs (Altunöz, 2014: 158).Green marketing is a type of marketing that ensures sustainability of scarce resources and embraces sustainability, while at the same time enabling the community to be conscious and sensitive to the environment (Giritlioğlu, 2015: 179-180).

The tourism sector can survive with the protection of natural resources and the environment. Due to the tendency of tourists participating in tourism activities towards natural and cultural values, the fact that their education level is high and they are in an environmentally friendly approach during the purchase; businesses are tending to green marketing (Güneş, 2011: 45-46).

General Information about Tarsus and its Tourism Potential. Livelihood of the people of the region is predominantly agriculture. Tarsus is a developed industrial town after Mersin. Tarsus is the largest district of Mersin, located in the Mediterranean region of Turkey, which brings Europe and Asia together. According to the census of the year 2016, the population of the town is 329,494.(http://www.tarsus.bel.tr).

Tarsus has a very rich history and is an important town for some religious beliefs. It is believed that the cave where Ashab-i-kehf (Seven Sleepers), which is on the Surat al-Kahf in the Qur'an, is in Tarsus. One of the authors of the Bible (New Testament) Paulus was also born in Tarsus. For this reason, it is also considered as pilgrimage place by Christians.Besides these, the world's first sewered Historical Roman Road and the Roman bath are in Tarsus. The Cleopatra Gate is among the oldest remains of the city. Taşkuyu cave 10 km northwest, the

waterfall and particularly the Tarsus Dam are places to visit and have excellent history and natural beauty in terms of tourism (https://tr.wikipedia.org/wiki/Tarsus).

Studies Made Related to the Subject. Survey technique was applied by Okşaşoğlu (2006) in order to measure the consciousness levels of the tourism environment and the differences in the level of consciousness among the employees who operate four hotels in the Antalya Kundu region and customers with various nationalities. According to the results of the study, it is stated that there is no difference in consciousness levels between employees and customers in relation to tourism and environment. Kervankiran (2014) assessed the tourism development and the effects of the local people in Beypazarı in April coming out with the development, with the participation of 250 participants in the study, and according to the result of the study, it has positive social, communal and environmental effects.

Kelkit (2003) investigated the effect of the industry on the environment in Çanakkale province, investigated the problems encountered during the application and examined the site selection of natural socio-cultural and economic structure of Çanakkale by the industrial development. As a result of the study, pollution of the environment, air pollution and pollution of the coastal areas were detected. Various solutions have been proposed to overcome these negative problems. In a research made by Emekli and Baykal in 2010 in Bornova region on the level of awareness of the local people with survey method, it was found that, although the people of the region have no knowledge about rural tourism, they are aware that they are tourism livelihoods and that they are aware of the protection of the environment.

III. Method

The Purpose of Research and Hypotheses. The purpose of the survey is to determine the level of consciousness of tourism and environment related local tourists traveling to the province of Tarsus in Mersin province and determine whether they differ according to their demographic characteristics. Below are hypotheses based on the purpose of our research. These are;

H1:There is a relationship between the accommodation facilities, that local tourists traveling to Tarsus prefer, and the region where they live.

H2:There is a relationship between the gender of indigenous tourists traveling to Tarsus and their thoughts of supporting environmental protection factors.

H3:There is a meaningful relationship between the ages of local tourists traveling to Tarsus and their reasons of preferring Tarsus.

H4:There is no difference in regards to the most important environmental problems that hotel customers from different country groups lead to tourism.

Selection of Universe and Sampling. The universe of the research is formed by local tourists who travel to the touristic places of the Tarsus district of Mersin province. Since there is no possibility of reaching the whole of the universe, the way of sampling was preferred. The sample of the research is composed of 110 local tourists who

travel to different touristic places of Tarsus. In determining the sample, 'probable random sampling' technique was used among 'probability sampling methods'.

Data Collection Instrument. Survey technique was used in the research. A questionnaire consisting of 21 questions, open ended and closed ended, was distributed to measure the level of consciousness of local tourists in relation to tourism and environment. In order to measure the different opinions of the individuals participating in the survey, blank options were provided under the name of "other". In order to avoid evasive answers to questions, the questions are usually sorted in a specific order, avoiding from those difficult to understand. In 2006, a scale developed by Kudret Aslı Okşaşoğlu "to measure the impact of tourism and environment relations on tourists and workers" was used.

Analysis of the Data. The data obtained from the study were analyzed by SPSS (Statistical Package for Social Sciences) statistical program.

The answers for the questionnaire comprised of 110 respondents. Their age was between 18 and 67, the average age of respondents being 34. 53,6% of the respondents were female and 46,4 % male. The respondents came from different cities of Turkey and in order to keep the responses anonymous, the cities were grouped into regions. Respondents' different accommodation preferences are classified according to accommodation facilities in the region. The majority of respondents came from the Mediterranean region. The number of respondents from the Aegean region is only one. The most preferred accommodation by respondents is the city hotels.

TABLE 1

DISTRIBUTION OF AGE GROUPS, RESIDANCE AND ACCOMODATION

	Male		Female	
Age Groups	**f**	**%**	**f**	**%**
18-24	17	15,5	16	14,4
25-31	10	9,1	8	7,2
32-38	4	3,6	7	6,3
39-45	7	6,3	8	7,2
45+	13	11,9	20	17,5
TOTAL	**51**	**46,4**	**59**	**53,6**
Residence	**f**	**%**	**f**	**%**
Mediterranean Region	30	27,3	40	36,1
Central Anatolia Region	7	6,3	6	5,6
Marmara Region	6	5,6	6	5,6
Black Sea Region	2	1,8	4	3,6
Eastern Anatolia Region	3	2,7	1	0,9
Southeastern Anatolia Region	3	2,7	1	0,9
Aegean Region	0	0	1	0,9
TOTAL	**51**	**46,4**	**59**	**53,6**
Accommodation	**f**	**%**	**f**	**%**
City Hotel	14	12,7	18	16,3
Holiday Village	5	4,6	12	10,8
Hostel	9	8,2	10	9,2
Mountain/Forest Hotel	9	8,2	5	4,6
Camp	2	1,8	3	2,7
Others	12	10,9	11	10
TOTAL	**51**	**46,4**	**59**	**53,6**

H1:There is a relationship between the accommodation facilities, that local tourists traveling to Tarsus prefer, and the region where they live.
ki^2=12,995, sd=8 p=0,773
There is no statistical difference because p> 0.05.

H2:There is a relationship between the gender of indigenous tourists traveling to Tarsus and their thoughts of supporting environmental protection factors.
ki^2=4,778, sd=6 p=0,427
There is no statistical difference because p> 0.05.

H3:There is a meaningful relationship between the ages of local tourists traveling to Tarsus and their reasons of preferring Tarsus.
ki^2=20,147, sd=7 p=0,219
There is no statistical difference because p> 0.05.

"Impact of Wastes" had the highest frequency score of this indicator group and "Plant-Animal Genesis Exhaustion" received the lowest. According to respondents, second important environmental problem is "Destruction of the Natural Environment", third important environmental problem is "Contamination of Natural Environment", fourth important environmental problem is "Irregular Urbanization", fifth important environmental problem is "Wildlife Deterioration" and sixth important environmental problem is "Traffic jam".

TABLE 2

INDICATORS OF ENVIRONMENTAL PROBLEMS CAUSED BY TOURISM

Environmental Problems/ Regions	Mediterranean	Central Anatolia	Marmara	Black Sea	Eastern Anatolia	Southeastern Anatolia	Aegean	TOTAL
	f	f	f	f	f	f	f	f
Impact of Wastes	52	12	10	4	2	1	0	81
Destruction of the Natural Environment	48	10	8	6	2	1	1	76
Contamination of Natural Environment	43	8	7	5	1	1	0	65
Irregular Urbanization	38	7	5	2	1	3	1	47
Wildlife Deterioration	22	5	4	4	1	2	0	38
Traffic jam	11	3	4	3	2	1	0	24
Plant-Animal Genesis Exhaustion	4	1	2	2	1	1	1	12

H4:There is no difference in regards to the most important environmental problems that hotel customers from different country groups lead to tourism.
ki^2=19,752, sd=9 p=0,622
There is no statistical difference because p> 0.05.

Conclusion

Negative impacts from tourism occur when the level of visitor use is greater than the environment's ability to cope with this use within the acceptable limits of change. Uncontrolled conventional tourism poses potential threats to many natural areas around the world. It can put enormous pressure on an area and lead to impacts such as soil erosion, increased pollution, discharges into the sea, natural habitat loss, increased pressure on endangered species and heightened vulnerability to forest fires. It

often puts a strain on water resources, and it can force local populations to compete for the use of critical resources. Tourism also contributes positively to the surrounding area both physically and culturally. Physically, natural and historical resources are protected. Culturally it helps to improve the quality of activities such as art, folklore, festival, theater and to live for many years.

With their behaviors and decisions, consumers have a substantial impact on the environment. Choices regarding food or modes of transportation, for instance, influence greenhouse gas emissions and contribute to climate change. As voters, people can further support or dismiss environmental policies. Since it is very difficult for consumers to recognize the environmental consequences of their actions, public knowledge about the issue may be limited. Even if consumers are aware of their environmental impacts, they may be unwilling to change their behaviors because of the costs or inconveniences involved.

The present thesis aimed to examine people's knowledge about the environmental consequences of consumer behavior, as well as their willingness to reduce these environmental impacts. Both aspects were investigated for the domain of climate change and food consumption.

The environmental and tourism awareness levels of the domestic tourists staying in Tarsus region are not related to the variables investigated. The level of consciousness of the research group towards tourism and environment relation is concentrated in certain topics. These issues are mostly not related to the negative effects of the tourist on the environment. It is about issues that tourism service providers and local governments are influential. Tourists are more aware of the physical effects of damage to the environment.

The environmental awareness of tourists living in nearby areas is higher than others. This can be related to the sense of ownership of the tourists living in nearby provinces. Infrastructure problems of Tarsus, which is a rich tourism region, also cause negative opinions to be formed. In future research, foreign tourists can be included in the research. In this respect, the attitudes of domestic and foreign tourists towards the environment can be evaluated comparatively. In addition, research on the sensitivity of employees and decision makers to the environment in the tourism sector will ensure that future research is more comprehensive. The impact of environment-based lessons given during the education life of tourists on tourist behavior can also be considered in future research.

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About problem of absorption of greenhouse gas by chlorophyilsynthesizing microalgae in the presence of sulfur dioxide

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Abstract – The presence of non-competitive reverse inhibition by sulfur dioxide in the process of photosynthesis based on the Lineweaver-Burk theory was theoretically justified and experimentally proved. The mathematical description of the growth of the cells of the microalgae is given and as a result of processing experimental data the growth rates of the algae at certain values of inhibitor concentration was defined. Based on the obtained values the analytical dependence of growth rate of biomass from the substance of inhibitor was redused. The maximum value of concentration of sulphur dioxide which may occur photosynthesis and biomass growth of microalgae was set.

Keywords: photosynthesis, sulfur dioxide (SO_2) , microalgae, diffusion, mathematical model, kinetics, enzymatic catalysis, inhibitor.

I. Introduction

It is well known that the vast majority of created by the modern world technology is unlocked by the processes that form certain waste. The harm and danger of a particular technology to the environment is determined primarily by the quantity and nature of substances which are a by-products, namely, waste technological processes. The question "what to do with the waste?" is very acute. Modern technologies of their utilization require new tough recycling processes, but most of them also provide waste which is not always easy to dispose of. But all the processes occurring in nature are cyclical and well-balanced.

The transformation of matter in ecosystems is realized by the cycle – the waste of one process are used in other biological processes.

A typical example of such process can be the transformation of carbon dioxide into biomass using photosynthesis in an industrial environment. However, the industrial gas emissions include not only carbon dioxide but sulfur dioxide. That's why it is important to reserch the influence of this component on the process of photosynthesis.Algae like other green plants need carbon dioxide and a small amount of minerals for increasing their biomass. They grow 7-10 times faster than terrestrial plants and thus «kill» more carbon dioxide and have the ability to adapt to unfavorable conditions. These properties of microalgae are the objective condition for the introduction of such processes in order to eliminate CO_2 from industrial gas emissions

In such circumstances, proven ability to manage technology treatment of industrial gas emissions using chlorophyilsynthesizing microalgae as basic biological object transform carbon dioxide into energy.

II. Description of the problem

The transformation of substance in ecosystems is realized by the cycle – the waste of one process are used in other biological processes. A striking example of such balance can be the biospheric cycles of carbon, oxygen, nitrogen and other biogenic elements. An amazing balance of natural ecosystems, a high level of correlation nutrixxion biotic processes give people conclusive evidence of their effectiveness, suggest ways of borrowing from the animate nature of the elements and principles that become the basis for the design and development of future technologies. Technology, which is built on ecological principles and is based on minimizing the negative impact on the environment, should be considered environmentally sound technology or environmental technology. In cases where the above principles hold, and the technological process based on the use of certain living organisms, it is advisable to talk about the origin and existence of trends in the environment – biological treatment and technology to be applied – environmental biotechnology

Biological treatment is based on the ability of microorganisms to include a variety of chemical compounds, pollutants in the scheme of metabolism. The decomposition of the pollutants occurs under the action of enzymes produced by microorganisms in the environment of pollutants, which are subject to extraction. To the biological treatment of gas emissions from carbon dioxide can be attributed to photosynthesis [1-2].

Photosynthesis – the process of converting sunlight into energy of chemical bonds and synthesis of organic compounds (carbohydrates) from inorganic (CO_2 ↑ and H_2O). This is the only process in the biosphere, which leads to an increase of free energy from domestic sources. The energy is stored in the products of photosynthesis – the main source of energy for mankind. Therefore, targeted products of photosynthesis can be used for the purpose of energy recovery, including anaerobic biodegradable to produce methane. The ability of photosynthesis are not only with plants, but also microalgae.

This microscopic alga, which has a large supply of chlorophyll and rare complex nutrients, takes part in the process of photosynthesis, absorbing carbon dioxide and saturating the air with oxygen. Microscopic algae chlorella is considered survivor of our planet. [3]

Moreover, the advantage of chlorophyll synthesising microalgae is that they grow quickly and absorb much more carbon dioxide than the plants, and able to adapt to the land of adverse conditions.[4] So, finding ways of photosynthesis in an industrial environment is an urgent task.

The main condition for photosynthesis is the presence of molecules of carbon dioxide, the product of burning solid, liquid or gaseous fuels. However, in such products

of combustion always contain other oxides, in particular sulphur dioxide. The presence of sulfur dioxide in the products of combustion, industrial gas emissions, due to the presence of sulfur compounds in a natural deposits of fuel. The structure of the molecules of sulfur dioxide and carbon dioxide are similar, but because there is an assumption that a stage of sulfur dioxide in the internal volume of the cell of the microalgae is the same as carbon dioxide. However, sulfur dioxide serve as inhibitor. Therefore, there is a need to study the process of purification of industrial gas emissions with participation of chlorophyilsynthesizing microalgae in the presence of carbon dioxide, which is equivalent to the study of the effect of sulphur dioxide on photosynthesis [5].

Substances which are able to inhibit the enzymatic reaction are called inhibitors.

Inhibitors which reduce the activity of enzymes on condition of interaction with the same functional groups of active centers as a substrates are called competitive. Inhibitors which reduce the enzyme activity under condition of interaction with other functional groups, are called noncompetitive. Competitive inhibition can be reduced or even eliminated by increasing the concentration of the substrate. In the noncompetitive inhibition the substrate concentration is not affected [6].
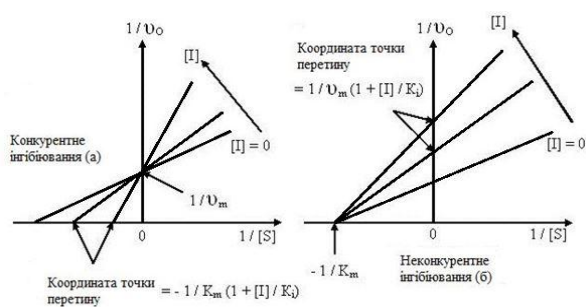
Fig. 1. Lineweaver – Burk plot for competitive (a) and noncompetitive (b) inhibition according to the literature [6].
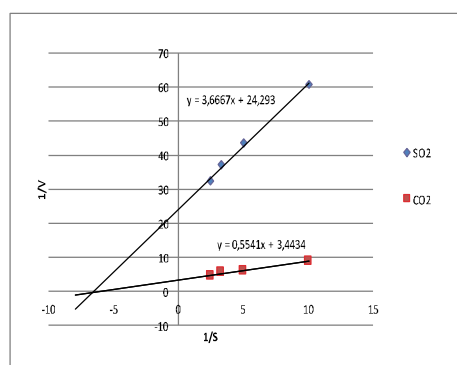
Fig. 2. Lineweaver – Burk plot for determination of type of sulfur dioxide inhibition.

According to our experimental data the sulfur dioxide significantly effects the kinetics of the growth of microalgae, which confirms the assumption that sulfur dioxide serve as an inhibitor. According to the obtained experimental data was constructed the Lineweaver – Burk plot in the coordinates 1/S 1/V (Fig. 2)

Comparing literature data, namely, Lineweaver – Burk plot (Fig. 1.) with the experimental schedule (Fig. 2.) it is important to note the similarity obtained direct lines(Fig.1.(b)) , so it is reasonable to assume that there is a non-competitive inhibition.

Conclusion

The influence of sulphur dioxide on the process of carbon dioxide absorption by chlorophyilsynthesizing microalgae was studied. The results of experimental research to study the dynamics of absorption of carbon dioxide gas from microalgae provided the presence of sulfur dioxide in it.The existence of non-competitive inhibition by sulphur dioxide the process of photosynthesis by chlorophyilsynthesizing microalgae was theoretically justified on the basis of the Lineweaver – Burk theory and experimentally proved. Therefore it is possible to control the absorption of carbon dioxide in the presence of sulfur dioxide.

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Public Policy and Biofuels: Energy, Environment and Food Trilemma

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Current policies in energy sector address issues including renewable energy supplies and encourage more efficient energy use. As expected biofuels can reduce dependence on imported fossil fuels, strengthen political and economic security, revitalize the economy by increasing demand for agricultural products. At the same time biofuels production can threaten food safety by making influence on price and demand for agricultural commodities. The article examines the influence of public policy in the sphere of biofuel on energy, environment and food security. As a result of this analysis, energy, environment and food safety impact of public policy for biofuels production were identified.

Key words: public policy, government regulations, biofuels, impact, energy, environment, food safety.

I. Introduction

The use of biofuels has been given much attention by governments around the world, especially in countries with limited reserves of energy resources. Governments that have public policy with the aim to increase the use of biofuels assert that these fuels have various advantages over hydrocarbon fuel, especially in minimizing greenhouse gas emissions, reducing dependence on oil-exporting countries, providing additional financial income and improving the quality of farmer's life. Currently the majority of assessments of the biofuel impact have only the preliminary estimates. There is no in-depth analysis of the impact of biofuels and biofuel production policy on economic, environmental and food safety of the state.

The aim of the research is to analyze the impact of governmental policy in biofuels on energy, environmental and food situation in major biofuel production countries. In particular, there have been studied political stimulation measures of the production and consumption of biofuels, taking into consideration the consequences of the increasing demand for bioethanol and biodiesel.

II. Material and Methods

This study was conducted to analyze the impact of public policy in support of biofuels on energy, environment and food security. Source of the data used in this analysis are regulatory documents, statistical and analytical data of international governmental institutions, organizations, associations that are used for theoretical analysis, graphic processing.

III. Results and Discussion

Countries that do not have sufficient reserves of fuel and energy resources, as well as those that are concerned about the harmful effects of the production and use of fossil fuels, actively stimulate the development of alternative energy in general and biofuel in particular.

A world leader in the field of bioenergy is the United States. Since 2005, the country is the largest producer of bioethanol and biodiesel. The share of bioethanol in the market of gasoline in the US increased in volume from 1% in 2000 to 10% in 2016.

However, the production of biofuels in the US would not have had such a significant success without effective public policies in this direction. In order to stimulate the production of cars working on alternative fuels, in 1988 the Law "On Alternative Motor Fuels" was adopted. The law encouraged biofuels producers to provide preferential loans for the production of cars that can run on a certain type of alternative fuel. Other government measures to stimulate the use of biofuels were caused by numerous interests including the desire to reduce dependence on imported fossil fuels, to reduce greenhouse gas (GHG) emissions, and to increase demand for domestic farm commodities serving as a raw material for biofuels. The current US biofuel policies consist of three main instruments – output-connected measures, support for input factors and consumption subsidies. Tariffs and mandates benefit biofuel producers through direct or indirect price support. While the mandates are indirect subsidies and do not provide direct price support, the tax credits serve as the largest direct subsidies [3].

However, the success of the United States in the field of bioenergy is ambiguous. Since corn is the main raw material for the production of bioethanol, the volumes of this crop, processed for bioethanol are constantly growing. The price increase can be considered as a positive and negative phenomenon. The positive effect of rising corn prices in the US is that farmers receive higher incomes, and the government is saving money by lowering the costs of subsidizing farmers for federal programs. At the same time, an increase in the price of corn has a negative socio-economic effect, because it leads to an increase in the cost of food.

Brazil is the second largest world producer of ethanol and the largest exporter of the ethanol fuel in the world. The ethanol-use mandate in Brazil has been mandatory since 1977 when the legislation required a 4,5 percent blend of ethanol to gasoline. According to the legislation, the ethanol blend can vary from 18 to 27,5 percent and it is currently set at 27 percent (E27).

At the initial stage, the Brazilian government provided three important tools for the production of bioethanol: guaranteed purchases by the state oil company, low interest loans for agro-industrial ethanol producers and fixed prices for gasoline and ethanol, for which ethanol is sold for 59% of the price of gasoline set by the government at gas stations. Subsidizing the production of ethanol in this way and installing an artificially low price have made ethanol a competitive alternative to gasoline.

The commercial production of Brazilian flex-fuel engine vehicles, which run on any fuel combination – from 100 percent ethanol to 100 percent gasoline, started in 2003 and as the result became very attractive for consumers who

own these cars, as ethanol and gasoline became perfect substitute goods. Currently more than 90 percent of all vehicles sold in Brazil use flex-fuel technology and, as a result, there has been a rapid increase in ethanol demand.

Production of ethanol in Brazil is based on the use of sugar cane as a feedstock. The economic dimension of Brazilian sugarcane sustainability is not a controversial issue. It is internationally recognised that Brazilian ethanol is produced at low costs and its feasibility does not depend on subsidies [2].

Regardless its economic feasibility, Brazilian ethanol production has been criticized for its potential environmental and social impact which includes direct and indirect land use changes; potential impacts on water availability and quality; impacts of fertilizer and agrochemical use on biomass production; soil impacts.

Some analysts argue that biofuels may lead to increased deforestation pressure, since farmers may convert forestland into biofuel feedstock production areas. However, the graphic analysis of the production of bioethanol in Brazil and the area of deforestation indicate that there is no connection between them.

The available evidence does not provide support to the argument that sugarcane expansion may lead to food supply disruption. Recent analysis of trends in land use changes indicates that the expansion of sugarcane areas has not occurred to the detriment of subsistence crops.

The third largest producer of biofuels is the European Union (EU). The EU biofuels policy was designed primarily in order to meet obligations made under the commitment to the Kyoto targets of GHG emissions and to meet a pressure from the EU population to address environmental issues. The policy of stimulating the production of biofuels in the EU consists of a combination of several regulatory instruments that include exemption from the payment of a tax on fuel made from renewable feedstock; mandatory addition of a fixed percentage of biofuels to the composition of petroleum fuel; loans and subsidies for the cultivation of energy crops (payments to farmers, compensation in case of failure); fines for failure to meet the established indicators; preferential loans and subsidies for plants engaged in the production of biofuels.

In 2009, the EU Renewable Energy Directive (2009/29) established a "20-20-20 Policy" for the post Kyoto period beyond 2012, which includes the targets on the biofuel consumption. Under this "20-20-20 Policy", the share of renewable energy in the total EU energy consumption is set at 20% by 2020. Due to the effectiveness of these mechanisms, the EU was able to achieve significant growth in the field of bioenergy. However, considering the limitations of its own resources, a significant portion of feedstock for biofuels production is imported from neighboring developing countries, therefore the biofuel production policy affects not only the agriculture of the EU countries but also neighboring countries.

In particular, the growth of demand for the oil crops usage at the biofuels industry led to a considerable increase of oilseeds gross yield in Ukraine. Currently, almost all grown in Ukraine rapeseed and soybean are being exported abroad.

In general biofuels present great opportunities both for developed and developing countries. The biofuels production and consumption cause a number of social, economic, environmental and technical issues. Economic advantages of a biofuel industry would include value added to the feedstock, an increased income taxes, investments in plant and equipment, reduced greenhouse gas emissions, reduced a country's reliance on crude oil imports and supported agriculture by providing a new labor and market opportunities for domestic crops [1]. The ecological effect of production and consumption of biofuels is the reduction of harmful substances emissions into the atmosphere that result from the production, transportation, processing and use of oil and its derivatives. The socio-economic effect of production and consumption of biofuels is the creation of additional jobs, as a consequence, reduction of the number of unemployed people and developing rural areas

Conclusion

As a result of the performed analysis, the authors came to the following conclusions: public policy in biofuels have positive and negative impacts on environment, food system; social-economic conditions, energy sector and environment. The advantages of production and consumption of biofuels vary significantly and depend on the market conditions and the political situation in the country. Although increase of biofuel production has positive impact on energy and environmental sector, gasoline and diesel consumers and improves welfare of farmers, it has a significant negative impact on food consumers, especially among poor people. The various policies that have been implemented or proposed, directly affect biofuels, including subsidies, mandates and a regulation of carbon in the fuel. However, current policies do not provide incentives for private and social welfare, as well as the safety of biofuel production and its impact on the environment, as well as food security, especially in countries that are developing. Countries that were the first on their way in research and production of bioethanol and biodiesel feedstock that also can be used as food should provide more attention and polocies in favor of second-generation biofuels produced from non-food crops and other sources of renewable energy. The next generation of biofuels can provide improved net benefits, but will require significant technological breakthroughs.

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Conditions for cyanobacteria biomass development and selection for further processing

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Abstract – the purpose of research is to define place of cyanobacteria in the system of micro and macroalgae, discover peculiarities for conditions of their development and biomass selection fur further processing.

Key words – cyanobacteria, microalgae, alternative sources, biomass development, nutrients

I. Introduction

Cyanobacteria appear to be one of the oldest, biggest and most important bacteria on earth, since they launched process of oxygen production. Because they are photosynthetic, they are often called `blue-green algae`. Cyanobacteria can modify in special cell types that are called heterocysts and fix nitrogen, tolerate high levels of temperature which proves in its blooming in hot springs and ice lakes of Antarctica. Cyanobacteria can product wide range of biologically active compounds, with some of which have antivirus, anticancer and UV resistant qualities. As nutrient source for biomass development, it is important today to use CO_2 aiming minimization of its negative impact on environment, and to use degistate in biogas production.

II. Conditions for cyanobacteria development

Cyanobacteria don't need vitamuns for existence. They can use nitrats or ammonia as a source of nitrogen and they also need phosphorus and such microelements as iron. Most of cyanobacteria types are phototrophs, but some filamentous types can bloom in darkness, using sugars, glucose or sucrose as carbohydrates and source of energy.

Conditions for cyanobacteria development depend on many factors and are interconnected.

Problem of impact factors on cyanobacteria development based on example of *Anabaena, Aphanizomenon, Cylindrospermopsin, Nodularia, Lyngbya, Oscillatoria, Microcystis, Planktothrix* was a research issue for large amount of scientists (Chorus and Bartram 1999; Carmichael 2008; Paerl and Huisman 2008; Hudnell 2008, 2010; O'Neill et al. 2012; Paerl and Paul 2012). Among factors that affect cyanobacteria development conditions, these scientists were focusing on: salinity, enough nutrient supply. The following factors were also taken into account: calm water, stratified conditions, a lot of irradiance, high levels of water temperature.

Salinity

Marine cyanobacteria such as *Prochlorococcus, Synechococcus sp.* та *Trichodesmium sp.* showed presence of high leve of salinity as a result of the research done in the laboratory. They also demonstrate wide salinity tolerance ranges. For instance, the least salinity tolerant *Cylindrospermopsis* thrives under level of salinity of 2,5 ppt. At the same time, the most salinity tolerant are *Anabaenopsis* and *Nodularia* that thrive under 5-20 ppt levels of salinity (Moisander *et al.* 2002). As an example, *Microcystis aeruginosa* is tolerant up to level of 10 ppt without changes in its growth, compared to those, that are in freshwater (Tonk *et al.* 2007). Based on such results one may conclude, that under optimal growth conditions, these species might potentially thrive in regions, where water is darker. Over the last decades one may observe a spread in the geographical extent such soecies into the mesohaline (5-15 ppt) (Paerl and Paul 2012). As example, blooming of *Microcystis aeruginosa* can be met in Baltic Sea (Maestrini *et al.*1999) and at the San Francisco Estuary (Lehman *et al.* 2013). These species as a result of research showed that other factors among salinity influence geographical distribution.

Level of nutrient concentration

As in other photosynthetic phytoplankton, under optimal temperature level and irradiance, cyanobacteria biomass accumulation is directly proptial to the amount of nutrients, available in water column.

Concentrations of nitrogen and phosphorus

Researches of great number of scientists have shown that cyanobacteria growth in freshwater systems (rivers and lakes) is frequently linked with excessive Posphorus loading (Likens 1972, Schindler 1977, Edmondson and Lehman 1981, Elmgren and Larsson 2001, Paerl 2008, Schindler *et al.* 2008). Supply of nutrients in stationary and non-stationary sources in agriculture or wastewater effluents leads to simultaneous increase of phosphorus and nitrogen concentrations (Paerl and Paul 2012, Paerl et al. 2014b). During summer researches the results showed that when cyanobacteria biomass is at its highest peak and given minimal nutrient concentrations, nitrogen and phosphorus exert equal control over biomass accumulation in this system (Paerl *et al.* 2014a). In general, dominance of both N_2-fixing and non-N_2 fixing cyanobacteria such as *Aphenizomenon flos aquae, Nodularia spumigena, Microcystis aeruginosa* and *Cylindrospermopsin raciborskii*, have increased world-wide in concert with increased loads of both nitrogen and phosphorus (Chapman and Schelske 1997, Jacoby *et al.* 2000, Gobler *et al.* 2007, Burford *et al.* 2006, Burford and O'Donahue 2006, Hong *et al.* 2006, Suikkanen *et al.* 2007, O'Neill *et al.* 2012). In order to change nutrient ratio aiming to affect phytoplankton growth, concentrations of nutrients should be so low (phytoplankton biomass relatively) that in the end either phosphorus or nitrogen will reduce their growth.

Phosphorus and nitogen supplement of cyanobacteria is greater than of other eukaryotic group due to the large protein demand of the peripheral light harvesting antennae.

Irradiance and Water Clarity

Carotenoid pigments that are concentrated in cyanobacteria serve a photoprotective function by dissipating excess light energy when required allowing cyanobacteria to be exposed to high irradiances without experiencing photoinhibition (Paerl *et al.* 1983, 1985). Aided by their positive buoyancy, cyanobacteria such as *Microcystis*, can grow very close to the surface by tolerating irradiance levels that are inhibitory to other members of the phytoplankton community. As a result, these cyanobacteria can increase their cell densities past the point where they would ordinarily become light-limited by self-shading. Growing close to the surface can also help cyanobacteria avoid light limitation if there is a high concentration of suspended sediment matter in the water.

Temperature

Perhaps one of the most important factors in controlling the growth rate of cyanobacteria is temperature (Robarts and Zohary 1987, Butterwick *et al.* 2005, Reynolds 2006, Paerl and Huisman 2008). Cyanobacteria isolated from temperate latitudes (i.e. excluding polar regions) typically have temperature growth optima between 25 and 35°C (Reynolds 2006, Lurling *et al.* 2013). For example, in a survey of eight cyanobacteria the growth optima of two *Microcystis aeruginosa* strains were 30-32.5°C and that of *Aphanizomenon gracile* was 32.5°C. Lower growth temperature optima were observed in *Cynlindrospermopsis raciborskii* and *Planktothrix agardhii*, both at 27.5°C while *Anabaena sp* had an optimum of 25°C (Lurling *et al.* 2013).

Cyanobacteria growth is reported from cryophilic (+4 °C) up to thermophilic conditions (e.g. *Synechococcus lividus*, 75 °C). Photosynthetic activity, without observable growth, was reported by De Vera even at –30 °C. Miyake and Nishioka reported PHA production with *Synechococcus* MA19 at 50 °C, while almost all the other authors had done their cultivation experiments in the range between 20 and 30 °C. Thermophilic conditions are beneficial because of increased metabolic turnover and because of a significantly reduced contamination risk. However, thermophilic cyanobacteria able to produce PHA are rare, and thermophilic production in a largescale photobioreactor will cause very high effort for thermal insulation.

Level of pH

According to Brock, cyanobacteria generally seem to be unable to grow at a pH lower than 4 to 5. In fact, most are alkalophiles having their growth optima between pH 7.5 to 10.

Although pH next to alkalinity and temperature influences the interspeciation of dissolved inorganic carbon, it has an effect on growth independently.

Overall, the optimal pH for maximal growth rate cannot be generalized as it varies from strain to strain and depends on their natural environment.

III. Selecetion of biomass for further processing

As a result of cyanobacteria biomass development, water and nutrients after harvesting cyanobacterial biomass and product extraction can be directly recycled. Biomass can also be anaerobically digested or hydrothermally liquefied via HTL (mineralization of organic nutrients) and then recycled. Recycling process water directly can increase the concentration of inhibitory substances and dissolved organic matter from the previous batch produced by cyanobacteria, which decrease the productivity of cyanobacteria. Furthermore, nutrient competition may arise by enhanced bacterial growth.

Auto-selectivity, a combination of cultivation conditions favourable for the intended strain and unfavourable for all potential contaminants, is a serious goal for all biotechnological processes. For cyanobacteria, this selectivity can be achieved by setting several parameters simultaneously: the lack of dissolved organic carbon, limiting concentrations of nitrogen and phosphorous, and a pH-value at or above 8.5. One can also observe repeatedly some growth of green algae (*Chlorellasp.*) in the relevant research. As the culture reaches its stationary phase, cells will die and release their content. This may be a carbon and energy source for heterotrophic contaminants, making long time running batch processes critical.

In cyanobacteria cultivation it is important to mind, that under unsanitary conditions the contamination is inevitable. Thus, purification will be one of integral elements of cyanobacteria selection for further processing.

Conclusion

Cyanobacteria growth conditions arrive from several factors that have different effect for every species. Cyanobacteria are important in the system of balanced environmental management, since their nutrients can be wastewater and industrial-agricultural effluents.

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Peculiarities of ecological labeling of goods in Ukraine

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Abstract – The notion of ecological labeling, in particular foods, and importance of the sign "Green Crane" in Ukraine and EU countries has been researched. Advantages and disadvantages of the labeling has been highlighted. Besides, stages of the ecological labeling of goods and main criterions of getting the labeling were determined.

Key words: the ecological labeling, the ecological labeling sign, the sign «Green crane», standardization, quality, customers, product.

I. Introduction

Customer majority understand importance of consuming quality and ecologically clean goods. Checking of goods quality based on the ecological labeling. The ecological labeling is relevant to requirements and principles of international standard ISO 14020 and determine some ecological properties.

Main purpose of the ecological labeling is to inform customers about quality and ecological aspects of goods and services. It is an opportunity for manufactures to expand demand and improve supply the goods with lower impact to environment. The price of the goods is higher, but it is fairly, because quality and checked product is more reliable and useful [1, p.1].

II. The main material

The process of ecological labeling consist of three stages:

1. Choice and development ecological criterions of goods. Choosing of characteristics of some good, that will be checked with aim of product achievement of the next stage.

2. Certification and making license agreement. The license gives the right to use environmental labels.

3. Supervision over certified products should be carried out periodically, so the product does not lose its properties and the ecological labeling complies with all standards [2, p.1].

Eco-labeling is confirmed by the ecological mark, which is given only to those products that have passed the state examination. Depending on the meaning of the sign, they are divided:

1. Confirmatory – such signs indicate that the disposal of this product is harmless to the environment.

2. Warning – will prevent the consumer of environmentally hazardous materials from which the product is made.

3. Agitation – these signs are present in almost all products. Manufacturers of such products ask buyers to protect nature, after using them to take the goods for disposal, or, if possible, for recycling and not rubbing [3, p 56].

The objects of certification are food products, various products, except for medical preparations and medicines. The main problem of food quality is the contamination of GMOs and human-hazardous materials. To date, in Ukraine, the Technical Regulation sets requirements for the use of eco-labeling. There is a sign of ecological labeling, in general it is called "Green Crane" in Ukraine. It presents the green creeper of the crane against the background of the Earth, which symbolizes life on our planet. (Fig. 1) [4, p.1]. This sign proves that the product has safety advantages over others.

Fig.1 Ukrainian ecological marking sign.

Also, in Ukraine, in addition to the sign "Green Crane", there is a sign "Ecologically clean", which indicates compliance with international criterions and guarantees the quality of products and their environmental friendliness.

Ecological certification of the goods is voluntary, because a number of requirements to the life cycle of goods are added to the usual certification: from raw materials to the destruction of the product. Such a mark has been introduced in Ukraine since 2002. There is an All-Ukrainian program "Implementation of the complex of environmental protection measures by enterprises and organizations taking into account the requirements of the international and European standardization and certification systems", which once a year organizes a competition for the award of the product "Ecologically pure" [5, p.1].

State marks of marking are responsible only for safety and the fact that the products meet the national Ukrainian standards. But the quality is paid insufficient attention: it remains "on the conscience" of the manufacturer. At the same time, more and more Ukrainians believe that among the main criteria for a quality food product is its naturalness and environmental friendliness. Specialists noticed a tendency: the buyers began to read the label more carefully, but some marks on it are still little known to them or incomprehensible.

The ecological criterions for obtaining the sign are different, it depends on the product which is being certified. The main criteria for obtaining certification are:

The impact of products on the environment at all stages of its life cycle: the receipt of raw materials, production, consumption and utilization.

Replacement of harmful materials more securely with the help of technical developments.

Re-use of the product after its consumption (waste treatment) [6, p.1].

In Ukraine, the ecological sign "Green Crane" has products such as sunflower oil "Oleina", TM "Chernigivske", TM "Sniezka", even the US washing-up liquor "GreenUnikleen". Today, TM "Oleina" is the best product in Ukraine among other sunflower-seed oils. "By chemical analysis, Ukrainian oil is actually a benchmark for the Codex Alimentarius," said Mykhailo Malkov, national coordinator of the EU / FAO project. [7, p.1].

If refer to organization "Living Planet", 70% of products submitted for certification are turned away, indicating the reasons for the refusal and the request to eliminate product defects and apply again [8, p.1].

The sign "Green Crane" complies not only Ukrainian requirements, but also international certification. Therefore, consumers can be sure in the quality of the products on which this sign is depicted.

The ecological sign "Green Crane" is recognized in 60 countries of the world, including the USA and the EU. The certification is included in the Global Environment Label Network. In Ukraine consumers try to use only environmentally friendly products, without GMOs and other additives, so domestic demand is high enough. Most of the products with environmental labels are exported from Ukraine. Most countries allow the export of only those products that have certification or further, ecological labeling complies international standards. The ecological sign "Green Crane" corresponds to such standards, therefore all products bearing the ecological mark are exported to the EU countries.

The special advantages of ecological labeling in Ukraine are:

1. The product with the ecological labeling is easier to export to other countries.

2. Consumers who buy a product with ecological labels are confident in the quality of the product and its security.

3. Ecological labeling affects sales growth.

4. Products with eco-label causes increasing of competitiveness.

5. Such products have the opportunity to expand in the marketing sector. [8, p.1].

There are some disadvantages, that scientists have noticed, in Ukraine. First of all, people are not aware of the labeling, that products are checked and certified by special agencies, so they are more useful and safer. Some citizens, knowing about the usefulness of a product, do not buy it because of the relatively high price. Also, further regulation of those products that have received certification is not clear and rigorous, therefore manufacturers sometimes counterfeit goods in different

ways and do not adhere to all the rules and requirements of environmental labeling. However, when certification bodies still learn about such maneuvers, they prohibit the use of environmental labeling, and consumers who are accustomed to the fact that products are safe to continue to buy it. [9, p.1].

Conclusion

Consequently, environmental labeling should provide reliable information for all consumers so that they are prepared to pay for eco-goods more than usual. Since ecological marking testifies to the quality and belonging of the product to the environmentally friendly. Ecological products with the corresponding markings have great advantages over other products, and especially food products. Such products are qualitative, useful, safe and reliable, because they passed the state examination and got the certification.

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Problems and prospects for export development of domestic organic production for the European Union Market

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Abstract – The paper presents general export trends of Ukrainian organic products to the European market. The advantages of Ukraine as an exporter of organic agricultural products are described. The list of permits and certificates for import of Ukrainian products from the countries of the European Union is given.

Key words: export, organic products, trade, international standards, certification, agriculture

I. Introduction

The modern stage of Ukrainian economy development is integration into the world economy. At the moment, Ukraine is a member of many international organizations, both political and economic, in particular the Council of Europe, UN, CIS, GUAM, IMF and others. The main form of international economic relations is foreign trade. Foreign trade relations are very important for the development of the Ukrainian economy [1].

II. The main material

According to the State Statistics Service of Ukraine, the volume of export of goods amounted to 36361711.2 thousand US dol., imports – 39249797.2 thousand US dol. in 2016. Leading export-oriented industries in Ukraine is metallurgy, engineering, agriculture, and the chemical industry. Among the imported industries, oil products, machine-building pharmaceutics predominate [2].

According to the State Statistics Service of Ukraine, one of the largest countries to which Ukrainian food products are exported are: Egypt, India, Italy, Germany and Turkey [3].

Consequently, in order to increase the efficiency of trade with foreign countries, it is necessary to introduce measures aimed at integrating the Ukrainian economy into the world economy.

Recently, exports of organic products began to grow rapidly in Ukraine. Ukraine is one of the largest states in Europe with a favorable geographic location, therefore, it has a great potential for the development of organic production. European countries regard Ukraine as an important strategic partner in supplying organic products to replace raw materials from China, because the advantageous geographical location of Ukraine makes it possible to deliver both by road and rail, as well as by sea [4].

Among the sectors of Ukraine, the largest export of agricultural products is organic (cereals, sugar, honey, etc.). Since agriculture is one of the main and most widespread activities of humanity, various social and social values, history and culture have been reflected in the principles of agriculture.
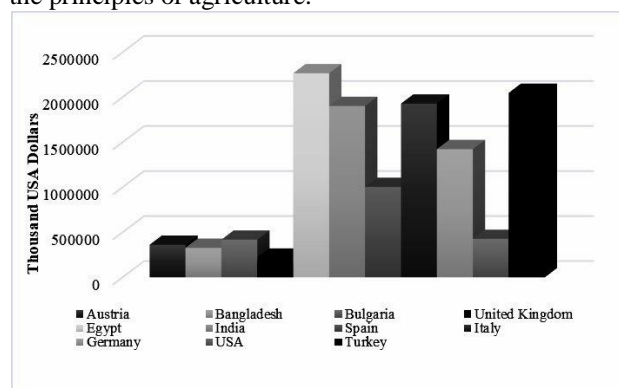
Fig. 1. The volumes and structure of food exports from Ukraine as of January 1, 2016

These principles are a major factor in the development of organic agriculture and include the various ways in which people care for their production and processing of food products. These principles became the basis for the development of organic agriculture. Their goal is also to stimulate organic movement, regulate the development of various standards and programs. Organic farming is based on the following principles:

- – the principle of health;
- – the principle of ecology;
- – the principle of justice;
- – the principle of care;

For the effective functioning of agriculture, these principles should be used as a whole [5].

The interest of foreign buyers in organic products from Ukraine is increasing year after year. For example, the US is ready to negotiate the supply of Ukrainian organic wheat, since in Ukraine the land is not so polluted and suitable for growing organic produce. In 2016, Ukraine exported grain crops worth 8 billion Euros. Now the largest importer of organic products from Ukraine is Germany, especially for legume crops in Europe. With great potential for organic agricultural production, Ukraine has made significant progress in the development of its own production of organic products [6].

TABLE 1

THE DYNAMICS OF AGRICULTURAL LAND AND THE NUMBER OF ORGANIC FARMS IN UKRAINE DURING 2013-2016

	2013	2014	2015	2016
Area, he.	393400	400764	410550	421200
Number of farms	175	182	210	390

According to the table, it is clear that the area of agricultural land intended for organic production, as well as the number of organic enterprises continues to grow every year. It is also necessary to pay attention to the number of organic farms in 2016, which is equal to 390 enterprises, which is almost twice as high than the previous year. In recent years, there has been a tendency to fill its own domestic markets with its own organic produce.

But for entering Ukrainian organic products to market and could be exported to the EU and the world, it has to undergo a long and difficult procedure for obtaining licenses, certificates and permits, and it must meet all the requirements and quality standards. First of all, this product should be authorized, the company must be certified by a controlling body with international accreditation. After the contract is signed, the importer must obtain an import permit, which serves as an official document for import of products, and each batch of organic products must be accompanied by an export certificate that allows the customs to clear the products as organic. In Ukraine, organic products must be certified in accordance with the criterions set by organizations such as the Global Environment Marking Network (GEN) and the International Federation of Organic Agricultural Movements (IFOAM) for the production of organic products. The IFOAM Federation, in 1980, developed the first standards for the production of organic products, and subsequently began to use its own "IFOAM Accreditation Criteria" to evaluate certification bodies. Now these basic standards and accreditation criterions, after a long improvement, are known as "international ISO standards" in the world. Therefore, to confirm the environmental friendliness of its product in accordance with the requirements of the international standard ISO 14024. Also, for import of organic products in the EU, they use an inspection certificate in accordance with Commission Regulation (EC). Although it should be noted that, like the Ukrainian government, it stimulates all operations related to export and production of organic products, and the European Union helps to develop organic goods trade, for example, by simplifying import regimes in the EU [7-9].

A significant advantage of organic products exports is that organic products are rather expensive compared to inorganic ones, so the export of such products can bring huge profits to enterprises and the state. Also, advantages can be attributed to the gradual development of organic agriculture, developing its own certification system of goods. The entry into the market for organic products exports establishes economic links between enterprises and countries of the world, increases the competitiveness of producers in the domestic and foreign markets. Access to the export market for organic products is accompanied by a variety of quality standards that guarantee the consumer healthy and high-quality products, and product recognition in many countries around the world [10].

Disadvantages in the organic products market are unstable price policies, this is not the market that can guarantee a stable price. In addition, we must be constantly prepared for any inspections. Ukrainian producers of organic products also have a much larger list of analyzes than European producers.

Conclusion

So, in order to improve the economy and develop foreign trade, Ukraine concludes more and more political and economic agreements with different countries of the world. Lately, these agreements also apply to the export of organic products. Due to its advantageous geographical location and fertile land, Ukraine is considered an important partner in supplying organic products. Ukraine also has to adhere to the principles of agriculture for the effective development of agricultural production. Although the organic products market has its disadvantages in the form of volatile prices and complicated permitting procedures, but both Ukraine and the European Union are striving to stimulate more and more the production and export of organic products, because in recent times, consumers are focusing more and more on organic produce.

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Macroeconomic factors of commercial entrepreneurship development in Ukraine

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Abstract: Scientific literature has been considered. On the basis of which formed the main problems and prospects of the trade entrepreneurship development in Ukraine. The analysis has been carried out on the basis of statistical data, and made conclusions about the prospect of trade entrepreneurship in Ukraine.

Key words: Ukraine, entrepreneurship, trade entrepreeurship, oligopoly, development, problem, prospect, barriers.

I. Introduction

Today, in the economic life of Ukraine, there are stabilization processes, as the exchange rate is normalized, GDP grows, market demand increases due to increased incomes, reforms has been made, in particular the creation of the CNAP facilitated the opening of business. These steps, taken at the state level, have contributed to the development of trade business in Ukraine, and will become a guarantee of further success of the country. A trade business is the main finance source of the state budget. Because this branch of business has the highest revenues, the state creates favorable conditions for the development of this business, for the purpose of greater revenues to the budget of the country.

II. The main material

There is a large number of enterprises in Ukraine, but the largest revenues to the budget are provided by trade enterprises [8]. However, this sector is a perspective in Ukraine and Europe. But big businesses are pushing small and medium businesses out. After all, the biggest market share is controlled by large trading enterprises and this is actually oligopoly. For example, large trading enterprises occupy 43 % of market in Ukraine, as opposed to Estonia, where large trading business has less than 25 % of market[9]. Accordingly, there are barriers to entering the market, because the market has its own rules, which were established by oligopolists, with the help of the government and other instruments. Restrictions have been set for other businesses, and besides, these enterprises are related to oligopolies. In most cases, government tenders are impossible to win for small business, and that's why big trade enterprises develop their business at the expense of the state [12].

At January 1, 2016, the largest sector of active enterprises is G category (wholesale and retail trade) and is 13.72%. Given that in Ukraine there are almost 606 thousand enterprises, of which the trade enterprises is more than 83 thousand [1]. This is a rather positive indicator, besides this, as of 2016-2017, trade enterprises opens more than previous years when their share decreased [2].
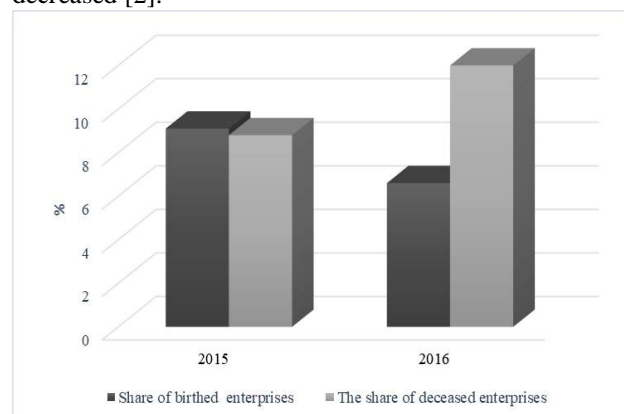
Fig. 1. Structural ratio of created and closed enterprises in Ukraine in 2015-2016

It should be noted that the number of large enterprises over the last three years has significantly decreased: from 659 units in 2013, 497 in 2014, to 423 in 2015. First of all, this is a consequence of the ATO's management and the temporary occupation of part of the eastern regions, where mostly large industrial enterprises were located, and the impact of the general economic crisis, which only intensified due to events of a military nature.

During 3 years, there is also a decrease in the number of medium-sized enterprises. Thus, at the beginning of 2016, 15.2 thousand medium-sized enterprises were registered in Ukraine, the number of which decreased by 703 units (4.4%) compared to the previous year. Recall that at the beginning of 2014 there were 18 thousand. Compared to 2010, in 2015 the number of medium-sized enterprises declined by 24% each year.

The main positive development dynamics in the category of small business was due to microbusiness. So, the number of micro enterprises in 2015. increased by 5 thousand units (2%) and reached 284 thousand enterprises. A trading company, as a mediator in the relationship between the producer and the consumer, is the main form or contact in the opposite direction in the event of problems between the buyer and the manufacturer. And also, in most cases, this business entity intends to save its reputation when making a contract for the sale of goods [4].

One of the key factors in the development of trade enterprises is that this kind of business does not require high costs, and has a quick return compared to enterprises of categories A, B, C, D, F. These enterprises are agricultural or industrial, and they have bigger hits risks, and besides, they have a very long process of selling goods compared to a trading company. Therefore, a trading company is more perspective in the short run [1, 3]. And this type of business has high demand, because through trade business passes all types of economic activity of buyer with the manufacturer. The basic development of this entrepreneurial activity is the ease of creating and managing the business. In addition, this type

of activity is rather branched out. Because mediators, distributors, retail intermediaries and the manufacturer themselves may come into contact with the buyer and the manufacturer. This path from seller to buyer can have a large number of links that are not negative and important. Therefore, this activity is a perspective for different types of entrepreneurship.

In Ukraine, trade enterprises are more innovative than other enterprises, because of the great competition and cheaper technologies for improving activity than the enterprise engaged in logging or machine building. Another key factor is that this type of business has direct contact with the buyer. And in most cases, the buyer prefers to a trading company where there are more innovative technologies and better staff. These are the main criterions for successful business and market competitiveness [5, 6].

Ukraine has positive indicators – cheap labor (inflation), taking into account the fact that labor is highly skilled. But there are barriers to the company's profitability. This barriers were created by oligopolists through the state. The construction of laws that promote the development of large businesses and destroys small and medium-sized businesses, unfair taxes burden and difficult to squeeze out competitors that are on the market. In addition, government, under the pressure of EU, make slow steps for the development of small and medium-sized businesses. Due to the fact that the form of political power is actually oligarchic in Ukraine [10].

But there are factors that negatively affect the development of trade activity in Ukraine. The first and main factor is unfair business taxation, because the interest rate difference is the same for both small and large businesses [7]. One more significant problem is that the market in Ukraine is actually oligopolistic. And large companies have a market advantage, and in fact they dictate the price they need. And when the government adopts innovations, it doesn't lead to destroying the oligopoly, but rather develop it. According to the global competitiveness index of Ukraine. It can be seen that the investor protection power is small. This is very frustrating for foreign investors, because there is a high risk of not returning their funds. In addition, macroeconomic indicators are terrible, because taking into account inflation, the entrepreneur will remain unprofitable. When delivering goods in the long run, as a winner in the tender. Also, taxation for investors is also great among other countries, which also slows down the development of a trading company in Ukraine [11].

Conclusion

Thus, trade entrepreneurship is a perspective for Ukraine, because the main revenues to the budget of the country are delivered by small and medium enterprises in this area of activity in EU. Also, if Ukraine grants preferential taxation periods when creating a new company in this area, it will give even more perspectives

and development of new trading enterprises. And Ukraine will have more investment from abroad, and will have a larger budget and better economic development. It is also necessary to solve the tax problem, and to set a lower percentage of taxation for small businesses, and for larger business – bigger taxation. And to destroy the oligopoly market that is present in Ukraine. It is also necessary to create favorable conditions for investors. After all, they can improve the GDP. And to increase the inflow of foreign currency, and make the national currency more strong. In addition, it is a perspective for Ukraine to enter the international arena, if Ukraine has more trade TNCs, GDP will grow by at least 10%.

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Environmental Impact of Mining and Chemical Industry

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Abstract – The work is devoted to problems of environmental impact in mining and chemical industry.

The purpose of the work is to evaluate the impact of mining activities on the environment.

It is shown that mining activities have resulted in land degradation leading to limited land available for local population, the accumulation of large-tonnage wastes, the presence of contaminants in soil and water, distortion of terrain, activity of various geophysical processes.

Keywords – environmental impact, mining, mining and chemical industry, large-tonnage wastes, water pollution, soil pollution, heavy metals, liquidation, reclamation.

I. Introduction

Minerals extraction is associated with both opportunities and challenges. Historical concerns around work conditions and the competitiveness of the mining sector have been complemented by a growing number of other issues. Today, an overarching goal is to find ways by which the mining sector can promote sustainable development.

Sustainable development is often defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Furthermore, it is commonly agreed that this must incorporate economic, environmental and social concerns.

The relationship between extractive industries and sustainable development was analyzed in the literature, but the problems of the impact of mining on the environment are not sufficiently studied, especially at the stage of their closure.

When active mining ceases, mine facilities and the site are reclaimed and closed. The goal of mine site reclamation and closure should always be to return the site to a condition that most resembles the pre-mining condition. Mines that are notorious for their immense impact on the environment often made impacts only during the closure phase, when active mining operations ceased. These impacts can persist for decades and even centuries. Therefore, the Environmental Impact Assessment for every proposed mining project must include a detailed discussion of the mine Reclamation and Closure Plan offered by the mining proponent.

The purpose of the work is to evaluate the impact of mining activities on the environment[1, 2].

II. Materials and methods of research

The impact of mining on the natural environment begins with geological exploration. There are the following types of environment violations:

• geomechanical (changes in the natural structure of the mountain range, terrain, surface layer of ground, soils, including deforestation, deformation of the surface);

• hydrogeological (change of stocks, mode of movement, quality and level of groundwater, water regime of soils, removal of harmful substances into rivers and reservoirs from the depths of the earth);

• chemical (change in the composition and properties of the atmosphere and the hydrosphere, including acidification, salinization, water pollution, and the increase of phytotoxic elements in water and air);

• physical and mechanical (air pollution, its heating, changes of soil cover properties, etc.);

• noise pollution, vibration of soil and rock mass, emissions of rock in explosions; deterioration of the transparency of the atmosphere and other possible phenomena that accompany mining, negatively affecting the environment.

Consider the negative impact of mining and chemical activities on the environment of Rozdil state mining and chemical enterprise "Sirka", which has been at the stage of liquidation since 2003. There is a distortion of the terrain of the quarries, tailing pits, dumps at the stage of liquidation. The soil cover is negatively affected, the fertility of soil in the territory decreases due to the activity of the mining and chemical enterprise.

The mining and chemical enterprise has left behind a large-tonnage wastes, which are difficult to apply to reduce their quantity. In these wastes and soils near them there are an excess of the maximum permissible concentration of heavy metals that migrate through soils and water objects. In place of the quarries man-made lakes were formed, which fall into the Dniester river through the channels. The maximum permissible concentration of many hydrochemical parameters is exceeded in water objects on the territory. They are: Chemical Oxygen Demand, pH, sulfates, mineralization, iron, dry residue, etc.

In addition, on the territory of the enterprise 17,195 tons of "MG" type modifiers, made from neutralized tar residues and residues boiler anhydrite maleic acid were imported from Hungary.

Complex man-made impact of mining activity leads to violations of the geological environment, which are divided into:

1. geomechanical (Fig. 1) [3];
2. hydrogeological (Fig. 2) [3];
3. violation and pollution of the airspace;
4. changes in flora and fauna.
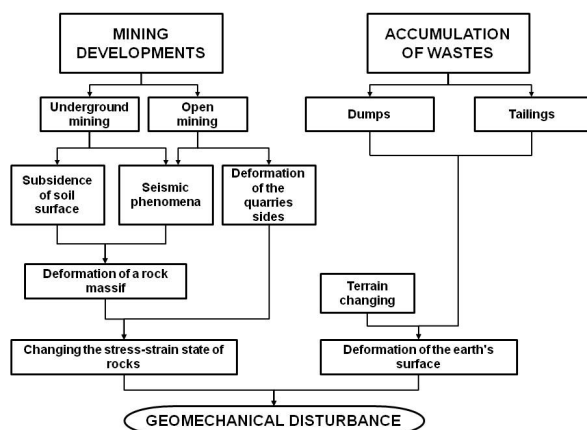
Fig.1 Causal and consequential scheme of geomechanical disturbance formation
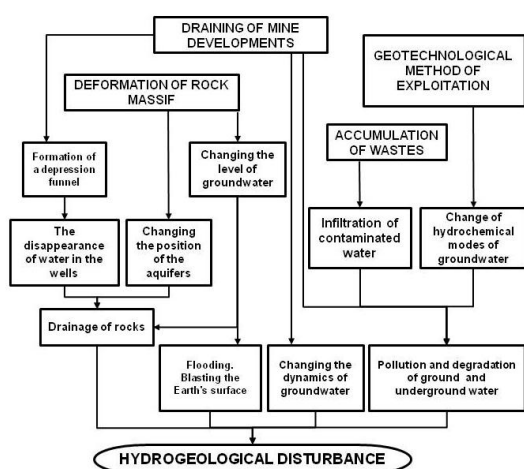
Fig.2 . Scheme of formation of hydrogeological disturbance of the mining industry

Deforestation and vegetation violations occur in open pit mining areas, during storing on the surface of overburden and dumps of mineral raw materials, laying roads and building structures for the maintenance of mining enterprises. Violation of the earth's surface occurs during the disclosure of minerals in places of quarrying, placement of shafts of mines and siege structures, underground extraction of minerals as a result deposition of surface. After removing the rocks, the surface of the soil sinks. The formed deposits are filled with water.

III. Research results and discussion

The problem of dumps, however, is so big that it can not be completely solved through their use as raw materials. None, even such material-intensive production, as construction, does not require such large volumes of raw materials. In addition, not all the overburden and rocks that are extracted intermittently, can be classified as minerals. According to estimates of geologists of Ukraine, currently 15-20% of overburden can be suitable. Areas occupied by dumps, like all the territory, affected by mining operations, are subject to reclamation. In Ukraine, the mining industry employs about 190,000 hectares of land. Annually 7,000-8,000 hectares are allocated for this purpose, with about 40-50% of all land plots are occupied by dumps. Reclamation of land after mining operations involves preserving the land resources of the country and providing the population with normal sanitary and hygienic conditions of life.

In accordance with the requirements of the current environmental legislation, all land that is violated as a result of extraction and processing of minerals, subject to re-establishment. The restored landscape occurs as a result of the interaction of a complex of liquidation, rehabilitation and reclamation works after the completion of the exploitation of the deposit with the processes of natural self-restoration. The program of liquidation of the mining enterprise must ensure the physical and chemical stability of the affected areas, regulate the hydrogeological and hydrological relations, and offer a monitoring system that required minimum [4].

Conclusion

On the example of the territory of the Rozdil state mining and chemical enterprise "Sirka" it was established that the mining and chemical activity has a negative technogenic impact on the environment.

Exploitation of mineral resources causes significant environmental impact. The large areas of agricultural land become unfit for use, also there is the damage to soils, forests, the hydrological regime of large territories changes and their productivity decreases, even the terrain and the movement of air flows change. Extraction of mineral raw materials leads to the creation on the large areas of anthropogenic-mining industrian landscape, which is characterized by surface accumulation of mountain masses (dumps, heaps, sludges), as well as other forms of terrain – quarries, areas of subsidence of a surface above mine fields, etc.

The activity of mining enterprises should be aimed at extraction of the maximum amount of necessary minerals. It should also be aimed at preserving them in immovable condition or derived and properly constructed formations that can become useful minerals in the future and for the reclamation of disturbed territories.

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Development of the Production of Ecological Goods in Ukraine and Their Labeling and Compliance With Standards

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Abstract –The urgency of the study is due to the fact that the domestic market of environmental goods and organic products in the current economic conditions characterizes the level of environmental and food security of Ukraine and the effectiveness of the implementation of state environmental policy in the field of quality management of goods, products and services.

Keywords: retail network, social and environmental responsibility, electronic equipment and machinery.

I. Introduction

The situation on the market of environmental goods of Ukraine reflects the urgency of the problems of ensuring environmental and food safety. The ecological consciousness of consumers, who are thinking of the purchased product safety and high quality in use and consumption, is growing. Due to this, a certain category of consumers, especially children, elderly people with special needs, prefers organic products that are in high demand both in Ukraine and abroad every year, the Ukrainian ecological goods market is developing rapidly, with significant potential. for the production of organic agricultural products.

Ukraine has all the necessary resources and opportunities for the growth of the market for environmental goods and services, and, above all, the political will of the country's leadership is needed.It is difficult to resolve all the issues related to the organization of the process of production of environmental products, at the level of the industry or the region, on the state scale. But under the current conditions and conjuncture of the market, individual producers are trying to satisfy the consumer's need for environmentally safe products.

Improvement of the production, sale and labeling of ecological and organic products is related to the regulation of these processes in the regulatory and information field of the functioning of the market for such products, which will bring eco-goods production closer to European standards, in particular in the field of labeling of eco-labels and will promote the production of high-quality, competitive organic products.

The purpose of the research is to identify trends in the development of the production of environmental goods and organic products on the territory of Ukraine and to assess the peculiarities of state regulation of its quality and safety through marking and certification.

II. The main material

It is known that Ukraine has always been famous as an agricultural country, which today possesses a powerful agro-industrial complex and modern scientific developments in the field of agricultural production

Thus, according to the Ministry of Agrarian Policy, for the last 5 years organic production has increased by 90%. The official statistical surveys of IFOAM confirm that in 2010, 142 farms that received the status of "organic" were registered in Ukraine, then in 2016 there were already 390 certified organic farms, and the total area of certified organic agricultural land was 421200 hectares (Table 1) [1].

Such rapid development of the production of organic products positively influences all spheres of economy and life of citizens: the society (gives the opportunity to the consumer to buy safe, ecologically clean and high-quality products); the state economy (creates new jobs, develops rural areas, creates new international relations, etc.); the state of the environment. But there are problems associated with the development of the market for organic products to ensure the quality of its production by marking and certification.

In our time, on the shelves of Ukrainian supermarkets, products with the words "environmentally friendly", "without preservatives", "bio" and "natural" are found quite often. But are these goods really organic products?

Such labeling of organic products indicates its "environmental friendliness", but one should distinguish what it is about: about product safety for the environment or its special consumer qualities.

Many manufacturers wanting to be competitive with producers of similar products are misleading consumers by marking their products with all sorts of inscriptions and signs that are by no means proven, but claim that the products are organic. Therefore, there is a high probability that consumers buying and selling eco-goods in retail networks simply overpay and buy pseudo-organics.

The use of organic markings in Ukraine is an element of the system of state regulation of the quality of goods. Normative acts establish procedures and rules for conducting and applying markings in the form of statements and graphic representations indicating the benefits of goods or services to human health. Use of such marking is allowed only in relation to certified products.

When it comes to organic products and the development of its markets, the "organic" guarantee system, which includes specialized inspection and certification bodies, plays an important role. This system uses in its activity legal norms that establish mandatory requirements within the framework of state regulation, as well as certain defined standards.

At present, in Ukraine, national standards for organic production are in the process of development and implementation. Now, organic certification in Ukraine is carried out according to international standards of

countries or associations of countries and private standards recognized in the international market.

Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labeling of organic products and repealing Regulation (EEC) No 092/91 – the EU law act contains a set of rules and requirements for organic production and operates in the countries of the EU as a whole. This is the most common standard under which organic production certification is conducted in Ukraine.

Organic products in the European Union are labeled with the unique logo (the organic logo of the EU – the so-called Euro leaf), which is indicated on packed certified organic products, along with information on the certification body and the origin of organic raw materials [2].

Also, since 2002, the international public association of bio production participants of 'Biolan Ukraine' has been operating in Ukraine, whose specialists have developed standards for organic farming and labeling of products and foodstuffs based on the Basic Standards of the International Federation of Organic Agriculture. Only 'Organic Standard', the first Ukrainian certification body, can certify manufacturers according to BIOLan standards in Ukraine. Certification is a necessary step, which confirms that the product is grown, processed and packaged in accordance with the BIOLan standards.

Thus, since 03.09.2013, as amended and supplemented by the Law of Ukraine of February 12, 2015, the Law "On the Production and Circulation of Organic Agricultural Products and Raw Materials" has been in force in Ukraine, but its provisions do not provide conditions for the implementation of EU legislation, regulation of the market for organic products and its filling with quality competitive products. Consequently, a favorable environment for the introduction of counterfeit organic products is created, which avoids the liability of producers of organic products for violating the legislation in this area.

Due to the fact that this law needs to be revised, and organic production is gaining momentum, in 2016 a draft Law "On Basic Principles and Requirements for Organic Production, Circulation and Labeling of Organic Products" was created. This Law defines the basic principles and requirements for organic production, circulation and labeling of organic products, the principles of legal regulation of organic production, the circulation of organic products and the functioning of the organic products market, the legal basis for the activities of executive bodies and the directions of state policy in this area [3].

In the first place, the law fully takes into account EU directives and regulations, which will allow Ukrainian legislation to be adapted to the European one. This means that Ukrainian organic products will be produced in accordance with international requirements and standards, and consumers will receive quality guaranteed proven goods.

This law strengthens control over the use of the brand "organic" and imposes more severe penalties for violations of the law, and the subject is excluded from the Register operators and deprived of the certificate

The bill No. 5448 specifically provides for the possibility of providing state aid directly to organic producers. For this purpose, the Ministry of Agrarian Policy has identified priority support within the framework of the Ukrainian State Fund. The organic producer has the priority to receive financial state support and the opportunity to participate in all state agricultural support programs, thereby creating additional jobs in rural areas.

Conclusion

Demand for environmentally friendly goods and services and organic products is increasing, but there is one significant negative factor – a high price, high costs and relative complexity of ecological production against the backdrop of an imperfect mechanism of confirming the quality of eco-goods. The main advantages of organic products and problems associated with marking and falsification are described.

An assessment of the domestic regulatory and information base of the functioning of the market for ecological products has revealed that one of the tools of the state environmental policy in relation to the regulation of the quality of ecological and organic products is to develop and implement for producers and distributors relevant statistical reporting on the availability of marking and certification.

In addition to improving the regulatory framework, it is proposed to improve the quality control of goods in the market for organic products through the development and implementation of appropriate forms of statistical reporting for producers and distributors on the availability of labeled and certified ecogoods and organic products.

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Contents of the socio-environmental responsibility in electronic equipment and machinery trade

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Abstract – The purpose of the research is to determine the content of the socio-environmental responsibility of the retailers (distributors) in the process of selling electronic equipment and machinery (EEM) to solve the problem of handling electronic waste. Identification of physical commodity flows of electronic equipment and machinery allows distributors to become elements of the financial flow management system from the collection of electronic waste, which will improve its financial standing.

Keywords: retail network, social and environmental responsibility, electronic equipment and machinery.

I. Introduction

The implementation of the "electronic directives" in domestic legislation strengthens the requirements for the implementation on the domestic market of such goods as electronic equipment and machinery (EEM), which facilitates the attraction of trade entrepreneurship in the system of organizational- economic and technological measures to return the outdated technology to the recurrent economic turnover.

This forces business entities to implement managerial measures aimed at increasing the competitiveness of a trading organization through the creation of a positive reputation among consumers as socially and environmentally responsible.

II. The main material

One of the areas of improving trade management is the development and implementation of the system of social and environmental responsibility at domestic trading enterprises based on the development of legal, economic and organizational foundations in the field of waste management of electric and electronic equipment through the introduction of the increased producers' responsibility.

The social and environmental focus of trade is becoming a key tool for the economic growth of the industry and the region as a source of additional competitive advantages for organizations against the background of the integration of domestic business into international economic relations and the growing importance of social and environmental criteria of goods for consumers and society.

It is revealed that the characteristic feature of a socially and ecologically oriented trading structure is the possibility to obtain the increase in a different type of capital, except for financial due to socially and environmentally responsible behaviour, since such type of capital can be "converted" into another, for example, reputation – in funds, funds – into knowledge, knowledge – into trust and image, etc. [1].

As the dynamics of the growth of the quantity and volume of material flows of the EEM is observed, the topical issue is applying modern approaches to their assessment at the final stages of the life cycle of goods, where a decision is made on the appropriateness of direct and reverse logistical costs in the reverse flows of the trading enterprise.

It is found that in the sphere of trade, where the risk of returning goods from warranty repair, replacement, completion or recycling is significant, logistics costs in return flows can account for 4-10% of total costs of the manufacturer [2].

Consequently, a set of commodity-material values is attributed to a certain time interval and is directed from the source of consumption to the source of formation for the purpose of restoring the value or withdrawal from circulation, forms, in accordance with the logistic conception of management, the reverse material flow (RMF), the objects of which may be raw material, finished goods and goods, reusable packaging or waste products.

The restoration of the value of RMF objects can take place through their transformation, and measures of optimization of reverse material flows include the collection, sorting, completion, processing, recycling and utilization of goods, containers, packaging that are consumed and returned to a trading company after the expiration date, damage, or organizational shortcomings in shipping and delivery of goods.

It is proposed to classify the processes of reverse commodity flows in the sphere of EEM consumption by the properties of liquidity and condition.

The reasons for the return of goods are determined by the interests of the one who initiates the return: dissatisfaction of consumers (in direct sales channels, consumers are guaranteed a refund within a specified period for goods that meet their requirements); problems of installation of goods; the need for repair according to the warranty requirements provided by the manufacturer or specialized centers; non-fulfillment of orders by volume and terms; end of the life cycle of a product or its replacement; non-compliance with the requirements of environmental safety of goods; return of goods sold through electronic business channels; the life cycle of electrical household appliances and electronic and electrical equipment leads to residuals in the supply chain [2].

Since in the wholesale trade for the organization of return logistics, there are stages of collection, sorting, processing or disposal of goods returned from the sphere of consumption, it was proposed to create collecting and sorting points of the goods returned from the sphere of consumption at the place of their sale (retail network) or

in specialized stores manufacturers as the most economical way for their setting up.

At the initiative of local authorities, retailers should primarily be interested in electronic waste collecting.

The initial element (object) of the system for collecting and temporal storing of electronic waste, that can be restored and reused, is the collection point, that is, the location of the distributor.

Subjects of trading activity can create points of collection of electrical and electronic equipment and machinery waste in the places convenient for users.

The system for collecting electrical and electronic equipment and machinery waste that can be restored and reused by designation includes objects where the assessment (testing) and marking of the equipment and its waste are carried out in order to determine their state for the purpose of restoration (repair) to reuse the whole equipment or its separate components, or further recycle and remove, while the equipment is not restored and its waste is not recycled.

At the points of collection, the waste of the equipment is stored in the way that creates the possibility of their re-use with their initial purpose, with the exception of their damage, unauthorized use and access to them. Points of collection equipment and machinery waste that can be restored and reused for the initial purpose are obliged to properly keep records of the quantities, kinds and types of the received equipment and the equipment waste, indicating to which entity and for what purpose they were handed over.

The equipment and machinery waste, collected for restoration and reuse with their initial purpose, is sent exclusively to specialized enterprises for the restoration and repair or recuperation of materials, recycling or removal [3].

Logistics costs for transportation of the used goods that are collected and sorted in the trading network, can be allocated to the network of selection and the recycling facilities on the basis of justified objects of the cost of electric waste logistics system.

In this aspect, the functions of commercial enterprises in the regional logistics network of waste recycling are proposed to be formulated as follows: carrying out actions for consumers of EEM goods and an information campaign on the management of electrical waste with the support of the departments of urban development; organization of collecting the returned for various reasons and used goods that are subject to and/or not subject to repair; transportation at the stage closest to the creation of returned and/or unrealized goods to producers and/or suppliers and/or to the distribution network where goods are transformed into waste; transportation and storage of waste as components, and goods for sale, and, if necessary, their transportation for processing in order to be sold as goods.

Consequently, the content of the social and environmental responsibility of distributors (retailers), that implement EEM exclusively for the end users, is to develop technology for interaction with municipal and private (including mobile) points of collection, while they will accept the oversized EEM of household origin directly in stores, as well as to remove outdated or dimensional household appliances used when buying and delivering new of similar type or similar features EEM to a consumer.

Thus, in the face of the challenges of the present day, the social and ecological nature of the entrepreneurial behaviour of the entities of the trading network, which implement electronic equipment and machinery, allows, through compliance with the principles of social and environmental responsibility (SER), to solve the problems of using electronic waste, thereby forming its positive image and stimulating demand.

Conclusion

Since the EEM full life cycle includes the stages of alternative reverse flows processes, the merchants (distributors) must implement a deposit system of payments for goods when the buyer purchasing the EEM pays the money that will be reimbursed to him when the waste is returned to the manufacturer.

The assessment of theoretical approaches to the interpretation of the concept of "social and environmental responsibility" trade in electronic equipment and machinery showed that the subjects of the trading network (distributors) in the long term should form relationships with organizations of individual and collective increased responsibility of the manufacturer in the field of electronic waste, which will increase the efficiency of trading activities by creating a social and environmental image of retail trade

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European demands
for food quality and safety

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Abstract – In this article was investigated regulations and other normative documents of the European Union concerning food quality and safety and was arranged EU demands regards to food safety. There were determined the basic business concerns of the domestic enterprises in the process of manufacturing and marketing food products.

Key words – quality, safety, foods, EU demands, regulations.

I. Introduction

Food quality and safety are one of the decisive components in the light of economical safety within every state determined by the state capacity of providing an effective production control and importing safety and high quality provisions according to generally accepted principles. European food safety system is considered as the most reliable in the world. European Union(EU) is governed by normative and legislative acts, as well as specific requirements and standards aimed at ensuring the food quality and safety. The irreversible process of Ukrainian economic integration to the EU market and commencement of the EU-Ukraine Association Agreement are updated the study of the European demands concerning the maintenance of the food quality and safety.

The issues related to the study of EU legislation in regard to the food quality and safety are dedicated works of the following scientists: O. Borodina, V. Yermolenko, T. Kovalenko, V. Korniienko, V. Kuryl, T. Kurman, N. Tytova and other leading scientists. However, in Ukraine, some aspects of the food quality and safety have no enough structural and methodological adaptation, thus some aspects of the EU and Ukrainian legislation need to be investigated further for the purpose of providing free circulation of the safety and high quality food.

II. Main part

Foods safety is one of the most important components in the light of economical safety within every country. The primary goal of the EU food safety legislation concerns health and consumer protection, as well as assurance of secure food trade. Therefore, production importing to the EU has to meet the standards, so it means that the life and health of the European consumers should be protected at the high level.

Demands concerning safety are confirmed by regulations, directives and other documents of the governmental structure in terms of legislation. Legal liability is accepted in the case this condition is not met.

The European fundamental principles of legislation concerning food safety ruled by the Regulation (EU) No 1881/2006 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

The EU food requirements could be classified as marketing and legal. Legal requirements are mandatory. We can emphasis upon the manufacturer requirement, product requirement and consumer requirement (Fig. 1).
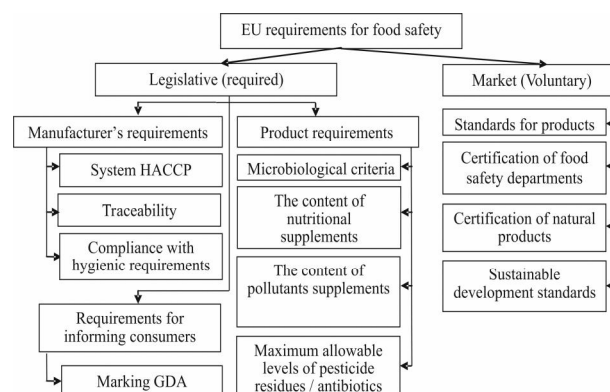
Fig. 1. Structure of the EU food safety requirements

The HACCP system (Hazard Analysis and Critical Control Points) is on the leading place among the manufacturer requirement (in other words production process). Implication of the HACCP system is mandatory for all kinds of industry producing or commercializing food products. The necessity of the HACCP implementation based on consumer demands for the food safety. Nowadays above mentioned system is the basic model of the food quality and safety management.

Traceability is the following requirement due to the principle "step forward, step back". According to the Regulation (EU) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, traceability is the ability to follow any kind of food products at all stages, such as transport, storage and sale for consuming. Due to above mentioned principle we can easily predict and avoid the risk.

There is likewise the requirement of labelling or providing the product by corresponding documents. The food importer into the EU has to ensure the availability of meaningful data concerning the food producing and transporting. Unfortunately, there is no perfect system tracing the food products in Ukraine. The program Guideline Daily Amounts (GDA), proceeding in Europe, informs the consumers about qualitative composition of the product in terms of preventing desease. GDA labelling consists of thee levels indicating by three colours: green, yellow and red. The colour depends on acceptable level of fat, salt and sugar in the food. Red colour indicates high level, it means attention, use from time to time. Orange or yellow one (medium level) is for using during the extended period. And green colour (low

level) is for utilizing in any amount. According to the Regulation No 1829/2003 operators, placing pre-packed food on the market produced from GMOs, should facilitate inscription on the label with the following words: "This product contains GMOs" or "This product is genetically modified organisms (name of organism)".

According to the Regulation (EU) No 1169/2011 on the provision of food information to consumers, the provision of food information aiming at improvement the quality of products distributing of the internal market of the European Union, as well as raising the level of awareness concerning healthy nutrition. Thus, together with traditionally providing information you should facilitate not only the energy value, the amounts of fat, carbohydrate, protein, but also the content of saturated fat, hydrogenated fats, sugar and salt. Therefore, the consumer makes a conscious choice of a food product, making safe use of food or harmful one.

Among the current terms should be set maximum levels for certain contaminants (nitrates, heavy metals) in vegetables of the EU indicating in Regulation (EU) No 1881/2006 and a list of products controlled the maximum permissible residual level of pesticides (Annexes to the Regulation No 396/2005). Active substances can be used in plant protection products under condition on including them to the EU pesticide database according to the Regulation (EU) No 1107/2009.

Whether food products are produced in the EU or imported to the EU the following types are controlled: plant products, foods of animal origin, fresh meat, game and poultry, meat products (semi-prepared food, minced meat and others); milk and dairy products; poultry meat; fish and fishery products; other foods of animal origin (eggs, honey, gelatin, snails, frogs' legs, blood and blood products, bones, edible coating, dissolve grease).

It should be denoted that Ukrainian enterprises have a permission for exporting to the EU only such foods as milk and dairy products; fish and fishery products; eggs. Only 106 food producers may export through the EU territories, in particular, producers of poultry, fish, honey, eggs, milk and dairy products.

Hence, according to the conducted research the EU food requirements are contained both in a number of regulations, decisions, directives and other documents of European governmental structures, and at the level of the international standards. quality Requirements of the quality refers to the sphere of manufacturer competence throughout the quality standarts' management at the level of the enterprise's management. Therefore, the food safety is a key factor for enterprises' entrance to the EU market.

It can be yeilded macro and micro levels in compliance with the EU demands for food quality and safety among the main domestic enterprises' issues (Fig. 2).
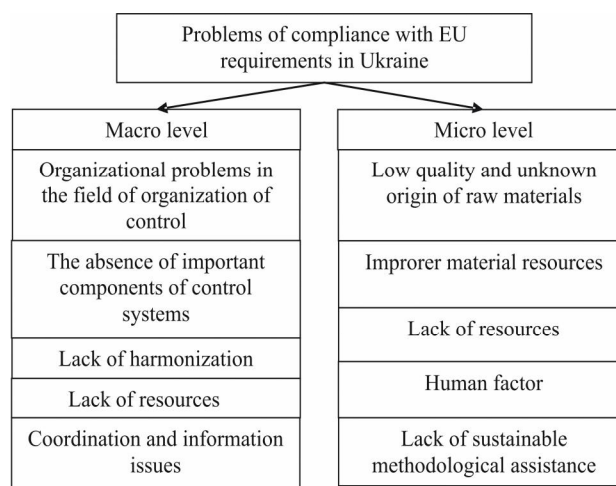
Fig. 2. Main domestic enterprises' issues in compliance with the EU demands for food quality and safety

Compliance with the EU requirements for the food quality and safety by Ukrainian enterprises will provide a number of advantages and new opportunities. Particularly, it can be highlighted the following benefits:

– protection of the consumers' rights and interests providing the opportunity to receive safe products and maintaining their health;

– enterprises will be gained in effective produc and expanding marketing boundaries;

– investment increasing, allows companies to be more profitable and remunerative;

– competitiveness of the country as a whole will provide favorable conditions for Ukraine's economy development.

Conclusion

Compliance with the EU requirements for the food quality and safety in Ukraine requires the circulation and application of special system upon control quality, particularly HACCP ensuring the competitiveness of domestic products in the EU markets.

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Relevance of implementation of the system of technical ISO quality control by companies in the agricultural sector

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Abstract: The authors substantiate the necessity of introducing a quality control system in agricultural sector enterprises under market economy conditions. A number of problems that may arise during the development and implementation of the quality system at the enterprise are highlighted. Possible solutions to these problems are suggested.

Keywords: quality, quality control, standards ISO 9000 agro-industrial sector, harmonization of technical regulation and quality standards.

I. Introduction

The liberalization of foreign trade, Ukraine's accession to the WTO and further accession to the EU against the background of transformations problems of domestic enterprises and the steady growing demand of international markets for organically-produced products have led to the domination of the agro-industrial sector in the domestic economy.

In the context of the development of international trade and related activities, all enterprises and sectors of the economy in the domestic and foreign markets are fully dependent on the fact that their products meet the world standards of quality.

Therefore, one of the main tasks of the Ukrainian economy is to ensure and increase the quality control of products at agricultural enterprises. The success and effectiveness of the foreign economy of our country depends to a large extent on its solution.

Domestic experience of integrated quality management serves as a good basis for the development and mastering of international ISO 9000 quality standards, the main feature of which is the possibility to be used by any enterprises and organizations, regardless of their size of ownership and sphere of activity.

II. The main material

The agro-industrial complex of Ukraine is one of the largest and most important sectors of the economy. The level of its development depends on the financial and food security of the state, the development of domestic and foreign markets. Today, the agro-industrial complex of Ukraine provides 95% of food resources, and over 2/3 of the consumption fund is formed at the expense of its products. Agriculture accounts for about 18% of the total gross national product. In 2006-2016, the volume of gross agricultural output increased from UAH 151 billion to UAH 252.8 billion [1].

The country faces serious challenges in creating economic conditions that would stimulate the growth of agricultural production of the required quality, a significant increase in investment in agriculture, the implementation of long-term programs of mechanization, automation, the use of chemistry in agriculture and livestock husbandry, the development of agricultural science, the improvement of forms of production management, procurement, processing and distribution of agricultural products. Important role in solving these challenges is played by the introduction of an international system of technical quality control ISO.

The signing of the Association Agreement between Ukraine and the EU countries, as well as the creation of the Free Trade Area (FTA) with the European Union under this Agreement and the harmonization of standards, are important factors in the development of the agricultural sector. This will allow Ukraine to open up the prospects of gradual development of the EU market by domestic companies, raising the level of quality, safety, environmental characteristics of Ukrainian agricultural products, improving the food security of the state, changing the Ukrainian legislation in the field of technical regulation in line with the European one, which will reduce the non-tariff trade barriers with third countries.

An important stage in the output of Ukrainian goods to foreign markets is the introduction and quality control of products. This aspect has several advantages, namely:

1) for the state: opportunities for entering foreign markets, development of enterprises and branches of the economy, as well as increase of tax revenues, reduction of unemployment, etc.;

2) for enterprises: improving the quality of products, the emergence of foreign markets, the introduction of new production technologies;

In general, the operating system of quality control in the food industry must meet some specific tasks. One of the tasks is to ensure compliance with sanitary standards and compliance requirements of the legislation, including with regard to food safety standards, the Good Manufacturing Practices (GMP) and the system Hazard Analysis and Critical Control Points (HACCP). The new regulatory guidelines of Ukraine should be based on the latest, most effective achievements of science, technology, and advanced technologies.

The discrepancy of Ukrainian products with world standards is one of the main threats to the development of the domestic agro-industrial sector, as this factor becomes the main barrier between the internal and external market for the period of harmonization of national technical regulations and standards. This leads to a reduction in the profits of Ukrainian small and medium-sized agricultural enterprises, as well as to weakening the competitive position in the domestic market of certain types of Ukrainian products in comparison with the European one, which has already been properly certified.

The Association Agreement allows domestic companies involved in the production, processing and marketing of livestock products, cereals, sunflower seeds and sugar beet enter the EU countries market with quotas [5].

In the near future, it is impossible to fill the established quotas for this product, since, for example, the vast majority of animals are kept by households (as of 07.01.2016, the household kept 71.6% of the total cattle population, including 77.7 cows %, pigs – 53.1%, sheep and goats – 87.0%), who are not able to use modern production technologies, which leads to its poor quality and non-compliance with European sanitary norms and standards. Standards on feed and feed additives have a significant impact on husbandry productivity and the quality of husbandry products. The standardization of feed, protein-vitamin supplements, and feed additives produced by the industrial process is of great importance for the commercial cultivation of animals and poultry.

For the vast majority of domestic small and medium-sized agricultural enterprises, there are also problems in ensuring compliance of their products with European standards, as processes of harmonization and adaptation of legislation in the field of technical regulation and sanitary and phytosanitary measures require not only long time but also considerable material resources. For example, the total cost of adapting to the EU standards of the Polish meat industry was about 2 billion euros [3].

The analysis of the current state of standardization of agricultural products shows that there are 566 national standards in force in Ukraine, of which 64.8% meet the requirements of international or European standards, which cannot be considered satisfactory.

The process of introducing international standards of safety and quality of food products in Ukraine is at a critical level. Thus, there is an urgent task to develop mechanisms of state policy in order to increase the efficiency of using the existing potential of the agricultural sector of the economy including its adaptation to new conditions and taking into account possible risks arising from the liberalization of foreign trade relations.

Conclusion

Based on the research material, it can be concluded that progress and economic development are impossible without guaranteeing an increase in quality standards, which cannot be achieved without the use of a perfect quality management system

Implementation of the quality control system under the ISO 9001 standard in national agricultural enterprises provides broad prospects for the development of foreign markets, improving the environmental quality of products and improving the condition of food security of our country.

To accomplish this task it is necessary:

firstly, to implement the requirements of EU directives and regulations concerning agriculture and food industry in Ukrainian legislation, as well as at least 80% of the current European standards;

secondly, in order to minimize the risks, implement a number of measures of the state agricultural policy that will provide conditions for increasing the competitiveness of the agricultural sector and protect the national producer from displacement from the domestic and foreign markets, for example, to intensify work with international donor organizations (EBRD, USAID, World Bank, etc.) on the development and implementation of technical assistance projects in order to harmonize the national system of technical regulation and standards in agricultural production with European and international standards (HACCP, ISO, EN, Codex Alimentarius);

thirdly, to initiate the development with the further dissemination of recommendations on the introduction by the agricultural producers and processing enterprises of the necessary changes in economic and production activities, which will lead to the confirmation of their products and production processes to European and international standards of quality and safety;

fourthly, to provide balanced and interconnected structural adjustments of all branches of the agro-industrial sector of Ukraine, while maximizing the latest achievements of scientific and technological progress, world experience and making use of the most progressive forms of economy.

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Features of environmental labeling in Ukraine

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The essence of ecological labeling and the procedure for its implementation in Ukraine and in the EU are explored. The main purpose and the necessity of environmental labeling are substantiated. The characteristics of the most popular eco-labels are given.

Keywords – environmental labeling, ISO, DSTU, EU, environmental signs.

I. Introduction

Nowadays, more and more Ukrainian consumers prefer goods of high quality and safety. A reliable benchmark for choosing such products is the environmental marking. Yes, environmental labeling provides the consumers with information about the import of the product on the environment trough the disclosure of data about ways of its production, packing, transportation using and also liquidation after using.

Since companies work to profit and increase their competitiveness, the environmental labeling is one of the possible ways to achieve there goods of enterprise. The analysis of research and publications, that this problem, has shown that this topic is mainly developed by western scientists. In Ukraine, well-known scientists who addressed their attention to this problem were: L. G. Melnyk, M. K. Shapochka, V. Ya. Shevchuk, Y. M. Navrotsky and others. However, particular features of the need for environmental labeling are still not fully reflected.

II. Main part

In an effort to meet the current needs of the consumer, most manufacturers want to emphasize the quality of their products, using such designations as: "ecological", "natural", "environmentally friendly", "organic", "bio", etc. However, only certification confirms the conformity of products, goods and services to the requirements of environmental standards.

Environmental labeling is a set of environmental information on products, processes or services in the form of text, individual graphic, colored characters (symbols) and their combinations, which are applied directly to the product, packaging (container), label, label or in the accompanying documentation [1].

The right to use the marks of environmental labeling can only be obtained by an enterprise that has undergone an examination in state structures or environmental organizations and has proved the ecological safety and high quality of its products.

For the first, the use of environmental labeling has been recommended at the World Summit in Rio de Janeiro in 1992. It should be noted that the main objective of the environmental labeling is to stimulate the market's impact on the improvement of the environment, namely, the prevention of environmental pollution in the production and use, and, above all, the ability to reprocess.

Environmental labeling, which is based on the qualitative advantages of products in relation to negative impacts on human health and the environment, is enshrined in the international standard ISO 14024 (since 2002 it has been introduced into the state standardization system of Ukraine – DSTU ISO 14024) and is classified as "voluntary" [3].

Requirements for the assignment and application of environmental labeling in Ukraine, procedures for the development and revision of environmental criteria are established by the Technical Regulation on environmental labeling, approved by the Resolution of the Cabinet of Ministers of Ukraine dated May 18, 2011 No. 529 [2].

For the application of environmental labeling of its products, the facility is required to undergo a procedure for assessing the conformity of products with the established environmental requirements in the body of environmental labeling.

An environmental labeling body, after submission by the business entity of a complete package of required documentation, issues it to him in accordance with the established procedure (subject to publication of measures on the implementation of environmental criteria and on the basis of a positive decision on the results of conformity assessment of the products with the established environmental criteria) issue an environmental labeling certificate that has a registration number, and concludes the agreement on the right to use the environmental marking for the validity period of the mentioned certificate.

The Ukrainian mark of environmental marking depicts a stylized green creeper sprout against the background of the Earth, and symbolizes life on our planet. For more than 10 years of its existence, around the people it has been called "Green Crane". Under the sign there is the code of the ecological standard for which the products marked by him have passed the certification. An enterprise has the right to place environmental labeling on products only after the conclusion of the agreement on the right to use environmental labeling with the mandatory indication of the registration number of the certificate of environmental labeling! [4]

The EU also needs environmental certification. According to international, European practice, only those food products whose production complies with the requirements of the European Organic Production Law can pass voluntary environmental certification. That is, there must first be an organic certificate. Eco-labels for non-food products, goods and services do not have such stringent requirements. This is done in order not to mislead the consumer.

The main types of environmental labeling of the EU include:

1. "Flower" – the EU ecological mark. Today, the EU's environmental labeling covers a wide range of products and services.

2. "North Swan" – the first international system of environmental labeling, established in 1989

3. "Blue Swan" – the most popular sign in Europe, which was first used by the Federal Republic of Germany in 1977.

4. The mark of a crossed-out tire on wheels – which containing dangerous substances, means that the waste products do not belong to household and they can not be emitted simultaneously with domestic waste.

It should be noted that all manufacturers of environmental products should use the EU logos on their packaging. The advantage of this logo is that consumers will be able to easily identify an ecological product, regardless of which country it would be brought.

Since, in most modern products, the source of information about them is packaging, then most of the exporter is placed on it. Accordingly, the existing eco-labeling on the package can be divided into the following groups:

1. Signs that prompt or call for the preservation of the environment. The content of these signs is to summon calls, to keep clean and to hand over the relevant items for recycling.

2. Signs that denote the environmental friendliness of the subject as a whole or from individual properties. Along with eco-labels that exist at the nationally and internationally, there are also so-called eco-labels that are created directly by the firm.

3. Signs reflecting the danger of the subject for the environment and is of the intersection of preventive and eco-labeling.

If must be noted, that the environmental labeling should include the following basic information for the consumer, such as: complete information on the environmental friendliness of products in general, which should take into account the entire life cycle of its production; providing information on the environmental friendliness of individual product properties; information for identifying natural feeding.

The International Organization for Standardization ISO distributes environmental labels to the following types:

1. The type of environmental labeling, according to which products have the right to obtain environmental labeling only if it has undergone environmental certification. This type of environmental labeling is defined in DSTU ISO 14024: 2002 [5].

The E-marking of type I is made for different groups of goods and services and may consist of separate or combined elements in the form of: allegations that characterize the product or indicate its superiority; graphic image (eco-label).

2. The second type of environmental labeling (the declaration itself), according to which the marking to the specific ecological characteristics of the products. The basic principles of applying type II eco-labeling are set out in the standard ISO 14021 [5]. So, an example of environmental labeling of Type II may be: "content of recycled material", "suitable for recycling", "suitable for composting", "diversified design", etc.

3. The third type of environmental labeling, which provides information in the form of quantitative environmental indicators to the selected product unit of a particular category at all stages of its life cycle, which is reduced to the form of a technical report prepared by an independent expert organization. The methodology for research, calculation of environmental indicators and the preparation of a technical report is set out in ISO / TR 14025 [5]. So, enterprises independently determine the type of environmental labeling, but with obscure or inaccurate environmental labeling, or eco-labeling, which can not be verified or the is a likelihood of misunderstanding is interpreted as a violation of the current legislation in the area of consumer rights protection, advertising and protection of competition in entrepreneurial activity.

Conclusion

Environmental labeling of goods is the basis for providing consumers with information on the degree of environmental friendliness of the product, it contributing to the selection of quality and safe products; and for the enterprises-manufacturers the possibility of expansion of the market and increase of competitiveness.

Thus, the environmental labeling of products in Ukraine is a guarantee of the success of the enterprise; reducing the negative impact on the natural environment and reducing the negative impact on the health of consumers.

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Importance of use international standarts of quality in Ukraine

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Abstract – The article substantiates the importance of application of international standards of quality ISO series 9000 at domestic enterprises. The problem, principles of international standards of ISO series 9000 has been substantiated. The advantages and deficiencies of ISO 9000 international quality standards have been proved. The characteristic of the main international standards of quality of ISO series 9000 is presented.

Keywords – quality, products, ISO, standardization, competition, management.

I. Introduction

The process of Ukrainian integration into the world community establishes new demands to the work of home enterprises with the aim to provide high quality of goods. The process of harmonization and implementation of international standards ISO 9000 Series aims to build a quality management system as a set of processes with the tools of their managing. Such a policy, in turn, will ensure the proper level of product quality.

The main principles of the theoretical substantiation of the quality management system are described in the works of such Ukrainian scientists as R.V. Bychkivsky, O. I. Momot, V.M. Novikov, T. Z. Bubeli, M. M. My-kiychuk, P.G. Stolyarchuk, P M. Trysch, G. M. Trisch, S. S. Zinina, A. V. Gunkalo and in the works of such foreign scientists as F. Crosby, V. Shuhart, V. Deming, K. Isikava, G. Taguchi, D. Dzhurana A. Feigenbaum, D. Harrington, T. Box and others.

II. Main part

Nowadays the quality of products is considered to be one of the most important conditions of economic development because the pace of industrial growth of the country, the efficiency of labour resources, the success of foreign trade and also national prestige of a country depend on it. The quality management systems, which would meet declared international requirements and stimulate the process of continuous improvement of production, need to be applied to domestic enterprises to enter the world markets with a tough competition. The system of quality assurance of products should cover all divisions of the enterprise and aspects of its activity, and also be based on the usage of the provisions of the standards of the international standardization organization of the ISO 9000 series. These international quality standards are one of the ways to manage the enterprise activity in order to ensure its effectiveness. The application of these standards in the enterprise management system helps to solve many problems:

However standardization in accordance with ISO 9000 standards is not obligatory for enterprises-manufactures, it is an important entity of success in many domestic and external markets.

ISO 9000 standards designed by International Organization for Standardization is the most common family of quality management systems standards (QMS). Standard family is formalization manual for quality management systems concerted in an international scale. They describe an effective quality management system, in which all processes and actions are controlled and documented.

The main ISO 9000 standards are [1]:
- – ISO 9000:2015 Quality management systems – Fundamentals and vocabulary. Given standard is an introduction to other three key standards in the family. It plays an important role in understanding and application of the whole family of QMS standards, since it determines main principles for enterprises and defines main terms, which are used in QMS family of standards [1].
- – ISO 9004:2009 Managing for the sustained success of an organization – A quality management approach. ISO 9004 provides guidance to organizations to continuously improve QMS to meet needs and expectations of all stakeholders, including consumers, organization personnel, owners and inspectors, manufacturers and partners. Standard is intended to improve QMS. Requirements of ISO 9004:2009 were not designed for certification since initiative of implementations of this standard must originate from the enterprise itself [3].
- – ISO 19011:2011 Guidelines for auditing management systems. Standard 19011 provides guidance adjustments on basics of audit, auditioning management systems of QMS and environment, as well as guidance on the evaluation of competence of individuals involved in the audit process of QMS and environment. Given standard is applicable to all auditors and organizations that need to conduct internal or external audits [4].

The principles, set out by the ISO Committee for the Development of Quality Standards, contribute achieve the quality objectives.

1. Consumer orientation:
– understanding of existing consumer needs;
– understanding of future consumer needs;
– satisfaction of the requirements of the consumer;
– trying to exceed consumer expectations.

2. Leadership:
– the unity of goals and orientation of the organization;
– establishing an appropriate internal environment in the organization.

3. Involving staff:
– full development of abilities;
– employing the abilities of the staff to the fullest extent possible to achieve the goal.

4. Process approach. To function effectively, an organization must identify and manage numerous, interconnected activities. Activities that use resources and which can be managed to convert "inputs" to "outputs" can be considered as a process.

5. System approach to management:
– determination;
– understanding;
– managing the interrelated processes of the system for the productive and effective achievement of the goal.

6. Permanent enhancement / improvement:
– improving your work – as a permanent goal.

7. Decision making based on facts:
– analysis of data and information from the point of view of the laws of logic.

8. Mutually beneficial relations with the supplier (for commercial enterprises).

Thus, the main advantages of implementing the ISO series 9000 are:
– increasing recognition through standards;
– worldwide accessibility of standards in many languages, which facilitates the expansion of communications between multinational consumers and suppliers.

The compliance with the requirements of ISO 9000 series do not mean that each product or service meets the requirements of the consumer: this means that the quality system used is capable of satisfying the requirements of the consumer.

Despite these important advantages of introducing a quality assurance system, domestic enterprises face a number of problems that slow down this process.

We can add to them the fact that the system, developed on the ISO standards of the 9000 series, is not a harmonious component of the enterprise management system in many cases. There is a lack of skilled personnel who could create a quality management system for a particular enterprise, taking into account all the factors of influence in which the company operates, as well as the high cost of work on the development of this system and the certification process.

It is noteworthy that the quality assurance system, based on the standards of the ISO 9000 series, does not require the creation of an entirely new system in the enterprise. Any enterprise has a certain management system based on unwritten rules and traditions, according to which the personnel performs the necessary actions, registers and analyzes their results, takes measures for elimination of failures in work. That is, in fact, certain quality management procedures specified in ISO 9000 standards are actually being implemented in enterprises, but they

may not always be appropriately or in some way different from the established requirements. The system of quality assurance of products, its functioning is impossible without ensuring its normative documentation. At the level of the individual company, the normative documentation should be formalized in the form of management organization standards (MOS). The basis for the development of the MOS is the requirements of the normative documents of the State Consumer Standard of Ukraine. The provisions of the current technical regulations, state and industry standards are the normative basis that enables the company to provide the specific content of the MOS for the functioning of the quality management system.

Conclusion

For the adaptation of the Ukrainian economy to the world economic system to enhance the competitiveness of enterprises, the practical application of ISO 9000 standards can be of great help. The ISO 9000 International Quality Standards are designed for market conditions, their main advantage is a customer orientation, the main difference between these standards and those previously operating was their focus not on product quality management, but on managing processes for its creation and optimization of these processes.

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Research of infiltrates content of landfills of hard domestic wastes (HDW) (on the example of Lviv landfill)

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Abstract – work investigated composition of infiltrates of Lviv landfill HDW. An estimate is given of his influence on an environment and a microbiological analysis was conducted of the formed culture in infiltraty after pre-clean it by aeration .

Keywords – infiltrate, landfill of hard domestic wastes, maximum permissible concentration, microbiological culture.

I. Introduction

Cleaning problems of infiltrate of dump and landfill HDW appear on all period of planning, exploitation and planned closure of these facilities. At the design stage, as usual, is being implemented innovative cleaning technology collected by the drainage system infiltrates, performance of which corresponds to the calculation. In the period of exploitation priorities in choosing of cleaning system for infiltrates depend on the history of exploitation, condition of systems for collecting infiltrates and the type of object (dump or landfill). What applies to functioning of cleaning systems of infiltrates at the stage of closing landfills of HDW, it should be noted, that the cleaning system in the overwhelming majority of such objects absent at all, and quite often uncontrolled leak of infiltrates has led to the accumulation of significant volumes of them in cumulative ponds.

II. Danger of environmental pollution by infiltrates of Lviv landfill of HDW

Infiltrates of landfill are dangerous pollutants of the environment, in the zone of their influence practically all storage places of HDW in Ukraine. As for the ecological condition of the territory of Lviv landfill of HDW his condition is assessed as critical and even catastrophic, because of the volume of accumulated infiltrates. According to various estimates, their quantity is within 100-120 thousand m^3.

Infiltrates of Lviv landfill of HDW is formed in a garbage body as a result of infiltration of atmospheric precipitation, exit of neogene and groundwater in the sides of the ravines, also because of the complex biochemical processes of decomposition of organic parts of the rubbish. The filtrate layer in the garbage body forms a saturation zone and is unloaded at the foot of the garbage body. [1].The filtrate flows through the drainage channels into the ponds – collectors. Infiltrate has a brown and dark brown color, unpleasant rotten smell, increased viscosity, caused primarily by high content of hovering substances.

Analysis of Lviv landfill of HDW about his impact on the environment testifies to that, that the landfill and especially its infiltrates, have a very negative impact on the environment, particularly on soil and groundwater. Based on the results of calculating the toxicity indices of infiltrate ingredients of Grybovychi landfill it is possible to do such conclusions. Since the absolute value of the index of toxicity of a single ingredient is determined by the value of its MAC in the soil, and its concentration in the infiltrate, then the smaller the toxicity index, the more safe is infiltrates. The hazard class of the of the infiltrate of Griboovitsky landfill – I, and a degree of danger – extremely dangerous [2]. The degree of exceeding of the maximum permissible concentrations (MAC) of pollutants in infiltrates is given in table 1.

TABLE 1

EXCEEDING OF MAC OF POLLUTANTS IN INFILTRATES OF LVIV LANDFILL HDW

Indicator	Excess of MAC for water objects, times		
	Pond-storage No. 1	Pond-storage No. 2	Pond-storage No. 3
Dry residue	21	17	14,8
Magnesium	4	4,6	6,2
Chlorides	12	11,6	8,8
Phosphates	213	84	62
Ammonium nitrogen	565,5	275	240
Nitrogen nitrate	2,6	2,5	2,3
Petroleum products	171	119,7	133,3
Biological oxygen consumption	419,3	315	233
Chemical oxygen consumption	300	279	293
Phenols	7330	5130	5940
Heavy metals			
Iron	3,5		
Plumbum	3,7	2,6	2,8
Nickel	1,7	1,3	1,4
Chrome	13,6	6,6	9,4
Cadmium	32	23	25

As can be seen from the presented material the biggest excess observed for ammonium nitrogen, BOC and COC.

III. Research results

For the revious cleaning of the accumulated infiltrates our attention was attracted by technology, which is realized in an aerobic environment in conditions of an aerated lagoon. We conducted research of aerobic purification of the infiltrate of Griboovitsky landfill on a laboratory installation, the working volume of which was 4 liters. Through laboratory aerator in the bottom part of

the flask air was served with discharge 1 l/min. The initial leachate parameters were: pH – 8,64; concentration of ammonium anions – 650 mg/l; a temperature was constant in limits – 13-15 °C. After a certain time period samples were taken, for which the above mentioned parameters were determined. By this study determined maximum degree of purification of infiltrates, which can be achieved in the process of aerobic biological oxidation under the conditions of the experiment's implementation.

We also conducted a microbiological analysis, formed in infiltrate biocenosis, what set wide range of microbiological aerobic culture (fig. 1, 2), which is different from the culture of activated sludge of municipal wastewater treatment plants.
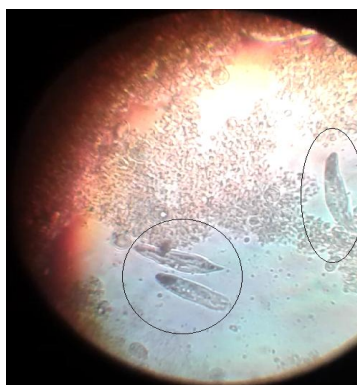
Fig.1 Microorganisms of the type *Stylonychia,* of subspecies *Hypotrichida*.
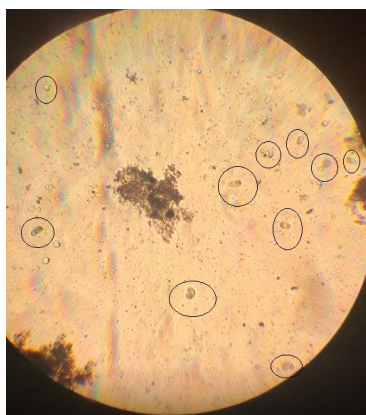
Fig.2 Microorganisms of the type *Hymenostomatida,* of subspecies *Peniculina.*

Also in the infiltrate were found a large number of cysts of helmints (fig. 3).

Fig.3 Photo of infiltrate under a microscope with a large number of cysts of helminths

Conclusion

A temperature condition in which the experiment was conducted (13-15 °C) is the most favorable for the development and formation of active sludge bacteria, which develops in infiltrate.

Research with more accurate identification of formed microbiological culture (peculiar active sludge infiltrate) after his previous cleaning is continued.

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Analysis of the environmental impact Ltd." Tarkett Vinisin" Kalush

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In the thesis work considered analysis of the environmental impact Ltd. "Tarkett Vinisin" described Technological processes producing parquet strips (lamellas) and friezes for parquet and made general characteristics of Kalush and Company Ltd. "Tarkett Vinisin".

Keywords − Ltd. "Tarkett Vinisin" emissions, discharges, environmental impact.

I. Introduction

Ivano-Frankivsk region is located in the west of Ukraine, near the geographical center of Europe. Its territory lies in the middle latitudes, the temperate climatic zone.The presence of hazardous industrial facilities in the Ivano-Frankivsk region, which are powerful pollutants, causes a large anthropogenic load on the environment.

"Tarkett Vinisin" plant is the only manufacturer in Ukraine of high-quality tuft coating for flooring, as well as textile textured yarn for the production of tuft coating, classic jacquard carpets and carpet products. The «Tarkett Vinisin» plant is a modern factory built with the latest imported equipment.

II. Characteristics of the technological process of production of parquet slats (lamellas) and production friezes for parquet

Production of parquet lath (lamella) is a division of production of parquet Ltd." Tarkett Vinisin ". The raw material for the production of parquet lath is a frieze for parquet.

In its properties, the frieze meets the requirements of Regulation No. RP – T – 01 and GOST 2695 "Sawn softwood". The freeze is manufactured in accordance with the requirements of technological regulations No. RP-T-01.

When processing non-planed friezes and further its rozpiltsi during the year, 1,440 tons of sawdust waste, which is compressed into briquettes and used as fuel.

In the technological process of lamella production, there are no chemical processes associated with the conversion of chemicals. The technology of lamella production is based on mechanical processes of wood processing.

Emissions of harmful substances into the atmosphere.

In the process of lamella production, wood dust is released into the atmosphere in the amount of 0.0135 tons per year (0.0374 g / s). Emission hazard class – 4.

MPC – 0.5 mg / mcub. The aggregate state is a (solid suspended particles).

The discharge is carried out through a pipe 8.0 m high, 0.4 m wide. The discharge speed is 9.55 m / sec, the emission volume is 1.2 m. Cubic / sec.

For the protection of atmospheric air, air purification is provided in two chain filter-recirculation units with a productivity of 50000 m. Cubic / h each, the purification efficiency is 99.0%.

Liquid wastes and wastewater.

There are no technological liquid wastes at production.

Domestic wastewater and rainwater are diverted to the existing networks of Ltd." Tarkett Vinisin ".

Solid wastes and their disposal.

Solid waste of wood is formed at the enterprise in the form of friezes, lamellas and sawdust, which is pressed into fuel briquettes, and is subsequently used as fuel.

With scheduled or unplanned production stops for repairs, as well as in other unusual situations associated with temporary or complete shutdown of production, emissions of harmful substances into the atmosphere and into water bodies are impossible.

The production of the frieze for parquet is a subdivision Ltd." Tarkett Vinisin ".

Protection of the environment: The stage of drying wood.

There is no solid waste at the drying stage.

Industrial waste water is not formed.

The moisture that evaporates from the wood is dried, drained by the ventilation system of the drying chambers.

Technological emissions are absent.

Water boiler house.

To provide the process of drying the wood with a heat-transfer medium, a boiler-house is provided. Two boilers with heating capacity of 1.0 MW are installed in the boiler house.

The thermal power of the boiler house is 3539 Gcal / year, the annual flow of gas 449 911 m. Cu. per year.

Emissions to the atmosphere.

Possible emissions of harmful substances into the atmosphere:

− nitrogen dioxide: 0,287 g / s; 1,8672 t / year

− carbon monoxide: 0,0422 g / sec. ; 0,2747 t / year

For the removal of flue gases from boilers one chimney is provided with a height of 12 m and a diameter of 630 m.

Solid waste.

Solid waste is absent.

Sewage

There are no wastewater in the water body.

Production waste water in the amount of 0,548 m. Cubic meter / day enters the purge well and then into the wrecker, from where periodically it is taken out by special vehicles to the treatment facilities of ZAO Lukor.

Other potential sources of environmental impact.

The noise level is less than 80 dB, ultrasound, vibration, electromagnetic waves, ionizing radiation are absent.

Conclusion

The enterprise belongs to the second group of facilities according to the composition of the Documents, in which the volumes of emissions are justified, depending on the degree of the object's influence on the atmospheric air pollution. «Tarkett Vinisin» LtD has developed and operates an environmental management system that complies with all the requirements of the Ukrainian legislation and is in compliance with the main provisions of the ISO 14001 standard. This system defines the main general objectives and principles of the company's environmental behavior and also the company's responsibility for environmental protection at all levels.

The design capacity of the factory is 4 million square meters. tuft in a year.

At the enterprise of LLC "Tarkett Vinisin" there is an integrated management system. The system of standards ISO 9001 is introduced; ISO 14001; BS OHSAS 18001.

According to the introduced standards 350 tons of solid polymer waste PVC linoleum, 25 tons of solid polymer waste PE packaging 40 tons of solid waste of cardboard packaging, 200 tons of wood waste and wooden pallets were sent to the company for processing, 500 cubic meters of liquid waste water were sent for cleaning, approval and receipt in state bodies – the Ministry of Ecology and Natural Resources of Ukraine, the Ministry of Health of permits for the formation and utilization of solid waste products, harm s Spanish maids in the atmosphere, rain, economic and technological waste, as well as the certification for safety for the environment Equipment for the production of slats.

«Tarkett Vinisin» LtD annually schedules the amount of harmful emissions, waste water, waste and also the quantity of consumed energy resources (drinking and economic water, electricity, fuel) required for the activity of the enterprise, according to the approved technological regulations and norms. indicators and is constantly working to reduce both the amount of harmful emissions, waste water, waste and the reduction in the amount of energy consumption.

The amount of technological emissions, waste and waste, energy resources is determined by technological regulations of production and is annually agreed and approved by the department of environmental inspection and the governor of the region. The company quarterly reports on the state of environmental protection and the amounts of generated harmful substances.

The control of the enterprise in the environmental sphere is carried out by the regional department of the ecological inspection and the regional bodies of state sanitary supervision. Qualitative and quantitative composition of harmful emissions, process wastes and wastes as well as noise, vibration, dust levels, and lighting quality at workplaces are monitored by state sanitary inspectorates in accordance with technological regulations for the production of products and current legislation. Technological effluents are sent to special treatment facilities for existing communications. Technological water contaminated with latex is recycled into the process. Solid technological waste products and solid household waste are sent to a specialized waste landfill. The enterprise constantly reduces the amount of solid waste and process effluents due to their processing as secondary raw materials at other enterprises. Wastes from fuels and lubricants, thermal oils, used lamps and other substances and objects of concern to people and the environment are transferred to specialized enterprises for processing.

For all types of chemical raw materials and finished products of the enterprise there are safety certificates of Ukrainian type (for finished products – linoleum of PVC and textile covering also passports of sanitary and hygienic safety of Russia and Belarus). All raw materials and finished products are preliminarily approved and verified by the sanitary and hygienic supervision authorities of Ukraine before use in production.

All production, construction, design work (including the choice and environmental condition of the land), which are conducted at the enterprise, are agreed and controlled by the state environmental authorities, sanitary supervision, fire safety, labor protection inspection. Violations of the current legislation in the field of environmental protection, environmental accidents at the enterprise have not been since the beginning of work.

The policy of the company "Tarkett Vinisin" is devoted to the protection and preservation of the environment. It will continue to make its contributions to the preservation of our ecosystem through the adoption of responsible and transparent business decisions and activities that include the protection of the environment.

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Adsorption of Cu^{2+} and Cr^{3+} cations by modified sorbents

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Abstract – the present article substantiates the theoretical bases of adsorption of heavy metals on modified adsorbents. The aim of this work was to study the simultaneous adsorption of copper and chromium cations on the surface and in the zeolite volume under static conditions. The regularity of the change in the amount of absorbed copper and chromium cations by a zeolite in the initial solution was established. It was settled the chromium ions were better adsorbed on zeolite modified by phosphoric acid. It was established that adsorbents modified in acid conditions were more selective to heavy metals then zeolites modified by NaOH .

Keywords − adsorption, modified sorbents, heavy metals, waste waters, external diffusion.

I. Introduction

Heavy metals are considered as hazardous pollutants due to their toxicity, even at low concentrations and inability to biodegradation. Increasing the level of heavy metals in natural reservoirses poses a serious threat to all living organisms, including humans [1,2]. It is important that the concentration of heavy metals in waste waters waters before dumping in the reservoir does not exceed the MPC. The most common methods available for reducing the concentration of heavy metals are chemical deposition, ion exchange, adsorption and reverse osmosis. Taking into account the characteristics of the crystalline structure of zeolites this adsorbents are capable to absorb only metal cations, and the chemical modification of the internal surface of the natural sorbent expands the range of sorption capacity of zeolites in relation to anions and nonpolar organic compounds.

The modification process consists in the reaction of ion exchange of the exchangeable cation of surface with exchangeable cations of the inner surface of the zeolite, for example, by aliphatic quaternary amines, acid activation of the natural sorbent, and the like. Previous studies have shown that with a two-component system containing both ions of copper and chromium at the same time, it is possible to remove mostly only copper, which is significantly less toxic than chromium cations. In Ukraine, the MPC for copper according to the sanitary limit value of harm is 1.0 mg / g, for chromium trivalent 0.5 mg / g, for chromium hexavalent 0.1 mg / g. The purpose of this work was to create an effective sorbent for the removal of heavy metal ions and to study the process of simultaneous adsorption of cuprous and chromium cations on the surface and in the volume of modified zeolite under static conditions.

II. Experimental

Modification of natural clinoptilolite was carried out by acid method, consisting in processing samples with solutions of sulfuric, hydrochloric, phosphoric and acetic acids in a certain period of time during heating and stirring. This method of influence on natural mineral sorbents actually accelerates the processes occurring in the natural environment under the influence of air, water containing carbon dioxide, pressure for a long time (the process of chemical weathering in the zone of hypergenesis) [3, 4]. And also a solution of sodium hydroxide. The test material of a homogeneous fractional composition was obtained by sieving the natural clinoptilolite through a sieve with a cell size of 2-3 mm. For the acid modification of the sorbent, a solution of phosphatic acid (20%) was added in a volumetric ratio of 1: 2 (solid phase: solution), thoroughly mixed, and kept the suspension formed under normal conditions for 24 hours.

For alkaline modification of the sorbent, a solution of sodium hydroxide (20%) was added in a volumetric ratio of 1: 2 (solid phase: solution), thoroughly mixed, and kept the suspension formed under normal conditions for 24 hours. Solid phase was washed with distilled water in a volume ratio of 1:10 (suspension: distillate). After precipitating, the resulting precipitate was collected and dried at 105 ° C

For the study of the change in the chemical composition of zeolite after the adsorption of heavy metals from the liquid phase, natural zeolite – klinoptilolit Sokirnitsky deposit was used modified with 20% solutions of H_3PO_4 and NaOH. The model solution contained a mass of ions of cuprum and chromium in a ratio of 1: 1. The concentration of each ion in the investigated solutions was 0.01, 0.2, 0.4, 0.6 and 1 g / dm^3.

To the contents of each sample, weight of mofied zeolite was added, stirred and sealed. The adsorption process was carried out for 48 hours in a thermostat at a temperature of $20 \pm 0, 5°C$. After completion of the process, the solution was filtered, and the zeolite was dried to constant weight. The amount of absorbed ions of cuprum and chromium was determined by photometric method.

III. Results and interpretation

We carried out studies on adsorption of a mixture of copper or chromium ions on a modified sorbent. The following types of sorbents were used: clinoptilolite modified with sodium hydroxide and clinoptilolite modified with phosphate acid. We stadied that in spite of the fact that copper in the initial solution is bivalent and chromium is trivalent, selective removal of copper from a two-component solution takes place. We have established the possibility of the following chemical reactions in the adsorbent-adsorbate system at the same time: precipitation – dissolution of contaminants in the form of sparingly soluble precipitates (hydroxides, salts, complex compounds), ion-exchange and non- ion-exchange sorption and desorption on the active surface of the sorbent.

$a*_{Cr}^{3+},g/g_{ads}$
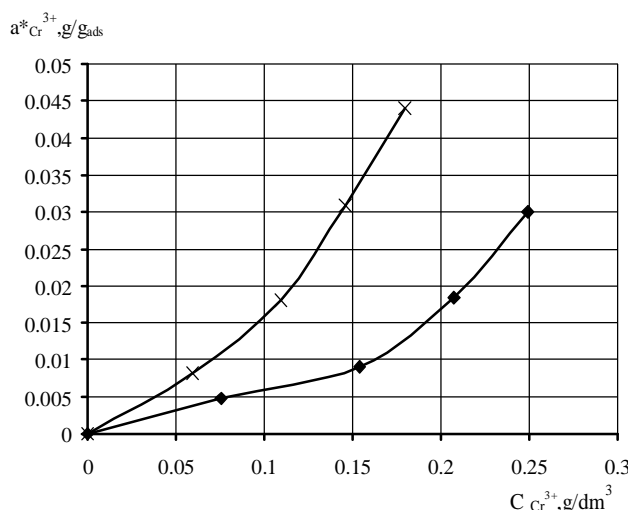
Fig.1 Isotherm of compatible adsorption of Cr (III) on modified sorbents: X – zeolite modified by H_3PO_4; ♦ – zeolite modified with NaOH

$k_{Cu}^{2+},g/g_{ads}$
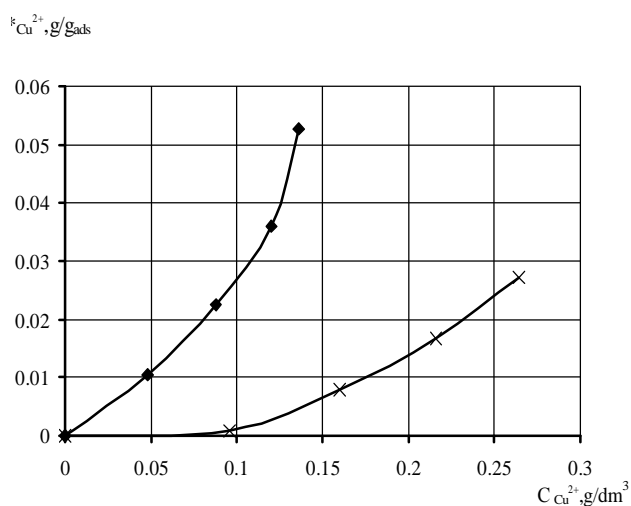
Fig.2 Isotherm of compatible adsorption ofCu (II)) on modified sorbents: X – zeolite modified by H_3PO_4; ♦ – zeolite modified with NaOH

The adsorption of ion-exchangeable ions on zeolite modified in alkali conditions was more intensive compared to phosphoric acid-modified sorbent.

Adsorption of chromium chromium ions passes intensively on the surface of the sorbent modified with phosphate acid. The comparison of the sorption isotherms presented in Figs 1 and 2 with the preliminary data [5, 6, 7] indicates an increase in the sorption capacity of the modified zeolite almost twice as compared with the naturally occurring sorbent.

The reason for this is the formation of wider pores as a result of the dissolution of the zeolite rock. This trend is confirmed by many researchers working in the field of modifying sorbents with mineral acids. It is indicated by the formation of a large number of mesos and macropores that allow absorbing large-sized molecules.

Conclusion

The expediency of using natural and modified sorbents due to high adsorption, ion exchange and filtration properties, as well as their prevalence on the territory of Ukraine and relatively low cost is substantiated.

On the basis of the analysis of experimental studies, the efficiency of the use of clinoptilolite, modified by acid activation as a sorbent of Cu (II) and Cr (III) ions from waste waters, was confirmed.

The sorption properties of modified zeolite against Cu2 + +Cr3 + ions have been checked. It has been established that the modification of zeolite with phosphate acid increases the capacity of zeolite in relation to heavy metal cations compared with natural clinoptilolite and zeolites modified by alkali. On the basis of the analysis of experimental studies, the efficiency of the use of clinoptilolite of the Sokirnitsky deposit, modified by the method of phosphate acid activation of natural zeolite as a sorbents of Cr (III) and Cu (II) ions from waste waters, was confirmed.

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Assessment of water resources in city Stryi of Lviv region

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Abstract – this paper is dedicated questions of assessment of water resources in city Stryi of Lviv region. Ecological and geographical characteristics of city Stryi in Lviv region were conducted. The analysis of water resources was executed. The determination of elemental composition in water samples was done in city Stryi of Lviv region. According to results of the research work, the assessment of the ecological state of water resources in city Stryi of Lviv region was done.

Keywords − analysis of the impact, water resources, pollution, ecological state, city Stryi.

I. Introduction

At present, the ecological pollution problem is one of the most important problem. Water pollution from human activities increases every day. The interest in water resources issues and the prediction of their impact on the health of the population is increasing throughout the world. The problem of supplying humanity with water is global, and for its solution, cooperation and coordination of the activities of all international organizations and states is required [1].

The problem of water pollution is the main processes that cause degradation of rivers, reservoirs, lake systems and deterioration of water quality. Although the main cause of both processes is the waste of business activity. Pollution of reservoirs by toxic substances of man-made origin often complicates or makes it impossible to use water for drinking purposes.

Prospects for solving water pollution problems are the formation of effective legal, economic and organizational preconditions for rational water use, the introduction of water saving forms of management, the establishment of closed water cycles with minimal pollution of water, and the restoring functions of water bodies [2-3].

Currently, the problem of providing quality of water resources is actual for every populated point of Ukraine, in particular in the city Stryi of Lviv region.

II. Results of the research work

The aim of the work is to assess the ecological state of water resources in the city Stryi of Lviv region using the results of the experimental research.

To achieve the goal, the following tasks are set:
- conducting ecological and geographical characte-ristics of the city Stryi;
- studying the ecological state of surface water in the city Striy;
- conducting analysis and assessment of the ecological state of the investigated water objects in the city Striy.

In this paper, a single sample of samples for assessment of the pollution from wells of two enterprises, wells of one of the households and the river Stryi was used.

The samples were sampled in the river Stryi within city Stryi in next places: 50 m above sewage treatment facilities, 500 m above sewage treatment facilities, 500 m below sewage treatment facilities, 100 m above the Stryi deposit of underground water.

The following indicators were studied: color, active reaction of pH, hardness, sulfates, chlorides, nitrites, nitrates, total iron, dry residue and others.

For each of the indicators for drinking water, the maximum allowable concentration (MPC) has been set in accordance with State standards of norms and rules "Hygienic requirements for drinking water intended for human consumption" (SSNR 2.2.4-400-10). For each of the indicators for river water, the maximum allowable concentration (MPC) has been set in accordance with «Sanitary rules and norms of protection surface water from pollution» (SRN 4630-88).

All results of the analysis are presented in the following tables.

TABLE 1

CONCENTRATION OF POLLUTANTS IN WATER OF THE STATE ENTERPRISE " STRYYSKYY KOMBINAT KHLIBOPRODUKTIV NO. 1", STRYI, ST. GRABOVETSKAYA, 2

Indicator	MPC	Results of the analysis
Color	-	without color
Active reaction of pH, pH	6,5-8,5	6,6
Hardness (mg-equiv /dm^3)	7,0(10)	6,9
Sulfates (mg/dm^3)	500	40,0
Chlorides (mg/dm^3)	350	30,0
Nitrites (mg/dm^3)	3,3	0,003
Nitrates (mg/dm^3)	50,0	22,5
Total iron (mg/dm^3)	1,0	0,09
Dry residue (mg/dm^3)	1000,0	280,0

TABLE 2

CONCENTRATION OF POLLUTANTS IN WATER OF LLC "BUDPROMVIR", STRYI

Indicator	MPC	Results of the analysis
1	2	3
Color	-	without color
Active reaction of pH, pH	6,5-8,5	6,6
Hardness (mg-equiv/dm^3)	7,0(10)	6,9
Sulfates (mg/dm^3)	500	39,0
Chlorides (mg/dm^3)	350	30,0
Nitrites (mg/dm^3)	3,3	0,006

1	2	3
Nitrates (mg/dm^3)	50,0	22,5
Total iron (mg/dm^3)	1,0	0,1
Dry residue (mg/dm^3)	1000,0	290,0

TABLE 3

CONCENTRATION OF POLLUTANTS IN WATER OF STRYI,
ST. YAVORNITSKY 28

Indicator	MPC	Results of the analysis
Color	-	without color
Active reaction of pH, pH	6,5-8,5	6,7
Hardness (mg-equiv / dm^3)	7,0(10)	6,8
Sulfates (mg/dm^3)	500	40,0
Chlorides (mg/dm^3)	350	30,0
Nitrites (mg/dm^3)	3,3	0,004
Nitrates (mg/dm^3)	50,0	22,5
Total iron (mg/dm^3)	1,0	0,1
Dry residue (mg/dm^3)	1000,0	280,0

TABLE 4

CONCENTRATION OF POLLUTANTS IN RIVER WATER (STRYI RIVER,
50 M ABOVE THE SEWAGE TREATMENT PLANTS)

Indicator	MPC	Results of the analysis
Color	-	without color
active reaction of pH, pH	6,5-8,5	7,28
Sulfates (mg/dm^3)	500	40,0
Chlorides (mg/dm^3)	350	30,0
Ammonia nitrogen (mg / dm^3)	2.0	0,045
Nitrites (mg/dm^3)	3,3	0,004
Nitrates (mg/dm^3)	50,0	18,00
Total iron (mg/dm^3)	1,0	0,09
Dry residue (mg/dm^3)	1000,0	440,0
Petroleum products (mg/dm^3)	0,3	0,29
Chromium (6) (mg/dm^3)	0,05	0,045
Cadmium (mg/dm^3)	0,001	0,04
PAEs (mg/dm^3)	0,5	0,02
Phenols (mg/dm^3)	0,001	0,001

TABLE 5

CONCENTRATION OF POLLUTANTS IN RIVER WATER
(STRYI RIVER, 500 M BELOW THE SEWAGE TREATMENT PLANTS)

Indicator	MPC	Results of the analysis
Color	-	without color
Active reaction of pH, pH	6,5-8,5	7,3
Sulfates (mg/dm^3)	500	40,0
Chlorides (mg/dm^3)	350	26,0
Ammonia nitrogen (mg / dm^3)	2.0	0,05
Nitrites (mg/dm^3)	3,3	0,003
Nitrates (mg/dm^3)	50,0	28,0
Total iron (mg/dm^3)	1,0	0,1
Dry residue (mg/dm^3)	1000,0	280,0
Petroleum products (mg/dm^3)	0,3	0,3
Chromium (6) (mg/dm^3)	0,05	0,05
Cadmium (mg/dm^3)	0,001	0,05
PAEs (mg/dm^3)	0,5	0,02
Phenols (mg/dm^3)	0,001	0,001

Conclusion

After conducting the analysis of water from wells in the city Stryi, we can say that only the active reaction of pH in one sample exceeds the value of MPC in 0.1 times, which does not significantly affect the total concentration of pollutants in water. Other indicators such as hardness, sulfates, chlorides, nitrates, total iron and dry residue are within acceptable limits and do not exceed the value of the MPG for drinking water in accordance with SSNR 2.2.4-400-10.

Concerning of river water, the ecological state of the river Stryi is within acceptable norms. After conducting series of tests it was determined that the river water meets the standard indicators MPC according to SRN 4630-88 for river water within the settlement.

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Development of "Archaean rocks" tour itinerary through the objects of geological heritage of Dnipropetrovsk region

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Abstract – Geological objects being interesting in terms of arranging the excursions for the citizens of the region have been singled out. Logistic possibilities of traveling to the proposed locations from the viewpoint of administrative identity, road interchange, natural conditions and seasons have been evaluated. Geotouristic typification of the objects has been performed.

Key words – geotourism, geosite, geotrip, tourism.

I. Introduction

Strategy of the Development of Tourism and Resorts of Ukraine up to 2026 has been determined the integrated approach to the formation and implementation of state policy in the sphere of tourism; that envisages the development of a certain system for strategic planning to frame the tourism types based on their clear classification and determination of the priorities both at state and regional level. The priorities with much attention to be focused on are as follows: natural, scientific and educational, and ecological tourism. These are the constituent parts being united by geotourism. Geological tourism is one of the essential components of geotourism.

It is required to have study thoroughly all the ways to implement and develop geotourism as the component of the Strategy of the Development of Tourism and Resorts of Ukraine. Geological objects that will be involved into the development of geotouristic itineraries of the central part of Ukraine have been proposed. It is necessary to determine the objects type, their geological aspects, evaluation criteria, attractiveness and prospects of geological formations as touristic objects. Each object requires the elaboration of optimal logistic solutions for future tourists. Geological object characterized by the complete range of public, easy-to-understand, and structured information is called a geosite. Several geosites united into a logical itinerary are called a geotrip.

For a number of reasons, Dnipropetrovsk region is a key region in Ukraine in terms of geotourism development. Historical traditions, unique geological objects, and rich mineral and raw material base of the country make our region rather attractive from the viewpoint of the development of the mentioned areas of touristic services. Geotourism is very popular worldwide. Everybody can find any data about any geological object; besides, there are a lot of leaflets with the detailed descriptions and schemes for tourists to have their own independent trips.

Geotourism is a complex touristic product aimed at demonstration of all the amount of diverse and original objects. Along with geological and mineralogical information, visitors learn paleontological, hydrogeological, historical, and cultural peculiarities of the objects. As for Ukraine, the Carpathians are the qualitative example of the development of geoparks with the required documentation according to the criteria; all the geoitineraries here are described and marked thoroughly. Moreover, there is the related electronic resource freely available on the Internet (geokarpaty.net).

Currently, geological objects which could be interesting from the viewpoint of geotourism have not been completely determined, described, and classified yet. Remote and small-area geological objects still require further processing and systemizing.

II. Main part

The paper proposes the development of a regional-level geotrip along the river Mokra Sura (the supposed name is "Archean Rocks"). Closeness of the itinerary to the regional center, its convenience in terms of physical loads, picturesqueness, and photogenicy are its obvious advantages. The georoute can be used both for hiking and cycling. The proposed geoattraction consists of 2 geosites: outcrop of plagiogranites of Sura Mesoarchean complex (Surianochka open-pit) and Novomykolaivka granite quarry with the the Mokra Sura valley

Consider the objects descriptions.

1. Outcrop of plagiogranites of Sura Mesoarchean complex (Surianochka open-pit), village of Sursko-Lytovske, western skirt, Dnipropetrovsk region. The coordinates are 48°19'38.8"N 34°54'12.5"E. Type of geosite is petrographic.

Plagiogranites of Sura Measoarchean mass (2985±90 mln years), being a petrotype of the homonymous plutonian complex, stretches along the left bank of the Mokra Sura river in the form of picturesque steep terraces of both natural and man-made origin. (It should be noted that petrotype is the specific petrographic object selected as a typical one for a particular basic petrographic subdivision – complex; it is the basis to recognize and single out the complex. The object recommended as a petrotype should reflect the complex to its full extent; it should have appropriate outcrop characteristics and be accessible for exploring and studying). Rock outcrops are represented by rather homogeneous medium-grained biotite plagiogranites and tonalites. The rocks are characterized by massive and subtle gneissic structure stipulated by flat-parallel arrangement of biotite flakes and oblong quarts grains. Important diagnostic petrographic and mineralogical signs of the rocks include large, up to 6 mm, intergrown biotite pieces associated with the inclusions of orthite, apatite, zircon, and magnetite [1]. Tourists interested in the mineral and rock collection can enlarge their collections with these samples.

Fig.2 Outcrop of plagiogranites of Sura Mesoarchean complex

Postgenetic magmatic processes represented by the outbreaks of light-coloured plagiogranites in the form of subvertical dike of diabasic composition of plateau-like shape with the thickness up to 6 meters are of special interests. Similar bodies are typical for Ukrainian crystalline shield (UCS) though they are rare accessible enough. Tectonic processes are represented by block rock jointing being divided by the set of subvertical and horizontal fissures.

The outcrop is of high educational importance for pupils and students learning natural sciences. Its transportation accessibility and observability make it an attractive object from the viewpoint of geotourism. Unfortunately, the geological object has no visual aids (stands with description, graphic information, route schemes). Activities dealing with the arrangements of local geotouristic attractions which can be the additional stimulus for the development of regional natural and educational tourism are only at their initial stage [2]. It is required to record and plan the activities in terms of the arrangement and information support of geotouristic objects in various projects and target programs on tourism development.

2. **Novomykolaivka granite quarry,** the village of Novomykolaivka, southern skirts. The coordinates are 48°18'56.2"N 34°51'55.4"E. Type of geosite is petrographic, geomorphological, mining and operational.

Novomykolaivka is located south-west from the city of Dnipro at the distance of 30 km. In terms of geomorphology, the area is located in the central part of UCS plateau within the boundaries of a wide valley of the Mokra Sura river. Rocks making up the area are represented by Archean (3150±50 mln years) amphibolites, granites of various compositions, and migmatites forming homogeneous masses. Shape of Mokra Sura valley as well as crystalline rocks being open due to quarry operations and subjected to tectonic crushing and weathering is of high geotouristic interest.

Geomorphological aspects of the river valley composition (elbows of capture) have tectonic reasons. Mokra Sura bed, as the majority of streamflows within the crystalline shield, is associated to the fissures in the earth's crust. The river has turned sharply due to the differently directed disturbances and elevated granite block available on its flow. Having such an obstacle, the

river began to flow on the path of least resistance – within the zone of submeridional fissure and the failed rocks.

When we pass the distance of 2.5 km along the picturesque slopes and brinks of the river, we come to the south bank of the immersed granite quarry. Quarry diameter is 300 m, its depth is up to 50 m. (Fig.3). The height of the above-water part of quarry walls is from 10 to 20 m. The worked-out quarry is within the tectonically disturbed area, granites are not crushed intensely. Coloured terraces display active processes of chemical and physical weathering with the areas of kaolin weathering crusts formation.

Nowadays, the quarry-lake is the place where local people have rest; besides, it is a diving center. All year round the water here is blue and clear as there are no sludge and clay deposits. Geotouristic aspects aimed at the popularization of such an interesting place both for having rest and learning are not taken into consideration. The required information support will make it possible to develop Novomykolaivka quarry as the geosite of regional importance that will no doubt give certain benefits to local communities.

Fig.3 Novomykolaivka granite quarry

Conclusion

Thus, further activities should be focused on the detailed photographing and video recording of the mentioned objects, development of itinerary schemes and classification of geotouristic objects of Dnipropetrovsk region on the basis of their attractiveness, duration, and complexity. In addition, it is necessary to develop such electronic resource as "Tour itineraries and significant geological sites of Dnipropetrovsk region" with its following advertising and promoting on the Internet.

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Preservation of Ancient and Old Value Trees of Ukraine with Using Biotechnology Methods

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Abstract – the practical significance of the work is to search new ways and methods of preservation ancient trees of Ukraine. Due to the natural aging condition this centuries-old trees are characterized by high risk of extinction as a result of biotic, abiotic and anthropogenic factors. Using of biotechnological methods, such as micropropagation can solve the problem of maintaining the unique gene pool of woody plants, study their ecosystem role and development of ornamental horticulture. In this work was shown peculiarities of getting aseptic culture and first stages of micropropagation of ancient trees..

Keywords − Ancient trees, explant, regeneration, in vitro

I. Introduction

In connection with the natural aging process, the condition of centuries-old trees is characterized by a high risk of death due to the action of biotic, abiotic and anthropogenic factors. The death or destruction of centuries-old trees will lead to a permanent loss of their historical and biological value associated with outstanding events and personalities, the processes of development of society, culture and art. Furthemore, such trees are having unique importance in terms of studying their ecosystem role and the history of ecosystem functioning. Most of the centuries-old trees are a natural heritage and heritage, the importance of which can not be overestimated for cultural and spiritual development [2, 10].

The progress of modern biotechnologies can solve the problem of preserving the unique gene pool of such plants, but such development is very difficult to create in connection with the biological characteristics of objects. One of such problems is obtaining aseptic culture of centuries-old trees.

In Ukraine, the experience of the study of centuries-old trees by biotechnological methods is rather limited [1, 2], there is practically no data on microclonal reproduction of centuries-old trees, there are no attempts of DNA-certification unique historical-valuable trees to analyze the possibilities of establishing their evolutionary-ecological features.

A comparatively large contribution to the development of research of ancient trees in Ukraine was carried out by the scientists of the Institute of Evolutionary Ecology of the National Academy of Sciences of Ukraine who conducted an inventory of age-old oak trees on the territory of the memorial-park of national significance "Feofaniya" and created a map of their location [3], and investigated the features of their growth [7].

The group of researchers led by A. I. Kushnir [6], whose efforts are directed to the development of technical solutions and means for healing centuries-old trees in Ukraine, deals with the preservation and treatment of centuries-old trees.

An important experience of preserving centuries-old trees and historical plantations was formed in the dendrological park "Olexandria" of the NAS of Ukraine [4]. Scientists have shown the richness of the centuries-old trees of the dendrological park and their role in the formation of the landscape.

Most of scientific works devoted to centuries-old trees are the results of dendrochronological studies of the history of climate and the evolution of ecosystems [8, 9].

According to the data of the re-calculation of territories and objects of the natural reserve fund of national and local significance [5] in Ukraine more than 600 centuries-old, historically valuable and unique trees have been identified. Such trees and groups of trees have, generally, the status of a botanical nature monument. Almost 70% of the total number of valuable centuries-old trees and their groups are represented by common oak (Quercus robur L.), and the third part of the total number of centuries-old trees is the heart-shaped lime (Tilia cordata Mill.), Pinus sylvestris L., (Fagus sylvatica L.), Platanus Orientalis (Platanus orientalis L.), Spruce (Picea abies (L.) H.Karst.), European Larix (Larix decidua Mill.), Acer platanoides L., Walnut (Juglans regia L.) and other species. There are single specimens of centuries-old apple trees (Malus P. Mill.) And pears (Pyrus L.). Obviously, the list does not include all existing centuries-old, historically valuable and unique trees of Ukraine and will gradually be supplemented.

II. Methods and research objects

As the source of explants were used ancient trees from natural conditions such as: Linden of P. Mogulu, (Kyiv) age over 400 years, Linden of T. Shevchenko, (Chernihiv region) age over 600 years, Oak of T. Shevchenko, (Kyiv) age over 300 years, Oak of M. Zalizniak, (Cherkasy region) age over 1000 years.

In researches, optimal explants for introduction to the culture in vitro of centuries-old trees were as winter shoots and awakening shoots had been getting from deferred shoot in control laboratory condition.

III. Results and discussion

As a result, for winter shoots the most effective is sterilization with using shoots (3.0–5.0 cm) which have washed under soapy water 20 min, and then immersed in 75% (v/v) alcohol for 30 s, before surface sterilization in 0.1% (w/v) mercuric chloride ($HgCl_2$) solution for 8–10 min.

On another way for shoots of centuries-old trees, which have been awakening were used sterilization solution of 25% (w/v) perhydrol (H_2O_2) for 7-10 min. After being washed three times with sterile distilled water (5 min) all shoot tips (0.5–1.5 cm) and nodal segments (0.5–1.0 cm) were excised and implanted to MS medium [12] for culture initiation. All nutrition medium have contained 30 g/l sucrose, 1 g/l glytation and 6.5 g/l agar. The pH of medium was adjusted to 5.7-5.8. All cultures have maintained in a growth chamber at 24–25 °C under cool, white fluorescent lamps with 16 h photoperiod.

After 3-4 weeks have recieved 70-80% of aseptic explants developed into 2.0–3.0 cm shoots, which were used for the following studies.

Conclusion

The centuries-old trees are of great importance for providing a complex of ecosystem services, among which the most important are recreational and biodiversity conservation. Data on the ecosystem of the role of centuries-old trees are very limited and do not allow to form a full-fledged view of the ecological value of such representatives of the plant world.

In such a way introduction of biotechnologies methods in practice of preservation of ancient trees have significant role and important for future research.

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The mathematical description of molecular diffusion penetration of fertilizers into the soil

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Abstract – The process of molecular diffusion penetration of components of mineral fertilizers into the soil was considered, as one of the possible ways of soil and groundwater pollution. Four mathematical models of migration of nitrogen fertilizers have been developed taking into account the adsorption of fertilizer components by the root system of plants and environmental conditions. Experimental investigations of the penetration of nitrogen fertilizer components have been carried out, on the basis of which the coefficient of molecular diffusion in sandy soils was calculated.

Keywords – soil, mineral fertilizers, pollution, migration, mathematical models.

I. Introduction

The distribution of substances in the environment mainly takes place due to diffusion processes. In such a way the penetration of pollutants deep into the soil occurs, which leads to the accumulation of pollutants in the underground aquifers. This process is constantly, increasing, during a period when there is a rapid melting of snow and a large amount of precipitation falls. This is ensured by the fact that in the absence of precipitation, the molecular diffusion penetration of pollutants in a vertical soil profile occurs.

The most dangerous is contamination of the soil by heavy metals, mineral fertilizers, pesticides, petroleum products, etc. However, if the pollution of petroleum products and heavy metals is mainly local, contamination by mineral fertilizers takes place in large territories, due to their constant use in agriculture in quantities of about 40% more than norm [1, 2]. All non-adsorbed by the plants components of mineral fertilizers will partially be adsorbed by the soil, and the rest will penetrate deep into the soil and pollute it. It is obvious that sorption has its limits and over time there will be only onedirectional diffusion stream of pollutants deep into the soil.

There is a number of mathematical models that makes it possible to predict the distribution of pollutants in air and water based on the laws of diffusion and probability theory [3-7]. However, is not paid enough attention to predict the penetration of pollutants into the soil environment.

The purpose of the work was theoretical and experimental research of the process of molecular diffusion penetration of mineral fertilizer components into the soil for prediction and reduction of soil pollution with nitrates.

II. Theoretical part

We have theoretically and experimentally investigated the process of migration of mineral fertilizers, for example, ammonium nitrate in soil and considered theoretical mathematical models of possible cases of this process [8].

During the development of mathematical models were taken into account the following possible cases: constant and variable concentrations of mineral fertilizer in the surface layer of soil; migration in the absence and presence of vegetation of plants.

The above listed cases in the complex constitute a continuous flow of fertilizer components deep into the soil, which contributes to environmental pollution throughout the year. Migration of fertilizer components under vegetative conditions of plants, that is, in the spring-summer period, when introduced mineral fertilizers are adsorbed by plants, is limited by the capacity of the roots and the need of plants. At the same time, the components of nitrogen fertilizers that penetrate below the root system become potential contaminants of the soil environment.

Constant concentration on the surface of the soil corresponds to the period of dissolution of solid mineral fertilizers in the moist soil. This mathematical model is represented by a system of equations that describe the migration of fertilizers in the soil:

$$\begin{cases} \dfrac{\partial C}{\partial t} = D \cdot \dfrac{\partial^2 C}{\partial z^2} & (1) \\[2mm] C(z=0, t) = C_{n0} & (2) \\[2mm] C(\infty, t) = 0 & (3) \\[2mm] \left(\dfrac{\partial C}{\partial z} \right)_{z=\infty} = 0 & (4) \end{cases}$$

The differential equation (1) describes the change in concentration in space and time; in our case, this is a one-dimensional concentration field. The differential equation of molecular diffusion is complemented by: initial conditions (2), the boundary conditions (3) and condition of symmetry (4).

The solution of system (1)-(4) allows to predict the distribution of the concentration of components of nitrogen fertilizers in the soil at any time τ without assimilating of the components of fertilizers by plants (5) and during the partial assimilation of the components of fertilizers by plants (6), for which in equation (1) we introduce the magnitude of adsorption of fertilizers by plants q:

$$\frac{C(z,t)}{C_{n0}} = 1 - erf \frac{\text{k}}{2 \cdot \sqrt{t}}, \qquad (5)$$

$$\frac{C(z,t)}{C_{n0}} = \left(1 - erf \frac{1}{2 \cdot \sqrt{Fo}} \right) - E \cdot Fo \times \qquad (6)$$

$$\times \left(1 + 4 \cdot \left(1 - erf \frac{1}{2 \cdot \sqrt{Fo}} \right) \right)$$

where $erf(x) = \dfrac{2}{\sqrt{p}} \cdot \int_0^x e^{-y^2} \cdot dy$ – error function;

$k = z/\sqrt{D}$; $E = \dfrac{q \cdot z^2}{C_{n0} \cdot D}$ – dimensionless complex,

which is a measure of the relation of the amount of component adsorbed by the root system of plants to the molecular diffusion stream.

Equation (5) is valid under condition:

$$\left(1 - erf \frac{1}{2\sqrt{Fo}}\right) > EFo\left(1 + 4\left(1 - erf \frac{1}{2\sqrt{Fo}}\right)\right),$$

which means that the resulting molecular flow of substence is larger than the flow assimilable by plants.

In the case of a change in the surface concentration of fertilizers in the absence of vegetation of plants, the mathematical model is represented by a system of differential equations (1)-(4) complemented by the condition $C(z = 0, t) = C_n$.

Then the solution of the mathematical model for the case of absence of assimilation of the components of fertilizers will be (7) and during the vegetation of plants (8):

$$C(z,t) = C_{n0} - \frac{a \cdot \sqrt{p}}{2} \times$$
$$\times \left[2 \cdot \sqrt{\frac{t}{p}} \cdot e^{-\frac{k^2}{4 \cdot t}} - k \cdot erfc \frac{k}{2 \cdot \sqrt{t}}\right] \tag{7}$$

where $a = 2 \cdot C_{n0}^2 \cdot \sqrt{D/p} / C^*$.

$$\frac{C(z,t)}{C_{n0}} = e^{-k^2 \cdot t} \cdot [\cos k\sqrt{a} \cdot (1 - erfa - I_1) +$$
$$+ \sin k\sqrt{a} \cdot I_2] - \frac{q \cdot t}{C_{n0}} \cdot \left(1 + 4 \cdot \left(1 - erf \frac{k}{2 \cdot \sqrt{t}}\right)\right) \tag{8}$$

where $I_1 = \dfrac{2}{\sqrt{p}} \cdot e^{-a^2} \cdot \int_0^b e^{y^2} \cdot \sin 2ay \cdot dy$;

$I_2 = \dfrac{2}{\sqrt{p}} \cdot e^{-a^2} \cdot \int_0^b e^{y^2} \cdot \cos 2ay \cdot dy$; $\dfrac{1}{2} \cdot \dfrac{k}{\sqrt{t}} = a$;

$k \cdot \sqrt{t} = b$.

III. Experimental part

To test the developed mathematical models, experimental researches of the penetration of nitrogen fertilizer components on the example of ammonium nitrate in two soils: sandy and loamy, were carried out.

The obtained results show that introduced nitrogen mineral fertilizers are rapidly dissolved and migrate in a vertical soil profile. Due to the fact that the sandy soil has good permeability, in 20 days of the experiment mineral fertilizers penetrate to a depth of 24 cm. In the loamy soil, this process is somewhat slower, however, the penetration of non-adsorbed components of fertilizers is constant, which leads to constant contamination of the deep layers of the soil with mineral fertilizer residues.

The results of experimental researches make it possible to determine the coefficient of molecular diffusion, the main indicator, that determines the rate of penetration of fertilizers from the soil surface. According to the experimental studies, the coefficient of molecular diffusion in the surface layer of soil is $D = 7,065 \cdot 10^{-10}$ $\text{м}^2/c$. Since the maximum relative error does not exceed 9%, this allows us to conclude that the proposed mathematical model is adequate.

Conclusion

The results of experimental studies show that the process of molecular diffusion of mineral fertilizers contributes to their penetration into the soil and pollution of underground waters. Taking into consideration that the soil is saturated with moisture throughout its depth, this process will occur contantly and continuously.

The developed mathematical models make it possible to predict the penetration of components of mineral fertilizers into the soil and thereby to predict the possibility of contamination of the soil environment by the usage of mineral fertilizers depending on the soil and climatic conditions.

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Disposal of poultry droppings with the use of natural sorbents

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Abstract − the objective of this research is to ensure environmental safety and increase soil fertility. Adding sorbents like clinoptilolite and palygorskite to poultry droppings reduces ammonia evolution to the atmosphere. Further, sorbents create conditions for gradual feeding of the root system of plants with ammonium nitrogen. This will prevent it from washing out by ground water, and allow reducing the environmental hazard of atmosphere pollution by ammonium nitrogen and utilizing droppings from poultry farms, contributing to lower nitrogen loss during storage and the increase of soil fertility.

Keywords − environmental safety, poultry droppings, natural sorbents, adsorption of ammonia, organic fertilizer, soils.

I. Introduction

Production of eggs and poultry meat by industrial poultry farms always results in accumulation of big volumes of poultry wastes. Poultry droppings are a quick-acting organic fertilizer that increases fertility of soil (first of all the content of humus and other nutrient elements), and improves agrophysical properties and water and air condition of it.

Disposal of solid wastes is an urgent issue for all antropogenic facilities, including poultry farms, which must be addressed in complex. One of the reasons of potential ecological hazard of a poultry house is low efficiency of technological operations on removal of droppings together with litter, and their improper storage, transportation and utilization during the application as an organic fertilizer.

Annual total amount of poultry droppings in Ukraine is 9249.1 tons [1]. Poultry droppings are of a complex and heterogeneous structure composing of organic and non-organic compounds. The organic compounds include basically nitrogenous compounds (proteins, peptides, amino-acids) and carbon compounds (lipids, fat acids, spirits, cellulose-lignin). The non-organic compounds include water, ammonia, copper, phosphate, potassium, zinc, manganese compounds, etc. The chemical composition of litter droppings: water – 22-60%; nitrogenous compounds – 0.8-1.8%; P_2O_5 – 0.4-0.9%; K_2O – 0.7-1.3%.

Today there are many methods of poultry droppings processing developed:
– composting;
– vermicomposting;
– litter utilization for production of biogas;
– direct litter incineration for producing heat energy;
– high-temperature drying;
– processing by a method of extruding and granulating.

During storage of wastes by poultry farms in dung yards, nitrogen in droppings (due to vital functions of microorganisms) starts decomposing into ammonia that evolves into the atmosphere, causing pollution.

To decrease nitrogen loss from poultry droppings, researchers focus much attention on adsorption methods of purification of gaseous and fluid secretions, in particular with the application of natural sorbents [2]. This allows reducing environmental risk of pollution, and disposing droppings from poultry farms in a rational way.

II. Results and Discussion

Our conducted researches are aimed at determining an optimal ratio of natural high-dispersive mineral adsorbents in a mixture with poultry droppings. The sorbents used were clinoptilolite from Sokyrnytsia Deposit and palygorskite from Cherkasy Deposit with the dispersive content 0.5-1.0 mm. At a later stage, content of the sorbent in such organic fertilizer provides conditions for gradual feeding of the plant root systems with ammonium nitrogen.

The source of ammonia is utilized litter composed of poultry droppings, chopped wheat straw and CaO hydrated lime). It was used for raising broiler chickens and accumulating droppings during 45 days. Influence of the studied composition was determined using grey, dark-grey and soddy podzolic types of soil sampled from the land in Pustomyty District of Lviv Region. These soils are characterized by well-developed humus horizon.

Soil was sampled by the envelope method on a square plot 10x20 meters in size at the depth of 0-25 cm, following the National standard DSTU 4287:2004 "Soil Quality. Sampling." The selected samples were used to prepare an average sample of 1 kg. The soil samples were dried to an air-dry state in a dryer with a thermal regulator.

Soil solution is a source of nutrients for plants, because plants can take up necessary elements only in a dissolved state.

The research methods involved analysing water extracts from soil. 50 g batches of a certain type of soil were put into 250 ml dosing cups. Then we placed a composition batch of 5 gram, topped with 15 gram of soil. Soil solution concentration depends on temperature conditions and moisture content of the soil. Therefore, temperature conditions were kept within 18-20 °C, and soil moisture in the cups was always 55%. Water extracts from the specified soil types were prepared every three days. For that purpose, an air-dry batch of soil was filled with distilled water (in a ratio 1:5), shook for 5 minutes and left in a static position for 24 hours. The obtained solution was filtered until filtrate was totally transparent. The obtained filtrate was a water extract studied.

We studied regularities of influence of the compositions on pH change in the above soil samples for a specific period (Table 1).

TABLE 1

CONTINUATION OF TABLE 2

pH VALUE OF WATER EXTRACT FROM THE SOIL SAMPLES

Sampling time	pH of soil solution		
	Soddy podzolic soil	Dark grey soil	Grey soil
0	6.78	6.76	7.18
4	7.35	7.16	7.18
7	7.48	7.42	7.40
11	7.30	7.40	7.45
14	7.25	7.16	7.25
18	7.32	7.28	7.46
20	7.38	7.24	7.50
24	7.41	7.29	7.52

1	2	3	4
11	23.72	16.15	13.91
14	20.28	23.72	16.15
18	23.72	20.28	12.36
20	20.28	23.72	14.77
24	23.72	27.17	16.15

According to the test results given in the Table 1, slight shift of the pH level in the soil solution towards the neutrality (for about 0.6 units of the pH indicator), i.e. the acidity decrease in the soil medium, has been detected in all the samples. The most favorable for vegetation subasidic and subalkaline reaction is within pH = 6 – 7.5.

In the air phase of soil there is a gaseous ammonia (NH3+) form of nitrogen that takes part in plant nourishing too. Denitrification and ammonification processes result in formation of gaseous nitrogen forms like ammonia and nitrogen oxides diffusing in the atmosphere as well as NO3- ion washing off from the depth of the soil profile.

Ammonium nitrogen (N-NH4+) was determined with the Nessler's reagent, following the DSTU 4729:2007 "Soil Quality. Determining Nitrate and Nitrite Nitrogen", using a photoelectrocolorimeter FEC -56.

The results of the research are presented in the table II.

According to the test results given in the Table 2 , the ammonium nitrogen capacity releasing during 24 hours increased in 4 times for dark-grey and grey soil types, and in 6 times for sod-podzolic soil. If at the beginning of the test during the first four days the level of mineral nitrogen in the soil was law (4–15 mg/l), after 7 days it rose to the medium level (16–24 mg/l). Within the next two weeks the level of mineral nitrogen in the soil remained medium and uniform.

Conclusion

The conducted study confirms the potential benefits of application of a mixture of clinoptilolite and palygorskite for absorbing ammonia from poultry droppings with their further use as an organic manure of prolonged efficiency. Sorbents like clinoptilolite and palygorskite added to poultry manure reduce the evolution of ammonia to the atmosphere. Further, sorbents create conditions for gradual feeding of the root system of plants with ammonium nitrogen. This will prevent it from washing out by ground water, allow reducing the environmental hazard of atmosphere pollution by ammonium nitrogen, and utilizing droppings from poultry farms, contributing to lower nitrogen loss during their storage, increasing the soil fertility.

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TABLE 2

AN IMPACT OF ORGANIC MANURE ON CHANGE IN THE CONCENTRATION OF AMMONIUM NITROGEN, DEPENDING ON A SOIL TYPE

Sampling time, day	$C(NH_4N)$ final, mg/l		
	soddy podzolic	dark grey	grey
1	2	3	4
0	4.09	6.88	4.09
4	15.11	4.09	4.09
7	23.72	16.15	12.01

Analysis of process parameters of wastewater treatment of edible oils production

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Abstract – Investigated the liquid extraction method for possibility to sewage treatment of oils production plants. The mixture of organic solvent (extractant) for selective removal of the main pollutants of wastewater was selected. The resulting equilibrium line and operating line process was obtained. Established transfer steps number. The mathematical model of liquid-extraction wastewater treatment was built. The solution of model allows to predict the kinetics of wastewater extraction for implementing the technology in practice. The equipment to design the flowsheet of liquid extraction method for wastewater treatment of food oils production was matched.

Keywords – liquid extraction, extractant, rafinate, extract, wastewater, mass transfer coefficient, mathematical model.

I. Introduction

The growth of production capacity of enterprises edible oil at this stage of the food industry led to the formation of huge amounts of waste water that form wastewater production process. The main components of polluting waste water is neutral fats, phospholipids, organic acids and other substances of organic origin that existing treatment plants are unable to clear the level of sanitary requirements. This creates a significant environmental problem, as is the pollution of surface waters by organic substances. For many enterprises of the industry the proper treatment of wastewater is a serious problem. So finding ways of industrial wastewater treatment is an urgent task [1-2]. Our previous goal was the emulsions destruction, which are the main wastewater polluter component [3]. Now our task was to continue further illuminated water purification method using liquid extraction. On the basis of experimental results we propose the equipment for efficient treatment.

II. Material and Methods

The methodology of experimental research is as follows: 50 ml of wastewater and 50 ml extractant (40 ml ethyl acetate (butyl acetate) and 10 ml of the appropriate alcohol) is mixed in the mixer for 30 minutes, then in the sump separated into two layers, extract and raffinate. The concentration of the contaminant in wastewater was determined by photocolorimetry analysis. The essence of the method is light absorption by pollutant in the visible spectrum at a wavelength of 490 nm. For this purpose the calibration graph using the pre-known values of concentrations of conventional pollutants was built. Then the concentrations of actual pollutants in the water layer and extractant after liquid extraction were determined.

III. Results and Discussion

Thorough analysis of physical and chemical methods of wastewater treatment used after the emulsions destruction shows the liquid extraction to be the most appropriate method for the final disposal of pollutants [4], [5], [8].

To achieve the maximum degree of wastewater treatment the extractant, which has selective solubility with respect to pollutants was chosen. Moreover, it was found that a substantial increase in extractive properties of ethyl acetate and butyl acetate is achieved by mixing them with alcohol (methanol, ethanol, propanol, butanol, isobutanol).

The extraction efficiency of the mixture ethyl acetate–alcohol and butyl acetate–alcohol is significantly higher during the extraction of pollutants from wastewater of oils production, than in the case of using of pure extractants. It was established that the increase in molar mass of alcohol leads to increasing the concentration of pollutants in the extract. From the list of studied alcohols there are the most appropriate using butyl alcohol (butanol)].

The target component distribution between the liquid phases was defined by balance conditions. Typically equilibrium determined by a straight line equation: a $y = kx$, where y – the concentration of the target component in the extract; x-concentrations in the raffinate; k – coefficient of distribution. But line character really depends on many factors: temperature, pressure, natural substances, concentration and so on.

The next step was to study the operating line of the process. The line shows the concentration of pollutant in wastewater after reaching equilibrium.

Therefore, the line of equilibrium in the studied conditions takes the form of the curve and is curved. Constructed line workers allowed to determine the transfer degrees number of the system using two types of extractants; ethyl atcetat-butanol and butyl acetate – butanol [6].
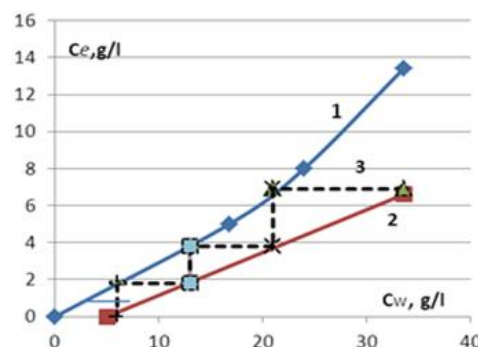
Fig. 1. Equilibrium line (1), operating line (2) and number of transfer stages (3) for ethyl acetate; counter-current process

Among a variety of liquid extraction apparatuses that can be recommended for the wastewater treatment of edible oils production, counter-current columns with mechanical stirring (vibrating, rotary-disc, pulsating) are the most rational ones. If the counter-current scheme is

used for liquid extraction the number of transfer stages is significantly reduced (Figs. 1 and 2).
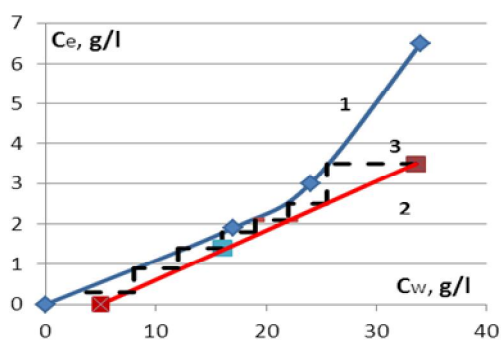
Fig. 2. Equilibrium line (1), operating line (2) and number of transfer stages (3) for buthyl acetate; counter-current process

Mathematical models of liquid extraction in the perforated-plate column are already known [8].

However, when we need an apparatus equivalent to a high number of theoretical stages of mass transfer (Figs. 1 and 2), and have to strongly control and correlate the concentration and composition of the extract on the individual stages of mass transfer the mixing-settling extractors should be used.

The mathematical description of the mixing-settling extractor [7] can be represented by the model with specific characteristics. The entire volume of the apparatus or their system is represented as individual extractor. All extractors were connected in series. Ideal mixing occurs in each extractor and is lacking between them. It is represented in Fig. 3, where C_1, C_2, C_3 – concentrations in 1, 2, 3 extractors, respectively; C_m – concentration in "m" extractor.
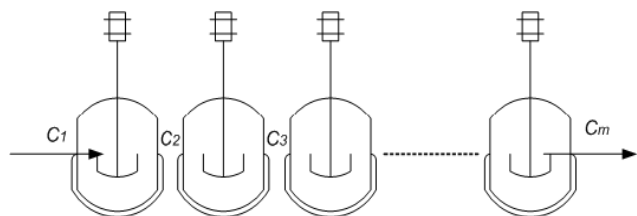
Fig. 3. Scheme of mixing-settling extractors

Since ideal mixing occurs in each extractor and output of the previous apparatus is the input for the next, it is possible to write a system of mathematical equations:

Eq. 1:

$$
\begin{cases}
\dfrac{dC_1}{d\tau} = \dfrac{C_{in} - C_1}{\tau_1} \\[4pt]
\dfrac{dC_2}{d\tau} = \dfrac{C_1 - C_2}{\tau_2} \\[4pt]
\cdots\cdots\cdots\cdots \\[4pt]
\dfrac{dC_m}{d\tau} = \dfrac{C_{m-1} - C_m}{\tau_m}
\end{cases}
\tag{1}
$$

In the system of "m" equations where m – number of extractors; t_1, t_1, ... , t_m – holding time of flow in the first,

second, ..., last extractor. The system is a mathematical description of the liquid extraction process in the system of mixing-settling extractors.

Conclusion

As the experimental researches result suitable extractants are selected – a mixture of ethyl acetate and butyl acetate with butanol, also are set the maximum alcohol content that provides heterogeneous region in the extraction system. An operating line and equilibrium line and set transfer steps number. The multistage extraction installation is the most appropriate and gives strong results for sewage treatment from oil production plants. and A mathematical model of multi-staged liquid extraction for wastewater treatment was developed. Its solution allows evaluating an order of diffusion coefficient of wastewater basic pollutants.

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Nonlinearity compensation for two-zone energy-shaping control systems of DC drive

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Abstract – DC machines are the keystone of world industry. Working in second zone they behave as nonlinear objects. One of the newest methods of control system design for such machine as a part of electromechanical systems are energy-based approaches. Energy-shaping control systems based on simplified model don't work in second zone and the use of accurate model leads to many complications. This article contains description and comparative researches of proposed nonlinearity compensators that allows to use simplified control system. It was shown that reference signal corrector provides highly effective control, but there are still many possibilities to increase energy-shaping system's efficiency.

Keywords – DC motor, nonlinear control, two-zone control, energy-based approach, energy-shaping control system, port-controlled Hamiltonian system.

I. Introduction

DC machines are the keystone of world industry. Simplicity in exploitation and regulating, as well as in control systems building, allows to get high quality properties of response, static precision, durability and reliability of synthesized control systems [1], and also the setup simplicity for most of them. Generally, these machines are considered as linear objects. In order to extend its regulation possibilities, the control in excitement loop is used. In this case they became nonlinear systems and are treated respectfully. All this transforms DC machine into perfect testing sample for different control systems and control approaches.

Nowadays there are numerous control systems developed for DC motors. Among them, one of the most perspective methods of control system design are physical control theory approaches. Exactly such are energy-based approaches, which are based on physical laws of energy transfer and conversion [2]. In order to simplify such energy-shaping control system (ESCS) synthesis procedure, control object as well, as automatic control system itself are representing as port-controlled Hamiltonian system (PCHs) [3].

By the method, given in [4], the ESCS regulator for DCM, based on simplified model, has been got:

$$\begin{cases} u_a = i_{a0}R_a + (i_{a0} - i_a)r_{11} + Ci_{ex0}w_0L_{ex} \\ u_{ex} = i_{ex0}R_{ex} + (i_aw_0 - i_{a0}w)(CL_{ex}) + (i_{ex0} - i_{ex})r_{33} \\ i_{a0} = [T_s - (w - w_0)r_{22}]/Ci_{ex0}L_{ex} \end{cases}, \quad (1)$$

where u_a and u_{ex} – armature and excitement voltages; i_{a0} and i_{ex0}– desired armature and excitement currents; i_a and i_{ex} – armature and excitement currents; R_a and R_{ex} –

armature and excitement circuits resistance; r_{11}, r_{22} and r_{33} – electrical (armature), mechanical and excitement damping coefficients; L_{ex} – excitement circuit inductance, C – feedback EMF coefficient; ω_0 – reference speed; ω – actual speed; T_s – static torque.

In case of excitement regulation, when DC behave as nonlinear system with magnetization characteristics and excitation winding time constant change, proposed regulator can't work efficiently [5]. Synthesis of ESCS, based on more accurate, nonlinear model of the machine, leads to increased complexity of both – the synthesis procedures and the obtained regulator equations.

So, there appears an actual task – to develop and research new control systems for DC motor electro-mechanical systems (EMS), which would, at the same time, provide nonlinear control and be easy and clear to set up.

II. Energy-shaping control system with nonlinearity compensators

In order to improve regulation possibilities energy-based approaches can be combined with other different regulators. One of the main approaches to develop control system for nonlinear object is to include in control system nonlinear element, that will compensate nonlinearity of original object [6].

To have a certain flow in the machine, it is necessary to give it the corresponding current in the winding. On the basis of the magnetization characteristic $F^*(i_{ex})$, it is possible to construct an amper-bireh characteristic, which is inversed to magnetization, and corresponds to the value of the required excitation current i_{ex}, to achieve the desired flow [5]. It is proposed to correct control signal of linear regulator (1) with designed nonlinear compensator:

$$u'_{ex} = F^{*-1}\left(\frac{u_{ex}}{R_{ex}}\right)R_{ex}. \quad (2)$$

However, the proposed approach has a number of shortcomings, one of them alleviation of the natural properties of Hamiltonian systems, in particular asymptotic stability. Thus, it is proposed to take into account the nonlinearity of the system at the stage of forming the signal of $i_{ex0,}$:

$$i'_{ex0} = F^{*-1}\left(\frac{w_n}{w_0}i_{ex\,n}\right). \quad (3)$$

In this case the structure of ESCS (control system + controlled object) remains unchanged and corresponds to the desired PCHs.

In order to analyze in detail proposed nonlinear compensators for ESCSs, there have been conducted a set of comparative researches of ESCSs with different regulators (Fig.1). There have been researched the response of systems in cases of rapid task and load changes in nonlinear – second zone, as well as electrical energy consumption (E_{el} as integral sum of all electrical consumption) and energetic ECE (η as division of consumed and useful energies).
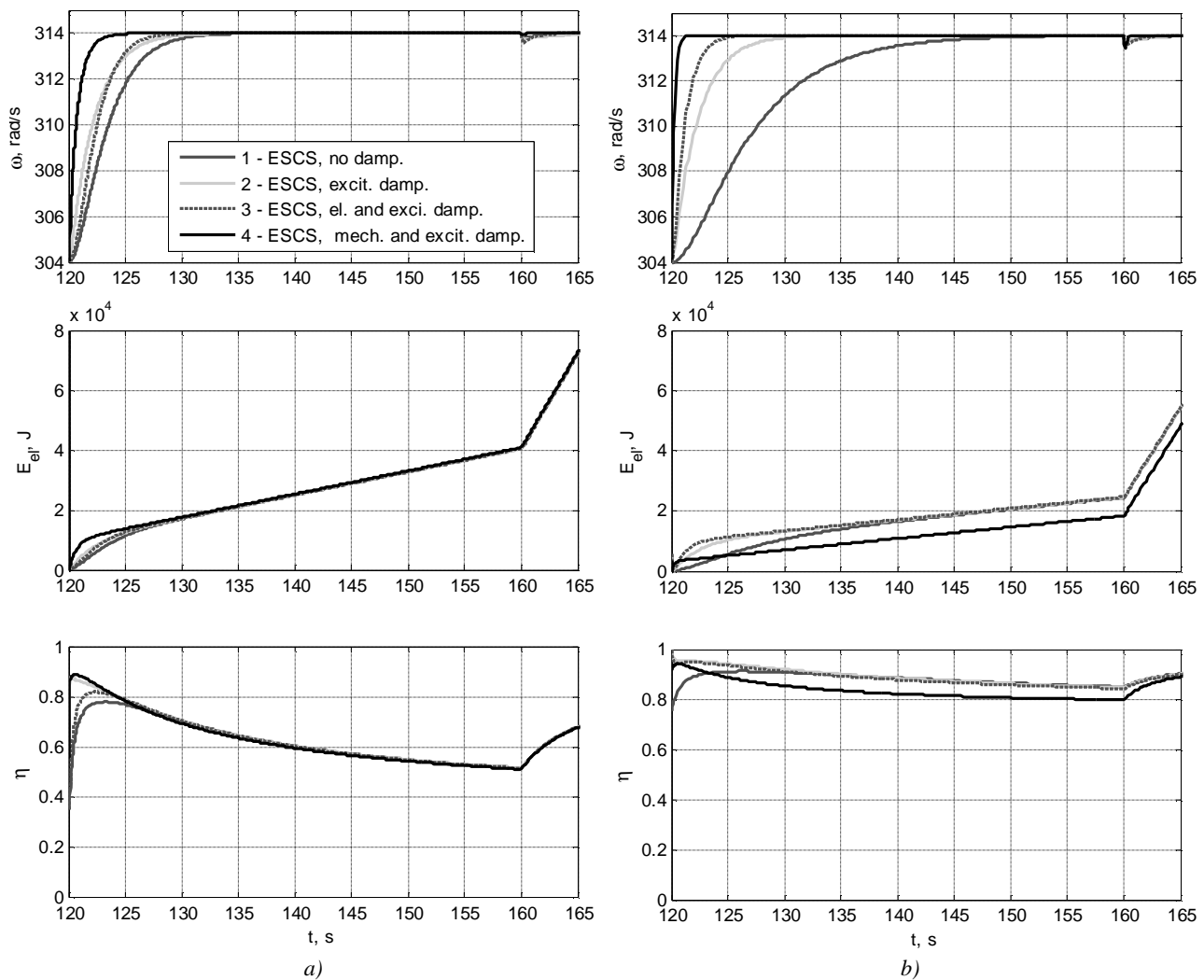
Fig.1. Comparative research of ESCSs with different settings in second zone:
a) with control signal corrector (2); *b)* with reference signal corrector (3).

Conclusion

It was proposed and researched two types of nonlinearity compensators, that allow to use simple liner ESCS regulators to work with nonlinear objects, on DC motor example. First type of compensation consists in correcting control signal of the ESCS u_{ex}, second – in correcting reference signal i_{ex0}.

Both types of achieved compensators support different ESCS structures. Reference signal corrector preserve desired PCHs structure of the system, provides better use of energy-shaping damping possibilities, also response and energetic characteristics of the whole system.

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Means and devices of lightning protection of overhead transmission lines of voltage class 110–750 kV

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Abstract – Traditionally, the overhead transmission line (OTL) can not function normally without special lightning protection. The article considers the main means and devices of lightning protection of OTL 110-750 kV according to the current normative documentation. The peculiarities of use and consequences of the establishment of certain protection means are indicated. A series of mathematical simulations was carried out, resulting in the level of overvoltages using the means and devices of lightning protection and their absence

Key words: lightning protection, the overhead transmission line, overvoltages, reliability of lightning protection, coordination of isolation.

I. Introduction

The reliability of the lightning protection of OTL and substations is as higher as the less the number of emergency trips due to thunderstorms over a certain period of time. A characteristic feature of objects of electric power systems is the complete restoration of their protective properties after the elimination of accidents caused by thunderstorms. In lightning protection, only the frequency of thunderstorms and the ability of the object to withstand each strike of lightning is determined.

The lightning strike in the OTL can not be regarded as a rare phenomenon. Without special devices for lightning protection, such OTL will not work normally.

II. Research results

The high reliability of lightning protection of OTL of the voltage class 110 to 750 kV provides means and devices are given in Fig. 1.

Depending on the location, the number of wires on the tower of OTL, the electrical resistance of the soil, the voltage class of OTL, the required degree of lightning protection, mount one or several ropes. In OTL on metal tower with voltage of 110 kV and above, the lightning protection ropes is usually suspended along the entire length of the line, on lines of low voltage only on approaches to electrical substations [1].

For lightning protection ropes, as a rule, steel ropes are used, made of galvanized aluminum-clad wire for particularly harsh aggressive working conditions and resistant to unscrewing by the twist method, with a cross section of at least [1,6]:

- 35 mm^2 – at 35 kV OTL without intersections and in intersections with public railways and electrified in areas with ice 1-2;

- 50 mm^2 – in other areas and on OTL constructed on double-circuit and multi-chain supports and on 110-150 kV OTL;
- 70 mm^2 – for OTL 220 kV and higher .
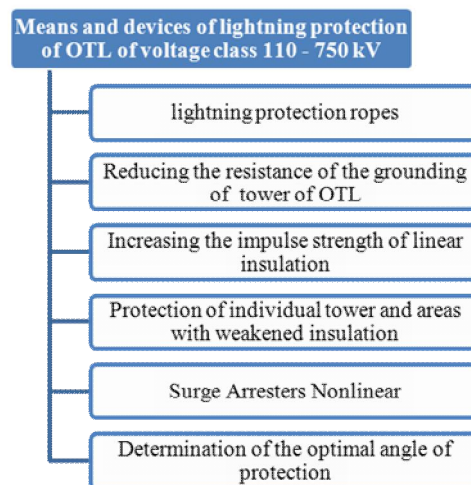
Fig. 1 Means and devices of lightning protection of OTL of voltage class 110 – 750 kV

Unlike conventional overlappings caused by wetting or contaminating insulation, the lightning current creates an electrical potential on the resistance, much greater than the potential of the phase wire, and thus overlapping occurs in the opposite direction. The lower the resistance of the grounding devices, the lower the probability of reverse overlapping [2].

Reducing the grounding resistance of tower of OTL with a ropes is one of the main ways to reduce the probability of impulse overlap of insulation when a lightning strikes a ropes or a tower.

To reduce the resistance of grounding devices, additional grounding must be carried out [3].

The total grounding resistance depends on the resistance of the adjacent soil layers. Therefore, it is possible to reduce the earth resistance by reducing the resistivity of the soil only in a small area around the earth electrode.

To create a zone with a lower specific resistivity in the soil, a cut (pit) of 1.5-2.0 m radius is made in the soil. After filling the excavation with soil, grounding is established and the soil is compacted. As a primer-soil, any soil can be applied, has a resistivity of 5-10 times less than the resistivity of the main soil.

Experience has shown that the maximum reduction in ground resistance is achieved when using electrolytes, charcoal and coke breeze.

An effective and cheap way to reduce the resistance to grounding is to treat the soil with salt. The effect of the latter is reduced not only to a decrease in the specific resistance of the soil, but also to a decrease in its freezing temperature.

On the other ways to artificially reduce the resistance of earthing switches proposed in different countries, first of all, the Swedish way – treatment of soil around the earth electrode with the help of electrolytes forming a gel [4].

The impulse strength of the insulation of the OTL with a ropes is determined by the type of insulators, the length of the garland, the length of the air gaps on the support and the gap of the cable- ropes in the span. The increase in the length of the garland, respectively, of air gaps on the support increases capital costs and is practically not used as a means of lightning protection [3,5].

Individual line locations require additional security measures. Such places include [1]:
- crossing OTL between themselves;
- crossing of OTL with communication lines, tram lines and lines of electrified railway;
- tower of the OTL with reduced electrical insulation strength;
- high tower of transitional spans;
- branches to the substations and sectional disconnectors on the lines;
- cable inserts on lines.

To protect the electrical equipment of electrical installations with voltages of 6-750 kV of an alternating current of industrial frequency of 50 Hz from lightning and switching overvoltages, overvoltage limiters must be used which, in comparison with gate arresters due to the absence of spark gaps and high nonlinearity of the volt-ampere characteristic of their elements, have several advantages [3] .

The use of non-linear overvoltage limiters of overvoltages is most effective in the following cases [1,6]:
- on one of the circles of the double-circuit OTL, which almost completely prevents cargo disconnection of two laps simultaneously;
- at high ground resistance of tower;
- on high tower, on the back, on crossings through water springs.

The protective angle of the rope (a^o) is the angle between the straight line passing through the rope and the wire and the vertical line. The angle of protection, depending on the height of the tower, is selected so as to reduce the number of direct lightning strikes in the phase wires by about 2-3 orders of magnitude. This condition is provided, as a rule, at angles of 20 ... 30 °. However, experience shows that the cases of lightning breakthrough to the wires are the determining factors in the total number of dangerous thunderstorm lesions of 330 kV lines and above, an increase in their number with an increase in the nominal line voltage is observed. This is due to the increase in the height of the tower and the corresponding reduction in the effectiveness of the rope protection, as well as the increasing influence of the electric field of the phase wires on the direction of development of the leader of the lightning. In order to maintain the high reliability of rope protection on lines 220 kV and above, the use of ropes with negative protection angles is recommended [3].

To investigate the influence of lightning protection means and devices on the reliability of lightning protection, we conducted a series of mathematical simulations for one of the OTL of PJSC "Lvivoblenergo". The investigated OTL with 110 kV voltage is made of tower of type PB 110-8, wire of AC-120 grade with insulators PS-70A, and is equipped with a lightning protection rope of C-50 mark. Calculations of overvoltage on insulation for two cases: normally installed lightning protection devices and lightning protection devices installed with violation (Table 1)

TABLE 1

LEVELS OF OVERVOLTAGES ON THE INSULATION OF OTL WHEN LIGHTNING STRIKES THE TOWER

$R = 10 Ohm, a = 25^o$, mark of lightning protection rope – C-50		$R = 50 Ohm, a = 50^o$, mark of lightning protection rope – C-35	
t, ms	$U(t)$, kV	t, ms	$U(t)$, kV
0,5	25,54	0,5	38,92
1	34,95	1	59,61
1,5	42,03	1,5	76,73
2	47,89	2	91,53
2,5	52,99	2,5	104,5
3	57,55	3	116,88
4	65,53	4	135,96
6	78,52	6	165,34
8	89,01	8	185,38
10	95,63	10	199,31

Conclusion

The article analyzes the existing lightning protection means and devices, which are recommended by the current normative documentation. All conditions and consequences of installation of lightning protection devices are indicated. As a result of the mathematical simulations, the levels of overvoltage on isolation by properly installed lightning protection devices and the incomplete implementation of regulatory recommendations are given. Since the insulation is installed, it can withstand the voltage of a standard lightning impulse + 100 / -100 kV, if the requirements of the lightning protection system are met, there will be no overlap of the insulation, and if there are violations of the established standards, an insulation breakdown will occur.

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Combined heating system based on solar collector and district heating

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Abstract – The scheme based solar collectors to support heating and hot water in the house, which has installed central heating. Submitted the calculation of the solar installation and its technical capabilities. In addition, a selection of equipment and explains the principle of operation of the solar.

Keywords – solar collector, heliosystem, diagram of covering the needs.

I. Introduction

The rise in prices and the shortage of solid, liquid and gaseous fuels, as well as for electricity makes more and more reflect on the use and development of unconventional sources of energy. Solar energy will play a fundamental role, as a source of heat, and the source of electric power.

On the territory of Ukraine the energy of solar radiation for one annual light day is an average of 4 KW per hour per 1 m2 (in the summer days – up to 6-6,5 KW per hour) that is about 1.5 thousand kilowatt hours per year for every square meter. This is about as much as in Middle Europe, where the use of solar energy is very broad.

Solar collector is the main element of the installation, in which the sunlight turns into heat energy, has proved its effectiveness, as evidenced by the placement of millions of collectors on the roofs of the houses on all continents.

The receipt of such low-temperature heat can be accomplished with flat and Vacuum solar collectors, working on the principle of the greenhouse effect. The physical essence of this effect is that the solar radiation falling on the surface of the solar collectors, transparent to sunlight, practically without any loss of penetrate and getting the receiver of the manifold heats up it, and the process of dispersion of heat energy receiver in the solar collector minimized. Since the main solar radiation in terrestrial conditions is located in the spectral range of 0.4 µm micron -1,8, how transparent top layer is used ordinary glass and having the transmission rate in this spectral range up to 95%. Located at the bottom of the manifold (flat) or inside the tube (vacuum), the receiver of the manifold is an absorbent coating with a coefficient of absorption of solar radiation to 82-95%. Absorbing solar radiation, this абсорбирующее coating can heat up depending on the power of the incident solar radiation to 50-90 ° C. A heated up to the temperature of the body radiates heat energy, the main power is in the infrared range.

In Ukraine the use of solar collectors hampered by expensive prices for them, since the full cycle of their production in the country is missing. However, the rise of energy and an example of the effective use of them in the diaspora will inevitably increase their popularity. There is another serious fact that must be taken into account in the implementation of solar collectors in life in conditions of Ukraine. The majority of the urban population in Ukraine live in multi-storey buildings with central heating. Cottage houses mostly equipped with boiler-houses facilities that provide water and heat supplies during the cold season. The transition to the full use of solar collectors in this situation is technically impractical and costly, especially in the area of heat, bearing in mind the low levels of solar radiation in winter time. Hence, it is necessary to focus on the gradual introduction of solar collectors in life. This means that the parallel use of watering system from the central heating system and heat circulation in solar collectors. The consideration of the possible variant, the implementation of such combined systems on the example of the house, to which a centralized heat supply is dedicated to this work.

II. The task

In this work we have developed a pattern to support the heating and hot water supply for the house, which already placed on the system of central heating. The house is located in Lviv.

Summarizing of our requirements for heating and hot water supplying.

Hot water supply:
1) The consumption – 350 liters/day.
2) The temperature of the hot water – 50 °C.
3) The temperature of the cold water – 10 °C.

Heating:
1) Heating area is 150 m^2.
2) For our convenience we accept that all of the heating system is carried out using a warm floor. So, that is a low temperature heating.

Text have to be prepared in two column separated by 5mm. Paragraph indent should be 3 mm. The page margins and size are given in Table 1.

III. Modeling

Based on the results of modeling, according to our source data and the location of the object, using the service polysunonline.com get that from solar collectors we can in general for the year cover 60 % of the needs in hot water, as well as 20 % in heating, that for solar collectors is a very good result. The total for the year we are covering 32% of our energy needs. To achieve this result, we need 10 solar collectors with an area of 2.5 m^2 each. Hence, the total area of the manifolds is 25 m^2.

Using the service Http://www.polysunonline.com/ we get a chart covering our needs for heating and hot water supply (Fig.1).
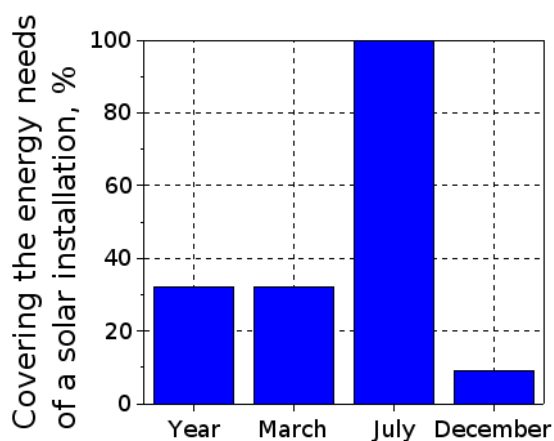
Fig.1 Diagram of covering the needs of heating and hot water supply with a solar installation.

From this diagram it is clear that all three months of summer (June, July and August) we fully cover our needs. This is due to the fact that in summer there is the most arrival of solar radiation, as well as the needs are nevliki (need only in hot water supply). In winter, we cover less of our needs, because, in addition to the need for hot water, we must support the heating system. But in general, we cover 20% of heating for the year and 60% for hot water supply, which significantly saves money and resources.

Consider the installation scheme. Its feature is that the combined install individual heating system based on solar collectors and central heating. Our two sources of heat combined with the tank battery. Solar collectors are connected via the installation of Drainback, which provides the unboiling mode in the heliosystem. This is done in order to improve the lifetime of solar collectors, which are the foundation of the solar heating and, of course, is the most expensive part of the installation, as well as for the prevention of emergency situations in their operation. The heated water in the tank battery and enters the boiler indirect heat, which is aware of its warmth of water, which goes to the hot water supply. In addition, the water from the accumulator is drawn for heating. All control of solar collectors and heat supply from the central heating system is controlled by the control unit.

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control of solar collectors and heat supply from the central heating system is controlled by the control unit. Its inputs is the temperature of the collectors, the temperature in the tank and the battery in the boiler as indirect heating and the temperature of the coolant flow to the warm floor. In the summer of the thermocouple is switched off, because there is no need for heating the building.

IV. Payback period

According to the payback period of this installation, it is approximately 9 years old, not taking into account running prices, and considering that the price for heating and hot water supply tends to increase, the establishment of this installation becomes more and more profitable. The number of collectors can be increased over time without any special system modifications of the installation.

Conclusion

Since the traditional fuel is an exhaustive resource, it must be all the more to migrate to the non-traditional resources. In this case, solar energy will play a decisive role. In this work we have developed a scheme on the basis of solar collectors for heating and hot water supply in the house, which already has central heating. Since the growth of prices for heat supply tends to grow, the use of this installation is a cost-effective and environmentally friendly.

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Analysis of Pulse-Width Modulation Methods

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Abstract − The purpose of this work is to present the results of analysis of pulse-width modulation methods, i.e. PWM based on the sawtooth waveform generator and PWM based on an integrator and a switch element. Mathematical formulae for designing the tuning parameters of PWM diagrams are presented. An example of PWM application for controlling a thermal plant is presented.

Keywords − pulse-width modulator, diagram, duty cycle, integrator, comparator, switch.

I. Introduction

Pulse-width modulation is often applied during automation of technological processes, in particular for controlling the rotation speed of an electric motor and for controlling a thermal plant. This type of modulation can also be applied in a step PID controller for controlling an electric actuator with a constant speed of movement [1].

Pulse-width modulator (PWM) is a device or a diagram in which the width of pulses at the output is defined by the value of the analog signal at the input [2]. The main parameter of the output pulse signal is the duty cycle (γ). It is the ratio of pulse duration to the period of pulses:

$$g = \frac{w}{t}100\%, \qquad (1)$$

where w is pulse duration (width); τ is period of pulses.

II. PWM based on sawtooth waveform generator

One of the most widespread methods of pulse-width modulation is application of the sawtooth waveform generator and a comparator. This method is also called the intersective method. Explanation of this method is presented in Fig.1. The sawtooth waveform can be generated by means of an integrator with zeroing its output signal (Y_i) when the signal reaches its maximum value. The analog input signal of PWM diagram (Y_a) is compared to the current value of integrator output signal (Y_i) by the comparator. The condition of the comparator operation is as follows

$$\begin{cases} Z = "1" & at \ \ Y_a \geq Y_i; \\ Z = "0" & at \ \ Y_a < Y_i, \end{cases} \qquad (2)$$

where Z is PWM output signal; Y_a is analog input signal of PWM; Y_i is integrator output signal.

The diagram based on the sawtooth waveform generator and a comparator is applied in most up-to-date programmable logic controllers for pulse-width modulation.
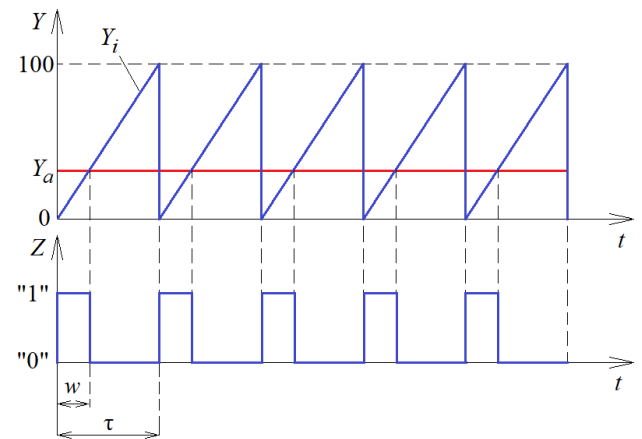
Fig.1. Pulse-width modulation based on the sawtooth waveform generator and a comparator.

III. PWM based on integrator and switch element

An other option of pulse-width modulation is to apply the diagram based on an integrator and a switch element with a negative feedback, see Fig.2
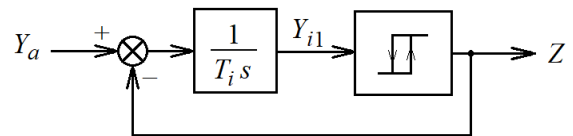
Fig.2. PWM diagram based on an integrator and a switch element.

This diagram can be tuned in the following way. The condition of the switch element operation is as follows

$$\begin{cases} Z = 100 & at \ \ Y_{i1} \geq \Delta_{HL}; \\ Z = 0 & at \ \ Y_{i1} < 0, \end{cases} \qquad (3)$$

where Y_{i1} is integrator output signal; Δ_{HL} is hysteresis loop width of switch element.

For the given values of period of pulses (τ), integrator time constant (T_i) and analog input signal (Y_a) the hysteresis loop width can be calculated as

$$\Delta_{HL} = \frac{t}{T_i} \cdot \frac{Y_a}{100}(100 - Y_a). \qquad (4)$$

It can be defined from Fig.2 that PWM provides the function of proportional conversion with the coefficient of unity. It means that the duty cycle of the output pulse signal is equal to the value of the analog input signal (γ= = Y_a). It can be proved by defining the transfer function of the diagram in Fig.2

$$W_{PWM}(s) = \frac{\frac{1}{T_i s} \cdot K_{sw}}{1 + \frac{1}{T_i s} \cdot K_{sw}} = \frac{1}{\frac{T_i s}{K_{sw}} + 1} \approx 1, \qquad (5)$$

where s is the Laplace transform variable; K_{sw} is the switch element gain coefficient ($K_{sw} \gg 1$).

The diagram based on an integrator and a switch element is implemented in PROTAR-110 [3] controller for pulse-width modulation.

IV. Application of PWM for controlling a thermal plant

The most widespread way of controlling a thermal plant is application of a two-point switch controller. This controller is simple and it can be tuned easily. The example of the transient process in an automatic control loop (ACL) with a two-point switch controller is presented in Fig.3. An electric oven with air flow through it is the controlled plant. Electric power at the oven input is the controlling action. And air temperature is the process variable. The detailed description of this controlled plant is presented in [4].

The transient process in Fig.3 was obtained by applying the mathematical model of the controlled plant [4] in the programmable-logic controller (PLC) MIK-51H of Microl Company. PLC Jazz (JZ10-11-R16) of Unitronics company was the automatic controller. MIK-registrator 1.1.14 software was applied for signals logging. The two-point switch controller was tuned according to the following condition: it was ON when the temperature was below 59.5 °C and it was OFF when the temperature was higher than 60.5 °C.
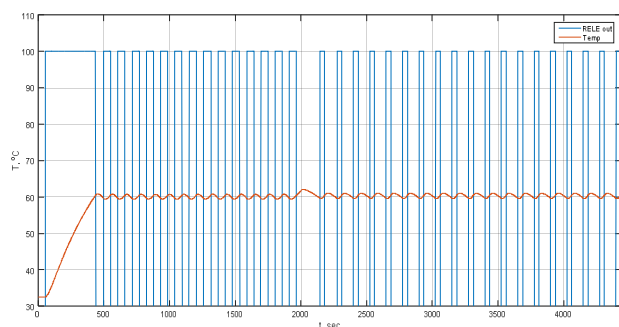
Fig.3. Transient process in ACL with a two-point switch controller.

The transient process in Fig. 3 consists of two parts. The first part (0 ... 2000 s) is movement of the system to the nominal operating regime. And the second part (2000 s ...) is processing of the disturbance introduced by reducing the air flow rate through the oven.

A shortcoming of a two-point switch controller is that there is a self-oscillating transient process in the ACL. In order to remove the self-oscillations a PID controller with PWM is applied. The example of the transient process in ACL based on the PID controller with PWM is presented in Fig.4. PLC Jazz (JZ10-11-R16) was applied for implementation of PID controller with PWM. The period of pulses was 20 s. And the duty cycle was defined by the PID controller output signal.

It can be seen from Fig.4 that there are no self-oscillations in ACL based on PID controller with PWM. And the temperature is maintained at the set point (60 °C).
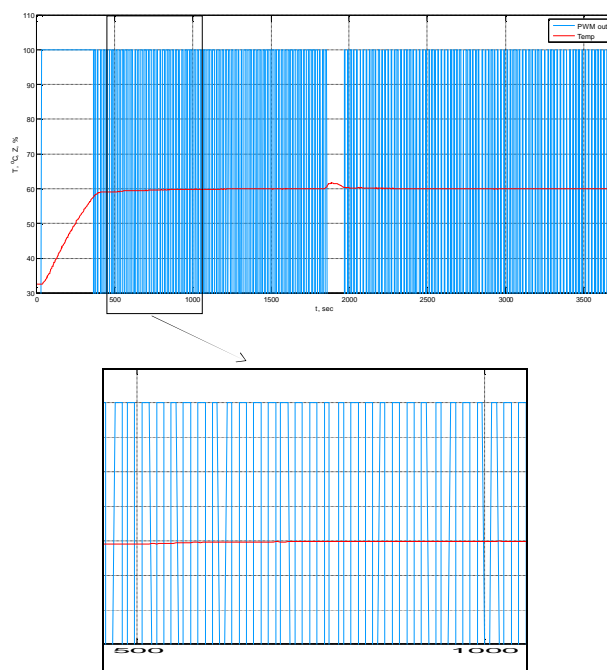
Fig.4. Transient process in ACL based on PID controller with PWM.

Conclusion

The results of analysis of pulse-width modulation methods are presented in the paper. PWM based on the sawtooth waveform generator and PWM based on an integrator and a switch element were considered. Mathematical formulae for designing the tuning parameters of PWM diagrams are presented. It is demonstrated in an analytical way that PWM provides the function of proportional conversion with the coefficient of unity. It means that the duty cycle of the output pulse signal is equal to the value of PWM analog input signal. An example of PWM application for controlling a thermal plant is presented.

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Development of flow meters and assistive devices for the technological air and carbon dioxide accounting

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Abstract – Result of development and implementation of gas flow rate measurement system for rapidly varying flows are considered in this paper. The flow rate meters in this system are based on pressure differential devices with fast processing of flow rate calculation algorithm by PLC`s united into a network and integrated in SCADA.

Key words: measurement of pulsating flow, flow meter, differential pressure flow meters, compressed air, carbon dioxide .

I. Introduction

Continuous monitoring of material and energy flows in production is a prerequisite for their economical use. Usual is a continuous recording of consumption historycal trends by production units of electricity, water, heat or refrigerant and their analysis in order to attribute the costs of these resources per unit of output.

For many food technologies, it is important and cost-effective to record the flow of compressed air and carbon dioxide. The accounting of the flow of compressed air is important in the food industry, which has a large number of pneumatic drives in the technological lines, and in air compression, where are used multiple compressors of high power. In the brewing industry are used many pneumatic drives for the relatively small production (PJSC "Carlsberg Ukraine", Lviv city) where the electric power of the multiple compressors reaches 250 kW. The compressor units control is carried out by the central programmable logic controller, which allows distributing the load to the compressors to make energy consumption maximum effective, taking into account the peculiarities of the compressors auxiliary equipment (lubrication systems, etc.) [1]. In addition, in the brewing industry is released and consumed carbon dioxide, which is a valuable raw material and its excess is sold to other industries, for example, for gassing soft drinks. For these technologies are needed high-speed flow meters of pulsed fluxes of compressible fluid , which can measure rapid changes in the flow rate within the range of 0.2-1 [2] from the measurement range within 1-5 seconds.

II. Terms of equipment selection

Measurement of the flow of compressed air solves two problems: the first is accounting; the second one is taking the flow signal for the multiple compressors automation. In automation system of multiple air compressors can be offered new algorithms to control them, which will significantly save energy, unlike the cascade of pumps for water pumping, where are used non-compressible fluid with a high speed change of pressure in it. To implement such a control system is required a flow meter with high speed facility and low pressure loss on it.

Measuring the flow of carbon dioxide consuming, which is used to create a carbon dioxide atmosphere, in technological devices (buffer capacities) and saturation of beer, it is not critical the pressure loss on the flow meter. However, it is important high-speed measurements and the flow's value limits, which does not exceed the maximum value of the measuring range of the instrument, in the supply line. It is critical to choose the upper limit of measuring the flow meter at the level of 2-2,5 values from the calculated average consumption and prevent the excess value of the flow of the technological bottling line beyond this value, because observational error will be significant when it integrate the flow to calculate large carbon dioxide capacity. The limit of the flow value was achieved in two ways: 1) the installation of an additional diaphragm in the flange of the flow meter after the control area; 2) the installation of a specially designed of the flow restrictor of direct action, after the flow meter.

The special restrictor installation is the best solution to the problem, despite the greater implementation complexity. This device is a local constriction, with a bellows or membrane actuating mechanism and a valve, which must have a static characteristic, shown in Fig.1
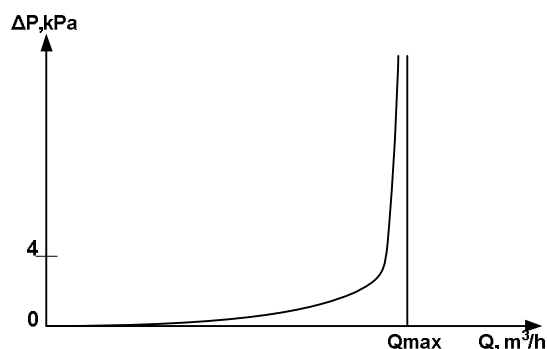
Fig.1 The flow limiter static characteristic (ΔP – pressure drop across the flow limiter, kPa, Qmax – maximum measuring range of the flow meter, m3 / h)

To construct flow meters of pulsed fluxes of compressible fluid, the differential pressure method was chosen on the basis of non-standard tapering devices. The pressure difference on the narrowing device was measured by a serial differential pressure meter, and two other measurements – the absolute gas pressure and temperature required to calculate the gas density under working conditions [3]. Rapid processing of information is implemented on a separate controller type S7-1200, which is easy to integrate into the industrial information network. In project was used Siemens concern equipment, which representation in Ukraine contributed most to the implementation of this development.

The peculiarity of the constructive implementation of flow meters is that they are made as a single-walled design with control areas and a minimum number of seals. The critical dimensions of the constituent of the

tapering device become hard to produce with an allowance less than 10 μm for pipelines with diameters of up to 50 mm, . Therefore, the calculated static characteristic of the flow meter was recalculated according to the actual dimensions of the finished parts.[4]

III. Developed flow meters

In fig. 2 shows the appearance of a batch of carbon dioxide flow meters manufactured for PJSC "Carlsberg Ukraine", Kyiv.
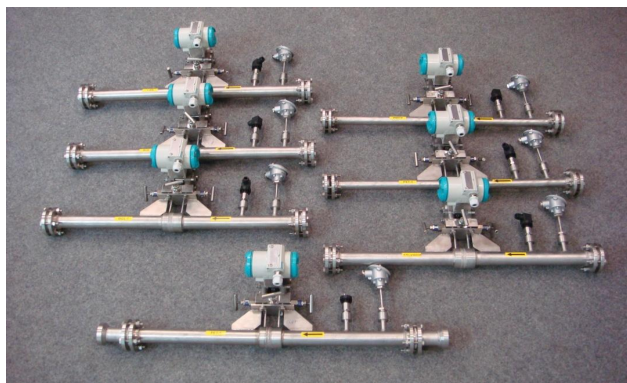
Fig. 2. General view of measuring units of flow meters of pulsed fluxes, executed as a single-welded structure.

In fig. 3 shows the flow-measuring unit for measuring pulsed compressed air flows, manufactured as a complete weldless design without control points of the pipeline, which is involved in the automation system of multiple compressors at PJSC "Carlsberg Ukraine", Lviv, one of which is driven by a frequency drive.
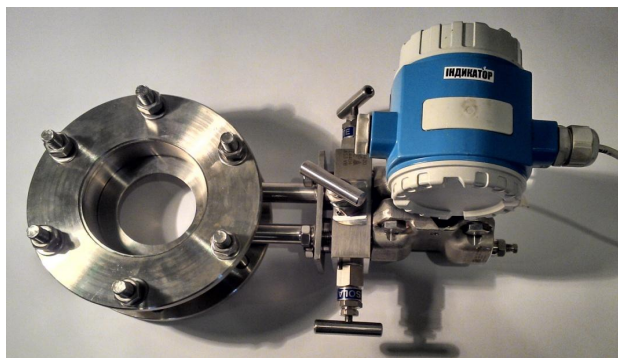
Fig. 3. General view of the measuring unit of the flowmeter of the pulsed compressed air flows, which is executed as a single-welded structure.

In fig. 3 shows a computing device for pulsed streams flowmeters of compression fluid data processing using the programmable logic controller S7-1200. This makes it easy to integrate the device into a multiple compressor control system.
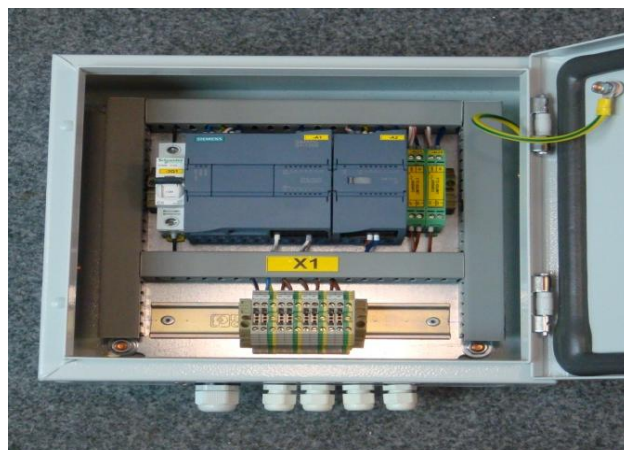
Fig. 4. General view of the computed device of the pulsed streams flow meter of ccompressed fluid using the programmable logic controller S7-1200.

Conclusion

The development results of flow meters of pulsed fluxes of carbon dioxide, liquid carbon dioxide, compressed air were introduced at the enterprises of PJSC "Carlsberg Ukraine", Lviv, Kyiv, JSC "Radomyshl Beer and Non-alcoholic Combine", Radomyshl, Zhytomyr region.

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Modelling of hydrodynamic processes inside coaxial channels of regular packing of cooling tower

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Abstract – The report is devoted to the analysis of physical processes associated with the motion of two-phase (fluid-gas) media inside the regular packing of cooling towers. Axisymmetric laminar flow inside the system of vertical coaxial infiniteness channels is considered. The mathematical formulation of the problem reduces to a boundary-value problem with the corresponding boundary conditions. The obtained analytical solution of the problem allowed carrying out a qualitative analysis of the flooding process in regular packing of cooling towers. It was shown that the flooding process begins on the inner surfaces of channels that located closer to the axis of the flow in regular packing of cooling tower.

Keywords – Two-phase flow, boundary-value problem, coaxial channels, flooding, regular packing, viscous flow.

I. Introduction

The extremely fast development of scientific and technical thought stimulates today many researches in different fields of classical physics. There are an enrichment of different sections of knowledge with new ideas and methods of research, and the formation of a large number of scientific problems, the solution of which requires practice today. A deep understanding of the physical features of transport processes in continuous media opens new opportunities for researchers and developers of various specialties in the design of new cooling systems, the creation of effective cooling towers in heat power engineering, chemical and pharmacological industries and other innovative technologies. Recently, this problem remains the actual one.

Complex physical processes occur in the gas flow inside the regular packing of cooling tower. Various phase changes lead to the appearance of a fluid film on the internal surfaces of the channels. The dynamics of this fluid can have a significant effect on the efficiency of heat exchanger apparatus, and in some cases can leads even to uncontrolled regimes. Such regimes in two-phase flows are called in the technical literature as critical regimes.

Theoretical analysis of the flooding process is associated with appearance of Kelvin-Helmholtz instability in continuous media under the action of forces of various physical natures.

Phenomenological study of the flooding regime [1] is always limited by the parameters of regular packing of cooling tower. Analytical investigation [2-3] are based on the representation of a fluid film as a smooth surface, or a wave surface. The latter option is semi-empirical. An analytical solution to this problem requires a sequence of experimental dependencies. Often this aspect in research limits its applying in the design of regular packing of cooling tower for various purposes and geometry.

The parameters of a smooth fluid film are calculated on the assumption that the viscous fluid flow is stationary, and its motion is averaged over the cross section. In other words, many researchers assume that the velocity of motion of a fluid film depends on the balance of pressure force, frictional force and gravity force. In fact, this problem is reduced to determine the value of these three forces, which depend on velocities of gas and fluid phase components.

Both experimental studies, and many observations show that the fluid film, despite a small relative thickness, is a continue environment that has own velocity distribution. A viscous fluid near a solid surface does not move, while the fluid-gas interface can have a nonzero velocity. Consequently, the velocity distribution inside the fluid film is important for the formation process of the flooding regime in the regular packing of cooling tower.

The main purpose of this research is determination of a quantitative relationship between the average velocities of the gas flow inside the coaxial channel system at critical regime, which leads to a flooding process in regular packing of cooling tower.

II. Mathematical model

Consider the stationary axysymmetric laminar motion of a two-phase flow (fluid-gas) inside infinite straight coaxial channels with a circular cross-section (R_1 is the radius of the inner channel, R_2 is the radius of the outer channel) located vertically (fig. 1). Let the gas with density ρ_1 and coefficient of dynamic viscosity μ_1 fill the middle part of the system ($R_1 + h \leq r \leq R_2 - h$), while a fluid with density ρ_2 ($\rho_2 >> \rho_1$) and coefficient of dynamic viscosity μ_2 placed near hard surfaces ($R_1 \leq r \leq R_1 + h$, and $R_2 - h \leq r \leq R_2$), where h is the thickness of the fluid layer. A pressure gradient dp/dz = const is formed in the channel for driving the gas from the bottom upwards.

It is necessary to determine the distribution of the longitudinal velocity components $U_2(r)$ of the gas and $U_1(r)$, $U_3(r)$ of the fluid in a cross section of the coaxial channels.
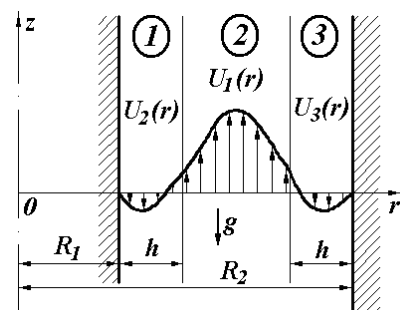
Fig.1. Geometry of the problem

The basic equations describing the motion of media are the Navier-Stokes equation, which for the axisymmetric

case in a cylindrical coordinate system (r, z) coincided with the axis of the channel, reduce to a system of ordinary differential equations, as following [4]

$$\begin{cases} \dfrac{m_1}{r}\dfrac{d}{dr}\left(r\dfrac{dU_1}{dr}\right)=\dfrac{dp}{dz}, & R_1+h\le r\le R_2-h \\[2mm] \dfrac{m_2}{r}\dfrac{d}{dr}\left(r\dfrac{dU_2}{dr}\right)=r_2g+\dfrac{dp}{dz}, & 0\le r\le R_1+h \\[2mm] \dfrac{m_2}{r}\dfrac{d}{dr}\left(r\dfrac{dU_3}{dr}\right)=r_2g+\dfrac{dp}{dz}, & R_2-h\le r\le R_2 \end{cases} \quad (1)$$

where $U_1(r)$, $U_2(r)$ and $U_3(r)$ are longitudinal components of the velocity of gas and liquid in the corresponding parts of the channel, dp/dz is a pressure gradient formed in the channel, which establishes movement within the channel, and g is acceleration of gravity.

Considered boundary value problem (1) contains the following boundary conditions

$$U_2(R_1)=0, \qquad U_2(R_1+h)=U_1(R_1+h),$$

$$m_1\dfrac{dU_1}{dr}\bigg|_{r=R_1+h}=m_2\dfrac{dU_2}{dr}\bigg|_{r=R_1+h}, \qquad (2)$$

$$U_1(R_2-h)=U_3(R_2-h), \quad U_3(R_2)=0,$$

$$m_1\dfrac{dU_1}{dr}\bigg|_{r=R_2-h}=m_2\dfrac{dU_3}{dr}\bigg|_{r=R_2-h}.$$

The first and the last boundary conditions in eq.(2) are no-slip condition for a viscous liquid at a solid surface. The second and fourth conditions in eq.(2) are the conjugation conditions for media with respect to velocity, while the third and fifth expressions are the conjugation conditions in respect to tangential stress.

The mathematical problem (1) together with boundary conditions (2) has the analytic solution $U_1(r)$, $U_2(r)$ and $U_3(r)$, which is presented in the report. This solution allows us to obtain analytical expressions for the volume capacity rate of gas Q_2 and fluids Q_1 and Q_3 through the cross section of the channel. In this case it is necessary to calculate the following integrals

$$Q_1=2p\int_{R_1+h}^{R_2-h}U_1(r)\cdot r\,dr,$$

$$Q_2=2p\int_{R}^{R_1+h}U_2(r)\cdot r\,dr, \qquad (3)$$

$$Q_3=2p\int_{R_2-h}^{R_2}U_3(r)\cdot r\,dr.$$

On the basis of [5, 6] was taken that at the flooding process the volume capacity rate of fluid leads to zero, so $Q_{1m}=0$ or $Q_{3m}=0$. This condition allows us to determine the values of the pressure gradients $(dp/dz)_{1m}$ or $(dp/dz)_{3m}$, which have to be applied to the channel to achieve the flooding regime. Analogue of obtained results allows to conclude that the values of the pressure gradients for the flood regime depend both on the geometry of the channel (the ratio between R_1 and R_2), but also on the thickness h of the films at inner and outer surfaces of the channel.

These pressure gradient values, $(dp/dz)_{1m}$ or $(dp/dz)_{3m}$, are used to determine the gas velocity profile $U_2(r)$ in the middle part of the channel.

III. Numerical analyse

As an example, we consider the motion of a two-phase medium (water-air) inside a coaxial chanel ($R_1 = 5.0\cdot10^{-3}m$, $R_2 = 10\cdot10^{-3}m$) system with a thin fluid film $h = 0.5\cdot10^{-3}m$.

Fig.2 shows the gas and fluid velocity profiles that are formed inside the system of coaxial channels at different modes: the counter-flow regime (the most of the gas and fluid move in the opposite directions), the loading regime (fluid and gas velocities at the interface is zero) and flooding regime (volume capacity rate of the fluid at the cross section of the channel is zero). It is shown that the velocity profiles have a shape close to the parabolic shape for all regimes. It indicates that the laminar gas flow in the middle part of the channel is achieved. It is interesting to note that gas and velocity near interface moves in the same direction (downwards) in the counter-flow regime (Fig. 3).

Analysis of the curves in fig.2 and fig.3 shows that the local velocity of the film at the interface between media 2 and 3 is lower in comparison with the corresponding velocity at the interfaces between media 1 and 2 for different values of the average gas velocity in the middle part of the coaxial channels. In other words, the flooding process begins on the inner surface of the channel (the interface between media 1 and 2) for different values of radii R_1 and R_2.
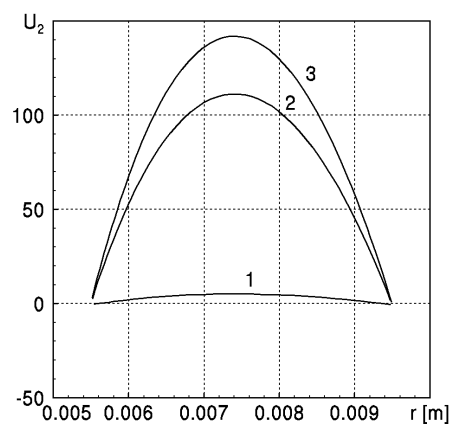
Fig.2. Distribution of velocity in the gas for: 1 – counter-flow regime, 2 – loading regime, 3 – flooding regime
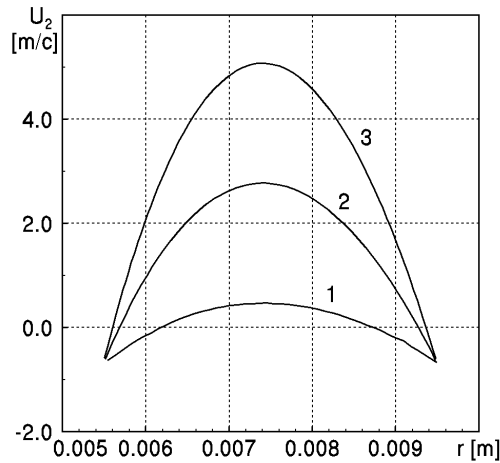
Fig.3. Distribution of velocity in the gas for counter-flow regime for different velocity profiles in the gas: 1 – $dp/dz = -10 \ Pa$, 2 – $dp/dz = -30 \ Pa$, 3 – $dp/dz = -50 \ Pa$

Figure 4 illustrates the dependence of the average gas velocity inside the channel for the flooding regime on the values of the channel radii R_1 at constant film thicknesses h and the width of gas channel $H = R_2 - R_1$. We can see that the velocities remain approximately at the same level over a wide range of values of the internal radius of the channel. However, they display different dependencies. On the one hand, increasing the radius R_1 of a smaller channel leads to increasing values of the gas velocities, at which the flooding regime occurs. On the other side of the channel, an inverse dependence is observed. Increasing the radius R_1 leads to a decrease in values of the average gas velocity. A comparison of this figures shows that the gas velocity, at which the flooding regime takes place, on the inner surface of coaxial channel system is always smaller than the corresponding velocity for the outer surface of he channel. In other words, the flooding process always begins on surfaces closer to the axis of the flow.

The dependence of the average gas velocity needed for forming the flooding regime on the fluid film thickness h at constant values of the internal radius $R_1 = 5.0 \cdot 10^{-3} m$ of the channel and the width $H = 5 \cdot 10^{-3} m$ of the gas channel is shown in Fig.5. Increasing the thickness of the film leads to an increase in the average gas velocity. This trend is preserved up to values $R_1 \approx 0.9 \cdot 10^{-3} \ m$. There are extreme values of the velocity. Then, increasing in the film thickness leads to a decrease in the corresponding averaged values of the gas velocity. This tendency is typical [6] and corresponds to the physical features of the flooding process in regular packing of cooling tower systems. Some detail physical processes in two-phase flows in infiniteness circular channels with vertical orientation we can find in monograph [5].

Analysis of the analytical dependencies and numerical data shows that the average gas velocity, at which the flooding regime is formed, is always large for the outer surfaces of the coaxial channel system as compared to the corresponding values for the internal surfaces. Moreover,

these values actually depends on the thickness of the film, which arises on the solid surfaces of regular packing of cooling tower. It is shown that an increase in the width of the gas channel leads to an increase in the values of the average gas velocity, at which the flooding regime on the inner surface of the coaxial channel system begins to form.
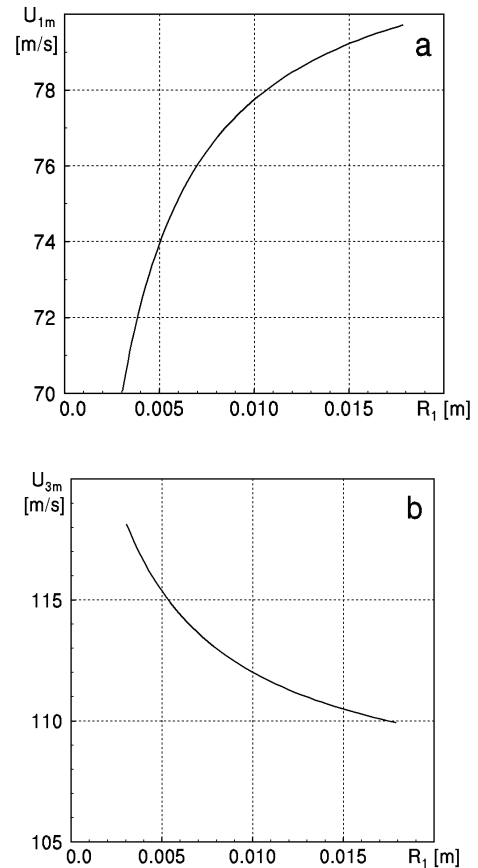
Fig.4. Dependence of overate gas velocity at flooding regime on radius of the channel for: a – internal surface, b – outer surface of the channel system
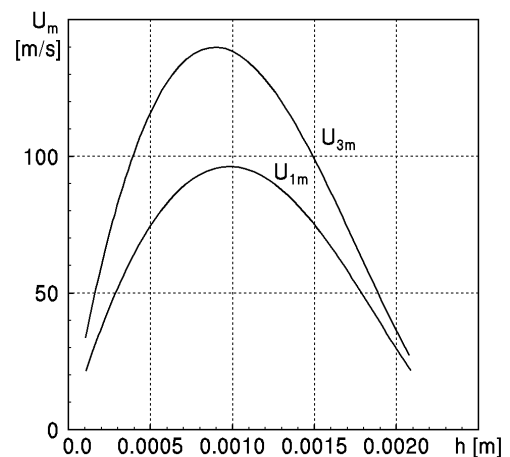
Fig.5. Dependence of overate gas velocity at flooding regime on thickness of the fluid film for internal and external surfaces of coaxial channel system

Conclusion

The problem of motion of a two-phase laminar flow (gas-fluid) inside an infinite rectilinear system of coaxial channels placed vertically is considered. The mathematical formulation of the problem reduces to the solution of axisymmetric Navier-Stokes equations in a cylindrical coordinate system together with boundary conditions at interface surfaces.

This problem has an analytical solution that has allowed to establish quantitative regularities of the flooding process in dependence on the physical properties of gas and fluid, the geometric parameters of the channel and the thickness of the fluid film formed on solid surfaces.

An analysis of achieved results shows that the flooding process begins at lower averaged along cross-section gas velocities for narrow channels. This process begins on the inner surfaces of the channel, located closer to the axis of the flow. Increasing the average gas velocity in the middle part of the channel system leads to the appearance of the flooding regime on the outer surfaces of the channel. This process can occur in a narrow range of gas velocities.

It is shown that the flooding process appears in narrow channels at lower averaged velocities. Moreover, this process depends on the thickness of the fluid film. The profile of the longitudinal component of the fluid velocity inside the films can vary with sufficiently large gradient forming a viscous friction force commeasurable with the gravity force.

The quantitative particularities of the influence of dynamic parameters of a continuous medium and flow geometry on the flooding process in contact devices containing a system of coaxial channels placed vertically. The obtained data can provide a certain support to researchers, designers and developers of regular packing for various purposes and different geometry.

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Study of Working Efficiency of Cooling Towers of Nuclear Power Plants

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Abstract – Working efficiency of cooling towers has been analyzed with the aim of detecting the change of their cooling efficiency during operation, as well as effect of organizational and construction decisions on cooling efficiency of the towers. Researches were conducted by comparison of actual temperature of water cooled in cooling towers with calculated value of the temperature. It has been found out that cooling efficiency of cooling tower worsens after continuous service because of disorder of tower flushing uniformity. Cooling efficiency of cooling towers can be increased by increasing the flushing area, as well as by diminishing unorganized leakage of cooling water.

Keywords – power efficiency, cooling tower, flushing area, splashing nozzles.

I. Introduction

The system of nuclear and thermal power plants water supply and cooling of heated circulating water using water from natural reservoirs is the most widespread. But it has significant constraints, because the effect of heated water on the functional state of existing aquatic ecosystems must be taken into consideration. Elevation of the reservoir water temperature over design value (overheating) causes so called "thermal pollution" of water environment.

The effect of temperature on aquatic ecosystems depends on discharged water temperature and sensitivity of different groups of organisms to it. Water temperature elevation up to about 30°C is marginal for most species of aquatic organisms. In addition, use of natural reservoirs as cooling water source has one another disadvantage: its cooling ability strongly depends on the season and considerably decreases in summer. This makes it impossible to ensure optimal conditions of power plants operation all year long. To abandon use of water from natural reservoirs, various systems where water is cooled in cooling towers were developed. Such systems have less negative effect on the environment, including only bearing out of condensed moisture, steam torch and noise. Besides, use of cooling towers in cooling systems of reverse water supply ensures saving of natural water 25-50 times compared to once-through systems and eliminates thermal pollution of natural reservoirs [1]

In most simple case a cooling tower is an apparatus for cooling large amount of water by directed stream of air. The water is cooled due to evaporation of small amount of water flowing down along flushing device, in opposite direction to which stream of air is moved. Evaporation of 1% of water results in decrease of remaining water by 5.48°C.

Working efficiency of cooling towers, wherein liquid and gas phases move in the opposite directions, does not depend on circulating liquid parameters (flow rate and temperature) and environmental conditions only. Rate of upstream air flow and, especially, its distribution in cooling tower volume have considerable effect on the process of cooling by evaporation [2]. In consideration of this, it makes sense to look for the ways of cooling towers working efficiency enhancement that would allow using all the advantages of reverse water supply system from technical, environmental and economical (decrease of specific fuel consumption, consumption of water and electricity, etc.) points of view.

Power plants water cooling systems with cooling towers (fig. 1) are most favourable in regions with limited sources of water [3], because additional fresh water in this case is needed only for recovery of water loss by evaporation and bearing out the tower.
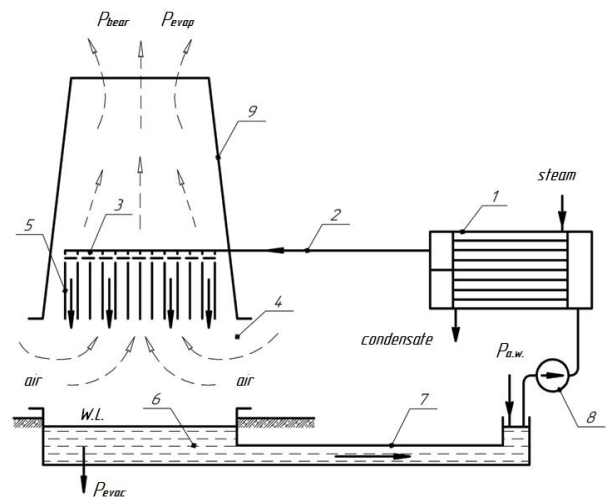
Fig. 1. Scheme of reverse water supply of power plant with cooling tower:

1 – turbine condenser; 2 – unloading pipeline; 3 – distributing chute of cooling tower; 4 – air supply; 5 – flushing device of cooling tower; 6 – water collecting pool; 7 – water supply line; 8 – circulation pump; 9 – draught tower; W.L. – water level; P_{evap} – water loss for evaporation; P_{bear} – loss of water bearing out; P_{evac} – evacuation of return water; $P_{a.w.}$ – additional fresh water

II. Technical water supply system of Rivne nuclear power plant

Technical water supply system of I stage of Rivne nuclear power plants is reverse, two-lifting with circulating water cooled in four film-type cooling towers of design productivity 100 000 m³/year each. The cooling towers are in-parallel.

Water is supplied to power house by group of pumps installed in two pumping stations, and to the cooling towers by another group of pumps installed in two separate pumping stations.

Highly productive cooling towers of flushing area 10 000 m² with 150 m high hyperbolic draught towers of reinforced concrete are used for circulating water cooling. Water losses from the technical water supply system

(bearing out, filtration, evaporation etc.) are compensated from the river by pumping station of additional water build on it.

III. Study of cooling efficiency of cooling towers of Rivne nuclear power plant

To determine cooling efficiency of the cooling towers and possibility to enhance it, number of studies has been conducted. According to the research method [1] parameters characterizing the cooling tower work, namely: circulating water flow rate, temperature of inlet and cooled water, environmental conditions, were registered.

Cooling efficiency of the cooling towers was assessed by comparison of actual temperature of water cooled in the towers with calculated value of the temperature, determined from their functional specification.

Works of the cooling towers testing were performed in two stages. On the first stage cooling towers No. 1-4 were tested with existing design systems of water distribution, including typical splashing nozzles, wherein cup deflector is whole and attached to the pipe by two holders (supports).

The aims of research on this stage include determination of cooling efficiency of all four cooling towers, comparison of current working efficiency of cooling tower No.1 with results of its testing in previous period, detection of changes in working efficiency of cooling towers No. 3 and 4 as a result of additional installation of stacks of asbestos-cement sheets.

On the second stage of research cooling towers No. 2 and 4 with their water distribution systems having been fitted with new splashing nozzles, wherein cup deflectors are perforated and attached to the pipe by three holders, were studied. The research aim on this stage was to determine the effect of splashing nozzles replacement on the cooling efficiency.

Analysis of obtained results of cooling towers research and their comparison with results of research of cooling tower No.1 in previous studied period (time interval between studied periods was 6 years) showed worsening of cooling efficiency of cooling towers No.1 and 2. The worsening of cooling efficiency is caused by disorder of uniformity of tower flushing with cooling water because of clogging and failure of typical splashing nozzles. The clogging and failure of splashing nozzles lead to diminution of a splashing torch, making crossing of bases of the torches from adjacent nozzles impossible. Consequently, the flushing of the cooling tower becomes insufficient. Such ineffective utilization of all the flushing area reduces working efficiency of cooling tower on the whole, especially in summer.

Enhancement of cooling efficiency of cooling towers No. 3 and 4 was caused by previous sealing of joints of asbestos-cement pipes of water distribution system, as well as installation of additional stacks of asbestos-cement sheets in existing holes of flushing devices of the cooling towers.

The sealing of joints of asbestos-cement pipes eliminated unorganized leakage of cooling water in amount of about 5 % of all water coming into the cooling tower. This allowed to ensure more uniform supply of cooling water to the flushing devices and reduce the cooling water temperature by about 0.3 ºC.

Installation of additional sheets of flushing device allowed to increase cooling area of each cooling tower by 5.6 % of design cooling area, as well as to reduce unorganized flow of cool air, having not contacted with cooling water, from the cooling tower. Thus, installation of additional flushing blocks in cooling towers No. 3 and 4 allowed achieving cooling water temperature reduction by 0.6 ºC on average.

Conclusion

The research conducted and analysis of obtained results of cooling towers operation allowed to found out that for enhancement of reliability and working efficiency of cooling towers the existing holes in flushing devices should be filled by additional asbestos-cement blocks. This ensures reduction of cooling water temperature by about 0.6 ºC. It is also recommended to replace the flushing devices made of asbestos-cement sheets by modern ones made of polymer materials. Use of polymer materials (high density polyethylene, polyvinyl chloride, polyester resins etc.) for flushing devices to be made of them has the following advantages: such flushing devices are corrosion resistant, have high firmness and low density, tubes, grids and other elements of complex configuration can be easily formed of polymers. Such flushing devices can be made with such configuration, which would combine high cooling efficiency and low aerodynamic drag coefficient. At the same air parameters the flushing devices made of polymer materials are more efficient and allow achieving lower temperatures of cooling water compared to flushing devices made of asbestos-cement sheets [4]. Splashing nozzles of ruggedized construction with perforated cup deflectors should be used in water distribution system of cooling towers. To prevent clogging of splashing nozzles of water distribution pipes of cooling towers, annular efferent washing nozzles should be installed.

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Implementation of biogas plants at food industry enterprises

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Abstract − According to the Energy Strategy of Ukraine for the period up to 2035, the priority direction of domestic energy development is renewable energy sources. Biogas is one of the most promising renewable energy sources, whose potential in Ukraine is significant. The distribution of biogas plants will also contribute to the improvement of the ecological situation in the country. The implementation of a biogas plant at the yeast production enterprise is shown in the work. The biogas plant is based on an anaerobic digestion process. The payback period of the biogas plant is less than three years.

Keywords − renewable energy sources, biogas plants, anaerobic digestion.

I. Introduction

The new Energy Strategy of Ukraine «Safety, energy efficiency, competitiveness» for the period up to 2035 was approved by the Government on August 18, 2017. According to [1], bioenergy is capable of developing at the fastest pace. Biomass is expected to provide an annual replacement of 9.2 million tons of fossil fuels. These trends are also consistent with world experience [2].

The distribution of biogas plants will also help to improve the environmental situation. Because, the organic waste from the food industry, agriculture, woodworking is one of the most dangerous for the environment.

In particular, such problems are faced by yeast companies, one of which is located in L'viv. This company not only controls most of the Ukrainian yeast market, but also delivers this product to Europe.

In the process of yeast baking production, the enterprise produces waste products that reach 2200 m^3/day. They accumulate in specially designated places. They are partially shipped to specialized enterprises for utilization or processing.

Wastewater of surface runoff is discharged into local sewage treatment plants. This is a big problem for both the company and urban wastewater treatment plants. Therefore, it is promising to install a biogas plant, which will clear the production runoff.

Since the installation will produce biogas, it can replace the natural gas that is used in the technological process of the enterprise.

Thus, the using of one biogas plant can solve two issues at once:
- reducing the burden on urban wastewater treatment facilities;
- replacement of expensive imported gas.

II. Biological processes of fermentation

The basis of the biogas installation is the biological processes of fermentation and decomposition of organic substances under the influence of methane-forming bacteria in anaerobic conditions [3]. The anaerobic digestion process includes the following stages:

hydrolysis − eco-enzymes transform complex molecules into simpler, which are better absorbed by bacteria;

acidification (acidogenesis) − acidogenic bacteria convert less formulated molecules into acetic, propane, butyric and other acids;

acetylation (acetogenesis) − a process in which bacteria convert propionic and butyric acid into octoic acid (CH_3COOH), carbon dioxide (CO_2) and hydrogen (H_2);

methane production (methanogenesis) − a process in which methanogenic bacteria in the course of their metabolism convert acetic acid, carbon dioxide (CO_2) and hydrogen (H_2) into biogas (CH_4) and a small amount of biomass.

The alternation of these processes is schematically depicted in Fig. 1.
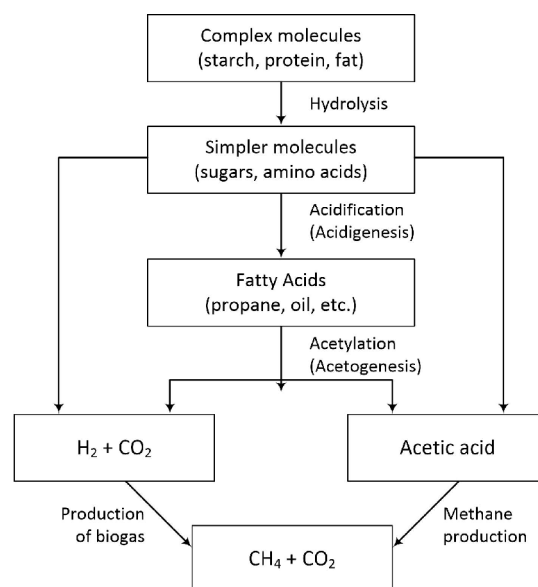
Fig. 1. Alternate processes of anaerobic digestion.

In the process of fermentation, there is a biogas release containing 40-70% methane, 30-60% carbon dioxide, about 1% hydrogen sulfide and a small amount of nitrogen and hydrogen.

The amount of biogas generated at a temperature of 35-37° and the average time of retention of raw material in the reactor for 10 days, is within 30-70 m^3 of biogas per ton of raw materials per day.

III. Scheme of biogas installation

Anaerobic fermentation is carried out in a sealed container (a reactor), usually cylindrical in the form of a horizontal or vertical arrangement.

The raw materials for bioreactors are wastewater. The company had previously installed a reactor for 800 m^3 of wastewater per day. It is necessary to install additional

reactors by 1400 m³/day of drainage. Since the wastewater requires dilution, we choose two vertical type reactors Biobed EGSB1000 with a working volume is 1000 m³. The expansion scheme of the biogas plant of the company is shown in Fig. 2.

Fig. 2. Expansion scheme of the biogas plant of the company.

According to the fermentation mode (mesophilic or thermophilic) it is necessary constant temperature for providing efficient fermentation in the reactor. Also it is necessary to mix the digestible raw materials regularly.

Typically, heat exchangers are used for heating, where hot water with temperature 60°C is the heat carrier. Higher temperature increases a risk of sticking the suspended particles to the surface of the heat exchanger.

The mixing can mainly be mechanical stirrers, biogas (for this biogas is passed through the thickness of raw materials) or pumping raw materials from the upper zone to the bottom.

The scheme of biogas plant operation is shown in Fig. 3.
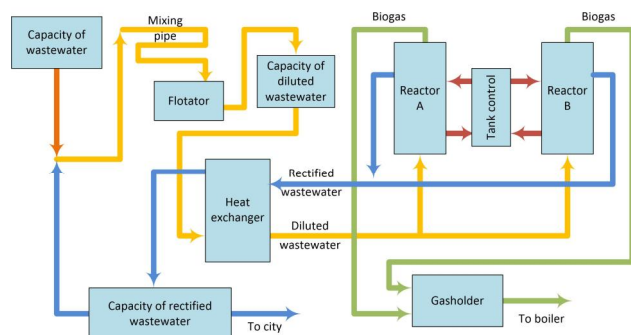
Fig. 3. Scheme of biogas plant operation.

Wastewater is formed as a result of the production of yeast so has a large amount of substances. The main characteristics of wastewater are concentration of calcium, nitrates, nitrites, ammonium nitrogen and pH level (see Table. 1).

TABLE 1

MAIN COMPOSITION OF MANUFACTURING STOCKS

Composition	Amount	Dimension
Calcium	760	mg/l
Suspended matter	370	mg/l
Nitrates	11	mg/l
Nitrite	1.5	mg/l
Ammonium nitrogen	145	mg/l
pH level	5–4.2	

These characteristics are the main, since the preparation of the wastewater to the bioreactor is tuned relative to their quantity.

Estimated volumes of biogas in the reactor depend on the volume of wastewater supplied to the treatment facilities from the enterprise, and its chemical oxygen consumption (*COC*)

$$COC = V_{runoff} COC_{spec} \qquad (1)$$

where COC_{spec}=11.8 кг/m³ – specific chemical consumption of oxygen.

Expected volume of biogas

$$V_{biogas} = COC \cdot k \qquad (2)$$

where k – biomass expansion factor.

According to calculations from 2200 m³ of wastewater production, 11925 m³/day of biogas can be obtained.

IV. Economic benefits

Annual biogas production is 11925 m³/day, but the calorific value of biogas is 30% less than that of natural gas. Hence the equivalent amount of biogas per day is equal

$$V_{ekv.biogas} = 0.7V_{biogas} \qquad (3)$$

So it is 8347 m³/day.

The current price for natural gas is 6.9579 UAH/m³. However, biogas in its properties is worse than natural gas. It has a small amount of harmful impurities, so its price will be lower than natural gas by 20%

$$C_{ekv.biogas} = 0.8C_{gas} \qquad (4)$$

that is 5.5663 UAH/m³.

Expected annual savings will be 16.96 million UAH.

A simple payback period for biogas installation is less than three years.

Conclusion

The biogas plants are a promising direction for the development of renewable energy in Ukraine.

At the yeast enterprise are offered biogas plant which is based on an anaerobic process of fermentation and includes the four stages.

The simple payback period for the implementation of a biogas plant does not exceed three years.

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Independent Controlling the Consumer of Electricity from Several Points

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Abstract – In this project, a device that independently manages the electricity consumer from several places and is completely safe was developed and constructed.

The purpose of this development is safe management by the consumer of electricity in the domestic premises (staircases, corridors, etc.), even without replacing the old electrical wiring due to 5 V.

Practical results – the simulated device was tested at a power consumption of 20 to 1000 W and showed a steady work of this design. The prototype of this device is successfully used at the Department of Electrical Engineering of the Mykolaiv National University.

Novelty – control of electrical devices designed for power 220 V with the help of several switches, connected with each other by a wiring, calculated at 5 V.

Keywords – convenient, easy to manage, safe, economical, constructed.

I. Introduction

This development has spread in various directions, for example, in the direction of "smart home" and is a *convenient*, *safe*, *economical* version of the solution to the problem of controlling devices from multiple points.

Existing multi-point consumer control systems are not sufficiently advanced, as they require an extra 220V electrical wiring to be put into operation, which requires additional costs.

One of the options for solving the problem is switching switches. Depending on the position of the switch key, the mobile contact closes with one of the fixed contacts.

Sometimes the situation requires management from three, four or more places. Here some pass switches cannot do. The circuit must be supplemented with four contact switches – so-called cross switches.

Another option is a bistable (pulsed) relay – these are relays that switch their power contact when applied to their coil or short circuit pulse control circuit.

II. The Original Version

An economic system for controlling electricity consumption from several points was developed and *constructed* which:

1) Connects to an existing circuit breaker.
2) *Convenient* and *easy to manage*.
3) Carries out the independent management of the consumer from several points.
4) Control lines which are absolutely *safe* (low voltage, low current, galvanically isolated from the electric network).

5) Has a stable position of switches "on-off", which allows users to determine the state of the consumer of electricity.
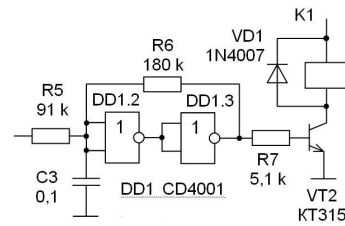
Fig. 1. The trigger

The basis of the device is a Schmitt trigger (Fig. 1), which remembers the last action of the usual switch. The state of the trigger is transmitted to the electronic key that controls the electromagnetic relay. The relay contacts or switches are the consumer circle.

The scheme can only be in one of the stable states – zero or single:

1) If the circuit is in a null state, it can be converted to a single state by feeding the trigger through the resistor R5 to a voltage close to the supply voltage for a short time (several microseconds).

2) From a single state, the circuit is translated, giving the trigger input a low voltage level.

3) After setting any state the trigger will stay there indefinitely.

For the formation of single or zero impulses, an amplifier of voltage with a differential link, R4C2 at its input is used. With an increase in voltage at the input of the differential link, a positive pulse is generated by a voltage close to the supply voltage, which lasts several tens of milliseconds for trigger reliability.

In order to increase the voltage at the input of the differentiator when each switch is switched on and its reduction when one of the switches is switched off, the idea of constructing digital-to-analogue converter (DAC) on the logical element DD1 .4, which operates in the linear mode of the inverse voltage amplifier is used.
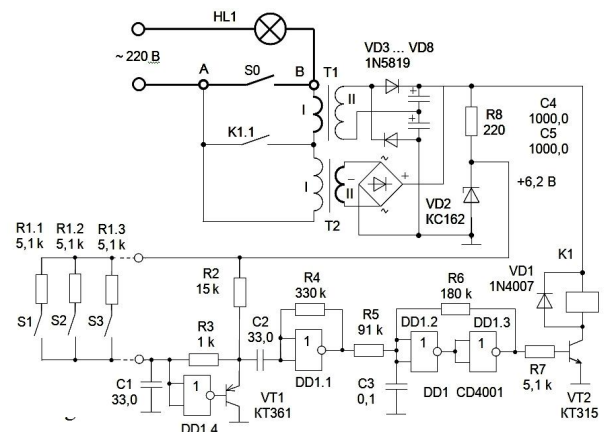
Fig. 2. The original version

With open contacts S1, S2 and S3, the amplifier on the DD1.4 element and the VT1 transistor are covered by the feedback on the resistor R3 is in idle mode. Voltages at

the input and output of the amplifier are equal to and equal to 0.5 voltage supply (6 V), that is 3 V.

When one pair of contacts, such as S1, is closed, through the resistor R1.1 the current flows, the voltage at the input of the element will increase. Since the amplifier is inverted, the voltage at the output of the amplifier on the emitter VT1 will decrease. Through the differential link, C2 R4 will generate a negative voltage pulse, which will be amplified by the inverse amplifier on the element DD1.1 and will form a positive impulse on its output. This impulse will roll the trigger on the elements DD1.2 and DD1.3 into a single state. From the output of the trigger, a single signal will go to the base of the transistor VT2 and open it, which will trigger the K1 electromagnetic relay. Contact relay K1.1 will close and switch on the consumer.

Up to 8 switches can be connected to the device, but reliability will decrease. The device works well with up to 4 switches.

III. The Improved Version

In the further development of the device, the trigger was modelled by a universal digital controller, and the electromagnetic relay was replaced by a combination of an opto-coupling resistor. This couple solved the circle of the controller and the triac (Fig. 3).
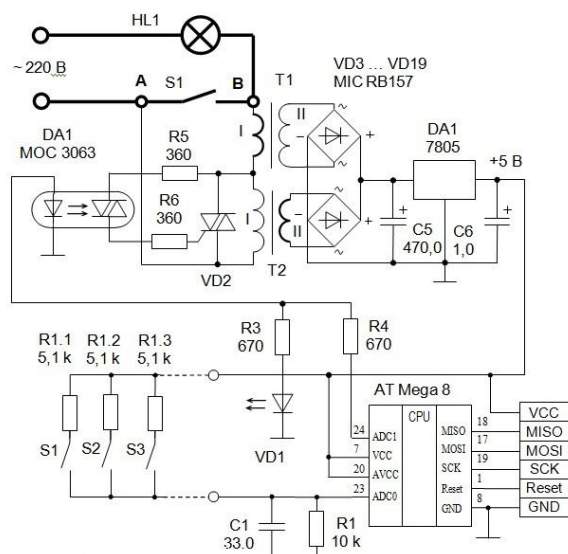
Fig. 3. The improved version

Reducing power consumption is possible by replacing the electromagnetic relay with a triac, and the logic chip is a universal controller. In the schematic there are only a few changes: the Schmitt trigger was replaced by the ATMega8 microcontroller, and the electromagnetic relay was replaced by a triac.

The advantage of the triac is that it is completely silent, non-sparking.

When the power user is switched off, it is possible to take power of the switch via a reducing transformer and a rectifier. The current consumed by the power supply is so small that in no way affects the consumer's state.

The operation of the power supply stops when the contacts of the switch of the customer are closed. For this case, you must install a second power supply that will use the current energy that flows through the connected consumer. The power consumption of a current allows the current transformer to be similar to that used to measure large industrial currents. It will be a small current transformer. In a small current transformer, the magnetic saturation of the core is rapidly applied and the subsequent increase in the current strength does not lead to an increase in the voltage of the secondary winding. Thus, the output voltage is stabilized, just as it happens in the ferroresonance voltage regulators. In the secondary winding of the second transformer, a rectifier is installed which connects in parallel with the first rectifier, forming a common power supply for the control unit (Fig. 4).
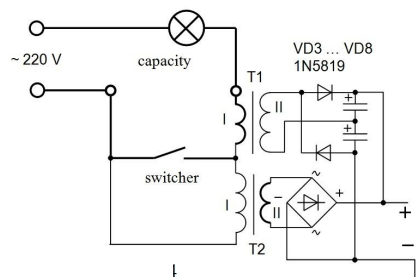
Fig. 4. Power supply

Conclusion

In the process of searching, the principle of constructing a device for controlling an electrical device from several points was chosen. The basis of the design is a Schmitt trigger, which remembers the last action of the usual switch. The state of the trigger is transmitted to the electronic key that controls the electromagnetic relay. The relay contacts or switches on the consumer circle.

The most difficult was the node of the independent power supply. The energy for the design work was used from the switch itself, a small proportion of it was taken at the expense of the consumer. This was realized on the basis of the use of a transformer current with a saturated core that stabilized the output voltage and a voltage transformer with an unsaturated core. Transformers provided galvanic isolation between the switches and the electrical network, which made the structure absolutely *safe*. Such a solution to the problem in the literature was not found.

In the further development of the device, the trigger was modelled by a universal digital controller, and the electromagnetic relay was replaced with a combination of a optoelectronic coupler. This couple solved the circle of the controller and the triac.

The simulated design was tested at a power consumption of 20 to 1000 W and showed a steady work of this design.

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Smart lighting for corridors of an educational institution building

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Abstract – In summer 2017 the law of Ukraine «On Energy Efficiency of Buildings» came into force. The law demands obligatory certification of energy efficiency of state-owned buildings. Therefore it is necessary to increase energy efficiency that includes the implementation of a number of organizational and technical measures. The main organizational measure is the introduction of a system of energy management in an educational institution. Technical measures mean the introduction of modern energy-use technologies, in particular, smart technologies. The basis of smart technologies is a mini computer like Raspberry Pi or microcontroller Arduino. The advantage of smart power management systems is their scalability and the ability to integrate with other systems (security, fire safety). In the article is shown an example of using the smart system in a lighting of educational institution building.

Keywords – energy efficiency, smart technology, microcontroller, lighting.

I. Introduction

On July 23, 2017, the Law of Ukraine «On Energy Efficiency of Buildings» came into force.[1]. This law, in particular, provides for mandatory certification of energy efficiency of state-owned buildings. The purpose of certification is to determine the actual energy performance of buildings and assess their compliance with minimum energy efficiency requirements.

Energy expenditures of budgetary institutions, in particular educational institutions, are quite significant and amount to 13-15% of all current expenditures [2]. So it is necessity to increase the efficiency of energy use, which includes the implementation of a number of organizational and technical measures.

An important component of organizational measures is the introduction of an energy management system. The system of technical measures involves the modernization of power consumption systems, the replacement of inefficient equipment and optimization of operating modes. It also demands the using of smart technologies as it enables the implementation of optimal power management algorithms.

II. Selected smart platform

Today, the industry offers many technical solutions, such as, mini computers Raspberry Pi, Latte Panda, Beagle Bone, Intel Edison, controllers Arduino etc. The analysis showed that Raspberry Pi is most often used to build start-up systems. The scope of Raspberry Pi application is quite large: from simple tasks to multi structural start-system [3].

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation. The Raspberry Pi hardware has evolved through several versions (from version 1 to version 3 with different modifications A, A+, B, B+) that feature variations in memory capacity and peripheral-device support. The block diagram of Raspberry Pi is given on Fig. 1.
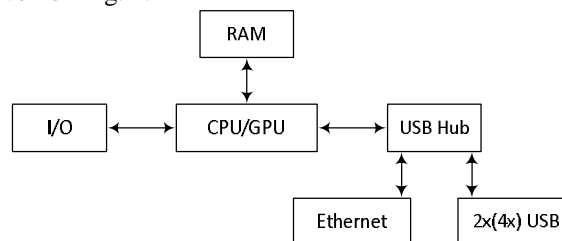
Fig.1. Block diagram of Raspberry Pi.

In the first generation Raspberry Pi was used the Broadcom BCM2835 SoC Processor. Later it was upgraded to a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor.

We can use Raspberry Pi with different operational systems like Debian, Fedora, Arch Linux, Gentoo, RISC OS, Android, NetBSD, FreeBSD, Windows 10 IOT etc.

Also Raspberry Pi 1 Models A+ and B+, Pi 2 Model B, Pi 3 Model B and Pi Zero (and Zero W) GPIO J8 have a 40-pin pinout (Raspberry Pi 1 Models A and B have only the first 26 pins). These pins are named GPIO (general purpose input-output).

When programming the GPIO pins there are two different ways to refer to them: GPIO numbering and physical numbering. Both numberings for Raspberry Pi 3 are given on Fig. 2.

Fig.2. GPIO and physical numbering of connectors for Raspberry Pi 3.

So, the 40-pin pinout is the base of smart system for control of energy consumption.

For this purpose there need to connect them in electrical circuits. The total output current of all pins should not exceed 50 mA. 5-volt pins can give up to 500 mA.

III. Lighting control system of corridors of buildings

The effectiveness of smart technologies is illustrated on the example of modernization of the lighting system for the corridors of educational institution building. Building contains nine floors and typical floor plan of the building is shown on Fig. 3.
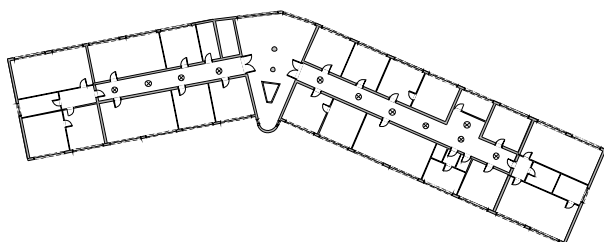
Fig.3. Typical floor plan of the building.

Building is characterized by long corridors that do not have access to natural lighting. Therefore, the system of artificial lighting (there are 4 luminaires in the left corridor and there are 7 luminaires in the right corridor) works every day for 10-12 hours except Sunday. Each luminaire contains two lamps with a nominal power 18 W. As a result monthly energy consumption is 51.5 kWh and annual energy consumption is 500 kWh. The annual cost of lighting only two corridors is more than 1150UAH.

Traditional approaches (like motion sensors in combination with the sensors of illumination) that are used to optimize the work of such illumination are ineffective. Instead, we propose to use of lighting control based on the educational process schedule. For example turning on all luminaires during breaks and reducing their number to quarter during training time.

Implementation smart control system will allow us to reduce energy consumption by 50-60%.

With this purpose it is necessary to divide all luminaires into four groups. First and third groups are permanent illumination of the right and left corridors (totally 3 luminaires); second and fourth groups are main illumination of the right and left corridors (totally 8 luminaires).

For switching power circuits, we could use 4-channel relay module (Fig.4a) or two 2-channel relay module (Fig.4b). 2-channel relay module (Fig.4b) contains 2 relays with parameters 10 A/220 V. Voltage supply is 5 V DC, control current 20 mA, speed 10 ms. The relay module owns 4 pins – Ground, DC Power 5 V and two control pins (Fig. 4.)
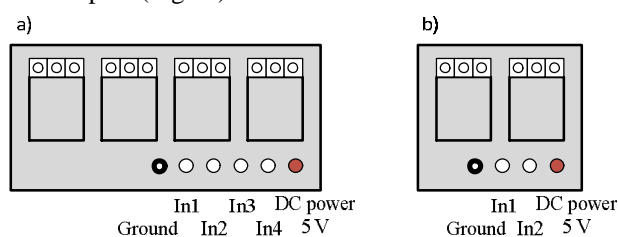
Fig.4. The pins and terminals of the relay module.

Each relay has three terminals allowing us to connect two devices that work at opposite time.

Lighting control system for building of educational institution is given on Fig. 5.
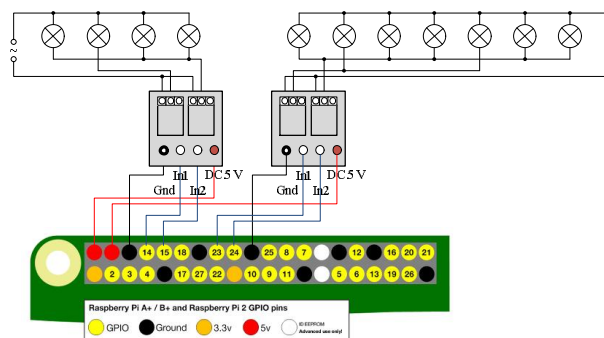
Fig.5. Smart lighting control system for building.

After the introduction of smart lighting control system monthly energy consumption will be equal 51.5 kWh and annual energy consumption will be equal 500 kWh. It is less than 50% of current energy consumption.

Annual expenses for electric energy will amount to UAH 565 and the expected annual savings of UAH 585. The simple payback period of the system is 4-5 years.

The advantage of the smart lighting control system is its scalability. In particular, it is easy to expand on lighting control of other floors. This will increase the attractiveness of the implementation of such systems.

The lighting control system (smart power management system in general) can be integrated with other systems like security system, fire safety system, etc. As a result we can easy transform it into «smart house system».

Conclusion

The introduction of obligatory energy certification of budget buildings leads to the need to increase their energy efficiency.

Increasing energy efficiency in particular involves using of the smart power management systems.

Efficiency of application of smart technologies is shown on the example of the lighting system for the corridors of educational institution building.

The smart power management system can be transformed it into «smart house system».

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Improvement of the Mechanical Consistometers for Paper Pulp

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Abstract – The purpose of this work is to improve the rotational and blade type mechanical paper pulp consistometers for enhancement of their metering characteristics and reducing the influence of pulp flow velocity, friction torques in shaft sealing and bearings on the measured pulp consistency. These goals are achieved by algorithmic control of the sensor motion velocity and algorithmic processing of measured data. The designs of upgraded rotational and blade consistometers are presented.

Keywords – paper pulp consistency measurements, viscosity, rotational consistometer, blade viscometer, paper stock, non-Newtonian liquids, magnetoelectric transducers.

I. Introduction

The papermaking industry in Ukraine begins to regenerate and the volume of production is growing. Prerequisite of the mentioned processes is the easiness of access of the raw materials – the paper pulp, which can be recycled till six times, and a sound liquidity of the manufactured articles – sanitary tissue products, cardboard articles, packaging materials.

The maintaining of the paper pulp preset concentration on the different stages of its preparation during the manufacturing process of the sanitary tissue products or cardboard articles significantly influence the quality and production cost. Continuing consistency control of the paper pulp is the most appropriate to realize by the mechanical consistometers. There exists two types of mechanical consistometers for the paper pulp – rotational, or mixer type, and blade type [1, 2, 3]. Both of them realize indirect consistency measurements by measuring of the paper pulp viscosity. Authors performed the scientific research works to improve the rotational and blade type mechanical paper pulp consistometers for development and further small-quantity production. These goals are achieved by algorithmic control of the sensor motion velocity and algorithmic processing of measured data.

II. Rotational consistometer design

The main difference of the paper pulp rotational consistometer [4, 5], which mechanical scheme is sketched on the Fig. 1 is application of the disk-like form sensitive element with the radial wave – like fins, which can rotate in opposite directions.

By rotation of the sensitive element in turn in the clockwise and anticlockwise directions, and the following algorithmic processing it is possible to decrease the influence of the torque caused by the sensor shaft sealing, by sensor shaft bearings and by additional torque caused by deformation of flow profile in the pipeline on the measured value of the paper pulp viscosity, and associated with it paper pulp consistency. The reversing of direction of the sensitive element rotation and the accurate controle of the sensitive element angular velocity of rotation and associated with it shear rate, at which the viscosity measurements are carried out, is provided by means of the variable speed controller.
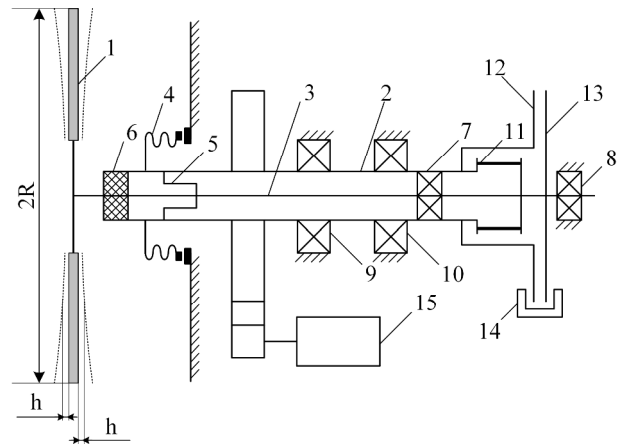
Fig.1 Mechanical scheme of the rotational type paper pulp consistometr. 1 – disk – like sensitive element, 2 – the main hollow shaft, 3 – the sensitive element shaft, 4 – the moving sealing of the main hollow shaft, consisting of bellow and two ring tungsten carbide – cobalt alloy inserts, 5 – elastic sealing in the form of longitudinally goffred thin walled tube, 6 – elastic sealing for protection against loading of the sealing 5, 7,8 – bearings supporting the sensor element shaft, 9,10 – bearings of the main hollow shaft, 11 – torsional spring made of cylindrical rods positioned around the circle, 12 – disc with perforations on the main hollow shaft, 13 – disk with perforations on the shaft of the sensitive element, 14 – optical transducer of the discs displacement angle between the disks 12 and 13, 15 – motor driven by the variable speed controller.

The general feature of the suggested measurement cycles is measurement of the viscous friction torque with gradual approach of the rotation frequency of the sensitive element to the set rotation frequencies. As the frequency increases (approach from below) the torque $M_{\uparrow t}$ is measured. And when the rotation frequency of the sensitive element is decreasing (approach from above) the value of torque $M_{\downarrow t}$ is measured for selected rotation frequency. With this purpose after the measurement is completed and the frequency approaches the rotation frequency Ω from the lower range, the rotation frequency insignificantly increases and stays permanent for a short time after which it decreases back to Ω and the torque value $M_{\downarrow t}$ is measured. The measured torque values are recorded and averaged by applying equation (1).

$$M = \frac{M_{\uparrow t} + M_{\downarrow t}}{2} = M_{cep} \qquad (1)$$

The viscous friction torque values that were measured with changing rotation directions and obtained for two

different rotation frequencies are averaged with results obtained for direct sensitive element rotation. And then the paper pulp parameters K and n are defined and subsequent conversion of the viscosity value into the measurement units of paper pulp consistency is done.

III. Blade consistometer design

The distinguishing characteristic of the blade paper pulp consistometer, which mechanical scheme is sketched on the Fig. 2 is that the blade 2, fixed on the shaft 4, swings straight and forth in reference for center position across the flux of the paper pulp. The mode of blade motion is defined by the triangle-shape pulse generator 7, and is provided by the following system with the magneto electric transducer 5 as actuating device. If the blade moves in the vicinity of the central blade position, the current over the winding of the magnetoelectric transducer is proportional to viscosity, and appropriately to consistency of the paper pulp. The blade rotates by the shaft in the plane of the paper pulp flux symmetry across the flux, what affords to take into account the paper pulp flow velocity, and to apply the corrections of determined values of viscosity and consistency by algorithmic method.
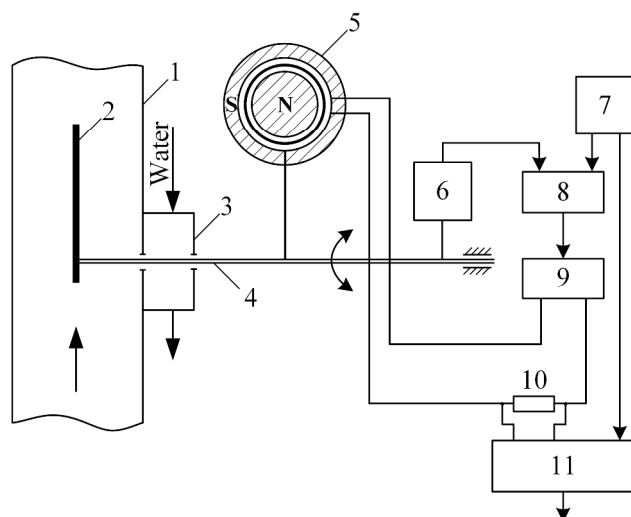
Fig. 2. Schematic diagram of the blade paper pulp consistometer with the paper pulp flow velocity compensation, 1 – the pipe, where the paper pulp flows, 2 – moving blade, 3 – "wet" shaft sealing, 4 – shaft, on the left side of which sensitive blade is fixed, and on the right – the lever arm with winding of the magnetoelectric transducer, 5 – magnet system of the magnetoelectric transducer, 6 – sensing shaft rotation angle transducer, 7 – triangle – shape pulse geneator, 8 – differential amplifier, 9 – power amplifier, 10 – resistor for measuring the strength of current throught the winding of magnetoelectric transducer, 11 – the microcontroller system for information processing, and connections with display system and industrial process control system.

The sheet-oriented realization on the electronic assembly units of the measuring circuit has no special features. Triangular pulse generator can generate one constant frequency or, for broadening of the functionality two or three preset frequencies that can be switched by a microcontroller. Two preset frequencies are used to extend the measuring range and the last, much higher value – is used for service operation – periodical blade shake – up to clean the blade from possibly adhering long fibered materials.

Conclusion

In designed rotational and blade type paper pulp consistometers the same values of shear rate can be set for measuring of viscosity of the non-Newtonian liquids, to which the paper pulp belongs. As a result, the calibration curves on consistency dependence and fiber composition dependence becomes as nearly as possible, and the same calibration curves can be used for temperature compensation. Together with the mentioned above compensation of the influence of the flow velocity and influences of torques, arisen by sealings, this allows to enhance the precision of the paper pulp consistency measurements.

The reversing of direction of the sensitive element rotation allows to reduce additional torque caused by deformation of flow profile in the pipeline on the measured value of the paper pulp viscosity, and associated with it paper pulp consistency. The reversing of direction of the sensitive element rotation and the accurate controle of the sensitive element angular velocity of rotation and associated with it shear rate, at which the viscosity measurements are carried out, is provided by means of the variable speed controller.

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Analysis of experimental researches of wood gasification process in a continuous layer

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Abstract − For today are known quite a bit methods redoing of wood and its wastes in energy, but one of the most perspective is gasification. The construction of the gazogene, on which the row of experiments is conducted with the aim of determination of conformity to law of influence of entrance factors which influence on the process of gasification and on quality of synthesis-gas, was worked out for this purpose. The statistical processing of experimental data enables to define the optimal parameters of work a gazogene.

Keywords: wood gasification, continuous layer, gazogene, synthesis-gas, optimal parameters, lower heating value.

I. Introduction

In many countries of the world biomass, as a source of making of energy today gets more ponderable value in the different sectors of economic activity, in particular: on the thermal and electric stations for the production of warmth and electric energy [1-3]. It is related first of all to exhausting of extractive block which results in the increase of price on them fuels. Except it an extractive fuel has a large influence on the state of environment, and it compelled world public to creation and introduction in an action of the program of the Kyoto agreement. It is necessary to notice that potential of biomass to ten one times exceeds possible requirements of humanity in energy, is ecologically clean and has a capacity for renewal.

Today the tendency of decentralization of energy takes place in the world, id est there is the use of cogeneration plant making of heat and electricity. Perspective cogeneration plant are engines of internal combustion, which work on the eider of synthesis gas.

II. Presentation of the main material

The impact of input parameters on the calorific value of the syngas is analyzed to find the optimal regime parameters of the gasification process and the gas generator operation. This is aimed at developing a gasification process technology and a constructive model of an industrial gas-generating unit.

The experiments were based on using the following materials: pine (Pinus sylvestris).

The problem was in finding the dependence of the lower heating value (LHV) (net calorific value (NCV) or lower calorific value (LCV)) of the synthesis gas on the size of the wood particles that are fed into the gasifier, as well as the dependence of the amounts of air and fuel on

the total volume of the reactor during the gasification of the studied species of wood.

The experiments were conducted and the technological process for gas synthesis was developed on the basis of designing a gasifier with a continuous layer [4].

The known modern gas generators with continuous layers [2, 3] allow obtaining synthesis gas with a calorific value of 5-7.5 MJ/Nm^3; they are vulnerable to the gasified fuel quality and hard to maintain. The challenge is to develop a gas generator that would be easy to maintain and that would help obtain synthesis gas of a higher calorific value and gasify fuel at a higher humidity.

In the developed gas generator with a continuous layer, the problem is solved because the gasification chamber is made in the form of two truncated cones. The larger bases of the cones are placed opposite one another with a small gap between them, which excludes fuel bridging and facilitates its passing to the nozzle at the top of the gasifier. The device for air supply is made of a casing, with a tube inside to drain the synthesis gas from the top of the case to the consumer. This design allows heated air to be blown into the gasification chamber and helps cool the syngas. The truncated cones and the enclosure parts are bolted for easy maintenance.

The tests have showed that the use of gas generators of the proposed design helps improve efficiency by increasing the speed and intensity of the chopped wood gasification process. This is achieved because the gases that are formed during the gasification process repeatedly pass through a layer of hot fuel in the zone of oxidation and recovery. At high temperatures, there happen the heterogeneous recovery of carbon dioxide, i.e. $C+CO_2 \rightarrow 2CO_2$, and the formation of carbon monoxide as a combustible component of the synthesis gas. If the recovery area contains water vapor, a high temperature produces the reaction of its conversion, i.e. $C+H_2O \rightarrow CO+H_2$ and $CO+H_2O \rightarrow CO_2+H_2$. In this case, there appears a second combustible component of the synthesis gas, which is hydrogen. Thus, due to the high content of carbon monoxide and hydrogen in the synthesis gas, the lower heating value (LHV) is relatively quite high.

In a series of experiments, the task was to find the LHV dependence on the particle size of the chopped wood as well as the amount of air and the amount of fuel in the gasification chamber for each of the studied wood species. Besides, another task was to determine the dependence of the LHV of the synthesis gas on the species of wood that was gasified.

Entrance x_i factors of experimental researches:
- the dimensions of the particles of wood l : 10, 20, 30, 40, 50 mm;
- the amount of air, which is given in the gazogene G: 40, 65, 90 m^3/h;
- the amount of fuel in the gasifier reactor q: 50, 75, 100 %.

Output parameter y :
- lower heating value of synthesis gas, MJ/m^3.

The number of the tests that were duplicated in each series was n=6. The data of each experiment were

subjected to statistical analysis to find gross errors; questionable results were checked by using the Student's t-test [5]. Any questionable result (y_i) was temporarily excluded from the sample, and the remaining data were used to calculate the arithmetic mean (y_{avg}) and the variance.

The regression equation, which can be obtained as a result of implementing plans of the second order, i.e. plans to obtain the mathematical description of objects in the second order [5], has the following form:

$$y = b_0 + \sum_{i=1}^{k} b_i x_i + \sum_{i=1}^{k} b_{ii} x_i^2 + \sum_{i,j=1}^{k} b_{ij} x_i x_j, \quad (1)$$

where x – denotes the variable factors; b – stands for the regression coefficients; k – denotes the number of the variables.

Then the normalized values are associated with the natural values by the following relations:

$$x_1 = \frac{1-30}{20}; \quad x_2 = \frac{G-65}{25}; \text{ and } x_3 = \frac{q-75}{25}; \quad (2)$$

The accuracy, objectivity, and reliability of determining the actual value of the measured characteristics and, therefore, the correctness of all subsequent conclusions depend on the accuracy of processing the experimental results.

After processing the experimental data and obtaining the regression equations, there followed their statistical analysis. This solved two major problems: the significance of regression coefficients was evaluated and the adequacy of the mathematical model was verified.

III. The results of researching

The B_3 plan was used to obtain the mathematical description of the object in a second order polynomial, which is:

$$y = 9.73 + 0.87 \cdot x_1 + 0.14 \cdot x_2 + 0.11 \cdot x_3 - 1.50 \cdot x_1^2 - 0.52 \cdot x_2^2 - \quad (3)$$
$$-0,27 \cdot x_3^2 - 0.02 \cdot x_1 \cdot x_2 - 0.01 \cdot x_1 \cdot x_3 + 0.02 \cdot x_2 \cdot x_3$$

The regression equation rationalization for pine wood produced important input parameters at which the lower heating value y reached the maximum in Table 1.

TABLE 1
THE REGRESSION EQUATION RATIONALIZATION

The coded values of the factors		The natural values of the factors	
x_1	0.287	l	35.74 mm
x_2	0.138	G	68.45 m³/h
x_3	0.199	q	79.98 %
y	9.88 MJ/m³		

This, the B_3 plan produced the mathematical description of the object in a second order polynomial for each of the wood species. The rationalization of the regression equations for the studied species of wood has specified important input parameters at which the lower heating value reached the maximum: Q_{pine}=9.9 MJ/Nm³.

The use of gas generators of the proposed design can increase the efficiency of the thermal processing of solid fuel into gaseous fuel by increasing the speed and

intensity of the fuel gasification process. It can also solve the problems of the ecological utilization of industrial and household waste as well as of obtaining cheap energy and securing ecologically-friendly industrial conditions for the environment.

The experimental findings have specified the regression dependence of the LHV of the synthesis gas during the gasification of pine wood. The resulting regression equation can be the basis for implementing the studied process and its rational management. The equations of the input factors' dependence on the original setting make it possible to determine every possible parameter of assessing the process under study at any value of the factors between the upper and lower levels.

Conclusion

The use of gas generators of the proposed design increases the efficiency of processing wood into gaseous fuel by increasing the speed and intensity of the process of gasifying fuel. It also can solve the problems of the ecological utilization of industrial and household waste as well as of obtaining cheap energy and improving industrial effects for the environment.

The heat from burning the syngas has been found to be dependent of the particle size of chopped wood, the amount of air and the amount of fuel supplied to the gasification chamber. The B_3 plan implementation has produced the mathematical description of the object in a second order polynomial. The rationalization of the results for the studied types of wood has specified the important input parameters for which the calorific value of the synthesis gas that is produced during the gasification peaks at y =9.9 MJ/Nm³. The average values of the rational input parameters for the gasification process in a continuous layer are the following: l=36 mm, G=69 Nm³/h, and q=80 %.

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Determination
of the Armor Wear and Tear
of the Drum Ball Mill

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Abstract −The object of the research to develop an analytical method for determining the armor wear rate of the drum ball mill was the boiler TP-100 (TP-100A) of the 200 MW power unit of Burshtyn TPP (Ukraine), equipped with two individual dust-preparation systems with drum ball mills KBM 370/850 (Sh -50A).

An effective analytical method for determining one of the main performance indicators of a drum ball mill – the wear rate of the drum armor, grinding balls and the relationship between them in case of "G" grade coal combustion for TP-100 boilers is proposed. Its essence is to reduce human labor costs, more accurately determine the wear rate of the drum armor and grinding balls. This method is characterized by the fact that the main estimation indicator is the drum armor wear rate depending on the manufacture quality of armored plates (manufacturer).

Keywords − analytical method, steam boiler, drum ball mill, coal, drum armor wear rate, ball wear rate, mill operation duration, ball charge.

I. Introduction

One of the key operating parameters of a drum ball mill is the drum armor wear and ball charge of a drum, which affect the performance and specific electric power consumption for dust preparation.

During the mill operation, the ball charge is maintained at a constant maximum level by the periodic addition of balls to the drum, which provides the best possible performance with satisfactory quality of the finished dust. According to the characteristic $N_m=f(G_b)$, the operating maximum ball charge corresponds to the mill electric motor loading, which depends on the value of the rotating mass of the drum and balls. In this case, the replacement of the drum armor wear (ΔG_δ) with the value of the ball charge (ΔG_b) increase occurs, which adversely affects the performance of drum ball mills and ultimately the reliability. Therefore, the development of an analytical method for determining the armor wear of the mill drum, taking into account its ball charge, is an urgent task.

II. Analysis of previous stadies and statement of the problem

In accordance with the development plans of Ukraine's power industry till 2030, TPPs operating on coal of own production will be the basis of flexible power facilities of the united energy system (UES) of Ukraine. It is planned to introduce clean coal technologies, based on the development of new and already known technological processes and to consider the issue of possible coal combustion in a pilot plant [1]. The works [2–4] highlight the issues of fossil fuel combustion and capture of fuel ash particles in flue gases. In the above publications, the authors consider not efficiency, but actual operation of drum ball mills. Ensuring the reliability of boiler units is a key component of efficient operation of TPP power units, as well as operation of drum ball mills and armor surfaces.

It is known that the coal grinding process is accompanied by a simultaneous wear of ball metal and drum armor [5]. Gradual and continuous wear of armor reduces the drum weight, which lowers the electric load N_m and introduces an error when determining the ball charge.

Experimental methods for determining the performance of drum ball mills are also known [6, 7]. However, the rational and maximum efficiency of the mills can be provided by reliable operation of armor surfaces of mills. At the same time, the recommendations contained in them have either a rather general nature, or, conversely, a very narrow application scope.

Therefore, the development of an analytical method that would allow carrying out diagnostic tests and engineering calculations of dust systems without conducting experimental studies is an important scientific and applied problem.

III. The aim and objectives of the study

The aim of the work was to develop an analytical method and carry out the corresponding calculations of the mill drum armor wear. To achieve this aim, it was necessary to accomplish the following objectives:

– to determine the armor wear of the mills KBM 370/850 (Sh-50A) that grind "G" grade coal;

– to determine the wear rate of the drum armor depending on the manufacturer in Ukraine

IV. Results of calculating the mill drum armor wear

The boiler TP-100 (TP-100A) of the 200 MW power unit of Burshtyn TPP (Ukraine) is equipped with two individual dust preparation systems with drum ball mills KBM 370/850 (Sh-50A).

The dust system of the boilers TP-100 is designed for grinding "G" grade coal of the Lviv-Volyn coal basin (Ukraine): Q_i^w=24.41 MJ/kg (5830 kcal/kg), W^P=7.4 %, A^P=22.4 %, V^G=38.5%; grindability index I_G=1.2.

Design parameters of the finished dust: R_{90}=24 %, W^D=2 %.

Basic elements of the mill KBM 370/850 (Sh-50A):
– rotating horizontal cylindrical drum;
– armor coating of the inner surface of the drum body;
– drum ball charge;
– mill drive – low-speed synchronous electric motor, connected to a drive gear and a gear ring of the drum through a coupling;
– self-lubricating bearings.

In the design, the cylindrical inner surface of the drum is equipped with armored plates, the mounting of which to the case shell is carried out by means of spacer wedges. Plates and wedges form a continuous wave that promotes capture and lifting of balls and coal material. The end walls of the drum are covered with flat armor plates.

Characteristics of ball charge and design armor of the mill drum:

– ultimate ball charge τ=100 t;

– design ball charge G_b^d =8 ball 0 t;

– maximum operating ball charge G_b^{max} =70 t;

– ball diameter d=40 mm;

– design weight of the drum armor plates G_δ^{max} =70 t.

– estimated specified life of the mill drum armor T=20000 h.

The results of the calculation of the drum armor wear rates of the mill st. No. 8B of Burshtyn TPP are shown in Table 1.

TABLE 1

INITIAL DATA AND RESULTS OF THE CALCULATION OF THE DRUM ARMOR WEAR RATES OF THE MILL ST. 8B OF BURSHTYN TPP

Parameter		Calculation	Calculation result
Initial data			
Initial armor weight G_δ^n, t		–	44
Operating maximum ball charge G_b^{max}, t		–	70
Ball wear rate in case of GSSh coal grinding g_{b1}, kg/h		–	15.7
Standard specific expenditure of balls in case of G coal grinding	G a_{norm}, g/t	–	224
	GSSh a_{norm1}, g/t		
Coefficient of proportionality M_p		–	0.067
Conversion factor M_p		–	0.36
Duration of the maximum interrepair time τ, h		–	25194
Calculation of drum armor wear rates			
Ball wear rate g_b, kg/h		$15.7 \cdot \dfrac{196}{224}$	13.7
Armor wear rate g_δ, kg/h		$0.064 \cdot 13.7$	0.88
Metal loss from drum armor wear ΔG_δ, t		$0.88 \cdot 25.194$	22.17
Drum armor wear magnitude b_δ		$\dfrac{22.17}{44}$	0.50
Over-expenditure of balls ΔG_b, t		$0.36 \cdot 22.17$	8
Drum overcharge with balls G_b^{over}, t		$70+8$	78
Estimated maximum ball charge G_b^p, t		$70-8$	62

According to the results of the calculation, the state of armor at the end of the interrepair time of the mill was characterized by:

– the drum armor wear magnitude b_δ=0.5 and the maximum possible metal loss from the drum armor wear ΔG_δ=22.17 t;

– the drum armor wear rate g_δ=0.88 kg/h;

– uncontrolled over-expenditure of balls in the drum ΔG_b=8 t and drum overcharge with balls G_b^{over} = 78 t.

The values of the armor wear rate g_δ for the mills whose drums are equipped with the Bilozersk and Dnipro armor are 0.69 and 1.37 kg/h, respectively.

Conclusion

The method of determining the armor wear of the mills KBM 370/850 (Sh-50A) is developed on the example of "G" grade coal grinding, which allows carrying out a partial replacement of armor plates during repair without a complete restoration of armor coating of the cylindrical or end surfaces of the drum.

The comparative analysis of armored plates of the mill ball drum is designed and conducted and the main estimation indicator is obtained – the drum armor wear rate depending on the manufacture quality of plates, which is: Bilozersk armor 0.69 kg/h, Donetsk armor 0.88 kg/h; Dnipro armor 1.37 kg/h.

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Hydrodynamic Flow Measurement Error of Ultrasonic Flowmeters

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Annotation – In this work the essence of hydrodynamic flow measurement error of ultrasonic flowmeter (USM). The methods of eliminating this error are analyzed. One of these methods is considered in detail – optimization of the location schemes of chordal acoustic paths (APs) of USM. The optimization is performed on the basis of the analytical-empirical power law of the distribution of the velocity of the undistorted flow. As a result of the work, the authors calculated the optimal location of the APs for chordal schemes of two- and three-path USMs. It was established that optimization of the location schemes of APs chordal USM allows to reduce the hydrodynamic flow measurement error to a value of 0.05 % (for USM with two hordal APs) and 0.1 % (for USM with three chordal APs). The developed approach is convenient when designing multipath USM and their research in laboratory conditions.

Keywords – ultrasonic flowmeter; hydrodynamic flow measurement error; power law; acoustic paths; location scheme.

I. Problem and purpose of research

The emergence of the hydrodynamic flow measurement error of the USM (δ_{GD}) is due to the fact that the flow velocity, calculated by the value of the passage of sound vibrations over and against the flow along its AP (u_L) is always different from the actual value of the flow velocity of the averaged over the diameter of the measuring pipeline (MPL) [1]. The correlation between these velocities does not depend on the angle of inclination of the AP to the axis of flow, but is determined by the number of Re and the location schemes of the APs USM (the number of APs and the way of their spatial location).

In the case of the use of USM with chordal location of AP (see Fig.1), to eliminate the error δ_{GD} developers of flowmeters of this type recommend:

1. To introduce into the flow rate equation of the USM calibration coefficient, obtained by the results of the calibration of the flowmeter in the conditions of the environment close to the workers. In this case, not only the influence on the USM of the structure of the undistorted profile of the flow velocity, but also the influence of other parameters (pressure, temperature, component flow composition) is eliminated [2].

2. Optimization of the location schemes of APs using numerical integration methods. This approach is most often used for USM with the number of AP N > 4 [1].

3. Optimization of the location schemes of APs with the use of analytical-empirical laws for the distribution of the velocity of undistorted flow [3, 4]. In this paper, precisely this approach is used to eliminate the error δ_{GD} for two- and three-path chordal USM with the use of the power law of the distribution of the velocity of undistorted flow.

II. Investigation of the hydrodynamic flow measurement error of USM

The analytical form of the power law of the distribution of the velocity of the undistorted flow has the following form [3]:

$$u(i) = \left(1 - r(i)\right)^{\frac{1}{n}}, \qquad (1)$$

where: $u(i)$ – normalized value (in the maximum, in the axial) of the flow velocity at the i-th point of the cross section of the MPL; $r(i)$ – normalized (within the radius of MPL) the value of the radial coordinate of the i-th point of the cross section of the MPL; n – number of Nikuradze, which is a function of Re.

The values of n for any Re are calculated by the equation [1]:

$$n = 11.269 - 3.019\lg(\text{Re}) + 0.432\lg^2(\text{Re}). \qquad (2)$$

According to (2), the range of numbers Re = $1.1 \cdot 10^5$... $1.4 \cdot 10^6$ corresponds to the values of $n = 7$, 8 and 9. For the same range in [3] one-peak analytic-empirical laws of distribution of distorted flow (Salami function) were obtained. Therefore, it is expedient in this work to perform the research for the indicated values of n, which will enable to further compare the results of research of USM in conditions of undistorted and distorted flows.

The volume flow rate of flow flowing through the cross-section of MPL can be obtained by integrating the power law of distribution (1) by the formula [3]:

$$q = 2\pi \int_0^1 (ru)dr. \qquad (3)$$

Applying the distribution law (1) and the geometric characteristics of location schemes of the APs (see Fig.2), we obtain the equation of the volume flow rate of multipath chordal USM [4]:

$$q_{USM} = \pi R^2 \frac{\sum\limits_{i=1}^{N} u_L(i)}{N} =$$

$$= \pi R^2 \frac{\sum\limits_{i=1}^{N} \dfrac{\left[\int\limits_0^{\sqrt{R^2-x(i)^2}} u\left(\begin{array}{c} \sqrt{x(i)^2+L^2}, \\ \alpha + arctg\dfrac{L}{x(i)} \end{array} \right) dL + \right.}{\left. + \int\limits_0^{\sqrt{R^2-x(i)^2}} u\left(\begin{array}{c} \sqrt{x(i)^2+L^2}, \\ \alpha - arctg\dfrac{L}{x(i)} \end{array} \right) dL \right]}{T(i)}}{N}, \qquad (4)$$

where: α, $T(i)$ is the angle of rotation and the width of the plane in which the i-th chordal AP USM passes relative to the horizontal plane; L – length of i-th AP; $x(i) = 0...$ 1 – coordinate of the location of the plane in which the i-th chordal AP USM passes; N – number of chordal AP USM. In this work, the case of standard horizontal installation of an USM is used, therefore the angle $\alpha = 0°$.

The calculation of the error δ_{GD} occurs according to the formula [1]:

$$\delta_{GD} = \frac{q_{USM} - q}{q} 100. \tag{5}$$

III. Research results

The optimization of the location schemes of chordal APs using the power law of distribution is to determine the coordinate $x(i)$ of the AP location in which the error δ_{GD} will be equal to or close to zero.
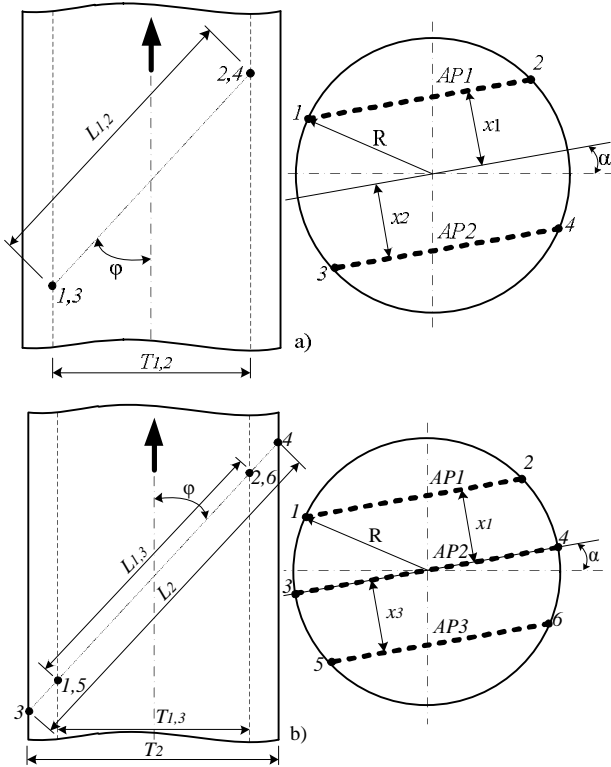
Fig.1. Two-path (a) and three-path (b) chordal location scheme

Fig. 2 presents the results of the calculation of the error δ_{GD} for typical chordal USM.
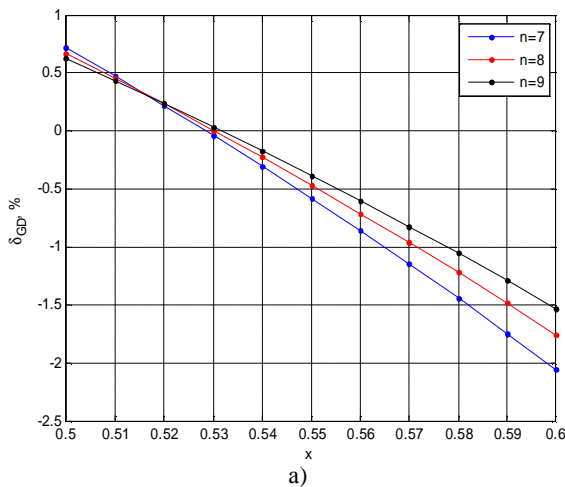
Fig. 2. Dependence of error δ_{GD} of two-path (a) chordal USM from the coordinates $x(i)$
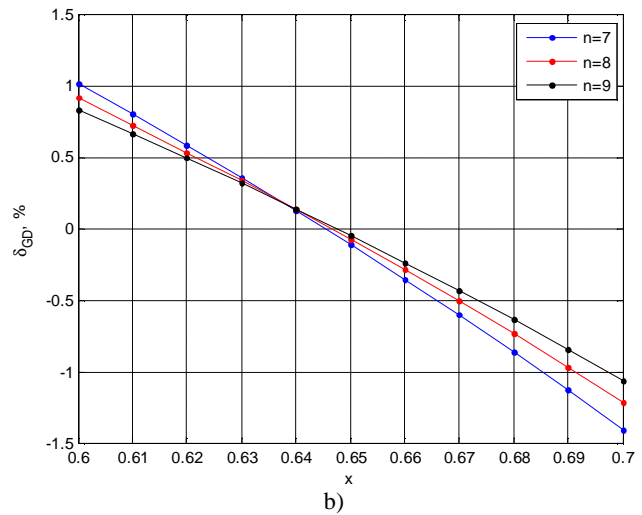
Fig. 2. Dependence of error δ_{GD} of three-path (b) chordal USM from the coordinates $x(i)$

Analyzing the results of work, which are partly presented in Fig.2, it can be argued that:

1. Using of the analytical-empirical power law of the distribution of the velocity of undistorted flow is a convenient way to conduct research on the location scheme of APs chordal USM.

2. Using of optimized location scheme of APs chordal USM allows to reduce the hydrodynamic flow measurement error of the cost:

– to the value $\delta_{GD} < 0.05\%$ for two-path chordal USM at $x_{1,2} = \pm 0.53R$;

– to the value $\delta_{GD} < 0.1\%$ for three-path chordal USM at $x_{1,3} = \pm(0.64...0.65)R$, $x_2 = 0$.

3. The obtained results can be applied during the design of multipath USMs and their research in laboratory conditions.

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Method of increasing the ecological indicators of the process of combustion of organic fuel in TPP boilers

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Abstract – Power boiler installations of thermal electric power plants (TPP) are among the main pollutants of the air basin of the environment.

The object of this study is the method to improve the environmental performance of the coal combustion process in TPP, which lies in supplying air with an increased oxygen content to the combustion zone.

The purpose of the article is the theoretical study of the application of the method of increasing the ecological indicators of the process of coal combustion in TP-100 boilers of the Burshtyn TPP, which is achieved by delivering pure oxygen to the prepared dust-air mixture directly to the burners. This article shows that it is possible to reduce the volume of combustion products by 30 thousand nm^3/h and by 50% by concentration of nitrogen oxides for a power unit of 200 MW with a boiler TP-100 of the Burshtyn TPP with fuel consumption of 55-89 tons per hour.

Keywords: coal, combustion process, oxygen, burner, boiler, thermal electric power plant, nitrogen oxides.

I. Introduction

A significant part of the emissions of harmful substances into the atmospheric air is made by industrial enterprises, among which the predominant portion belongs to power boilers of TPP and industrial furnaces. The main process, in which such harmful substances are formed as sulfur compounds, nitrogen oxides, carbon monoxide and others, is the process of combustion organic fuel [1-3], which are the basis of the thermal generation of electric energy by the steam cycle. Environmental problems of thermal energy, associated with the wear of the main technological equipment, can be resolved not so much by developing and wide use of dust and gas cleaning equipment, but also by combining the steam and gas mode of generation in combined steam and gas power plants (SGPP). Such installations are characterized by a wide range of station flexibility and high mobility [4], which makes them indispensable in case of necessity to cover peak loads in the consumption of electric and thermal energy.

II. Presentation of the main material

Among the harmful substances that are released by TPP, the most dangerous are nitrogen oxides [5 – 7]; and the source of formation is also atmospheric air nitrogen, which is fed with a certain excess. Environmental problems of thermal power associated with the wear of the main technological equipment can be solved at the stage of technical re-equipment [8]. The combination of the steam and gas generation cycle at Ukrainian TPP has not been widely used due to the high cost of turbine fuel. Recently, developments relating to the adaptation of the gas part of the generating equipment, which can work on products of gasification of coal, are ongoing. In such SGPPs, it is possible to simultaneously solve two inextricably connected tasks. Along with the decrease in the amount of harmful substances released into the environment, it is also possible to improve the start-stop characteristic of the TPP, as well as slightly increase the speed of the power ascension. In the proposed SGPP, it is possible to ensure the function of the gas part by burning coal of even poor quality. The portion of coal of low quality, both domestic and imported, will increase. Therefore, its use is possible only in the case of efficient combustion, ensuring the minimal formation of nitrogen oxides.

We have proposed a method for decreasing the formation of nitrogen oxides in the process of combustion of organic fuels, the formation of which is endothermic, which leads to a decrease in the temperature in the combustion zone. This further reduces the efficiency of the whole power unit. The source of the so-called "atmospherics" is nitrogen, the content of which in the air can reach 79-80%. Additional problems arise in the case of two (three)-stage burning of low quality coal, when, at the initial stage, the excess air ratio is less than one, and further it may assume the value of 1.14-1.2.

The feature of the proposal is the supply to the combustion zone of the air with increased oxygen content, which can be achieved by delivering pure oxygen to the prepared dust-air mixture (the so-called "oxygen blast"), which is widely used in metallurgy. In order to reduce the cost of oxygen production at the place of consumption, dissolution of air in ordinary water and then its degassing can be used. In this way, oxygen content in the enriched air can be obtained in volumetric percentages of up to 33.3%. The process of water degassing, which is not difficult what concerns the implementation, will result in a 1.5-fold enrichment of the oxygen mixture fed to the combustion of the organic fuel, which, additionally, will reduce the volume of flue gases.

At the end of the last century, one of the authors proposed the use of membrane technologies for such processes, which membrane technologies at that time began to develop rapidly. Nowadays, technologies of non-cryogenic nitrogen production at the place of consumption ensure the release of industrial gases from the air, with which significant technological progress is observed in this regard.

It should be noted that by separating atmospheric air into "oxygen" and "nitrogen", it is possible to organize the full use of atmospheric air separation products. Oxygen-enriched air can be supplied in the combustion process, and the nitrogen fraction can be used to form the working fluid for the gas part of the generation.

In order to confirm some of the above-mentioned assumptions, we present some results of the theoretical studies of the burning process of coal of grade G from the Lviv-Volyn Basin at the 200 MW power unit with the TP-100 boiler of the Burshtyn TPP. At the same time we shall assume that for the Burshtyn TPP, the coal (the quality of which will only deteriorate in the future) has such a composition per fuel working mass: ash content – $A^P = 29\%$; humidity – $W^P = 10\%$; the lower net calorific value $Q_i^{\delta} = 4650$ kcal / kg (19.47 MJ/kg).

The results of the calculations of the air consumption for combustion of coal in the TP-100 boiler, depending on the power of the power unit are summarized in Table 1.

TABLE 1

EXPENDITURE AIR FOR COALING IN COPPER TP-100

Power of the power unit, MW	200	160	120
Theoretical amount of the air flow, nm³/h	461821	368419	285395
Air flow rate at $\alpha=1,15$, nm³/h	530094	423681	328204
Volume of combustion products at $\alpha=1,15$, Vg, nm³/h	570024	455536	352880

Also, it is worth noting that the volume of the combustion products does not take into account the suction air in the convection shaft and boiler ducts.

In order to reduce the negative influence of the TP-100 boilers upon the environment, in particular, to reduce emissions of nitrogen oxides, let us consider increasing the proportion of oxygen, and, accordingly, reducing the proportion of nitrogen in the air supplied for the fuel combustion.

We shall study how the flow of air and flue gases will change, if the ratio of oxygen and nitrogen in the air fed to the combustion of coal, is changed by 35/65 and by 40/60.

The calculation results are summarized in Table 2.

TABLE 2

CONSUMPTION RATE OF PRODUCTS DURING BURNING COAL IN THE TP-100 BOILER

Power of the power unit, MW	200	160	120
Volume of the combustion products at $\alpha=1,15$, nm³/h	570024	455536	352880
Volume of combustion products with the oxygen content in the air of 30%, nm³/h	505698	403422	312510
Volume of combustion products with the oxygen content in the air of 40%, nm³/h	483198	385473	298606

The theoretical amount of nitrogen in combustion products with the oxygen content of 30% is 3.38 nm3 / kg

of the combusted fuel and with an oxygen content of 40%, it is 3.12 nm³ / kg of the combusted fuel.

Thus, we see that as a result of an increase in the oxygen content in the air supplied for coal combustion, the consumption of combustion products and nitrogen content is reduced, which allows to increase the technical characteristics of the TP-100 boiler by reducing the flow of the flue gases, reducing the consumption of electricity for transporting flue gases , and environmental indicators – by reducing emissions of nitrogen oxides.

Conclusion

This work proposes a method for increasing ecological parameters of the process of combustion of organic fuel in TEPP boilers by way of feeding air with increased oxygen content into the combustion zone, which can be achieved by feeding pure oxygen to the prepared dust-air mixture directly to the burners.

Theoretical calculations show that, it is possible in case of the power unit of 200 MW with the TP-100 boiler of the Burshtyn TPP with the fuel consumption of 55-89 t/h to reduce the volume of combustion products by 30 thousand nm³/h and the concentration of nitrogen oxides by 50%.

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Toward geodynamic studies and GNSS CORS measurements: West Ukrainian GNSS network data processing using Bernese v5.2 software

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Abstract – Presented study is organized to enhance the services provided by number of GNSS stations in Western Ukrainian region, which are mainly a network of Continuously Operated Reference Stations (CORS) established in different years by different institutions, and improve the efficiency of the GNSS data usage. The main objective of the study is to compute CORS velocities, using available three years' data, establish an automated procedure of further data computation. The interpretation of the velocities together with geological data for the region and estimation of the crustal movement as well as extension of the studied region to all Ukrainian area.

Keywords – satellite geodesy, GNSS, GPS, CORS, velocity vector, time series, plate tectonic, Bernese GNSS software v5.2

I. Introduction

Nowadays, mainly in all countries over the world, the main carrier of the National coordinate systems are GNSS networks of the Continuously Operated Reference Stations (CORS). Applying unified algorithm for homogeneous data processing allows to provide homogeneously accurate information regarding the measured points for the users, who are dealing with the land survey (Real Time Kinematic mode), as well as users performing high-precision geodetic tasks (static observation with post-processing data). From other side, the destruction of the reference GNSS station, unlike the traditional geodetic point, is close to zero.

Beside the CORS network coordinates, measured on the earth's surface, an important role for geoscience (geodesy, geology and geophysics) take place a knowledge about velocities of their movements, caused by the various global and regional geodynamic phenomena (tectonic plates, regional and local crustal movements with technogenic and natural character). One of the important condition for such scientific investigations – availability of the rather dense GNSS network which fully cover all region, with long time period of measurements. Unfortunately, today in Ukraine there is no any unified GNSS network, established and coordinated at the National level. There are number of private networks: ZAKPOS, SysNet, TntTPI, as well as GEOTERRASE network which is installed by the National University "Lviv Polytechnic".

At the presented study, 28 GNSS stations from different private CORS networks and 8 IGS stations as a reference points (Fig. 1), were selected to cover the West Ukrainian region and to compute the daily based coordinates and their velocity, using three years of GNSS measurement in the frame of Bernese Processing Engine (BPE) [3], [8]. This is start attempt to create unique network from available private networks, with the data quality and network consistency check for the future computations over the all Ukrainian territory (around 140 GNSS CORS).
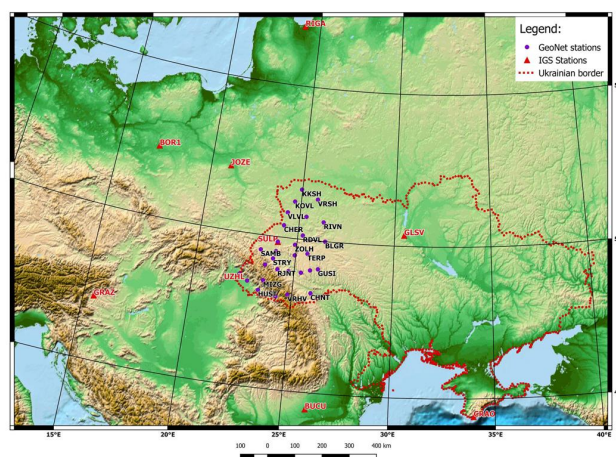
Fig. 1. GNSS stations distribution.

II. Initial data

The data required for the network computation can be divided into two main categories:

- Input data, such as observations files from GNSS stations, precise ephemerids from GNSS satellite, Earth rotation parameters, reference coordinates and velocity, station information, etc. This is also including the data and information from the local network stations,
- A-priory files, such as tectonic polar motion, ocean loading, atmospheric models, etc., which are provided by the International IGS Data and Analysis Centers.

For the precise solution of the GNSS processing the input data such as precise orbits, differential code biases, Earth Orientation parameters, ephemerids of planets and moon, files with calibrations of satellite and antennas phase centre, and other files are required and were collected. Reference stations and velocities coordinates, a priory processed stations velocities, coordinates and station information files as well as the information about station receivers are important to consider setting-up the geometry of the network.

Final results of GPS data processing, partly based on these models, will be stabilized in terms of dynamics and atmospheric effects. The geodynamics effects especially movement of tectonic plates cause displacement to the GNSS stations. Atmospheric effects accumulate a lot of noise and errors when the GNSS satellites signals passing the troposphere and ionosphere layers [9].

Station coordinates are changing in time due to the steady movement of tectonic plates. This movement must be taken into account in precise GNSS processing. Station coordinates (especially of reference sites) should therefore always be propagated from the reference epoch to the observation epoch based on corresponding station velocities. To ensure consistency with the IGS satellite orbits and prevent network deformations caused by the plates movement, complying with the IERS Conventions the NNR-NUVEL-1A tectonic plates motion model is recommended to be used [1], [4]. The NNR-NUVEL-1A model is already a part of the Bernese GNSS Software, installed and will be used at final network computation. Another important site displacement effect is the crustal deformation caused by the changing mass distribution due to ocean tides (ocean tidal loading). The model of the ocean tidal loading effects is known as the FES2004. A file of ocean loading effects containing station-specific coefficients for the magnitude of the ocean loading effect (amplitude and phase shift for the eleven most important constituents) may be selected where necessary.

For the obtaining ocean tidal loading effects values for each local CORS stations the FES2004 model, provided by Centres Onsala Space Observatory, will be used. The model was computed using the service provided by the Onsala Space Observatory.

The troposphere (neutral atmosphere) is the lower part of the atmosphere and extends from the Earth's surface up to an altitude of about 20 kilometres. The signal propagation depends mainly on temperature, pressure, and water vapour content of the atmospheric layers.

In Bernese processing several a-priori models and corresponding mapping functions [2] are used to take into account the tropospheric refraction:

- the Saastamoinen model [8],
- the (dry and wet) Niell model [6];
- The Saastamoinen zenith path delay together with the Niell mapping functions (recommended for GNSS data analysis with low elevation cut-off angle). The Niell model is implemented as a product of the Saastamoinen zenith delay and the Niell mapping function.
- The Saastamoinen and Niell models are installed already with Bernese GNSS Software and can be used for the computation

III. Computation of the coordinates time series and stations velocity

The main objective of this stage of the presented study is a determination of a final configuration of IGS reference stations, and computation of data to obtain final coordinate time series, tropospheric zenith path delays and velocity vectors for the GPS stations, located in West Ukrainian area. The activities of this stage include four main blocks with several main stages (Methodology diagram is presented at Fig.2)

Block 1 – preparation for the processing:

Block consists of finalizing of the input data, creation and analysis the IGS and local CORS a priori data and settings for a processing of daily session using the Bernese Processing Engine (BPE) that makes possible automated processing of observations.

Accuracy of coordinates and velocities of reference stations, a priory coordinates and velocities as well as the information about station receivers and antenna\dome were collected and used to setup the geometry of the network [7].

The computation of a priory coordinates for the local CORS network is done using Precise Point Position. DEMO module of the Bernese GNSS software.

Block 2 – computation with different network configurations:

Main purpose of this block is to find out an optimal IGS stations configuration for the processing of local CORS observations. A free network solution for local CORS network and comparison IGS time series with other solutions has also been done for entire period.

Block 3 – final computation and analysis

The computation of all three years for West Ukrainian CORS network is done using RINEX-TO-SINEX (RNX2SNX) process control file. The main purpose of the RNX2SNX is to compute coordinates and troposphere parameters.

GPS data processing should be made continuously for each GPS week. The process of obtaining solution for the separate GPS week has been divided into several steps:

- Pre-processing of daily sessions of observations;
- Obtaining estimates of coordinates for every day of observations;
- Obtaining velocity vectors for all period of observation.

Block 4 – final results

This is final block of current stage and the results obtained are:

1. Computation of high precision station coordinates (on the millimeter level accuracy), Solution Independent Exchange Format (SINEX);
2. Estimation of station-specific troposphere parameters, Tropospheric Exchange (TROPEX) files
3. Computation of velocity vectors.

Final daily based GNSS stations coordinates were derived using minimum constraint approach through three translation conditions on the network's barycentre is that (small) errors in the coordinates of a reference site do neither distort the network geometry nor significantly degrade the datum definition per site. It is thus the recommended by Bernese team method to estimate final results [3]. The coordinates of the stations are computed in geocentric coordinate system ITRF2008 [5]. For more correctly time series representation it is generally accepted to display time series in local North East Up (NEU) coordinate system, connected to the reference epoch of observation. Station velocity vectors are computed using program ADDNEQ2 (Bernese). As input data normal equations files, which contain only the station coordinate parameters and a-priory coordinates and velocities of all stations are used.
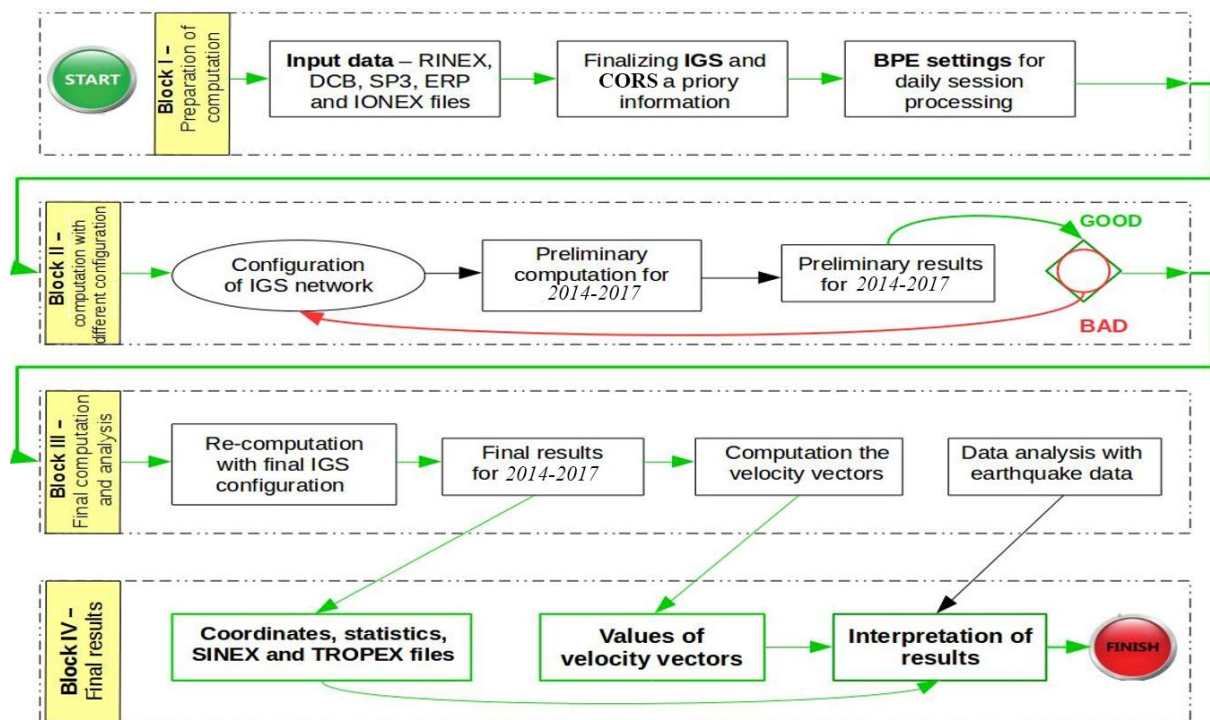
Fig.2 Methodology block diagram
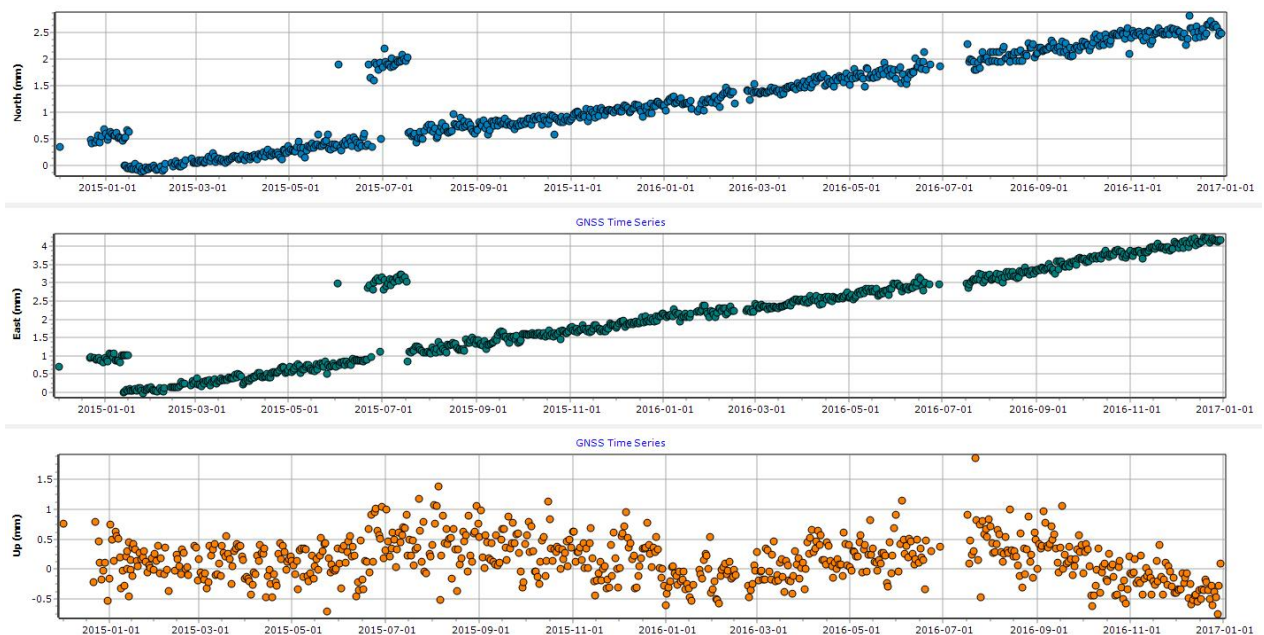
Fig. 3 NEU coordinates time series for station VRSH

The normal equation files have to cover a reasonable time (2014 – 2017) to reliably estimate the velocities.

IV. Results

Computed after final processing reference stations daily coordinates were compared with IGS solutions. Comparisons demonstrates that average differences for all stations are within +0.6 to +6.8 mm. Values of differences are not exceeding 5 mm. Based on daily coordinates solutions the coordinates times series were plotted and analyzed for each station separately in NEU coordinate system. During the analysis of the time series, from one side not significant out-layers (around 2-5 mm) was detected mainly for all stations (Fig. 3) what might be caused by some local issues connected with the stations maintenance. In some cases, such out-layers can exceed 10-15 cm. For final data analysis and geodynamics interpretation all computed coordinates time series should be de-trended to avoid mistakes in interpretations. From another side, small data gaps occurred in 80% of processed stations measurements, have same behavior as out-layers.

Fig. 4 illustrate the velocity vectors directions and values computed based on coordinates time series using two difference approaches.

First one based on NNR-NUVEL-1A tectonic plate model and resulting NE velocity (Fig. 4 A) demonstrate the CORS movement relative to the Eurasian tectonic plate (ITRF2008 system [5]). Velocity values range of this solution is vary from 7 to 17 mm per year and shows a good consistency with the speed of Eurasian tectonic plate and direction of movement. The uplifts and subsidence of the CORS stations shown in the Fig. 4 B. Second one, allows to compute the stations velocity without any tectonic plate model to see the real behavior of the studied region. The results of such method shown in the Fig. 4 C-D. Computed velocity vectors directions and eigenvalues are referred to ETRF2000 system. Comparing the results from Fig. 4 A and Fig. 4 C, clearly visible a big difference in velocity directions as well as velocity values. Fig. 4 C shows local movements of the region which should be more accurate analyzed together with geological data. Same conclusions can be applied to the uplifts and subsidence of the student area from the Fig.4 B and Fig.4 D. However, unlike the NE directions, the Up velocity in both cases have same directions but different values.

Conclusion

This stage of the presented study has completed the computation of the available observations data for entire period. Based on the results of the final data computation it can be summarised that the data quality of the combined CORS from different private networks in to the one unique network is in general good. However, despite of generally good quality of the observation data, the data availability in some stations is not at the required level and is much less that for other. Some station demonstrated the trend of coordinate time series and resulting velocity vectors that require additional explanation, finding out of the causes and resolution of the issues. The velocity vectors for the local CORS network are also computed and are in a good conformance with the IGS stations velocity vectors for the Eurasian tectonic Plate and obtained results can be used in a next block of the project activities – velocity vector analysis with the tectonics and geological data available for Eurasian Plate as well as West Ukrainian area especially.

For the next step of presented study, all computed results will be combined with geological and tectonophysics information for future interpretation, strain tensor determination, automation of the computation processes and extension of the studied region to the entire Ukrainian area.

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The Definition of Deviation of "Geoevolutionary" Plumb Line Based on Data from the Transformation of the Earth

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Abstract – This article is about dynamic transformation of the litosphere relative to the geoid. Calculated of deviation of "geoevolutionary" plump line, which is interpret as the angle between the normal to the surfaces of ellipsoids approximating the shape of the litosphere and the geoid. These values are converted into tangential force and determine the stress-strain state in the Earth's crust.

Keywords – the geodynamic evolution of the Earth's, the deflection of the plumb line, transformation of Earth, tangencial forces.

I. Introduction

Earth – is a celestial body of Solar system and its shape is developed under the influence of external and internal factors, which have cosmogeneous, endogenous and exogenous origin [4]. Variations in rotational motion of Earth as cosmic body, along with endogenous and exogenous processes lead to the transformation of the Earth's shape during geological history. Considering structural composition of the Earth with several layers with different rheological properties: lithosphere, asthenosphere, mantle, internal and external core, an assumption can be made that gravitational and rotational forces perform different influences on those internal layers. Consequences of such impacts may appear in: cyclic geodynamical instability of the Earth's shape, Earth's center mass movement, variations in geopotential coefficients, secular motion of terrestrial poles, ocean level changes and variations in Earth's rotation. There is no doubt that internal and external factors such as climatic changes, seismic and volcanic activity and many other natural processes are interrelated to the Earth's shape transformation.

Let's consider the geodynamic evolution of the Earth's image as a consequence of the process of redistribution of its mass in a dynamically changing force field, with the acquisition of a form with minimal potential energy. These masses are under the influence of three groups of forces: the cosmogenic, endogenous and exogenous nature, the effect of which leads to processes of transition from one state of equilibrium to another in different time and space scales in the planetary field of geodeformation. This continuous process of reaction has its critical boundary depending on the physical and mechanical and geological properties of the rocks and the environment, the magnitudes and scales of geometric parameters, tectonic forms and duration of forces. After reaching the critical edge, the shape of the planet changes its shape. As a result, on its surface there is a destruction and huge geological faults are formed.

If we present the Earth without water, then we find that the relief of the earth's surface differs significantly from the geoid. Comparing the geoid map with tectonic maps, we arrive at a well-known conclusion that there is no link between geoid heights and tectonic structures. The heights of the geoid reveal an absolutely independent distribution, even in relation to the largest tectonic structures of the lithosphere: continental protrusions and oceanic trough. This absence of the relationship between the heights of the geoid and the structure of the lithosphere is due to the non-homogeneous placement of planetary structures of the physical surface of the Earth relative to the figure of a geoid, which may be caused by the displacement of lithospheric plates. The latter can lead to the rotation of the entire lithosphere of the Earth relative to a more stable figure of the geoid, which may have been reflected in the difference in the values of parameters and in the orientation of geometric shapes that approximate the physical surface and geoid.

II. Problem definition

Scientific concepts of planets evolution show that in the past Earth was closer to the state of hydrostatic equilibrium than now. Consequently – external surface of lithosphere coincided with ellipsoidal shape, fitted geoid in best way. This means that in that past period plumb line direction coincided with normal to ellipsoid, which approximated external surface of lithosphere. Schematic illustration of Earth's shape evolutionary forming process is shown on Fig.1, where the following notations were introduced: PP' – Earth's rotation axis, P_L – lithosphere surface, E_L – ellipsoid best suited to the lithosphere surface, E_G – ellipsoid that describes Earth's shape in the ancient geological epoch. All notations in Fig. 1a are marked with a prime in Fig. 1b for the figure and surface of the Earth's lithosphere in the modern era.

Thus, comparison of two positions of the outer shells of the Earth in Fig. 1a and Fig. 1b allows to assume the appearance of a stressed state due to changes in the rotation speed and the position of the rotation axis with respect to the Earth's shape. Stress distribution within the Earth's lithosphere, which may appear because of Earth's shape transformation, is shown schematically in Fig.2. Such a stress distribution scheme was proposed by K. Tyapkin in a new rotational hypothesis of structure formation [3]. In the case of simultaneous changes of the parameters of the Earth's rotational regime (angular velocity and the position of the rotation axis), it is assumed that the slowing down of the Earth's rotation causes the appearance of stresses in the lithosphere (distribution of which is shown in Fig. 2a) and change of position of the rotation axis leads to a reorientation of the figure and formation of compression and expansion zones (Fig. 2b). Actual geological evidences suggest that a significant role in this process is played by the tectonic factor caused by the displacement of lithospheric plates, which can affect the terrestrial poles position.
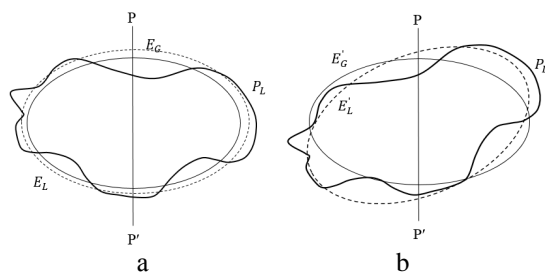
Fig.1 Schematic illustration of the body forming the Earth: a – in the initial period when the Earth was closer to the state of hydrostatic equilibrium; b – the current state of Earth's shape and Earth's lithosphere surface
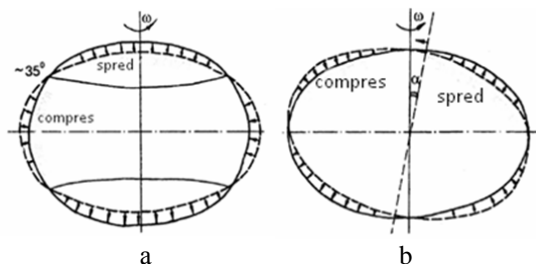
Fig. 2 Schematic stress distribution within Earth lithosphere: a – due to changes in rotational movement around the axis; b – du to position changing of the rotational axis [6]

Geologists A. Malouf and G. Halverson [1] assumed that 800 million years ago the terrestrial poles shifted. This assumption may be considered as a confirmation of such interpretation for Earth's figure transformation. By studying the magnetization of minerals in the old sedimentary rocks of the Norwegian archipelago, they discovered that the north magnetic pole shifted quickly by 50 degrees during 20-million-year period. Since the tectonic plates motion is very slow authors explained such displacement of lithosphere surface with respect to the core, where the magnetic field is formed, by the global mass redistribution, which may results in rapid change in the position of the rotation axis. Such process might have started after a large imbalance of masses in the mantle. For example, due to the appearance of a super volcano near the equator. The studies carried out by A. Tserklevich and A. Zayats [5] give grounds for a statement that tectonic structures of planetary scale appeared in the process of geological evolution of the Earth, which could significantly affect the rotational parameters and the figure. In particular, the hypothetical Darwin's relic rise [2] on Earth could shift the pole by 15 km, and slow down the rotation speed by 0.09 sec. The volcanic Tarsis rise [3] on Mars respectively, could change the pole position by 6 km and the rotation speed by 0.06 sec respectively. Obviously, the obtained results are estimative and can be interpreted as a possible option of dynamic processes development, which can lead to changes in rotation axis position and result in appearance of stressed state and fault structures in the lithosphere of planets.

Such placement of the figure of the lithosphere and of the geoid figure can create a strain aimed at bringing the distribution of the masses in line with the figure of the geoid.

III. Method of solving the problem

We restrict ourselves to the definition of only the tangential forces that arise in connection with this redistribution of masses in the upper shells of the Earth (bark and upper mantle). We introduce the concept of deviation of "geoevolutionary" plumb line and assume that the tangential forces are proportional to the angle g, which is defined as the angle between the direction of the plumb lines in the past geological epoch and the direction of the plumb lines at a given point. Note that the ellipsoid E_L in the past approximately represented the level surface of our planet. Now he is responsible for the ellipsoid E_L'. It is clear that the dimensions of the ellipsoid E_L' in comparison with E_L the changed, since the external surface of the lithosphere has changed. Accordingly, the parameters of the ellipsoids are not identical. However, we can assume that the surface of the Earth in the past roughly coincided with the surface of ellipsoid E_L', and in the case of such an assumption, the angle between the directions of the plumb lines (normal line to surface ellipsoids) is formed g.

When determining the angle g we will not take into account the discrepancy of the centers of ellipsoids E_L' and E_L, since it will not significantly affect the result.

In addition, the longitude will be measure not from the Greenwich meridian, but from the line of nodes, that is, from the line of intersection of the plane of the equatorial ellipsoids E_G' and E_L.

Consequently, at an arbitrary point of the ellipsoid surfase , we have the expression for calculating the radius of a vector:

$$r_0 = a_0\left(1 - a_0 \sin^2 j_0\right) \qquad (1)$$

where r_0 is the radius vector of the point, j_0 is the latitude, a_0 is the flattening of the Earth.

The radius vector r_0 crosses the surface E_L' at some point. Denote by ρ the radius vector of this point, and we will have an expression for its calculation:

$$r = a\left(1 - a \sin^2 j\right), \qquad (2)$$

where r – the radius vector of the point, j – the latitude, which is measur from the plane of the equator of the ellipsoid; a and a – respectively, the semi-major axis and the flattening of the same ellipsoid.

The distances between the ellipsoids and determine :

$$S = r - r_0 = a - a_0 + \\ + a_0 a_0 \sin^2 j_0 - a a \sin^2 j \qquad (3)$$

From the spherical triangle we express j through j_0 and l_0. Note that l_0 - the longitude of the point, which is measure from the line of nodes. Refer to Figure 3, where the following notation is taken: P_G' and P_L' the

points reflecting the position of the poles of the ellipsoids (E'_L and E'_G) in the single sphere; $P'_G L$ – the initial meridian whose plane passes through a line of nodes; z - average distance between the poles and; T - point in which we determine the angle g .
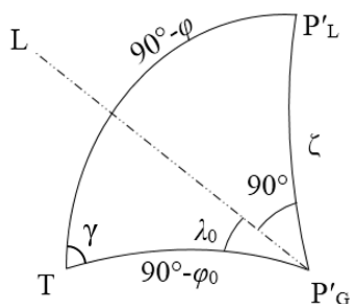
Fig. 3 Illustration to the definition of angle g

From the figure we have:

$$\sin j = \cos z \sin j_0 - \sin z \cos j_0 \sin l_0. \quad (4)$$

Now formula (3) can be written as:

$$S = a - a_0 + \left(a_0 a_0 - aa \cos^2 z\right)\sin^2 j_0 -$$
$$- aa \sin^2 z \cos^2 j_0 \sin^2 l_0 + \quad (5)$$
$$+ \frac{1}{2} aa \sin 2z \sin 2j_0 \sin l_0.$$

We introduce the following symbols to simplify the writing of formula (5):

$$A = a - a_0; \quad (6)$$

$$B = a_0 a_0 - aa \cos^2 z; \quad (7)$$

$$C = -aa \sin^2 z; \quad (8)$$

$$D = \frac{1}{2} aa \sin 2z. \quad (9)$$

As a result we will receive

$$S = A + B \sin^2 j_0 + C \cos^2 j_0 \sin^2 l_0 +$$
$$+ D \sin 2j_0 \sin l_0 \quad .(10)$$

The components of the "geoevolution" deflection of the plumb line in the plane of the meridian and in the plane of the first vertical, respectively, will have the form:

$$x = \frac{1}{R}\frac{\partial S}{\partial j_0}, \quad h = \frac{1}{R \cos j_0}\frac{\partial S}{\partial l_0}, \quad (11)$$

where R - the mean radius of the Earth.

Taking the corresponding derivatives of expression (7), we obtain:

$$\frac{\partial S}{\partial j_0} = 2B \sin j_0 \cos j_0 - 2C \sin j_0; \quad (12)$$
$$\cos j_0 \sin^2 + 2D \cos 2j_0 \sin l_0$$

$$\frac{\partial S}{\partial l_0} = 2C \cos^2 j_0 \sin l_0 \cos l_0 +$$
$$+ D \sin 2j_0 \cos l_0 \quad . \quad (13)$$

Accordingly, for the components of the deflection of the plumb line, we will have:

$$x = \frac{2B}{R}\sin j_0 \cos j_0 - \frac{2C}{R}\sin j_0 \cos j_0$$
$$\sin^2 l_0 + \frac{2D}{R}\cos 2j_0 \sin l_0 \quad ; \quad (14)$$

$$h = \frac{2C}{R}\cos^2 j_0 \sin l_0 \cos l_0 +$$
$$+ \frac{D}{R}\sin 2j_0 \cos l_0 \quad . \quad (15)$$

From the components of the "geoevolutionary" deviation of the plumb line, we turn to the tangential components of forces acting on a unit of mass in the upper layer of the Earth. To do this, we multiply the expressions (11) on g – acceleration of gravity.

Consequently, we obtain:

$$m = \frac{Bg}{R}\sin 2j_0 - \frac{Cg}{R}\sin 2j_0 \sin^2 l_0 +$$
$$+ \frac{2Dg}{R}\cos 2j_0 \sin l_0; \quad (16)$$

$$n = \frac{Cg}{R}\cos^2 j_0 \sin 2l_0 + \frac{Dg}{R}\sin 2j_0 \cos l_0. \quad (17)$$

Thus, according to the formula (10), we can calculate the distance between the ellipsoids E'_G and E'_L, that is, the reduction or increase distance of the lithosphere relative to the sea level due to the rotation of the tough part of the Earth caused by the displacement of the lithosphere as a single shell.

By formulas (13) and (14), we determine the potential forces that act as a gradual return of the mass distribution to the equilibrium state as a mechanical system with a rotation around the smallest moment of inertia.

Note that in the formula (10), in addition B, C, D to the coefficients A, there is a coefficient that needs to be corrected, taking into account the invariance of the volume of the ellipsoids.

Consequently, in determining A we will proceed from the fact that the volume of Earth in the last geological epoch has not significantly changed. This condition leads to equality

$$a_0^2 b_0 = a^2 b. \quad (18)$$

If we accept

$$\left.\begin{array}{l} a = a_0 + \Delta a = a_0\left(1 + \frac{\Delta a}{a_0}\right) \\ b = a_0\left(1 - a_0\right) = a\left(1 - a\right) \end{array}\right\}, \quad (19)$$

then we will get

$$1 - a_0 = \left(1 - a\right)\left(1 + \frac{\Delta a}{a_0}\right). \quad (20)$$

Taking into account small values and expanding in a series, we have

$$a_0 = a - 3\left(\frac{\Delta a}{a_0}\right) \qquad (21)$$

and

$$aa = a_0 a = c, \qquad (22)$$

where c – constant, which is calculated when replacing aa the corresponding value.

$$a = \frac{c}{a_0}, \Delta a = \frac{a_0}{3}(a - a_0). \qquad (23)$$

Taking into account the previous simplifications, the expression (10) can be represented as

$$S = \frac{aa}{2}\sin I_0 \sin 2j_0 \sin 2z - \\ - aa \cos^2 z \sin^2 j_0 - \\ - aa \sin^2 z \sin^2 I_0 \cos^2 j_0 + a - a_0 \qquad (24)$$

Conclusion

The calculated values of the components m, n illustrating the stress-strain state of the lithosphere in the modern era are shown in the form of a vector field in Figure 4. As can be seen from the figure, the largest values of the constituent forces are concentrated in the so-called "critical latitudes" from 35 ° to 45 °.
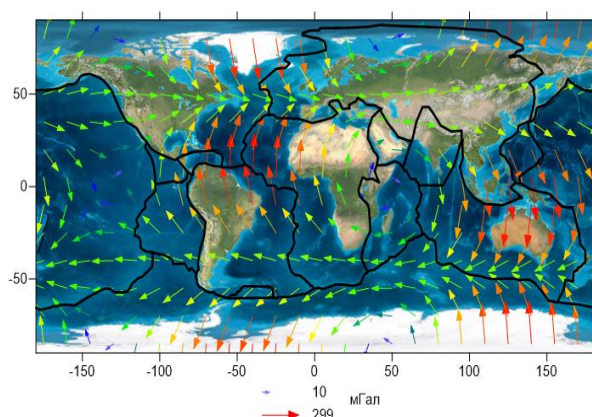
Fig. 4 Map of tangential forces against the background of continents and oceans and tectonic plates. Arrows show tangential forces in mGal.

Investigation of tangential forces arising as a result of reorientation of a thin solid shell of our planet has shown that a field of stress is formed on its surface. Its forces are located in the form of four vortices, two polar , located near the poles, as well as two equatorial ones. Having analyzed the acting forces, it is observed that the values of the forces acting near the vortex axis are minimal, and on the edges they are maximal. The axes of this vortex system are mobile, respectively, their force lines should be spiral, as illustrated by the map(Fig. 4).

It is very difficult to interpret these forces, it is certain that they have a role in the tectonic dynamics of our planet. The question is for how much they affect it, and these thin relation still need to deeply research.

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Monitoring crustal deformations in Carpathian fold system

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The main territory of Ukraine is located on stable Eastern European platform but some parts are also in the Mediterranean zone: Carpathian fold system and Folded-brylova Building Mountain Crimea. These tectonic structures are characterized by seismicity. Monitoring such seismic active regions is great interest for geodynamic study. Nowadays, monitoring of these regions is more available with development and distribution of GNSS technology. The Department of Geodesy and Astronomy of Lviv Polytechnic National University operate several reference GNSS stations in Carpathian region. These stations are used for engineering purpose but they also have a strong potential for the monitoring of regional and local crustal deformation. This research intends to quantify crustal deformation trend in Carpathian fold system using GNSS technique observations starting from 2013 to 2016. GNSS measurements are processed by Gamit-Globk software. Absolute rates of reference stations have been estimated (22 mm/yr). Horizontal rates show a clear trend – a dextral character. Movement components are in the direction of northern east.

Keywords – GNSS, reference network, crustal deformation, GAMIT-GLOBK software, tectonic structures, Carpathian fold system.

I. Introduction

Nowadays there has been a continued and growing interest using GNSS for monitoring crustal deformation. Many experts around the world [1, 3, 4, 5, 6] are trying to detect the natural disasters event in advance by using GNSS technique. So regional and local networks of GNSS reference stations are elements of a great interest to the study of regional crustal deformations and seismic activity. The Department of Geodesy and Astronomy of Lviv Polytechnic National University operate several (~30) local reference GNSS stations in Southeast part of Ukraine. Until now, these stations have been mostly used for engineering purpose but they also have a strong potential for the monitoring of regional and local crustal deformation. This is important because this part of Ukraine has the seismically active tectonic structure – Carpathian fold system.

II. Carpathian fold system

Carpathian fold system is an arcuate tectonic zone included in the megastructural elevation of the Carpathians on the external periphery of the mountain chain. The Carpathians are divided into three parts: the Western Carpathians and the Southern Carpathians, both of which consist of three bands, and the Eastern Carpathians, which are only 100-120 km in width and consist only of the flysch and volcanic bands. The Eastern Carpathians are known as the Forested or Ukrainian Carpathians. The Ukrainian Carpathians lie on the border of the East European Platform and the Mediterranean Geosynclinal Province. The Carpathian fold system was formed during the Alpine orogeny in the Tertiary period. Carpathian fold system consists of four longitudinal structural zones, which extend from the northwest to the southeast: (1) the outer or overthrust fold zone, 40 km wide, built of Cretaceous and Paleogene flysch; (2) the central synclinal zone, 30–40 km wide; (3) the core of the inner anticlinal zone; (4) a zone of volcanic deposits—trachytes, andesites, rhyolites, and tuffs—separated from the rest of the Carpathians by the Inner Carpathian Valley and the Maramureş Basin, which are covered by horizontal layers from the Miocene period [7].

III. Data and processing

We use data from different GNSS stations of Ukraine. Additionally, we also use data from several stations of the neighbors GNSS networks such as ASG-EUPOS (Poland), ROMPOS (Romania), MOLDPOS (Moldavia), SKPOS (Slovakia) (fig. 1). We considered data available between 2013 and 2016 years.

Fig. 1. Reference GNSS stations

Observation data files are downloaded automatically on a daily basis via ftp-server in Department of Geodesy and Astronomy of Lviv Polytechnic National University. Then GNSS data were processed using the Gamit-Globk software [2] developed by MIT. Using Gamit-Globk the input files were imported the main analysis by software package – Gamit. This program inverted the (constrained) correlation or covariance matrix to the unconstrained normal equation. Reference frame were realized by the EPN/IGS stations from Poland (BYDG, JOZ2, LAMA, USDL), Austria (GRAZ), Moldova (IGEO), Italy (MATE), Russian (MDVJ, ZECK), Germany (POTS, WTZR), Latvia (RIGA), Bulgaria (SOFI), Lithuania (VLNS) and Ukraine(CNIV, GLSV, MIKL, POLV, SULP, UZHL). Seven components of Helmert translation

related to ITRF08 were estimated by minimum constraint method. Following such a strategy allowed to eliminate the errors in network's geometry trigged by some errors in stations.

Final processing of GNSS data from reference stations in the Carpathian fold system gives the station velocities in their north (N), east (E) and altitude (H) components. Annual stations movement velocities are determined from station time series, in units of mm/yr. Final processing of GNSS data from reference stations in the Carpathian fold system gives the station velocities in their north (N), east (E) and altitude (H) components. Annual stations movement velocities are determined from station time series, in units of mm/yr. Statistical analysis which is represented in table 1

TABLE 1

Statistical result of the stations velocities

	Carpathian fold system		
mm/yr	VE	VN	VH
max	23.1	14.6	2.8
mean	22.0	13.8	0.3
St. dev	0.6	0.7	1.7

The analysis of detected movements in the Carpathian region was directed toward an evaluation of movement velocities of structures in the region. The size and direction of the horizontal component of the relative site velocities, determined from measurements on all GNSS stations, are given in Figure 2.
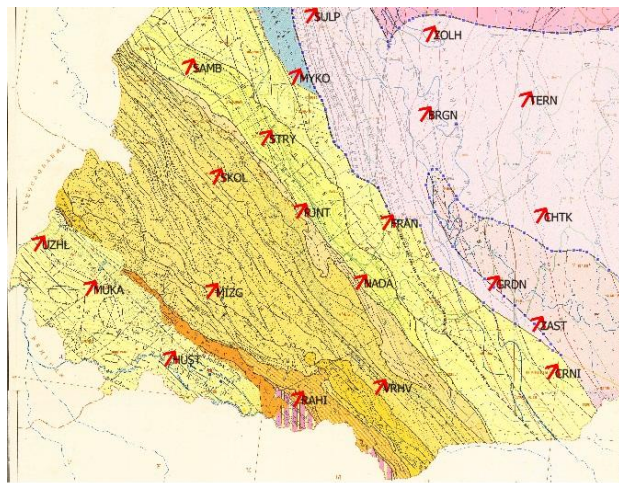
Fig. 2. Geodynamic interpretation of GNSS data of the reference stations located in Carpathian region

The movement components of all stations display a dextral character. Movement components in the direction of northern east. The analysis of the movement trends completed for Carpathian region displayed points toward the importance of geodynamic studies on the local scale. Subsequently, their mutual consecutive linkage will allow the creation of a regional geodynamic model of Carpathian fold system to be compiled.

Conclusion

We draw the following conclusions from our analysis of continuous GNSS data from stations in Carpathian region, spanning between 4 years:

1. Horizontal rates show a clear trend – a dextral character. Movement components are in the direction of northern east. Absolute rates are about 22 mm/yr.

2. According to the results of satellite observations, we can not confidently detect the dependence of the obtained velocities on regional geotectonic.

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Analysis of Archival Cartographic Materials for the Modeling of Digital Terrain Model of the Lviv City Landfill during 1988-2008

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Abstract – Made selection archival cartographic materials for further modeling of the digital terrain model of Lviv city landfill.

Keywords – Lviv city landfill, Archival topographic maps and plans, aerial photography materials, digital terrain model.

I. Introduction

Maps that depict terrain with horizontals allow you to carry out all, without exception, measurements and calculations. With maps you can define different types of characteristics: geographic and rectangular coordinates, squares, volumes, lengths of lines, vertical and horizontal angles [1].

II. Analysis of archival cartographic materials on the territory of the Lviv city landfill from 1950 to 1990.

Significant changes in the area after the World War II led to the need to update topographic maps, but also on decades of new topographical surveys. According to the decision of the Council of Ministers of the USSR No. 760 of April 7, 1946, a single system of geodetic coordinates and heights was introduced on the territory of the USSR, which was named "System of coordinates of 1942". The altitude of the Baltic Sea was taken for counting altitudes. A significant development since the mid-1950s was acquired by topographical maps at a scale of 1: 100 000 and 1:25 000. The representative of this period is a topographic map (Fig. 1), the state of the area in 1957 was made at a scale of 1:25 000 with a section of relief of 5 m. In particular, a fragment of this topographic map was used as the initial surface to determine the volume of the municipal solid waste landfill in Lviv [2].

Fig. 1. A fragment of a topographic map of scale 1: 25000 with contour lines of 5 m (1957).

In 1972 a topographic map was issued on a scale of 1:25 000 with a section of the contour lines through the 5 meters coordinate system of 1942, the system of heights of the Baltic Sea (Fig. 2).
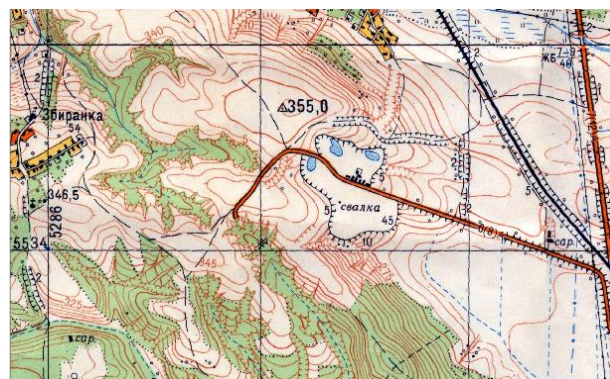
Fig. 2. Fragment of a topographic map of scale 1: 25000 with contour lines of 5 m (1972).

In 1985, a topographic map with a scale of 1:10 000 with a contour lines of 2 m of the nomenclature M-35-73-A-1-I (Fig. 3) is published.
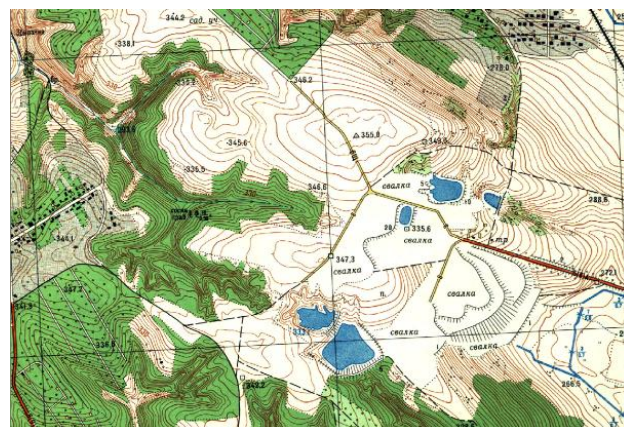
Fig. 3. Fragment of a topographic map of scale 1: 10000 with a contour lines of 2 m (1985).

On the basis of taking off of 1985 from a map of scale 1: 10000 in 1991, a topographic map of 1: 25000 with a 5-meter- contour lines was issued.
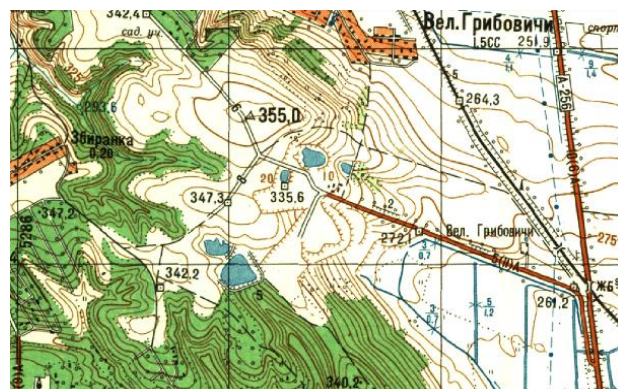
Fig. 4. Fragment of a topographic map of scale 1: 25000 with a section of relief of 5 m (1991).

As a result of the study, a collection was made and a retrospective geographic analysis of cartographic works on the territory of the Lviv city landfill from 1950 to 1990 (4) was presented..

In particular, mapping one-dimensional maps pertaining to different periods is one of the most important ways of studying the dynamics of landfill [3], which in combination with the use of geographic information systems (GIS) will better understand the specifics and stages of the functioning of the Lviv landfill, which in further and is planned to be implemented.

III. Analysis of archival materials for modeling digital terrain models from 1988-2008

As a result of aerosizing on October 5, 1988, the researchers obtained photos that can be used to simulate the digital terrain models using the photogrammetric equipment of the digital stereophotogrammetric station "Delta".
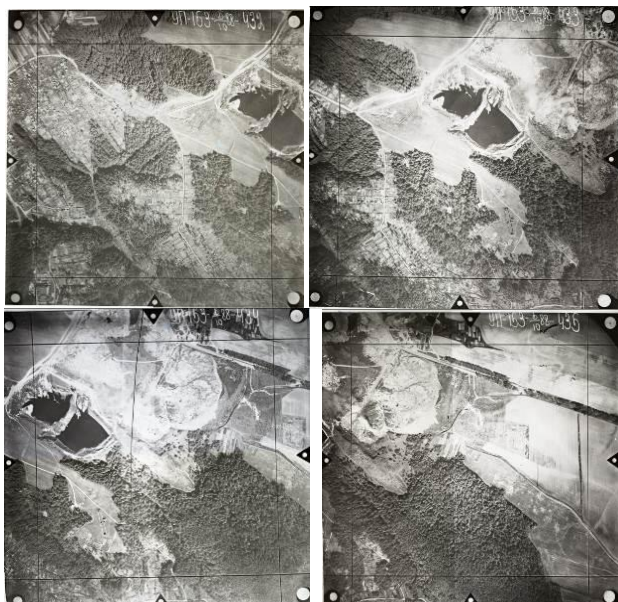
Fig. 5. Aerial photos of the state of the Lviv city landfill in 1988.

At the request of the Lviv City Council in 2006 LvivDiproCommunBud created a topographical map of the Lviv city landfill of solid waste, shown in Figure 6.
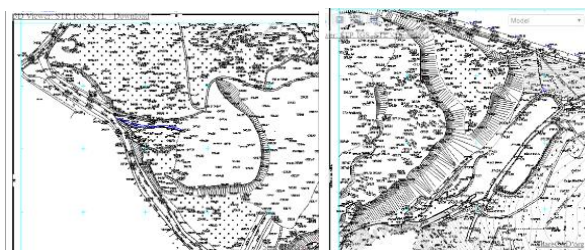
Fig. 6. Fragment of a topographic plan at a scale of 1: 1 000 with a contour lines 5 m creating as 2006.

In 2008 SE "Zahidheodezkartohrafiya" created topographical plan of the village Hrybovytshi in a scale of 1: 5000 showing the digital terrain models on Lviv city landfill.
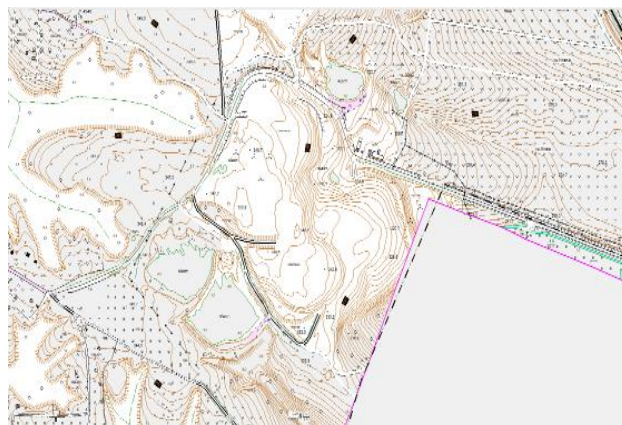
Fig. 6. Fragment of a topographic plan at a scale of 1: 5 000 with a contour lines of 1 m. creating as 2008.

Conclusion

As a result of this research, the collection of four topographic maps, aerial photographs as of 1988 and two topographical plans for 2006 and 2008 of Lviv city landfill. The further processing of these materials in specialized GIS will enable the construction of digital terrain models from 1988 to 2008 and will be useful for studying the stages of functioning of the Lviv municipal solid waste landfill.

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Models of representation of selenopotentials by spherical functions and using point masses

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Abstract – there are many approaches to studying the gravitational field of the moon, and depending on the method chosen and the input information, each of them has certain advantages.

Key words – gravitational potential, gravitation field, selenopotential, Moon, modelling.

I. Introduction

The complicated gravitational field of the Moon is the result of the heterogeneity of the density of the internal structure of the moon and its figures. In addition to the expansion of selenopotentials in a series of spherical functions, other methods of representing the gravitational field of the moon are widely used. One of these methods is representation using discrete models – point masses or disks.

II. Presenting main material

The application of the selenopotential to a schedule in a series of spherical functions has become widespread. In this case, the form of the entry will look like this [1]:

$$\Delta g = (\frac{GM}{R^2})\sum_{n=3}^{n}(n-1)(\frac{R}{r})^{n+2}$$

$$\sum_{m=0}^{n}(\overline{C}_{nm}\cos ml + \overline{S}_{nm}\sin ml)\overline{P}_{nm}(\cos J) \qquad (1)$$

r, θ, λ – spherical coordinates; GM – Moon gravitational constant; R – mean Moon radius; r – distance from the origin to an arbitrary point of space; n – model degree,

Cnm and Snm- fully normalized spherical harmonics,

Pnm(cosϑ) – fully normalized associated Legendre functions.

Along with the expansion of the selenium potential in a series of spherical functions, it is convenient to use a model of point masses to display local gravitational anomalies of short lengths but large in magnitude. We define the capacity definition in the following way

$$V = GM\sum_{1}^{n}\frac{m_i}{r_i} \qquad (2)$$

m_i – mass in units M, r_i – distance to point mass.

From formula (2) we find a formula for determining gravitational anomalies

$$\Delta g = \frac{\partial V}{\partial r} \qquad (3)$$

Receiving partial derivatives, we get

$$\Delta g_R = \frac{GM}{R}\sum_{1}^{n}(\frac{m_i(r-d_i\cos y)}{(d_i^2+r^2-2d_ir\cos y)^{3/2}}) \qquad (4)$$

$$\cos y = \cos J \cos J_i \cos(l - l_i) \qquad (5)$$

It should be remembered that the total mass of the moon remains unchanged, the sum of the quantities of abnormal masses must be equal to zero. [2]

When determining the magnitudes of gravitational anomalies, we will accept the mean radius of the moon R=1737,6 km. [3]

TABLE 1

PARAMETERS OF MODEL

	μi	di	ϑi	λi
1	1.622399	0.8	51.89999	342
2	0.7166	0.8	46.39999	77.7
3	-1.5189	0.7654	59.89999	2.7
4	-0.5405	0.8087	39.09999	70.89999
5	0.3831	0.8153	93.09999	118.6
6	0.2139	0.8954	75.09999	226.6
7	0.9928	0.7366	95.89999	173.9
8	-0.1889	0.8459	119.2	78.5
9	-1.6884	0.6457	45	337.3999
10	0.29971	0.77	109.7	26
11	-0.38289	0.7724	78.79999	35.7
12	0.28328	0.8076	4.299999	150
13	-0.07552	0.8735	77	96.5
14	1.626699	0.8	63.39999	13.7
15	-0.4453	0.8	73.2	17
16	0.5914	0.7757	130.8	275.8999
17	-0.4093	0.8211	109.1	261.3999
18	0.6445	0.7995	103.2	232
19	-0.8094	0.7686	123.6	196.8
20	-0.4516	0.8181	84.5	147.9
21	-0.6546	0.7164	80.59999	195.7
22	-0.0846	0.9253	127.9	331.2998
23	-0.15868	0.8583	28.7	229
24	0.22094	0.8026	170.9	323.2
25	-0.18684	0.8263	102	350

di – distance to point mass in units R,

μi – mass in units M,

ϑi – polar distance,

λi – selenographic longitude.
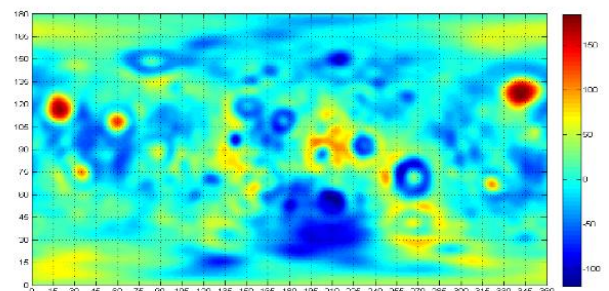
Fig.1 Anomalies of gravity Δg at an altitude of 100 km, calculated by the expansion in a series of spherical functions using model values Cnm , Snm

Spherical functions are their own functions for the sphere, and their widespread use is due to the slight deviation of the surface of the planets of the spherical. This form of presentation is quite convenient in constructing theories of the motion of artificial satellites

of the Moon and for studying the planetary features of the gravitational field structure.
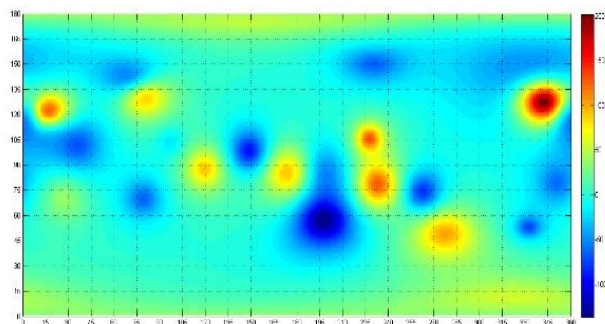
Fig.2 Anomalies of gravity Δg at an altitude of 100 km, calculated using a model of point masses

When solving certain problems due to the features of the gravitational field of the moon, the representation of the potential by a set of point masses may be more efficient and convenient. This method is especially convenient when describing the gravitational field of separate regions of the moon, and the ones where maskons are located.

Conclusion

In this paper we describe the gravitational field of the Moon by means of determining the gravitational anomalies by a decomposition in a row with spherical functions, as well as constructing a model of point masses. The analysis of feasibility of using one or another method of representation of selenopotentials depending on the tasks set.

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The Peer Land Exchange in Land Readjustment Models

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Abstract − The research is aimed at substantiation of land readjustment optimization models based on the equivalence of land plots to be exchanged. European experience of land readjustment has been considered. The formation of the notion of equivalency in the readjustment optimization models has been scrutinized. Factors influencing the land plots equivalency have been singled out. Land reallocation modelling with the formation of demands to the equivalence of the reallocated land plots by qualitative and spatial and technological characteristics has been suggested.

Keywords − land exchange, mathematical model, land readjustment, land consolidation, optimization.

I. Introduction

At the current stage, land readjustment substantiation and improvement is an important issue for most countries. Land readjustment is considered as the basic part of the existing land tenure improvement (concerning agricultural land [1], [2], [3] as well as urban territories [4], [5]).

Land readjustment is aimed at the correction of land plot characteristics in accordance to social, environmental and economic demands. The most common aims are the removal of fragmentation, land allocation for nature conservation, infrastructural objects, squatting, etc. [3], [6], [7].

Local peculiarities predefine the need for the adaptation of general approaches to readjustment aims and conditions.

II. The peer exchange at land readjustment

As the result of readjustment the improvement of land plot characteristics like mutual placement, dimensions, configuration, land massive (plot) structure are expected.

In accordance to UN Food and Agriculture Organization (FAO) recommendations [6], the general principle of land readjustment aiming at its improvement is the avoiding of land owner's losses.

Let us scrutinize the case there is no need for compensation. Since land plots are contrasted at readjustment, in accordance to FAO recommendations [6], the relative value can be used in this case. This approach is most essential provided the land market is weak or underdeveloped.

Land exchange is the mandatory readjustment step reflected in land readjustment algorithms [5]. It is suggested to put peer land exchange into the basis of readjustment by the principles outlined in the researches [8], [9].

III. Land readjustment modeling

The exploration of the best possible options of land tenure mutual placement and their characteristics is effectively realized by optimization models building [5], [10], [11].

In accordance to the existing approaches to readjustment modeling the exchange of land plots of equal area with the considering of the soil quality [11] or of equal value (within the preset acceptable value fluctuation range) is envisaged [10].

Researches of FAO [6] point out "Equal value" is thus not only a question of soil values but includes all factors that have a substantial impact on the use of land.

It is desirable to scrutinize the exchange as the peer one in case land plots to be exchanged are of equal value according to a set of main natural and acquired properties from the point of view of its general functional role [8], [12].

At agricultural land readjustment modeling it is suggested to take into consideration the characteristics of agricultural land plots as the production factor [12]. Useful properties of the land plot like soil quality in accordance to demands on cultivation of crops and existence of improvements should be taken into consideration. Technological processing conditions predefine the production capability in case of the equal fertility. The placement of the land plot predefines the profit from land usage in case of equal production capability. The existence of easements or servitudes can cause agricultural production losses.

IV. Land readjustment model based on the peer exchange

It is assumed that at land readjustment the exchange of land plots equal by a set of qualitative and spatial and technological characteristics is envisaged. As the result of the readjustment, land tenure spatial and technological characteristics should be improved.

The modeling is conducted in accordance to the readjustment aims. In case of the strip farming priority the following model is suggested.

Target function meets the condition:distance between new lots and holder yards should be minimal [10], Eq. 1:

$$F = \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{1}{d_{ij}} x_{ij} \to \max , \qquad (1)$$

where d_{ij} is the distance from the land plot of the owner j within land massive i to the household centre;
x_{ij} is unknown area of j-th participant in i-th land massive;
n is the quantity of land massives involved to the project; m is the quantity of land owners involved to the project.

It is suggested to form the demands considering the following list:

1. The exchanged land plots should be the peer ones at the readjustment, Eq. 2:

$$\sum_{i=1}^{n} K_{ij} B_{ij} x_{ij} = \sum_{k=1}^{l} K_{jk} B_{jk} S_{jk} , \quad j = 1,2,...m, \qquad (2)$$

where K_{ij} is the coefficient characterizing the combined impact of qualitative, spatial and technological characteristics of the land plot after readjustment [9]; B_{ij} is the average ball-bonitet of the land plot soil; K_{jk} is the coefficient characterizing the combined impact of qualitative and spatial and technological characteristics of the land plot before readjustment [9]; B_{jk} is the average ball-bonitet of the land plot soil of the land plot k belonging to the owner j before the readjustment;S_{jk} is the area of the land plot k belonging to the owner j before the readjustment; l is

the quantity of land plots belonging to the owner j before the readjustment.

Ball-bonitet of the corresponding land plot soil (specifies the soil quality by the core natural and acquired properties from the point of view of growing basic crops by 100-point scale) [11].

Value K is calculated as the product of separate factors depending on the presence of the corresponding factors by Eq. 3:

$$K_i = K_{qi} \times K_{li} \times K_{imi} \times K_{fi} \times K_{ri} \times K_{gi} \times K_{mi} \times K_{oi}, \qquad (3)$$

where K_q is the factor characterizing the lowering of the soil quality as the result of contamination, erosion, etc.; K_l is the factor characterizing the type of agricultural land; K_{im} is the factor characterizing the land improvements; K_f is the factor characterizes configuration; K_r is the factor characterizing relief; K_g is the factor of the hydrographic characteristics of land plot; K_m is the correction factor for land plot placement; K_o is the factor characterizing the existence of easements or servitudes [9].

2. The total of all land plots within a land massive before and after the reallocation is equal (Eq. 4):

$$\sum_{j=1}^{m} x_{ij} = S_{0i}, \quad i = 1,2,...n, \qquad (4)$$

where S_{0i} is the area of i project land massive.

3. The total land area within the project before and after readjustment should be equal, Eq. 5:

$$\sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} = \sum_{i=1}^{n} S_{0i}. \qquad (5)$$

4. The shape of the newly created land plots should be the most convenient and should not worsen after readjustment. The total newly created land plot configuration index should be not less than the total land plot configuration index before readjustment, Eq. 6:

$$\sum_{i=1}^{n} K_{ij} x_{ij} = \sum_{k=1}^{l} K_{jk} S_{jk}, \quad j = 1,2,...m, \qquad (6)$$

where K_{ij} is the coefficient characterizing the land plot configuration after readjustment; K_{jk} is the coefficient characterizing the land plot configuration before readjustment.

It is reasonable to calculate this coefficient as the alignment index [9].

5. Variable x_{ij} are nonnegative values only, Eq. 7:

$$x_{ij} \geq 0. \qquad (7)$$

Conclusion

According to the European experience, land readjustment at the existing land tenure and ownership improvement has been considered. Peer land exchange as the basis for land readjustment has been considered. The equivalency of land plots to be exchanged is defined as the precondition for the land owners' losses avoiding. The exchanged land plots equivalency criteria have been suggested.

Land reallocation modelling with the formation of demands to the equivalence of the reallocated land plots by qualitative and spatial and technological characteristics has been suggested.

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Hemp-Lime Bio-Composites – Properties and Applications in Architectural Design

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Abstract – This paper discusses physical properties and applications of hemp-lime bio-composites in architectural design. Hempcrete is a new, innovative construction material with significant ecological benefits, which gains popularity all over the world. Research on this topic is being conducted in many areas: material science, civil engineering, agriculture, ecology and architecture. The aim of this work was to review the worldwide publications and systemize the knowledge about the issue to provide information designated mainly for architects.

Keywords – hempcrete, hemp-lime composite, sustainable construction materials

I. Introduction

Construction is responsible for very high energy consumption and consequently significant share in GHG emission. Production of construction materials causes about 8 – 12 % of global CO_2 emission [1]. Materials, because of their physical properties, have also impact on energy efficiency of the buildings.

Energy efficiency policy, implemented in line with the widespread recognition of the need to protect the environment and the climate, led to development of an entire branch of „green" architecture. „High-tech" solutions, which include complex installations, control systems and superior insulation (often using synthetic or toxic, high embodied energy materials) are the mainstream, but at the same time, a „low-tech" approach exists and develops at the opposite pole. It focuses on using natural materials and natural physical phenomena in order to save energy and provide favourable living conditions, rather that invest in expensive technical infrastructure.

Hemp-lime composites are materials with properties that provide significant opportunities to exploit in design of „low-tech" sustainable architecture.

II. Production process and physical properties

The composite is obtained by mixing the following ingredients: hemp shiv, lime-based binder, and water (sand may be also added to the mix).

Hemp shiv is an inner part (a core) of *Cannabis Sativa L* (industrial hemp) stem, obtained in decortication process and chopped into particles (diameter of 1 – 5 mm and length of 5 – 35 mm are dimensions desired for building purposes [2]). It constitutes about 70% of the plant mass – fibers (as well as flowers and seeds) are removed and used for other purposes in other industries. Cellulose represents 40,4 – 51,7% of the its chemical composition [2].

Cultivation of the plant has low negative impact on the environment (comparing to other crops) [3,4] and absorbs CO_2 from the atmosphere (approx. 2,5 tons per ha [2]). Processing of hemp involves no chemicals and produces no waste [2].

Lime-based binder is a mix of binding substances with the largest share of hydrated lime. Other ingredients often present in the mix are: cement, natural hydraulic lime, pozzolans and other additives (in different proportions, depending on the expected properties). Production of a binder consumes energy and causes considerable carbon dioxide emission. Carbonatation process which occurs in building partitions, lowers the final emission.

The material has low mechanical strength, quite low thermal conductivity and high vapor permeability [5]. It is fire resistant [5]. Lime content provides resistance against biological corrosion [5]. The properties can vary to a great extent depending on: characteristics of the organic infill, characteristics of the binder, proportions of the ingredients in a mix and construction technique (associated technological process of manufacturing the material may result in different density and other properties). An example of properties of the material provided by an European producer [6] are shown in table 1. These values fall within the ranges found in the publications. Table 2 shows other parameters based on the publication review.

Properties of the material provide environmental benefits. Low thermal conductivity, medium density and quite high specific heat results not only in a good insulation but also in a considerable „thermal mass" of the building elements. The overall carbon dioxide emission is an important factor as well – the material is considered to have low, zero or negative carbon footprint (depending on properties and methodologies used for calculations). Overall CO_2 emission in *cradle to grave* approach can be negative (-3,5 kg/m³ in the most probable variant in [7]).

TABLE 1

PROPERTIES OF THE MATERIAL ACCORDING TO EUROPEAN PRODUCER

Density	280 – 320 kg/m³
Compressive strength at 90 days	0,7 – 0,9 Mpa
Thermal conductivity	λ = 0,076 - 0,085W/mK

TABLE 2

OTHER PROPERTIES OF THE MATERIAL ACCORDING TO SELECTED PUBLICATIONS

Specific heat	1000 – 1560 [8] J/kgK, generally about 1300 J/kgK
Vapor diffusion coefficient	4,61 – 5,72 [8,9] generally about 5
Carbon capture (cradle to gate)	-358 – 62 kg/m³ generally about -100 kg/m³ [5]

III. Construction techniques and architectural applications

The material can be used in construction in the form of: monolithic walls manually compacted in a 2-sided formwork with structural (timber or steel) frame inside; monolithic walls or vertical insulation layers manufactured by projection (spraying) the mix on a one-sided formwork; precast blocks or bricks ready for bricklaying; prefabricated entire building elements or horizontal insulation layers (less dense, only slightly compact).

Modern history of the material began in late 1980s, when it was invented specifically for renovation of historical wattle and daub buildings in southern France. Fig.1 shows the first building where the material was used. Properties of the material, allowing resistance in damp environment and providing good „cooperation" with wood, brought success in the renovation works. Later, the material was improved and used in new buildings world-wide (most of them were built in France and UK where the technology has developed to the highest extent).

Fig.1 [10] Maison de la Turquie – Nogent-sur-Seine France. Renovation in 1986.

Experimental buildings with partitions made of hempcrete revealed excellent thermal and moisture performance [11]. Application techniques allow to minimise thermal bridging and increase air-tightness. Low thermal diffusivity may result in lower heat loss than expected from λ value [9]. Hempcrete partitions provide high inertia against temperature fluctuations and stabilize temperature in the rooms [12]. „Breathability" of the partitions helps to regulate humidity of the interiors and creates favourable microclimatic conditions [13].

Conclusion

An analysis of the properties and applications of hempcrete, as well as laboratory tests and experiments conducted in the existing buildings confirm usefulness of the discussed material in architectural design and its high potential for development of environment- and user-friendly architecture.

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Mobile housing design: overview of current trends

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Abstract – The relevance of using mobile housing is substantiated, its classification is based on an own version of a mobile home (transformer type).

Keywords – design, designing mobile housing, mobile houses of container type, modularity of mobile housing, transformation, adaptation, environmental friendliness, using renewable energy sources, energy saving houses.

I. Introduction

The dwelling house stoped being a simple scenery for the city for a long ago, buildings are creating in order to fit the modern rhythm of life. Modern architecture is much more "smarter" and varied. One of the main trends of our time is increasing popularity of mobile housing.

Mobile housing is an alternative option for solving the problems of building urban structures. For the installation of moving houses, as a rule, does not require capital fixing on the ground, and after the displacement of the mobile settlement is the fastest process of updating the earth's bioresources. In addition, during using mobile buildings (including kinematic ones with transformation and adaptation), the flexibility of the settlement system and the degree of architectural and construction response to different changes (socio-economic, demographic) increases.

Today, using mobile housing in Ukraine has become particularly relevant in connection with the problem of massive population migration from the eastern regions of the country and the Crimea. However, residential mobile products, to a large extent, are represented by foreign manufacturers.

Modern socio-demographic conditions in Ukraine and the level of provision of housing for people of different types and quality provide possibility of active development of mobile homebuilding. At the same time, the use of mobile housing in Ukraine differs by the limited functionality and typological diversity.

II. Species diversity of mobile housing

In Ukraine, mobile houses are traditionally used mainly as a temporary housing.

There are the following main types of mobile housing:
A) by type of transportation:
– self-propelled – with non-accessible chassis and engine, similar to automobile;
– with the possibility of towing;
– without wheels, ie transport vehicles.
B) for structural and technological features:
Designed from bulky elements (container and superblock), and from flat and linear elements(Fig 1-3).

Container and superblock are formed from block-containers of high factory readiness, often with complete set of engineering devices and furniture. Such buildings are put into operation immediately after delivery [1].

Fig.1 Mobile housing KODA by Kodasema
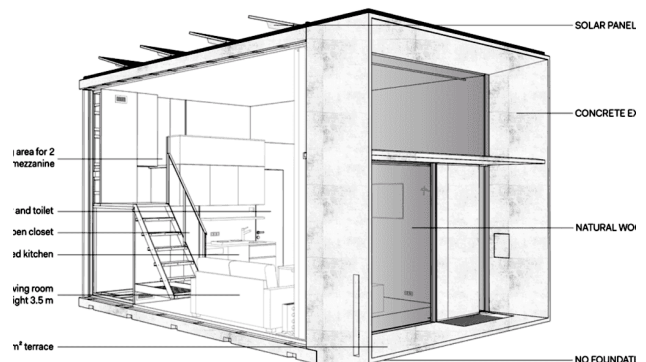
Fig.2 3D model of mobile housing KODA by Kodasema
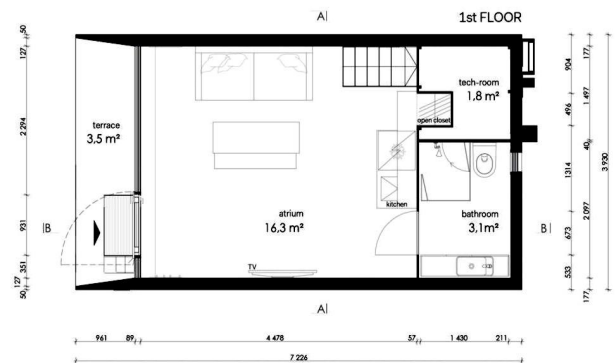
Fig.3 Typical pan of mobile housing KODA by Kodasema

There are the following main types of transformation of mobile homes:

A) with the change of external parameters in the process of building the house in stages, by adding to the main module additional volumes through special connecting elements;

B) with the change of internal parameters, by redeveloping the interior space with the help of transforming partitions. This changes the area and the proportion of premises, functional zoning and the relationship between the premises;

B) combined, which applies the principles of external and internal adaptation.

Depending on the methods of adaptation, the following main types of transformer houses are distinguished:

– Made up – that is, those that are made up of special constructions;
– pneumatic – houses with elastic fabric fencing, supported by excessive air pressure;
– retractable – with special retractable elements of walls and ceilings;
– cassette – for which characterized high-density complementary design elements [2].

III. Author's project of mobile housing for the place with a complex terrain

The proposed project of mobile housing transformer-type provides integration of the following functions (Fig 4-6):

– zone of cooking and eating (kitchen-dining room);
– wardrobe;
– a bathroom;
– a bedroom

The main goal of the developed project is to create an ecological, ergonomic and at the same time comfortable, small-sized environment for life.

Moving panels used in the design of mobile housing allow the complete closing of translucent slots and thus guarantee full safety for its residents. The front and back panels can be operated in the form of terraces.

The project is made of sandwich panels, which make it possible to quickly mount the house on a selected plot of land.

Fig.4 Visualization of mobile housing №1
The advantage of the proposed mobile home project is the easy adaptation to the place with difficult terrain.
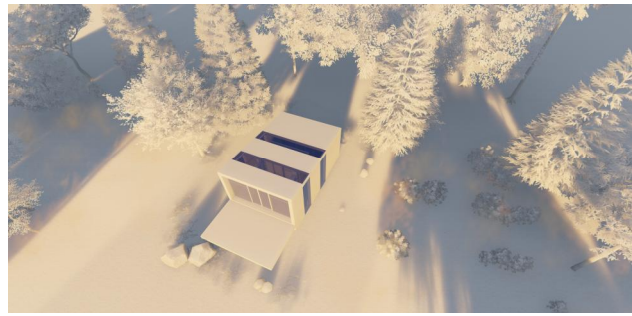
Fig.5 Visualization of mobile housing №2
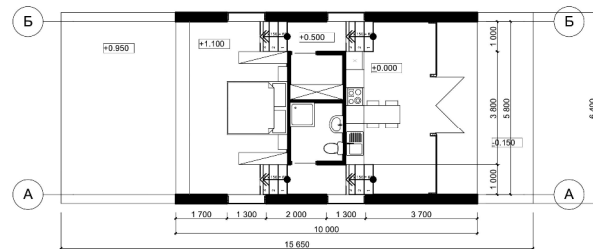
Fig.6 Plan of mobile housing

Conclusion

The development of the mobile housing industry has a wide range of practical applications, and is particularly relevant in connection with the problem of mass migration from the eastern regions of the country and the Crimea. Therefore, the market of domestic mobile housing should increase its typological range, which should first of all conform the ecological, ergonomic and energy-saving requirements.

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The significance of open-air museums for preserving of memorable architectural ensembles of Ukraine

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Ukraine owns a great number of architectural monuments. Many of them are large ensembles and complexes. They require a special approach to their protection. In this article problems of their preservation in connection with the region, society and environment are analyzed. The method of their preservation by way of museumification and creation of open-air museums on their basis with the aim of revealing their historical, cultural, scientific and artistic value is proposed.

Keywords – open-air museum, museumification, preservation of monuments, architectural heritage, architectural ensemble.

I. Introduction

Today, it is generally recognized that globalization prevails. The environment of our life is constantly transforming. Due to rapid changes in the social sphere, the issue of preserving values that ensure the self-identification of the individual and spiritual development of a person is particularly acute. The use of the historical and cultural heritage becomes the world community's object of interest. In recent years, preservation of monuments turns to be one of the most important factors of the harmonious development of society, all its systems and subsystems.

Architectural and urban-planning ensembles, as well as objects of the landscape and archeological heritage, occupy the special place among all the variety of historical and cultural monuments because in their forms they synthesize manifestations of a great range of cultural and technical achievements of society during the certain historical period.

The search for effective approaches to preservation of the historical and cultural architectural heritage has led to the formation of a special type of museums – open-air museums.

It is important to identify fundamental characteristics of such monuments as objects of protection to determine the optimal way of their preservation and usage. The main feature of architectural, urban planning, landscape and archaeological monuments is their complex nature due to peculiarities of formation and functioning as an integral part of the natural, territorial, historical, cultural and social environment simultaneously. Because of this feature, the search for architectural solutions for the organization of open-air museums is relevant. Museums have to create the best conditions for monuments ensembles perception as a complex system in the place of their origin, development and modern use, with minimal interference in the structure of the monument.

II. Analysis of recent publications

Despite the thorough interest in the topic, in independent Ukraine, the problem of architectural ensembles museumification is not developed enough and is poorly highlighted in the scientific literature. This issue is considered in general theoretical works on museum science by E. Dobrovolska, M. Maystrovska, O. Mishura, O. Soustin, T. Yurienyeva, O. Mastenitsa. The issue of open-air museums was considered by V. Alekseyev, O. Afanasyev, A. Danylyuk, V. Vecherskyy, O. Sevan, M. Kaulen, A. Kirpan. Some aspects of this subject were investigated by V. Ivlevva, O. Serdyuk, E. Hradun, O. Zhukova.

III. Open-air museums

The need to preserve the cultural heritage of humanity promotes the actuation of memorial protecting activities. The guidelines of cultural policy are changing, as well as the content and functions of existing and newly created museum institutions. Museums today are regarded as an important resource for the development of the territory.

Today the complex approach to the protection of objects of the cultural heritage, which clearly defines the need to preserve the historical environment, is actual. It represents the spatial and temporal field of human life, organized by the historically inherited system of buildings and structures in relation to landscape features of the territory. Since architecture is directly related to the complex phenomena of the synthesis of culture and everyday customs, the monuments should be shown not on their own, but in combination with other close-standing creations of the material and intangible heritage.

Museum and memorial protecting concerns are in search of new forms of the historical and architectural heritage preservation. Now combining of architectural, archaeological and landscape monuments within the guard zones tendency is in trend. The area of museum interests actively includes environment, landscapes, and objects of the intangible heritage. This step indicates the transition from the preservation of individual monuments to museumification of entire urban planning complexes, reproduction of the cultural and historical environment of the past. In these conditions the appeal to open-air museums, created on the basis of museumification of architectural monuments, territories and historical environment, is reasonable.

The main reason for the open air museums emergence, distribution and popularity lie in a wide range of possibilities that allow representing the historical and cultural heritage of past ages in a complex and versatile way. Exhibits are perceived by visitors not as museum objects, torn out of reality, but as elements that are inextricably linked with each other, as well as with historical and natural surroundings.

The first open-air museum called Skansen was opened in Stockholm in 1891. It was the museum of folk architecture, whose monuments were brought from different regions of Sweden. For a long time, the word "skansen" was identified with the term "open-air museum" and meant the museum of folk, mostly wooden, architecture, created by using the "ex-situ" method (placing monuments outside the territory

of their historical existence). Over time, open-air museums transformed and their functions expanded. At first, open-air museums operated only in the rural environment. Later they began to include the urban and industrial environment too. To date, more and more importance is attached to the original environment, and most open-air museums are striving to be created "in situ", directly at the site of the monument's existence. If the word "skansen" still refers to ethnographic museums of folk architecture, then "open-air museum" is a more general concept that includes museums based on ensembles and complexes of architectural monuments, urban planning, gardening, landscape, archaeological and other monuments.

The purpose of creating open-air museums is not merely the transformation of town-planning heritage objects into objects of museum display, or plain museum use of architectural monuments, but also the preservation of their historical and memorial value. Therefore, during the museumification of historical monuments, it is considered to preserve both material structure and its location, as well as intangible evidence of historical events and prominent persons. This feature made open-air museums environmental.

Now there is an increase of interest in a fundamental change in the model of interaction between the museum and its visitors. The era of "participatory culture" comes. It is interpreted as a free, active, conscious participation of people in cultural and social processes; an opportunity to be not only "consumers", but also to contribute to the creation of cultural events, to comprehend and update the cultural heritage. Therefore, the atmosphere of past epochs, the recreation of ancient holidays and rituals that are practiced in open air museums make them so popular among tourists.

IV. Features of monuments preservation in open-air museums

Undoubtedly, not all monuments of the immovable heritage can be museumificated and adapted for tourist visits. There are certain selection criteria for which the monument should correspond. Objects that are historically valuable – both for studying the history of the individual people and mankind as a whole – can become the object of the display. The second condition is the degree of monuments preservation as a whole, as well as its separate parts. It is not recommended to museumificate sites with only scattered fragments that cannot give a holistic picture of the historical past of this object. In some cases, such objects are conserved in their existing form, with the arrangement of special bridges to inspect remains, followed by models or images of virtual reconstruction. Not the last significant value is the placement of archaeological sites in relation to large settlements and transport connections. It is not easy to provide the museum with visitors if it is difficult to reach.

Despite the diversity of existing open-air museums, common features can be singled out, typical for architectural projects of their spatial organization. Open air museums perform a number of functions, such as cultural, educational, communicative, environmental, social, economic, recreational, complementary, and others. Having viewed such diversity, the world practice of architectural

and spatial organization of open-air museums [5] involves the use of the following principles: the principle of preservation, the principle of truthfulness, the principle of integrity, the principle of reversibility and functionality, the principle of the multilayers. It is important to prioritize the protection of the natural and cultural environment, the reproduction of the image integrated with the landscape, the dominance of authenticity over the interpretation, compositional and stylistic conformance and the principle of the symbolic signage.

It is an extremely tough task to form the architectural space of the open-air museum correctly to maximise the use of the potential of monuments ensembles. Approaches to the organization of infrastructure and methods of museumification will differ in each case due to the diversity and complexity of the architectural heritage. Moreover, the possibility of new buildings construction can be limited because of protected areas of historical and cultural reserves, within which open-air museums may be located.

Activities of contemporary open-air museums are based on museumificated ensembles of immovable historical and cultural monuments. They are based mainly on architectural monuments with their interiors, adjacent territory, and the natural environment. Such museums perform the documentation function by way of preserving or reproducing the ensemble of immovable monuments and its environment.

To develop the architectural and space plan of the open-air museum, it is necessary to fulfill the preliminary tasks:
• study the historical and urban development of the territory, where the museum will be located;
• determine the boundaries of the museum territory;
• investigate the traditional spatial planning, functional zoning of land plots, building elements, natural landscape, greenery;
• conduct field surveys, inventory existing objects, elements of the historical planning and spatial structure, boundaries and nature of the use of land, objects and elements of the building, the environment, greenery, places of destroyed historical objects;
• identify the objects and elements of a building, the natural environment and greenery, which form the exceptional cultural value of the monuments ensemble, and the traditional nature of the environment;
• identify important historically formed visual connections within the territory of the monument and in its surroundings;
• identify objects and elements that do not constitute a cultural value and do not correspond to the traditional nature of the environment or violate these visual links;
• explore the territory on the basis of the data of the State register of immovable monuments of Ukraine and lists of objects of the cultural heritage;
• develop the historical and architectural general plan of the open-air museum.[1]

The existence of museums in the open air requires a comprehensive implementation of organizational and technical measures. First of all, to create the open-air museum by an architectural or urban planning ensemble, boundaries and designation of land plots should be determined, free of the buildings territories to be preserved,

restored, landscaped or planted with greenery. On the basis of scientific researches, the boundaries of the territory are determined.

It is important to think thoroughly about infrastructure, engineering networks and facilities, as well as the placement of roads and streets to be reconstructed. It is especially important to consider the possibility of using small-scale transport on the territory of the museum without detriment to the monuments. Museums of this type mainly occupy a large area and visitors can get tired of trying to get around the entire exposition.

In order to create the open-air museum, elements of the buildings, natural landscape, greenery, important for preserving the exceptional cultural and artistic value of the architectural ensemble, the traditional character of the museum historical environment, which require a strict regime of protection and do not subject to any changes, should be identified. Objects that are subject to demolition, removal or liquidation are defined separately. These are predominantly modern buildings that do not carry any value and destroy the integrity of the architectural ensemble. Later, the places of reproduction of completely or partially lost objects, elements of planning, public welfare, greenery, important for the traditional nature of the environment are determined. Some of the preserved structures are subject to reconstruction or rebuilding, functional purpose modification or external forms changes. In such facilities, you can arrange separate rooms, necessary for the proper functioning of the museum. The architectural and spatial expansion of the open-air museum involves identifying the places where it is permissible to construct new objects and elements of an accomplishment, to plant the territory for the purpose of its better adaptation to the museum function.

For architectural ensembles, the artistic, historical and urban design credibility of the image is especially relevant. Therefore, integrity, which is often lost due to the destruction and loss of individual elements of the ensemble, is important for such monuments. In such cases, fragmentary or integral restoration may be used.

A fragmentary restoration, which involves the restoration of documented fragments of the monument, focuses primarily on preserving authenticity. But in the terms of this method, for the most part, it cannot reproduce a reliable and integral image of the ensemble. This problem is solved by the method of holistic restoration, which purpose is to return to the monument its integral architectural and artistic appearance by completing its lost elements. [3]

An expanded version of holistic restoration is the reconstruction of the monument. The use of the method of integral restoration is often motivated by the purpose of revalorization of the architectural and urban planning ensemble. In this case, authenticity and integrity on the macro level of the historical environment. The preservation of the artistic image of the ensemble, which is more valuable than the material authenticity of individual small elements in these conditions, is the most important issue. Holistic restoration aims at maximizing the features of the monument as a work of art. This method partially neglects authenticity but retains the artistic credibility that is major to architectural ensembles.

The expediency of this method is still causing raging discussions. International and native documents do not recommend restoring lost monuments. Therefore, reconstruction should be applied only in particular cases. If the monument loss percentage is rather significant, and its restoration is motivated by the need to regenerate the architectural ensemble and restore its key components, then reconstruction is allowed (only in case of sufficient scientific basis presence).

In open-air museums, the main exhibits are the architectural monuments themselves, therefore, according to the museum theory [4], they do not require additional displays and exhibitions. But they can complement the museum in a qualitative way.

Modern museums are constantly expanding and complemented by new features. They become centers of education, communication, cultural information and creative innovation. The cultural and educational activity of open-air museums can be enhanced by the performance and artistic imagery, spatial perspectives and the natural environment in order to increase the interest of visitors to our heritage in all its manifestations.

With such a diversity of museum functions, the architectural organization must solve even more problems, since all buildings and structures in the open-air museum should fully perform the planned tasks, not harm the archaeological monuments, harmonize with them, with the environment and with each other, forming the appropriate historical environment at the same time.

In those museums where the complex reconstruction of the past is being carried out, historical buildings are not only individual exhibits, but they form an interconnected complex. Such museums are usually called "live museums". They are characterized by numerous animation programs to recreate the historical environment. Thus, tourists are attracted not only by monuments of antiquity but also by professional actors who reproduce the way of life, behavior, material and spiritual culture of past epochs; they demonstrate folk traditional crafts that are featured for specific place and time (for example, weaving, carpentry, beekeeping, etc.). Mainly, museum visitors can take part in these types of activities under the direction of a specialist. As for the architectural organization of space, such measures determine the necessity of adapting premises for the appropriate crafts application, which will maximally replicate all the constructions of the era and place features – stylistics, design, form and materials, according to scientific research. An integral part of environmental museums is the use of traditional cuisine, which involves the mandatory presence of cafes or restaurants on the territory or near museum complexes.

The result of the design work should be the development of the architectural and spatial organization project, which includes descriptions of a set of protective measures for conservation and restoration works, the reconstruction of individual monuments, the construction of functionally necessary museum premises and communications, the development of premises and territory, as well as work on revalorization of authentic architectural and archaeological content.

V. Open-air museums in Ukraine

In Ukraine, there are seven big and middle-measured open-air museums now. But all these are museums of folk architecture (the National Museum of Folk Architecture and Life in Kyiv, the Museum of Folk Architecture and Life of the Middle Dnieper in Pereyaslav-Khmelnytsky, the Museum of Folk Architecture and Life in Lviv, the Museum of Folk Architecture and Life in Chernivtsi – these are the most significant among them) [2] Recently, the ideas for the creation of new open-air museums in the Ukraine appear.

In March 2017, Lviv Polytechnic National University conducted an international round-table conference "Preservation and revalorization of monuments of Pidhirtsi village. Reproduction of the lost wooden church of St. Michael". The village community expressed its desire to recreate the wooden church of St. Michael, which burnt down in 2004. The conference was attended by Ukrainian and Austrian specialists in the fields of architecture, restoration and archeology. Discussing the expediency of the lost monument reproduction, which was an integral part of the ensemble of Pidhirtsi castle and an important composite element of the Pidhirtsi village landscape, the participants of the conference summed up their decisions in the resolution: it is necessary not only to restore the church (detailed drawings are available) but also to create the large open-air museum, which would combine the Pidhirtsi architectural and landscape Ensemble and the Historical and Cultural reserve Ancient Plisnesk. This approach can attract visitors, thus will help to attract new funds for the preservation and restoration of the mentioned attractions. Pidhirtsi castle is included in the famous tourist route Golden Horseshoe of Lviv region, so the mentioned open-air museum will be able to gain popularity fairly quickly.

The inclusion of the Brody castle in the route, which is located nearby, may become one more relevant decision. Unfortunately, this monument dilapidates and collapses now. The conceptual combination of the Pidhirtsi-Plisnesk open-air Museum and the Brody Castle will attract attention and funds for the restoration of the latter, which is in a despicable condition.

Thus, the complex nature of open-air museums allows preserving large architectural and urban planning monuments, landscape and archaeological sites to use their potential as fully as possible. A wide range of functions performed by museums of this type attracts a large audience. Mainly, the popularity of such museums attracts sponsors to preserve exhibits. Therefore, open-air museums play an important role in involving immovable monuments, uppermost architectural, to modern life.

Conclusion

For the effective preservation of the historical and cultural heritage, it is important to reorient the activity of the modern memorial protecting complex from traditional forms of passive protection of architectural monuments to

returning them an active and even decisive role in the cultural life of society. Today museumification provides an opportunity to represent the cultural heritage to the public, allowing its comprehensive study.

In Europe, the open-air museums creation is an acknowledged way of museumification of architectural ensembles. The main reason for the appearance of such a form of the museum, its distribution and popularity among the public is a wide range of possibilities that allow to represent the legacy of past ages in a comprehensive and versatile manner, with monuments of architecture, science and technology, household items and works of art in the midst of their historical existence (or in close to original conditions). Exhibits in environmental museums are perceived by visitors not as museum objects, torn out of reality, but as elements that are inextricably linked to each other and to historical and natural surroundings. Due to the creation of such museums, it is possible to preserve large architectural, urban planning, park and landscape objects as integral historical, cultural and natural complexes that accumulate values and meanings of both material and intangible heritage.

Unfortunately, the current socio-cultural situation in Ukraine is not conducive to the development of the museum network. The problem of inclusion of fallen monuments of architecture and urban planning to modern life remains unresolved. Today creation of open-air museums is an effective mean of preserving material and spiritual values of Ukraine, which allows to represent the cultural heritage and to interpret it qualitatively for the public.

The experience of different countries in the creation of open-air museums is not only cognitive interest but also helps to preserve the cultural heritage of Ukraine and especially architectural ensembles. The author believes that implying such methods will bring the future to historical and cultural heritage.

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The basic principles of the formation of the palace architecture of the Eastern Podillya in the period of early classicism

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Annotation – The article analyzes the influence of the early classicism period on the formation of the main aspects of the architectural environment of the palace complexes in the Eastern Podillya. For the first time, monuments are classified according to the stages of development of classicism and it is described the principles of organization of palace structures of the late 18th century. It is considered the historical and socio-political preconditions for the establishment of palace complexes of that period. In the article the author gives examples of palace buildings and follows their architectural-planning and functional-spatial features. It is proved that the principles of the European early classicism had impact on the creation of conceptual features and typical signs of the palace complexes of the Eastern Podillya in the context of regional architectural tendencies and belonging to the territory of the Polish-Lithuanian Commonwealth in the XVIII century.

Key words – palace, early classicism, architectural features, Podillya, period.

I. Introduction

The palace complexes of Vinnytsia's early classicism occupy a significant place among the architecture of Ukraine among other regions not only in numbers and in variety, but also in stylistically compositional solutions. The Ukrainian history of architecture at the end of the eighteenth century proved to be quite complicated, despite the unity of the style concepts of that period, and therefore landlords' estates of the Podolsk region underwent a difficult evolutionary path and reflected the socio-political and socioeconomic relations of the region during its statelessness.

II. Formation of early classicism: Historical background

At the end of the 18th century, the map of Europe was reshaping: the Russian Empire (which included Slobozhanshchyna, Left-bank Ukraine and Kyiv) invaded the Black Sea coast, and as a result of the 2nd and 3rd partitions of the Polish-Lithuanian Commonwealth, Volyn and Podillya were also appropriated [1]. Architecture in European countries was characterized by the development of the classicism style, the scope and grandeur of which actively spreaded to neighboring states. The Russian Empire and the Polish-Lithuanian Commonwealth, under the rule of which the Ukrainian lands were in power, immediately approved the aesthetic concept of France's classicism. In the Eastern Podillya (the territory of the present Vinnytsia region), which was part of The Polish-Lithuanian Commonwealth, the active introduction of classicism took place in the palace architecture. After all, the Polish magnates did not limit themselves in the scale of building their estates and attracted to the design famous world architects, which served as additional evidence of their influence and power on ordinary Ukrainian peasants and among the noblemen.

III. Palaces of early classicism: Architectural features

The structures of early classicism and, in particular, palace architecture were characterized primarily by the symmetry of the composition and all its parts. The basic means of harmonizing the form were the rhythmic combinations of constructive and decorative elements. The main concern of the architect was the warrant [1], that expressed the scale of the palace and caught sight of the main axial central portico, which was completed by the entablature. The volumes of the buildings were semicircular with side wings or side full outhouses, which formed a court of honour, less often – in the form of a rectangle.

The architectural features of the palace buildings of the early classicism era were greatness and restraint, clarity and perfection, symmetry of volume and shape. But at the same time, decorative elements and some plastic motifs were preserved: triangular gables, pilasters, friezes, and garlands of antique themes.

The palaces of the early classicism period in the Eastern Podillya were often designed in combination with the natural environment and turned into palace ensembles, which were distinguished by their exquisite finish and harmonious matching with classical patterns. An example of French and English regular parks extended to the volumetric location of the palace in the middle of ornamental trees, often on the banks of rivers or ponds, supplemented by pavilions, rotundas, etc. The park and the palace were integral elements of each other and created an artistic and architectural integrity.

High stylistic level of the Potocki Palace in Tulchyn (1782) began early classicism not only in the Eastern Podillya, but also in Ukraine as a whole [2]. The majestic central two-storey building, with a loggia along the rhythm of ten columns of the ionic order, was connected by one-storey semi-circular galleries with side two-storey high-grade outbuildings and formed by its volumes the space of a huge court of honour with flower beds and lawn.
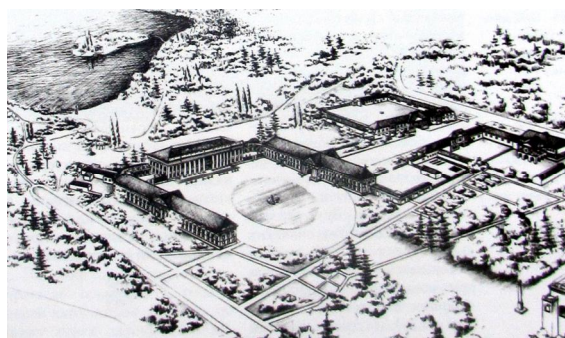
Fig.1 Ensemble in Tulchin. Reconstruction by L. Borisova.

Baths, stables, an arena, a theater, ponds, canals and greenhouses, together with a huge park, created a palace architectural ensemble of incredible scale and grandeur. The palace of such an extent worthy for comparison is Rumyantsev-Zadunaisky Palace in Kachanivka in Chernihiv Oblast.

The core of the residence in Voronovitsa (1770-1777) was a three-storey building with a massive rustic base and three arch-entrances, on which it was raised the eight-column portico of the composite order [3].

The lateral arched in plan two-storey wings touched the central volume and completed it. The palace was surrounded by outbuildings and auxiliary buildings and was located in the middle of a wide front yard in the middle of a large regular garden park [3].

The palace in the village of Serebryntsi (1770-1780), as a model of early classicism, was rectangular in plan and it was raised to a high base [4]. The structure also had a geometrically clear two-storey volume, underlined by porticos of the corinthian order with triangular pediments on the main and park facades and was located among the planned majestic park on the shore of the pond.

At the end of the 18th century, a palace in the village of Andrushivka was erected on the territory of Eastern Podillya, almost the only one, which was small, one-storey, asymmetrical, complex in plan and consisted of two different in time volumes. The old part of the palace was rectangular in plan with a central hall and rooms on both sides, the main façade of which was preceded by pilasters of the ionic order, in the tympanum of the triangular gable there was a family coat of arms. The park facade was distinguished by a semicircular bay window, decorated with pilasters of the ionic order with large arched windows. The main facade of the completed part of the palace accented with columns of the Ionic order, at the level of the second floor there were arranged decorative niches with plat bands [5]. Near the farm there was a park that had access to a pond.

The castles in the Eastern Podillya which experienced modifications of forms and already lost their functional-defensive significance, were modernized to palaces, such as the palace in Ivanov and the palace of the Grokholsky family in Pyatnychany. The latter was a palace ensemble with baths, greenhouses, stables and a menagerie [6].

At the center of the estate was a three-storey main building with lateral narrow risalits, from below connected by a colonnade. The composition of the building created a kind of open horseshoe. Around the palace there was a magnificent huge park with rare kinds of trees and plants [7].

The interior layout of the Vinnytsia palaces was respected by the front suite, in the interiors of the premises it eas often used artificial marble and plaster molding.

The architecture of Podillia's classicism was stylistically variegated, evidently because there were no authoritative and large-scale models like Tulchin, but the above mentioned palaces during the early classicism had graceful features and became examples of the classic architecture of that period like historical structures [8], associated with important events in the Podilsk region and with the life of famous figures of the past.

Conclusions

The architectural and artistic system of the early classicism period, preserving its viability and acquiring a wide scope, established stable principles of compositional solutions of palace constructions in the whole territory of Ukraine and especially in Eastern Podillya.

The development of style tendencies of early classicism developed in a sequence of common European culture with a combination of local features. Landlords' palaces of this style period in Vinnytsia occupied a prominent place in the architectural heritage of Ukrainian culture and received the status of monuments of national importance.

The palaces of the Eastern Podillya of early classicism, which although did not impress by their size in comparison with other regions of Ukraine, like Chernigiv region or Poltava region, still presented the result of the high skill of world architects and talented masters of construction.

This was a special place where the Polish-Ukrainian intelligentsia existed – the world of literature, theater, architecture, art and music of drama, progressive ideas of that time.

Manor complexes that are preserved, serve as a kind of creative laboratory for studying and specifying stylistic devices in the practice of modern construction of similar objects (both landscape territory and structures). Therefore, the research and the analysis of the past, the revival of the lost will become the guarantee of the preservation of the individuality, the identity of the cities and villages of the harmonious combination of the old and the modern aspects in them.

Early classicism and the era of classicism in general became the "golden age" of manor construction, because being free from the duties the noblemen could create new and convert old palaces in accordance with the aesthetic principles of architecture of that period and local peculiarities of the region.

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Educational establishments and their role in the formation of the architectural environment of Vinnytsia at the beginning of the XX century

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Abstract – The article deals with the formation and development of the architectural environment of Vinnytsia at the beginning of the 20th century under the influence of socio-cultural and historical factors. It is established that the architectural and town planning system of the city at the beginning of the XX century was formed under the influence of traditional elements, like the environment, in combination with fundamentally new components, caused by the functional and spiritual needs of the society of that time. In the article the author reveals the city as a multifunctional social organism fulfilling an important cultural function. That is why the influence of the development of the educational infrastructure on the formation of the architectural and spatial organization and the aesthetically artistic image of Vinnytsia is studied in the work.

Key words – architectural environment, cultural heritage, urban development, educational establishments.

I. Introduction

With the beginning of the era of industrialization at the end of the XIX century, the rapid economic and social development of Vinnytsia began, which led to the formation of a harmonious architectural environment. The architectural environment of the city is the result of the interaction of the social and cultural component with the natural environment of human existence and reflects the characteristics of the material and spiritual conditions of existence of a society. The educational establishments had an important influence on the formation and development of the architectural and town-planning structure of the city as a whole. They concentrated in social precincts and determined the further planned organization of the city.

II. Architectural and urban development at the beginning of the XX century

Vinnytsia in the early XX century was a county town with a population of more than 30 thousand people. [1] The formation of a harmonious architectural environment began after the introduction of local government reform and completion of the construction of the Kiev-Balta-Odessa railway line in 1871 nearby. The provincial town gradually turned into a powerful administrative and cultural center of Podillia.

Spatial development of the city was carried out in two precincts: within the Old and New district of the city. However, the harmonious dynamic development was given namely to the new town-planning form. [2] The cultural environment, formed along the central highway of the New City – Poshtova Street (now Soborna St.), was a reflection of the functional and spiritual needs of society at that time. Along the main axis of the city, which began from Kalichi and went to bridges, crossing the city from west to east, the main administrative and cultural and educational institutions were built with facade compositions of classic and Renaissance forms.

Despite the growth of economic and technical opportunities, significant works on civil engineering improvement and tracing of the streets began only at the beginning of the XX century. Thanks to the fruitful work of the mayor M. Ovodov (1899-1917) and the chief architect G. Artynov (1900-1919) Vinnytsia received new well-planned wide streets and boulevards. In total there were 44 streets, 11 lanes and 6 squares in the city. [2]

III. Educational establishments of Vinnytsia at the beginning of the XX century

The tendency of the development of scientific and technological progress and the establishment of capitalist relations in the early XX century required an increasing number of educated and highly skilled workers. This fact led to the emergence of a number of educational establishments which acquired the significance of an important city-forming factor. [3]

Formation of the educational system in the Podillia was based on the model of the Russian Empire. Under the leadership of the Ministry of Education in the early XX century there were parish and district schools, classical full and incomplete vocational schools. The leading role in the formation of the cultural environment of the city was played by primary and secondary schools. However, the majority of children could not receive education (in 1899 there were 4,027 school-age children living in the town but only 1179 were enrolled in the system of formal education). [2] Therefore, the municipal Duma in 1889 adopted a resolution on the transfer of the Mogyliv-Podil's'kyi real school to Vinnytsia. [4]

The educational building of the real school, located in Soborna Street (formerly Poshtova St.) is a vivid representative of the pseudo-Russian style. The construction of the house that was endowed by merchant Tsal' Weinstein was completed in 1888 according to the design of the engineer-architect M.I. Chekmariov. However, to ensure the proper conditions for the educational process, it was decided to finish building of the left wing of the school and to build a house for the director, inspector and class teachers under the project of architect V. Krause. [5]

Important reforms in the social and economic life of the Russian Empire caused changes in the educational environment and led to the emergence of higher women's education. Female gymnasiums began to appear massively in Podillia. Thus in July 1900 the women's gymnasium was opened consisting of the preparatory and four junior classes in Vinnytsia. Other classes – the fifth- seventh- were opened a year later respectively. [3]

The house of the women's gymnasium (now school-gymnasium No. 2, Sobornaya St., 94) is an example of modernized classics. A two-storey building (1901) by the first city architect G. Artinov, had a classically symmetrical composition and formed the corner stop of the main street of the city. Together with elements of classical architecture, modernist elements were applied – a large tri-centered arch of the central window aperture and molded rivets. [6] With this project G.G. Artynov began the formation of a harmonious architectural environment of Vinnytsia.

At the beginning of the 20th century the chief architect G. Artynov implemented new planning principles for the formation of urban space. In 1913 the first tram line "Railway Station – Women's Gymnasium" of 8.6 km long was opened along Poshtova Street. [7]

The creation of recreation zones in the city structure was a new phenomenon. So along Poshtova Street,from the women's gymnasium to the first six-storey hotel "Savoy", was arranged a boulevard, named after the mayor M. Ovodov. The banks of the river Bug and the island in the Kumbar region became an important sports and cultural center of Vinnytsia. In the spring of 1910 V.F. Korenev, a teacher of drawing in a real school with the funds of Count Groholsky and the other wealthy people in Vinnytsia, created water sports club. Later, the "sports town" for the youth had in its structure a beach, baths, playgrounds, a park and a yacht club "Sport". [8]

IV. "Mury" of Vinnytsia is a cultural and spiritual part of the city

Since the beginning of the XVII century "Mury" of Vinnytsia was the center of enlightenment. The beginning of the capital construction of the complex in the 1630s defined further urban development and formed the historically cultural environment of the city.

Today, the architectural and historical complex "Mury" is a national monument and covers the State Archives of Vinnytsia Region, the Transfiguration Cathedral with the adjacent economic zone, the Vinnytsia Regional Museum, the Vinnytsia Regional Art Museum and the Vinnytsia Technical Lyceum.

Until the middle of the 19th century inside the walls of the "Mury" complex there were educational institutions such as the Jesuit school, the suburban school (since 1776), and then the district school (since 1785) of the Polish National Education Commission, the county school (1799-1814), Podolsk province gymnasium (1814) -1831) and on its basis Russian gymnasium (1832-1847). [9]

Thanks to the efforts of the mayor M. Ovodov, in 1907 there was opened one of the largest institutions of the city – a male gymnasium, located in the main building of the complex. In 1912, under the project of G. Artynov for the gymnasium, a large and comfortable three-storey house was built in classic forms in the southern part of the complex. The first floor of the house was occupied by office space, the second – the Vinnytsia Second Women's Gymnasium, the third -the Vinnytsia Men's Gymnasium. [6] Thus, the time of the most dynamic and intensive

development of the network of educational establishments in Vinnytsia was in 1900-1915. Formation and development of educational infrastructure in Podillia occurred in a united historical and educational process of the country.

Conclusions

In this article in order to create an integral picture of the formation and development of the architectural environment of Vinnytsia at the beginning of the XX century, it has been identified and analyzed the main factors determining the architectural and planning structure and stylistic solutions of the buildings of educational establishments in the central part of the city. The historical architectural environment, as a complex of architectural space in combination with a functional component, should be regarded as one of the aspects of cultural heritage.

The rapid growth of the network of educational establishments in the early XX century in Vinnytsia was due to the intensive socioeconomic and demographic development of Podillia. As the article shows, the expansion of the educational infrastructure of the city not only influenced the formation of a functional three-dimensional organization and the ensemble integrity of urban development but also multiplied the cultural potential of the society.

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Bearing capacity of anchors in thin aerated concrete masonry under tension and shear loading

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Abstract − This article is devoted to a problem of anchoring strength of anchors (wall plugs) in thin aerated concrete blockwork. Aim, research tasks and programme of experiment are represented.

Keywords − anchors in masonry, aerated concrete blockwork, frame anchors, tension, shear, research program

I. Introduction

Cellular concrete masonry systems are commonly used in civil and industrial construction. However these structures has to be fastened to reinforced concrete or metal frames in multi-storey buildings. In other hand in one- or two-storey buildings aerated concrete blockwork can be a base structural material. In both cases a suitable fastening should be guaranteed. For such reason anchors of different types are used.

Masonry is a heterogeneous base material. The hole being drilled for an anchor can run into mortar joints or cavities. Owing to the relatively low strength of masonry, the loads taken up locally cannot be particularly high. Futhermore, masonry made of aerated concrete which is manufactured from fine-grained sand as the aggregate, lime and/or cement as the binding agent, water and aluminium as the gas-forming agent with the density between 0.4 and 0.8 kg/dm³ and the compressive strength 2 to 6 N/mm² results in even lower strength of anchoring [1].

Many anchors obtain their holding power from a combination of three working principles: friction, keying, bonding. The weakest point in an anchor fastening determines the cause of failure and its mode. There are 4 main modes of failure which are as follows: 1) break-out; 2) anchor pull-away; 3) failure of anchor parts and 4) edge breaking.

The tensile strength of the fastening base material (aerated concrete in our study) is exceeded in the cases of break-out, edge breaking and splitting. Basically, the same modes of failure take place under a combined load. The mode of failure 1. break-out, becomes more seldom as the angle between the direction of the applied load and the anchor axis increases.

Generally, a shear load causes a conchoidal area of spall on one side of the anchor hole and, subsequently, the anchor parts suffer bending tension or shear failure.

The properties of the base material play a decisive role in selecting suitable anchor and determining its bearing capacity. Another factor that influence much is the length of anchoring. Thus the aim of current research became bearing capacity of anchors in thin aerated concrete masonry under tension and shear loading.

In order to reach aim of research we have to solve several tasks that are as follows:
- to do literature review ;
- to evaluate physical properties of aerated concrete by checking its compressive strength;
- to design and manufacture laboratory models of thin masonry that meets our aim and mount anchors of two types;
- to determine experimentally mode of failure and bearing capacity of anchors in blockwork thin specimens subjected to loadings which are parallel and perpendicular to the anchor axis;
- to test anchor metal screw with a hook in order to measure mechanical properties of steel used;
- to compare obtained results with other researches [1, 2, 3];
- to prepare some recommendations or amendments to current design code for aerated concrete masonry [3].

Following programme and methodology of experiments are proposed.

II. Experimental Programme and Methodology

For securing support frames, timber frames, fascade panels etc. frame plastic anchors with screws are used. We used KPR-12x100N nylon plug with Ø8 woodscrew with an O-shape hook for testing with loading applied parallel to anchor axis and PR-8x100 nylon plug with L square shape screw for testing under shear loading. Both were manufactured by Wkret-met (Poland) (see Fig. 1).
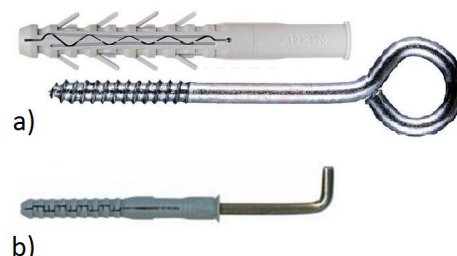
Fig.1 Shape of anchors used in research:
a) KPR-12x100N; b) PR-8x100

For experiments we also prepared 4 masonry fragments, 2 per every type of loading. The shape of test specimens is shown on Fig. 2.
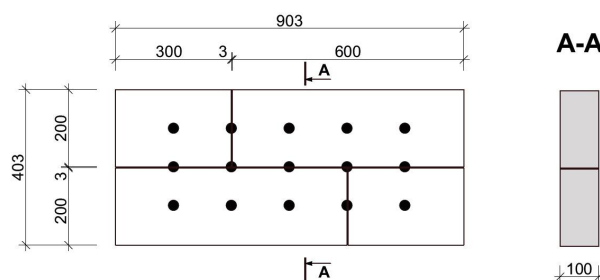
Fig.2 Shape of test masonry specimens

Each specimen consisted of two masonry rows with 1.5 blocks in a row. We used prefabricated autoclaved aerated concrete blocks AEROC Classic (D500 density grade) with declared compressive strength not less than C2.5 class. Nominal sizes of blocks were 600×200×100 mm.

Blockwork was made with thin mortar layers with the depth of the mortar set to 3 mm or less. Pre-mixed cement-based mortar produced by local manufacturer (TERMIT™ TK-16) was applied to the bed joints and perpends. Places where anchors were applied are marked on Fig. 2 as black dots. Holes were drilled with drill bit Ø12 mm for KPR-12x100N and Ø8mm for PR-8x100 without hammering. Length of both anchors were 100 mm.

After mounting the anchors specimens were tested. They were laying in horizontal position. Two supports were placed on specimen to create vertical tension loading on anchor's hook. The loading was done by talrep M12 with hooks and measured by ring dynamometer. PR-8x100 anchors were tested horizontally by the same devices. Measuring and loading devices were connected with anchor and support by metal chain. Loadings were applied in case of tension until anchor displacement was 10 mm and shear loading – until metal screw was bent so far that angular displacement became more then 45˚. The common view of experimental stand for two experiments is shown on Fig. 3 and Fig. 4.

After main experiments on anchors bearing capacity four cubes of 100 mm edge were sawn from blocks that were not damaged to obtain aerated concrete compressive strength. They were precisely measured and weighed to check declared density grade of blocks and compressed on laboratory press P-125 with 62.5 kN measuring scale. Aerated concrete moisture was measured by electronic testo™ 606-1 moisture meter by taking data from more then 10 points of several different blocks.

Fig. 3/ View of experimental stand for tension loading.

Fig.4 View of experimental stand for shear loading.

Expected characteristic resistance F_{Rk} for KPR-12x100N in masonry made or autoclaved aeretad concrete with density ≥350 kg/m³ and compressive strength class ≥2 MPa is 0.75 kN according to ETA-12/0272 [2]. Characteristic bending resistance of the screw in concrete and masonry for anchor Ø8 mm is $M_{Rs,k}$=9.3Nm with partial safety factor γ_{Ms}=1.25 for galvanized steel. Displacements under shear loading F=0.11 kN for anchor Ø8 mm should be δ_{NO}=0.21; $\delta_{N\infty}$=0.32 mm. Partial safety factor for use in autoclaved aerated concrete γ_{MAAC}=2.0 in absence of other national regulations.

Conclusion

Modern Ukrainian design code for cellular concrete blockwork construction [3] sets usage of anchors for fastening as common practice, the only limitation is that theirs bearing capacity under tension should exceed 0.25 kN. Other parameters should be measured by experiment. As for data written in above paragraph they were obtained for walls with minimum thickness 250 mm. We suppose there is a lack of data about bearing capacity of anchors in thin aerated concrete masonry thus we focus on it in our research. Aim, research tasks, programme of experiment and methodology in details are presented in this thesis.

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Optical illusions:
the path of enlightment

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Abstract – The article presents a periodization of optical illusions done by the authors.

Keywords – optical illusions, periods of optical illusion development, trompe l'oeil, organic portraits, illusory enfilades and plafonds, skull optical illusion, the Pentrose Triangale, 3d illusions.

I. Relevance of research

The research focuses on the optical illusions and is a natural continuation of our research of the year 2015 [1]. This immediately raises logical question «Why would it be this subject again? Elena Chernychuk first got excited about optical illusions at school, but thanks to Victoria Bazylevych, who once happened to be her lecturer of the course "Principles of Composition," and who is now her student advisor, the fascination has become a serious issue, because the reasons for optical illusions are detected, but to this day there is no any scientific rationale for most of them. And what else appeals men more than the unknown? Little by little we went deep into this unknown and moved way back from the apogee of optical illusion development to their emergence. Artists and innovators – all of them tried to distort or change reality in one way or another at different times. What exactly led to creation of illusions? Was it just an escape from reality, desire to stand out or probably a search for ourselves and our self? Optical illusions develop in every country in the world without exception. We see them in monumental 3d drawings in the sand somewhere on the beach of sunny Bali, or in a shadow installation at an art exhibition in Britain, or in the paintings of Ukrainian artist Oleg Shuplyak. In fact, all artists who have tried to create an optical illusion at least once continue to develop the potential of their ancient colleagues – artists-inventors. Following various artists in social networks, we continued to examine this fascinating subject, and in order to shed light on the present, one need to plunge into the past. Throughout the study, we daily discovered for ourselves more and more varieties of optical illusions, their secrets and amazing functionality. Everything genial is simple, and, in our case, is yet not investigated and therefore – remains relevant.

II. The periods of optical illusion development

The recent articles on the Internet [2], [3], [4], [5], [6], [7] are devoted to specific types of illusions, exhibitions, and the works of artists of this direction. The works of world-famous masters of optical illusions in graphics, art and architecture are presented in the illustrated encyclopedia 2007 "World Art: Optical Illusions in Painting and Graphics" [8]. The studies on optical illusions, that we know, do not contain information on the periods of their development. These studies can also hardly be called generalizing and systematized.

The purpose of our scientific article is to shed light precisely on the past of illusions.

In the previous publication [1] we talked about the fact that optical illusions began to develop in the 16th century. However, after a detailed investigation, we found out that illusions emerged long before Hans Holbein and his "The ambassadors". (Figs. 1 and 2).

Figs. 1 and 2. « The ambassadors». Hans Holbein, 1533 [9]

This summer, while traveling through Italy, in Pompeii, Olena discovered an ancient example of optical illusions. The plate in the House of the Faun (79 AD) is designed in the best styles of Vasarelli, and this is the 79th (!) year of our era (Fig.1)The illusion perfectly complements the extraordinary interior of the house, which has such a bizarre name (Fig. 3).
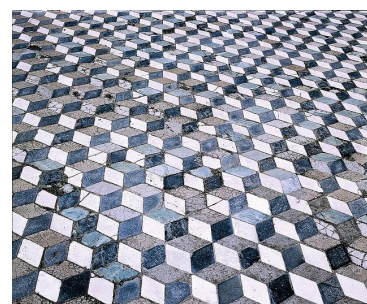
Fig. 3. Floor plates, the House of the Faun, Pompeii (79 AD) [10]

We continued our research, taking into account the updated material. We have also named the identified examples of optical illusions and developed their periodization.

#RENAISSANCE (XIV-XVI*).* We found the following images with optical illusions of the Renaissance period as: *images with trompe l'oeil, organic portraits and impossible figures* (in particular, in the painting 'The Magpie on the Gallows by Peter Bruegel' (1568)).

Illusory images with trompe l'oeil (French for *"deceive the eye"*) are three-dimensional images in a two-dimensional plane of an object. Ancient artists already knew that impressed audience is the best appreciation and therefore decided to add a little "zest" in their works (Fig.4). In the Renaissance period such an art technique as trompe l'oeil was used in portraits and sculpture.

Fig. 4. Petrus Christus «Portrait of a Carthusian» (1446) Pay attention to the fly (!) [11]

Organic portraits. At first sight these pictures look like a still-life but once you put them upside down you happen to see faces. It was an incredibly painstaking work, which required the artist's energy and endurance, because even the smallest detail identifies the face of the model. People who carried such tasks had active imagination and were experts in botany, since it was something bordering on fantasy for the people of the Renaissance to create a portrait out of chaos and a bunch of organic products. One of the brightest representatives of this extraordinary style is Giuseppe Arcimboldo (Fig. 5).

Fig 5. Giuseppe Arcimboldo «Reversible head» (15??) [12]

#BAROQUE (late XVI – mid XVIII centuries). During this period *illusory images with trompe l'oeil* were transformed and significantly developed. Also, in parallel, illusory *enfilades and plafonds* began to emerge and become popular.

The illusory images with trompe l'oeil became an important part of the Baroque artistic language when everyone strived to effeciency. Then the artists believed that everything genial is simple, and deceived the audience through three-dimensional images, as if saying: "Here, you can just observe, but you will never use one of these things." The representative of the baroque trompe l'oeil is Samuel Dirksz van Hoogstraten (Fig. 6).

Fig. 6. Samuel Dirksz van Hoogstraten «Trompe l'oeil» (1668), Karlsruhe [13]

Illusory enfilades (French for «string on a thread») and plafonds. The artists created a quite real "Heaven above their heads" using spatial elements and cross-cutting perspective. Such a "divine atmosphere" greatly strengthened the faith of each parishioner and contributed to the sense of the high power presence (Fig. 7).

Fig. 7. Andrea Pozzo «An allegory of the Apotheosis of S. Ignatius», (1690) [14]

#CLASSICISM (XVII – early XIX). This period has made its adjustments to *illusory images with trompe l'oeil*. They were inspired by the philosophy of rationalism and the spirit of ancient times. Artists seemed to contradict themselves: they wanted to step over the bounds, but without violating ancient laws.

#REALISM of the second half of XIX also experienced the influence of optical illusions. One of the representatives is Pere Borrell del Caso (Fig.8). His work "Escaping criticism" is a vivid example of a realistic optical illusion with trompe l'oeil.

Fig. 8. Pere Borrell del Caso «Escaping criticism» (1874) [15]

#MODERNISM (late XIX – the first half of XX). Optical illusions, that actively developed in this period, were: *illusory images with trompe l'oeil* (in painting); *skull optical illusions* began to emerge and become popular. Such an illusion was used in illustration, painting and photography. *The Penrose Triangle*, as well as skull optical illusions, captures the public as much as possible, and that's why the Triangle appears on posters and stamps.

Illusory images with trompe l'oeil are plastic and light. They are enriched by stylized flowers and wavy lines, taken from nature. A deeply sensual representative is Frida Kahlo (Fig. 9).

Fig. 9. Frida Kahlo «The Suicide
of Dorothy Hale» (1939) [16]

Skull optical illusions. Hungarian artist Istvan Oros made these skull illustrations in medieval style for the new edition of «The Ship of Fools», the satirical book by Sebastian Brant of the late 15th century. Each of them is an anamorphic illusion. At first glance there seems to be just a skull in the picture, but in fact it fully illustrates a fragment of the book. (Fig.10).

Fig. 10. Istvan Oros,
illustration for the book
«The Ship of Fools» by
Sebastian Brant (195?)
[17]
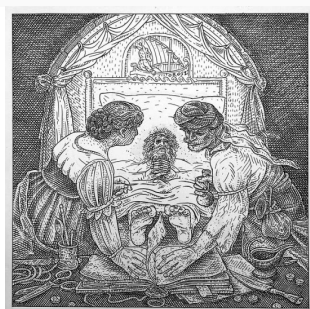
Impossible figures, in particular the Penrose Triangle. The figure was found in 1934 by the Swedish artist Oscar Reuterswards, and later was generalized and popularized by English mathematician Roger Penrose. Due to its simple presentation of an impossible figure, the Penrose Triangle became increasingly popular. Impossible figures in the painting of the XVI century seemed to be in the background along with the story of a picture.

Roger Penrose gave the impossible figure the central role on time and it was immediately noticed by the audience. At first glance, the figure looks like a projection of an ordinary three-dimensional object, but if you take a closer look, the contradictory combinations of the elements of the figure become evident. An illusion of the impossibility of what we see is created. The viewer is confused and subconsciously tries to understand the figure and the method of its construction. Since this is what human nature is about: we are always looking for answers to questions (Fig. 11).

Fig. 11. Roger Penrose, the
Penrose Triangle (1958) [18]
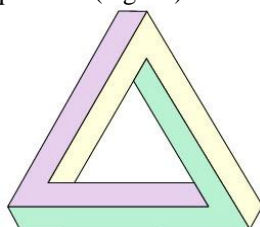
#OTHER STYLES of 1980-s – 2000-s.

Nowadays optical illusions have reached the apogee of their development. Artists have become even more creative. They create spatial and shadow installations out of shapeless bunches of stuff, angular installations with philosophical

content, street art in the streets of our cities, gallery anamorphoses and anamorphoses on paper, cylindrical mirrors and art installations in the air, surrealism, the reverse of three-dimensional images and body art. All that was created and successfully developed by our contemporaries. Here we present the most vivid and impressive examples of optical illusions in our days.

"Classic" images with 3D illusions. It is creation of drawings on flat planes, which at a certain angle acquire shapes volume. In order to create the perfect image, the artist has a scrupulous eye for detail. Therefore, the work has much more sense than it may seem at first glance. Everyone can see something special for himself. There is no right perspective in art (Fig. 12).

Fig.12. Justen Ladda (80-s) [19]

Bifacial optical illusions (images that hide ambiguity in the picture). The representatives are Oleg Shupliak (Ukraine), Rob Gonsalves (Canada). Oleg Shupliak is a bright representative of surrealism in Ukraine. He creates masterpieces, embodying the ambiguous content of the works, where the silhouette of the giant Taras Shevchenko is usually depicted.

The Paintings by Gonsalves are always a magical combination of worlds, imperceptible metamorphosis, the flowing of objects from one figure to another. The artist sort of implies, that everything is interconnected in the world (Figs. 13 and 14).

Fig. 13. «I was thirteen…» by
Oleg Shupliak [20]
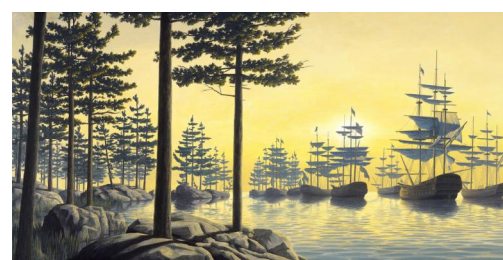
Fig. 14. Sailing Island. Surrealism Rob Gonsalves [7]

Optical illusions are an attractive kind of art and have the potential for further development and improvement. This is an important component of art, and not only of its present, but also of the past. Student Elena Chernychuk learned about the illusions from the Internet, but why wasn't such an interesting subject discussed in school or during the course on art history in university? We believe that it will help develop lateral and very creative thinking of children and adults, and not only for those of them who are fond of art. After all, you need to be good at mathematics to make calculations for an illusory enfilade or good at botany to create a bizarre portrait. Art as well as religion, is blessing for everyone. Sometimes, to solve a problem, one just have to look for another angle.

Conclusion

Following the research, we found that optical illusions existed already in ancient Pompeii. And from century to century they confidently won the attention of audience and artists. Illusions have always existed beyond competition, it was a kind of art that did not need any promotion, because it amazes you, and, therefore, got recorded in your mind.

On the path to enlightenment, illusions were subjected to transformations, additions and influence of the epochs, but continued to exist and develop to the present day.

Creation of optical illusions is an extremely painstaking work that requires maximum creativity and engagement. Not everyone is able to create "strange" art. This vocation has been looking and is still looking for its artists at different times.

While telling the history of the optical illusion emergence and development, we smoothly moved from the first century to our days. Illusions surround us everywhere and at all times, but we do not have enough knowledge to notice and appreciate them. We found the roots of that mighty tree of "Art." And when you learn the past, you get answers to the current questions and knowledge for the future. That is what modern artists do. Whatever country the artist lives in, he is always inspired by his predecessors, history and the time space, that separates us from eternal geniuses.

Thus, we see for ourselves once again, that all new is well overlooked old.

Whatever you are and whatever you do, remember, we are children of light, we are children of art.

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The evolution of the ceiling in architecture

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Abstract – The evolution of the ceiling, vault, as an important element of forming the interior space of architectural buildings is highlighted. The form, structure, materials and aesthetic factors in the building history of mankind are analyzed. The changes in the formation of the ceiling, the principles of the application of polychrome are described. The topic of artistic aesthetics ceilings (e.g. vaults) was discussed in detail. Examples of modern types of ceilings, such as geo-grating, ceilings made of red shoe laces, modern interpretation of the vault – stretch ceilings, etc., which today are extremely important for interior design of buildings, are given.

Keywords – ceiling, vaults of the building, art aesthetics, interior design.

I. Introduction

From the beginning of their existence, the primitive men tried to protect himself from adverse weather conditions, other dangers, creating a comfortable environment, optimal for existence (Fig. 1). Thus, the fencing structures of the primitive dwellings, horizontal ceilings, primitive roofs had to protect dwellings from rain (Fig. 2).

The stand-beam system was preceded by the complicated structures of the overlay, and is based on the use of trunks of trees as the main building material.

So ceiling began to form – horizontal fencing of the building or structure that receives and transfers the load to the supporting walls or columns [1, 7].
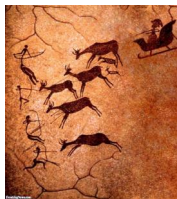
Fig.1. Painting on the rock of the Paleolithic era [16]

Fig.2. Trypillian housing [16]

Despite the fact that stone blocks and bricks soon replaced wood, the stand-beam system remained the main principle of construction in the Ancient World – in the architecture of Ancient Egypt and Ancient Greece (Fig.3- 6). The painting on the ceilings of primitive dwellings originates from the Paleolithic Age (Fig.1). Ceilings of caves, flat horizontal wooden ceilings of the buildings with polychrome, fragments of the ceilings of Herculaneum buildings, Pompey, beams of Hypostyle hall of Egyptian temples with an illusion of a starry sky, bright polychrome of the Greek temples' gates – all of these topics require a separate study.

The situation changed only with the invention of the Roman concrete, when people started using it for the construction of the vaults. In architecture, this is the type of ceiling or covering space, limited by walls, beams or pillars – the structure that is formed by slopingsurfaces (rectilinear or curvilinear).

Fig.3. Gery II Temple in Paestum [16]

Fig.4. Temple of Bel [16]
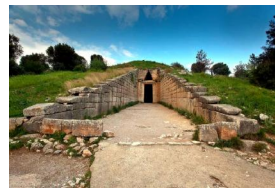
Fig.5. Treasury of Atreus, Mycenaea, Greece [16]
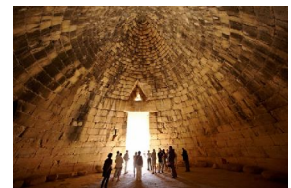
Fig.6. Treasury of Atreus, Mycenaea, Greece, interior [16]

Vaults allow to cover large areas without any columns in between and are used primarily in the round, polygonal or elliptical rooms. The structures of the vaults, that is, the arched-dome floor system, was the next step in the development of architecture. The development of science in our time allows us to calculate more complex curvilinear constructions [6].

II. The evolution of ceiling in architecture

The invention of arches and vaults, built of raw clay brick, was a great achievement. The oldest arches and vaults, are distributed around the Middle East and the Mediterranean (Fig. 4), and originate from the method of masonry with a nap (it is the name of the false vault). This method involves sequentially placing the rows of the bricks horizontally so that each upright row rises above the lower one. In the construction of one of the buildings in Tel-Razuk (Iraq), built around 2900 BC, there are elements that can be called transitional evolutionary forms: the vault, constructed using both the stepped and oblique masonry [1].

None of these vaults survived, but the construction of a cane strap that mounted vertically on the ground, bent and bundled at the top (it was the ceiling and the roof), was their prototype.

In ancient Egyptian drawings and in hieroglyphs, there are images of reeded vaults above the temples, huts in the form of boats and other buildings. This method of their construction has been preserved and is now used in southern Iraq, in a swampy area near the confluence of the Tigris and the Euphrates rivers, where the Arabs still build large vaulted cane buildings, the outer surface of which is clad with clay. This type of construction can be attributed, probably, to the transitional stage of the vault evolution.
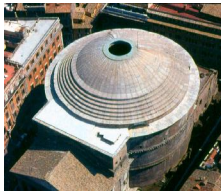
Fig.7. The Roman Pantheon [16]

Fig.8. The Roman Pantheon, interior [16]

Fig.9. Colosseum, Rome [16]

Fig.10. The Arch of Constantine, Rome [16]
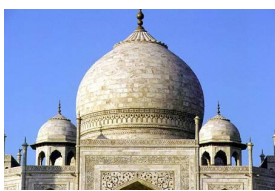
Fig.11. Three stone domes of the Taj Mahal [16]

Fig.12. Sophia Constantinople [16]
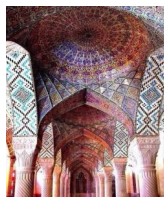
Fig.13. Taj Mahal, interior [16]

Fig.14. Sophia Constantinople, interior [16]
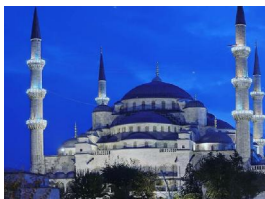
Fig.15. Blue Mosque, Istanbul, Turkey [16]
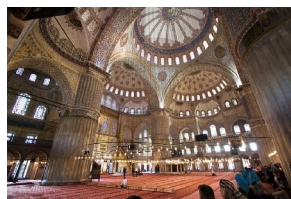
Fig.16. Blue Mosque, Istanbul, Turkey, interior [16]

sand – and it does not get solidified in the kiln, but in the sun, therefore, it is one of the cheapest building materials, and its production is more time-consuming than energy-consuming. In addition, raw brick is the most suitable material for arid areas, where during the day the air temperature varies widely, due to its low thermal conductivity,. When the temperature exceeds to 32 ° C on a sunny day, the temperature inside the room, built of raw materials is not higher than 27 °C.In a similar building, build of concrete, in which there are no air conditioners, temperature can exceed to 38 ° C [5, 8].

Arches first appeared in the II millennium BC in the architecture of the Ancient East, in Ancient Mesopotamia in particular, where the construction of brick buildings has reached a high level. The arches in the architecture of Ancient Rome were also widespread and further used, both in small and in large, even monumental scales (e.g. bridges, aqueducts, triumphal arches, amphitheatres, caissons of temples, the dome of the Pantheon in Rome (Fig. 7, 8) – this is the evolution of the ceiling, the vaults of the interiors of buildings)

Yet the arch was invented not by the ancient Romans, and they did not first combine several arches to get the vaults.

At the time of the completion of the Coliseum, arches (Fig.9, 10) and vaults existed in the Middle East for about 3000 years [7].

Fig.17. Pisa's Cathedral [16]

Fig.18.Amen's Cathedral, France [16]

Fig. 19. Cathedral interior picture. Pisa's Cathedral [16]

Fig.20.Amen's Cathedral, France, interior [16]

After all, most builders in the Middle East abandoned the reed (which people only could gather in marshy areas) and began to use more reliable building material, sun-dried raw brick. Almost all arches that survived in the Middle East are constructed of raw brick or adobe. Even after the burnt brick appeared, the raw materials continued to be the main building material in the Middle East. Thus great vaulted palace complexes of the Middle Eastarose (Fig.11-16).

The reason for this is clear. The raw bricks are made of the most accessible components – clay, water, straw and

III. Arch – a precondition for the appearance of a vault

Arch (synonyms – bow, arches) (lat. arcus. – arc) – a curvilinear ceiling of a slit in a wall or a space between two supports (columns, pylons), which transfers the load to the basis.

The term is also used for any curved structure shaped like an arch. Arches can be used as a constructive architectural element, for example, above a doorway or gate, or as a decorative element.

The arch is one of the architectural decisions that have been long known to the mankind. Nature itself has created amazing beauty all around us – caves, cave entrances — they all have an arched shape. For people it's only left to observe a little bit and try to translate it into reality. Arches have always been an attribute of an ancient temples, palaces, houses of influential and rich people.

Different variations of arches were used at different times. For example, in the Romanesque style of architecture, the arch was sound and monumental (Fig.17, 19), in the Gothic version – pointed and elaborate (Fig.18, 20), it created the impression of a light temple. With the advancement of the technology of manufacturing monolithic reinforced concrete structures, arches began to be used as supporting bases. [11].

Even Gothic-shaped Florentine dome (Fig. 21, 23) is replaced by a hemisphere, round Renaissance dome (Fig. 22, 24, 25) is replaced by a dynamic baroque ellipse (Fig.26, 27), classical (Fig.29-30) and a semicilindrical vault is replaced by interesting paintings-deceptions. The Rococo style (Fig.28) brings the themes of Putty, Garlands, and the Modern era brings whole storylines.

Fig.21. Dome of the Florentine's Cathedral, Florence [17]

Fig.22. Dome of the St. Peter's Cathedral, Vatican [17]

Fig.23. The Florentine's Cathedral, Florence, interior [17]

Fig.24. The St. Peter's Cathedral, Vatican, interior [17]

Fig.25. San Lorenzo Church [17]

Fig.26. A dynamic baroque ellipse, dome of church [16

Fig.27. The Carmelite Church in Mdina in Malta [16]

Fig.28. Interior of the Rococo style church [17]

Fig.29. St Paul's Cathedral Church of St Paul the Apostle, London [16]
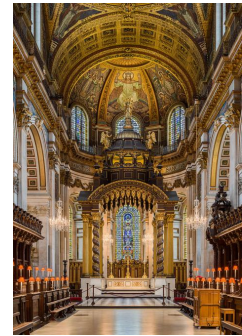
Fig.30. St Paul's Cathedral Church of St Paul the Apostle, London, interior [16]

IV. The vault as a constructive and decorative element of architecture

The vault became a key architectural element back in the Roman period. In its simple form, it consists of two parallel walls, which gradually leaned towards each other, joining at the top of the centre with a central key stone. The vaults were a necessary part of the various large basilicas of the classical architecture (Fig. 31). They flourished in the cathedrals of the Middle Ages, which did not seem to obey the power of earthly gravitation [2, 6].

Unlike a single vault of the basilica, the enormous space of the Gothic cathedral is being covered by a complex network of vaults (Fig.32).

Semi-cylindrical (Fig.35, 36), concave arch is the oldest and the main one. It appeared in the IX. B.C.

The semi-cylindrical vaults are built on the basis of a wooden frame form work, which is taken apart right after the arch's highest point is finished [2].

The buttress has been developed as constructions that convey the weight of the vault to the ground in buildings that did not have massive walls. In the most refined Gothic architecture, the buttresses could even be located separately from the main building. These "flying buttresses" are shown in the Cologne Cathedral (Fig.33, 34).

The shape of these vaults is different: from a simple cross to a complex system of the primary and secondary ribs. One of the most complicated Gothic vaults is the stellar vault (Fig.37). The ribs are in the form of stars, performing mainly decorative function, and are used as an adjunct to design. Together they form a mesh pattern of the vault [1, 3].

Fig.31. Basilica of Sant'Andrea-Mantua [16]
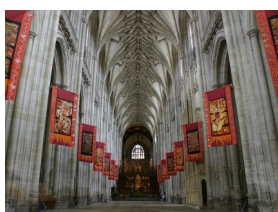
Fig.32. Winchester's Cathedral, England [16]

Fig.33. Milan's Cathedral, Italy [16]

Fig. 34. Interior of the Milan Duomo [16]

Fig.35. Alhambra: ruined decorative semi-cylindrical vault [16]

Fig.36. Church of Santa Maria del Naranjo, Spain

Fig.37.Star-shaped vault, Lincoln's Cathedral, England [16]
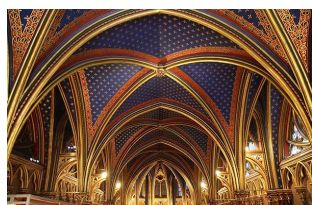
Fig.38. Cruciform vault, Church of Saint-Chapelle, France [16]

The intersections of the ribs, especially located in the center vault section, are often decorated with protruding cast-stone, covered with a beautiful carving.

Stone ribs supported the masonry located between them. Also this place was adorned with the jewellery of the vault.

One of the later variants of the Gothic vault, with pendants, which seem like they hang in the air, but is actually a continuation of the stone vaults of the castle (Fig.39, 40).

When two cylindrical vaults intersect at right angles, they form the protrusions, or ribs, as in the Swedish church of the XI century. In other cases, where these ribs are supported by the stone supports, a cross-vault is formed (Fig.38) [6].

Fig.39. St. Stephen's Cathedral, Vienna [17]

Fig.40. The main nave of the cathedral in Lincoln [16]

V. Beauty with accuracy up to a millimeter (artistic aesthetics of the ceiling)

The painting son ceilings originate from the Paleolithic era. Rock paintings of various animals, plants and natural phenomena still remain untouched (Fig.1). A huge number of pictures of an extraordinary beauty on the ceilings of buildings were found in the Greek cities of Herculaneum and Pompey.

In the Middle Ages paintings were forgotten. During the Renaissance, many artists began to return to the ideals of antiquity. At that time many temples, basilicas and dwellings were decorated with paintings (Fig. 39, 40).

Fig.41. Painting of the Sistine Chapel by Michelangelo, Vatican[16]

Fig.42. Painting of the Charlottenburg's Palace, Germany [16]

Subsequently, each of the new styles contributed to the history: in the lush era large ceilings were combined with the motifs of the ceiling painting, and, thanks to the rococo style, "women's themes" appeared – flowers, angels, garlands (Fig. 41, 42).

During the Enlightenment period, so-called painting-deceptions were enormously popular. Their secret was to depict the reality of fictional volumes and sizes.

The Modern era combined the Western and Oriental traditions into a single entity, so that the ceiling paintings included the whole plot lines, and also got involved with some eastern beliefs [3, 7].

For example, many city residents believed that plot lines from drawings on the walls or on the ceilings could protect the house from evil and misery.

• The artistic aesthetics in the motifs of painting domes and vaults of the Christian temples.

The image of the dome or the main arch is divided into central and peripheral. Among the central images are the Cross, the Monogram of Christ, the Lamb, the theophany composition ("Baptism").

The peripheral part of the dome, which is the entire area of the non central zone of the dome, usually includes the images of the apostles, prophets, forefathers, and in some cases the Heavenly Forces, the Virgin Mary and John the Baptist.

Fig.43. Painting of the Dome of the Pochaev Lavra, Ukraine [16]

Fig.44. The figure of the Holy Virgin Mary is made on the inner surface of the dome of Saint Sophia's Cathedral, Kiev [16]

"The Old Testament series row" of the central zone of the dome may have any topic, such as the theme of the Savior's Pedigree. The inscriptions on the dome's skull may be short texts (Fig. 43, 44) [2].

• Art aesthetics in the motifs of the painting of the dome of the Islamic temple.

Islamic architecture is one of the most complex forms of art based on geometry. Islam forbade the depiction of a person or any other living being, which contributed to the active development of geometric and plant ornamentation.

One of the features of the Arabic decoration is the "carpet" ornamentation, in which the pattern covers the entire surface of the object or the construction on the principle of "horreur vacui" (fear of emptiness).

There are two styles in the Islamic ornament: geometric – hirih and flora – islimi.

Hirih (pers.) is a complex geometric pattern, composed of a stylized rectangular and polygonal shapes (Fig.45, 46).
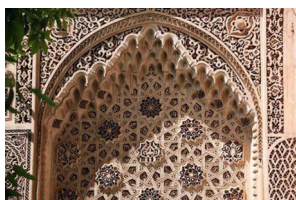
Fig.45. Girih Tiles and Islamic Geometric Designs in Modern Architecture [16]

Fig.46.Tashkent. Hazrati Imom architectural complex. [16]
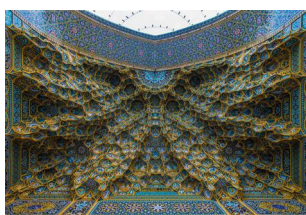
Fig.47. Dome of the Islamic temple [16]

Fig.48. Dome of the Persian Temple [16]

Islimi (pers.) is a kind of ornament, built of a combination of a wicker and a spiral (Fig. 47, 48). It embodies the idea of a constantly changing floral ornament and includes an infinite variety of variants. It was widespread in clothing, books, interior mosque, dishes. Most of the time, these styles are used separately, but they can also be combined.[1-8].

VI. The vaults in modern interpretation – stretch ceilings

The history of the stretch ceilings is lost in the depths of centuries. It is known that even in ancient times in Egypt, Greece and Rome a similar method of treatment was used.

Ever since ancient times, it was known that the ideal ceiling (a prototype of a modern stretch ceiling) makes home even more comfortable. Different fabrics were used to create stretch ceilings. In Armenia, cotton was used, flax was used in Egypt and in Rome silk was used to create primitive stretch ceilings. Perfectly even surface of the stretch ceilings were archived by wetting the fabric, which then was stretched over a frame. While drying the fabric shrank. Thus, the first stretch ceilings were made [12]. Over time, these ceilings became obsolete.

In the middle of the twentieth century stretch ceilings began to gain popularity again. As the history was developing, there were even more and more ways of processing the ceiling. So the stretch technologies were forgotten. They haven't been mentioned until the 60s of the XX century. In 1967, in France, an idea to revive the technology of stretch ceilings appeared.

Fig.49. Matte stretch ceiling [16]

Fig.50. Glossy stretch ceiling [16]

Fig.51. Suzeme stretch ceiling [16]

Fig.52. Satin stretch ceiling [16]

In implementing the idea a significant role was played by new materials: a heavy fabric, which quickly loses its appearance has been replaced with lightweight plastic sheet of polyvinyl chloride (PVC). According to some data, stretch ceilings were invented in Sweden, but it was the French who have perfected the technology of making PVC-film, which is why the second name of the stretch PVC ceilings – "French ceilings ".This phrase has become anonymous, and does not speak of the country of the manufacturer any more. As the production of stretch ceilings does not require special licensing, now in many countries stretch ceilings (sometimes of dubious quality) are being mounted , and they are positioned exactly as "French ceilings" [11-14].

The surface of the material does not have to be firm and durable, as in the course of operation practically nothing touches it, but at the same time 20-30 mm of the height of

the room is lost. True, instead we get a clean and beautiful ceiling that does not differ from the traditional one. No wonder similar products – of different sizes, shapes and colours – are now so popular all over the world. Applicable material should be not only clean, durable, light, but also environmentally friendly.

There are also stretch ceilings made of fabric. In 1997, the Swiss company developed a unique technology for the canvas mount. This technology allowed to use lower temperatures. But there was a new problem – the PVC film was not strong enough for a new way of stretching. The solution to the problem turned out to be brilliantly simple – the decision was to return to the origins and to replace the film with a cloth! For 3 years there were experiments, development, searches for a material which will be as good as a PVC-film. Experiments ended with a great success.

In 2000, Europe started using this unique ceiling system. The basis was a wide loom of synthetic fabric. The width of the canvas reached 5 meters, which allowed to solve the problem of seams. With a small mass (canvas density is 240 g / cm), this material is 15-20 times stronger than PVC!The use of strong, light fabrics gave different decorative opportunities such as painting, decorative painting, printing and easy installation. Stretch ceilings can have different texture: matt (Fig. 49); glossy (Fig.50), which allows you to achieve the mirror effect and thereby visually expand the room; marble; suede (Fig. 51); satin (Fig. 52) [12-14].

VII. Ceiling of the present

The construction of arches never completely stopped in the Middle East, and now there is some revival of it. The main figure in this process is the architect Hassan Fathi, whose brilliant and original designs, using vaults constructed by the slanting method, are of great interest and have some followers, both in his own country and in other countries (Fig.53, 54). With the discovery of the meritsof raw brick by the modern world, that understands the acuteness of energy problems, the practical s ignificance of arches and vaults is becoming more and more obvious. Arches and vaults of raw brick are not only practical but also very beautiful.
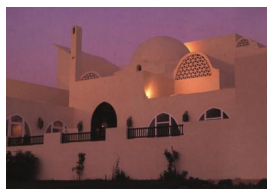
Fig.53. Hassan Fathy, private house project [16]

Fig.54. Hassan Fathy, private house project, interior [16]

In the "visual" world, rectangular and square shapes dominate. They allow the architect to reduce the sharpness and monotony of a straight line, and instead use the curves (the most common form in nature) – in almost unlimited number of variations [15].

In the XX century, a lot of great successes appeared in the construction made of reinforced concrete. A great

variety of shell designs appeared and hyperbolic paraboloids were better understood, which allowed to create of a very thin, durable structures.

A great example is a cloud-ceiling made of geogrid "Paritzki & Liani Architects" for an office PRS in Tel Aviv, Israel (Fig.55) – it is an environmentally friendly geosynthetic material, which has a cellular shape and wide range of polygons. Geogrids are commonly used to reinforce retaining walls, as well as subbases or subsoils below roads or structures [14].

The ceiling, resembling honey combsat the hairdresser Les Dada East by Joshua Florquin in Paris, France (Fig.56) – The ceiling in Hairdresser's Les Dada East is decorated with wooden hexagons. Hairdresser's is located on the first floor of a building, built at the end of the 19th century in Paris. A founder of this place – Edoardo Shogi (Edoardo Seghi) – prefers natural cosmetics. That belief has also influenced the design of the place. An unusual interior of a barbershop is designed by an architectural company called "Joshua Florquin Architects". The concept of using only natural ingredients defined the style of the interior, which resembles forest on a sunny day. Thus, the barbershop's customers will have the opportunity to enjoy the work of a hairdresser, while being surrounded by some stylized trees and the light that penetrates through the "leaves" [14].

Fig.55. Paritzki & Liani Architects, PRS office, Tel Aviv [16]
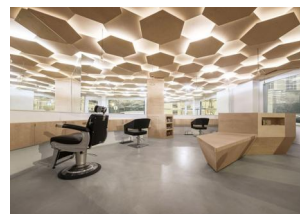
Fig.56. Joshua Florquin, Hairdresser Les Dada East, Paris [16]

Fig.57. Sawako Kaijima, Singapore's Research Center [16]
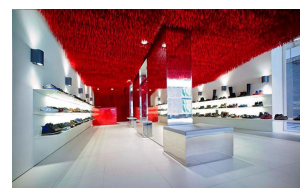
Fig.58. Architectural bureau Atelier Marko Brajovic, Ceiling of red laces in the Camper shoe store, Australia [16]

A Japanese architect Sawako Kaijima (Fig.57), a professor at the Singapore University of Technology and Design, has developed a scattered lighting system for an area of 13x16 meters in a research center in Singapore. The scattered lighting system is mounted on a ceiling at a research center in Singapore. The system contains six thousand polycarbonate illuminating modules with LED bulbs. Each module contains two light-emitting diodes directed to the opposite sides. A system of lenseevenly dissipates light by refractingit. Thus, no object in the room can cast a shadow. Light is simply everywhere [14].

Arches are widespread today, both in architectural design and construction. They are also used for both facades and interior solutions (Fig. 53).

Modern construction materials allow designers to experiment with arches, giving them new additional features and shapes moving further and further away from the classics (Fig.54). Now it is safe to say that arched structures in the present interiors are bold, relevant and fashionable [1-3, 7].
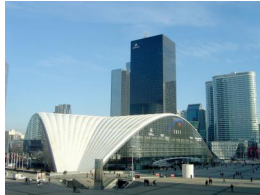
Fig.59. Défense, Technology Center [17]

Fig.60. Museum of American Air Force in Cambridge [17]

VIII. Design of ceilings of the present

It's no secret that today interior design is a very deep and multifaceted process that requires deep knowledge of the capabilities of the latest technology. Nowadays designers can create magnificent works that capture the unique beauty of the images because of that knowledge.

Ceiling design, as well as any other field in design, is easily influenced by trends and peculiarities of each style. The ceiling must remain in harmony with other decorative elements in the interior. And it does not matter in which style design of the ceilings is executed.

Design of the ceilings in the classical style is one of the most interesting directions today (classical style involves using stucco decoration, paintings and massive chandeliers) (Fig. 61).
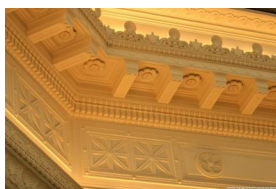
Fig.61. Design of the ceiling in a classical style [16]

Fig.62. Art Deco, Park lane hotel, London [16]

Design of ceilings in Art Deco style incorporates all of the best features from the previous styles (Fig.62).

Design of the ceilings in the modern style is a field for improvisations and applications of the bold designer's ideas. (Fig.58).

Conclusion

Ceiling had a diverse shape and structure throughout the human history. It was made of different materials: from primitive stand-beam structures to complex spatial vaulted systems.

The semi-cylindrical vaults and cross-vaults of the medieval Romanesque temples were replaced by the flying buttresses and ribbed vaults of Gothic cathedrals(star-shaped, mesh-shaped, fan-shaped, cross vaults) (Fig. 39, 40), which seemed like they didn't obey the power of gravity.

The return to the ideals of antiquity during the Renaissance contributed to the distribution of polychrome on the vaults of buildings. Even Gothic-shaped Florentine dome (Fig.21) is replaced by a hemisphere, round Renaissance dome (Fig.22) is replaced by a dynamic baroque ellipse (Fig.26,27) and a semicilindrical vault is replaced by interesting paintings-deceptions. The Rococo style (Fig.28) brings the themes of Putty, Garlands, and the Modern era brings whole storylines.

Christian religion brought about hierarchy of symbolic paintings, religions of Islam perfected the technique of filling the surface of the vaults with geometric and floral ornaments [9, 12].

Thin and strong structures of the ceilings, triple shell of a dome, constructions from reinforced concrete, achievement of mathematical understanding of hyperbolic paraboloids have been replaced by historical analogues in ecostyle: reed, wood, glue, suspended, cassette, rail, hinged ceilings, caisson ceiling, etc. The modern interpretation of the vault is a stretch ceiling, a prototype from the antiquity (velarium of the Coliseum).

So nowadays, design of the ceilings in the modern style is a field for improvisations and applications of the bold designer's ideas.

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Straw in architecture: traditions and future

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Abstract – The study has analyzed the use of natural and eco-friendly material – straw – in construction activities. The history of straw housebuilding, construction methods of straw, advantages and disadvantages of straw houses were considered. Examples of practical application of wood-straw panels, their production technology are given. The were shown mistakes made during the construction of tje straw house (the danger of straw decay, mice, difficulties with hanging heavy furniture elements on the walls, unplanned during the design of the frame, the protection of plastered walls from wetting in the process of use) and the methods of their removal or early prediction and resolution. There was considered the stage construction of a country house with straw for 50 days. The were presented foreign and domestic examples of eco-houses with straw: their constructive and planning solution. And also shown the advantages of straw when comparing the characteristics of straw and bricks in building materials systems.

Key words – eco-friendly material – straw, straw architecture, construction methods, wood-straw panels, ecological architecture.

I. Introduction

Annually in the world a huge amount of straw is produced, most of which remains in the fields or is burned. This raw material can be used in construction, which would solve many social and economic problems in various countries of the world. The practice of building houses of straw is known for a long time and has been used in Ukraine, Canada, Holland, the United States and other countries. For example, in the USA intensive construction of houses from straw began in the 19th century and is connected with the invention of a steam press for laying straw in bales and blocks. In our time, the technology of building straw houses is reviving and intensively spreading. In Western Europe, there is government support and interest in building eco-houses. This program is designed to reduce the overall energy consumption in the manufacture of building materials and the exploitation of low-rise housing. The project of eco-house made of straw can be made using wireframe and frameless technology. In first case, a frame is constructed of wood first (less often – metal). This technology is somewhat more expensive, but the house is more reliable. The latter option involves the erection of housing immediately out of pressed straw blocks. The timing of the building depends on the choice of technology. On average, "turnkey" construction takes from four to eight months. (Pic.1, 2)

At the same time, I would like to note that an ecologically clean house made of straw returns us to old traditions, but at the same time, such housing allows us to feel the full comfort thanks to modern technologies and design solutions.

Pic. 1-2. village Hotyanovka, Kiev region. The biggest house made of straw in Ukraine

II. History of straw housebuilding

Since ancient times, wooden blocks have been used in construction. The modern construction of thatched buildings began in the late of 19th century in Nebraska, USA. In Nebraska, there are vast steppe spaces, on which a large number of cereals are grown. Settlers faced a shortage of drillwood, so the first straw houses were built without a skeleton.

Hand press for hay was patented in the US in 1850. By 1872, balers were sold on a cart drive. In the middle of the 1880's, steam balers began to be produced serially.

Living houses of about 70 m² were built, as well as shops, schools, and facilities for other purposes.

In the 1980s, there was renewed interest in thatched house construction. In Russia, the first building of straw blocks was built in 1994 in the village of Mayak near Chelyabinsk.

In Europe, the leader in straw building industry is France, which has built more than 1500 buildings. The first European straw building, dating back to 1921, is preserved there. The world leader is the United States, where the straw housebuilding is massive (over 100,000 houses). In the last 25-30 years, the technology of straw production has become widespread in different climatic zones from Norway to Australia.

III. Construction methods

Straw houses are built in two types: frame and without a frame.

In a frameless method, the bearing walls are laid directly from the straw blocks. Blocks are fastened together by vertical stakes or mortar. For strength, metal or plastic rods can be used instead of wooden stakes – the lower end of the rod is attached to the foundation, to the upper end of the rod is fastened the nut for the screed of the straw blocks. Advantages of this method of construction are low cost and simplicity of erection.

In the wireframe method, a wooden supporting frame is built, between which the straw blocks are laid. Blocks are densely packed into the frame, it is also possible to use bonding methods similar to those used for the frameless method. Straw blocks are placed on a small elevation above the floor – to protect against moisture penetration.

The frame is similar to that used in the construction of frame houses. A double frame is also possible (with

two rows of vertical pillars, between which the blocks are stacked).

Over the stacked straw blocks, a metal or polymer mesh is attached and several plaster layers up to 75 mm thick are applied. Plaster protects straw blocks from water, fire, rodents and other pests. (Pic.3)

Straw blocks can be used both in dry form as well as with clay mortar treatment. In the latter case, the block before stowage is dipped for a short time in a thin clay solution. This technology was called "light Saman" (the share of clay is not more than 10%). It gives advantages in accuracy of wall geometry, strength and fire safety, but more time consuming; the walls are harder to dry, they dry long enough and, in wet weather may become moldy while drying, and somewhat worse keep the heat. (Pic.4)

Pic 3. Frameless   Pic. 4. Framework

IV. Characteristics
of the building material – straw

For the construction are used blocks from pressed straw. Straw is pressed with balers, or manually on special presses. The compressed block is tied with a metal wire, or a nylon cord. The average block size is 90 cm in length, 45 cm in width and 35 cm in height. The weight of the block is about 23 kg. Either 40cm × 50cm × 50cm (40cm × 50cm × 100cm) at a density of 100 kg / m³. Usually rye, flax or wheat straw is used, but hay can also be used.

The weight of a good block should not be too large (heat-insulating properties worsen and laboriousness of the erection process increases) or too small (especially important for frameless construction). The straw block must be of correct shape and tightly bound. The best type of strapping is a polymer cord. (Pic.5).

Pic. 5. Straw and its collection

V. Advantages and disadvantages of straw.
Necessary conditions for construction

Low cost. A straw block costs about 1000 times cheaper than a brick one.

Availability of materials.

Light weight. Due to the light weight of the straw blocks, the building does not require a heavy foundation, no lifting devices are required for the construction.

Low labor costs.

Good heat conductivity. The thermal conductivity of the straw (0.050-0.065) is 4 times lower than that of the tree , and 7 times lower than that of the brick (0.56-0.7), which leads to lower costs for house heating.

Good soundproofing indicators.

VI. Production of wood-straw panels.
The essence of technology.
Characteristics of the straw panels

The summer of 2013 is marked by interesting events in eco-building. In Ukraine, simultaneously, several construction companies developed and manufactured the first wood-straw panels.

The essence of the technology is as follows:

– According to the prepared draft of the house, separate components of the walls are developed – panels (in the right amount and the right sizes).
– In production, the wooden frame of the future panel is clogged with straw bales with the help of a hydraulic press (as is the case, see the picture below).
– The lateral surface of the panels is tamped, leveled, if necessary – sheared;
– The resulting product is transported to the site.
– Next, the wall panels are mounted on the previously erected foundation.
– The walls are covered with a layer of clay plaster, after which they begin finishing the walls. (Pic.6)

Characteristics of straw panels:

– dimensions of a standard straw panel – height – up to 3 m, width – 1 m, thickness – 0,45 m
– the weight of such a product is from 70 to 250 kg (depending on the density)
– recommended insulation density (straw) – 150 kg / m³
– the vertical load that each panel can withstand – 7 tons
– plasterd wall of such panels withstands 90-120 minutes. direct exposure to fire (higher fire resistance than most other building materials).

Рис. 6. Wood-straw panel

VII. Errors in the construction of a house with straw

Danger of straw decay with a constant source of moisture. Even if this is a local decay, such a wall should be disassembled and redeployed, it will take 2-3 days without involving hired workers.

Mice. The ignorance of the technology of frame assembly, styling and methodology of plastering will turn out to be unexpected problems in the future. Mice do not eat rye straw, but with strong frosts they will gladly settle in the cracks and voids left in the rush by the builders.

Difficulties with hanging on the walls of heavy elements of furniture, unplanned at the design of the frame. Nevertheless, shelves of moderate weight or decorative embellishments will not be difficult to hang. To do this, use a few 25-30 cm wooden stakes, which are perfectly clogged in straw and hold firmly enough. The plaster adds strength.

Protection of plastered walls from wetting during exploatation. This includes annual maintenance at home, especially plaster inside and outside the house, wherever it is possible to suction moisture. Legislation of a straw house. In the passport, you can not proudly write that your house is built on a new technology of straw bales. It will have to be registered as usual, a frame wooden house, with 40-50 cm of insulation in the walls. In this regard, consult with an architect who is aware of the list of official construction technologies. (Pic. 7, 8).

Pic.7. Restoration of a rain-washed facade.

The effectiveness of the waterproofing properties of clay plaster depends on the oil content and density of the clay itself.

Pic. 8. A low base and a slope from the house can be disastrous when spring flood or abnormal rainfall.

VIII. Straw houses abroad

The eco-building in Southern Finland, "The House for Hobbits", Stunning Modular Framework Houses from ModCell, the Carol Atkinson's straw blocks holiday House, Sustainable and Energy-efficient Houses of Straw Blocks, The First House of Straw Blocks in Rome, Eco House from straw

Pic. 9. Small ecohouse in the south of Finland

Pic. 10. House for Hobbits

Pic.11. Framework houses from ModCell

Pic. 12. Rest house from straw blocks by Carol Atkinson

Pic. 13. Stable and energy-efficient homes from straw block

Pic. 14. First straw blocks house in Rome

IX. The technology of building a country house from straw blocks in 50 days (Canada)

The main bearing structure of this house is made of straw according to the old technology "pillars and beams". It differs from the usual framed construction technology of houses, where the bearing support is rarely installed massive columns, connected by beams. It is permissible to use a small surface tape foundation lying on a drained cushion of gravel. (Pic. 15) Outside, the foundation is protected by the EPPS from freezing. This method does not apply to trophies.
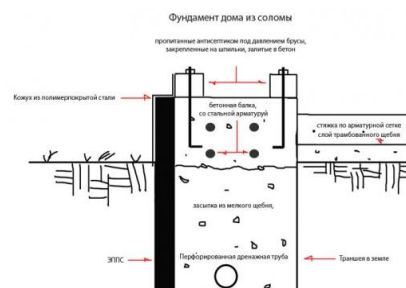
Pic. 15. Foundation.

After the foundation is laid, we go to the floor set up on the ground. The interior space is covered with rubble and

trampled. (Pic.16-17) If you plan a set up of warm floors in a house of straw, then it is necessary to put 3-5 cm of the EPPS over the rubble.

Pic. 16-17. Laying the foundation

Such a section of the floor on the slabs makes it possible not to fill the floor instantly, but by stages without fearing that the concrete floor of the house of the straw will crack in unexpected places. In fron of the house the holes are drilled and two supporting piles for the porch pillars are poured. Under the porch, rubble is strewed and a thin (10 cm), divided into two parts, floating reinforced slab is cast. (Pic. 18)

Pic. 18. Floor

On the studs U-shaped steel supports under the beams of the pillars are welded or screwed. Pillars of the future house of the straw are set using a level or a vertical plumb line and are caught by the braces. Wooden beams are mounted over the supporting pillars of the straw house. Installation is carried out with the help of special steel angles. The rafter system is put together based on a ridge beam and not requiring puffs or braces.

On the porch pillars a pre-assembled farm is installed, reinforced with steel straps, stitched with studs and tightened with nuts. The roof of a house made of straw is covered with sheets of profiled galvanized iron. Also on the top of OSB can be used a simple fusible roofing or bitumen soft tile. (Pic. 19-22)

Pic. 19-22. Arrangement of constructive caracas and roof

The basis for laying straw blocks into the wall: a layer of waterproofing is put on the foundation, a sheet of OSB is laid on top, the bar is impregnated to the studs under pressure (the incisions on it are the factory treatment against cracks, which reduces the internal pressure in the bar). The poles are fastened with braces of steel tape crosswise. This tape and the pillars themselves are externally insulated with a waterproof membrane. Blocks of straw are stacked like bricks – with overlapping of vertical seams. Straw blocks are well cut with an ordinary chain saw. (Pic. 23-24).

Pic. 23-24. Arrangement of walls and window openings

We prepare the wall for applying cement (and not clay) plaster. We tighten the windows and doors with a packing tape and carefully glue the tape. Plaster will be applied mechanically using a compressor and a sprayer. Mechanized plastering. A mixture of sand and white cement (from lime stone) is recommended. Outside, the house is plastered with a mixture of sand and white cement – it is much more durable than portland cement and has a beautiful white color. The house does not need to be painted. (Pic. 25-26)
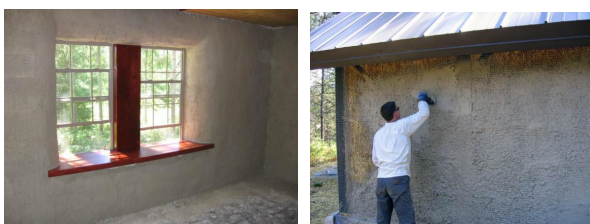
Pic. 25-26. Facing the house

Pic. 27 Hemming of soffits

Pic. 28. Ceilings and a roof in the house of straw are sheathed with lining

Pic. 29. Final look of the house

The plaster is carried out in two layers. The first roughing layer of the plaster during curing will shrink and crack. Drying time is several weeks. After drying out all the cracks and defects of the plaster are sealed. (Pic.27-29)

X. Straw versus brick and concrete (Assessment Methodology, Building Systems, Estimation of Construction Systems, "Solo Straw").

When choosing a building system, it is necessary to take into account many factors and make their integral evaluation. On the one hand, it is important to fully take into account all the significant characteristics, properties and aspects of the construction system. On the other – do not get lost in their diversity and multiplicity. These requirements, in our opinion, are best met by a point weighted criterial evaluation. The multiplicity of criteria helps to make the analysis more complete and comprehensive.

Under the construction system is understood the totality of the basic building materials, together with the ways of their use in the construction of the building. For example, the term "tree mass" means construction systems in which the tree is laid horizontally. This can be planed or rounded logs, glued beams, etc. If the same tree we use in the construction vertically, we get another construction system – wireframe. Besides wireframe it also consists of different wall materials.

To date many materials and building systems are known. Buildings can be made of wood, brick, concrete or combinations of these materials. Houses can be erected on frame, monolithic and other technologies.

It should be noted that the concept of a building system primarily characterizes the bearing walls. The foundation, roof, floors and partitions are to some extent independent of the materials and construction of the main walls.

Brick

Like other ceramic materials, bricks can have an increased specific activity of natural radionuclides in finished products. This is often found in situations where the radiological control of raw components is not performed properly. However for the effect on health it gets positive rating of "+1".

The opinion about the good thermal insulation properties of the brick is erroneous: to get at least a minimum standard heat resistance for Novosibirsk, it would take a wall of 2.8 m thick. The heat resistance of a common wall 1.5 cm thick (38 cm) is 0.7 m2 × oC / W, with the minimum required 3.7. Increasing the thickness of the brick wall for reasons of increasing thermal insulation does not make sense: even a "warm" (with voids) brick is not a heat insulator. Not insulated brick houses require large expenses for heating.

Brick – is not a cheap material. It requires relatively high laying skills of workers, and the construction speed is low. All this leads to a negative sum of points for the main group of criteria. According to the second group of criteria, brick received a rather high positive rating, but the third one again goes into negative. As a result, the overall low score is less than 30. (Pic. 30)

Concrete

An uninsulated concrete wall receives a total minus amount. Concrete due to variability of its composition may represent a greater or lesser danger for health. Studies have shown that the toxicity of concrete depends on the components used in the production. So, sometimes the ash used in its production can have increased radioactivity. Concrete on granite gravel is often with excessive radioactive radiation. (Pic. 31)

Foam Concrete

In general, foam concrete has a greater air permeability than ordinary concrete, and can be considered as neutral in terms of health effects. Having similar assessments for the second and third groups of criteria, foam concrete wins against the brick in the first group due to the best thermal insulation properties, speed, construction cost and current resource availability (availability in the market). This determines its relatively high overall score. (Pic.32)

Woodmass

House of solid wood (beam, log) has a good effect on health, but it is cold (the walls are thin, the insulation is weak). Wooden houses are expensive to operate and fire hazardous, which predetermines a low score for the main group of criteria. Woodmass got little points in other groups as well, which determined its presence in the group of outsiders. Woodmass houses certainly, require warming. But there is a nuance: good heat insulators for wooden walls (straw or reed mats) are not produced now, and the use of artificial insulants largely crosses the ecological advantages of wooden walls. (Pic.33)

Foamed concrete + styrofoam

The system "foam concrete + expanded polystyrene" receives

the sum of points comparable to the "carcass + minvata" system, somewhat winning in the first group of criteria and losing in the third.

Adobe

The house got a good amount of points, much bigger than the "brick" or "woodmass" ones. A significant role in this played the cheapness of construction, the availability of materials and good buffer properties. (Pic. 34)

Geokar

Frame walls with a geocar filler, having few shortcomings and many advantages, got a high score for all criteria groups and as a result a high total amount. (Pic.35)

Straw

The properties of straw as a building material are not widely known to the general public, and therefore it makes sense to dwell on them in more detail. To begin with, straw has high thermal insulation properties. They are 3.5-4 times higher than wooden across the fibers (and 6-7 better than along). This makes it possible to class the pressed straw to good heaters. The cost of operating straw houses due to good thermal insulation is low.

Straw is not only not harmful to health – it has healing properties. This is evidenced both by subjective assessments of living in straw houses, as well as objective evidence (for example, statistical studies of French physicians). Even a tree that has a high rating on this parameter loses to straw. The cost of construction form straw is one of the lowest. The current resource availability for straw blocks is low: the supply market is

not formed due to unfulfilled demand. Building systems from straw bales have a minimum of negative estimates by our method: only for the current resource availability, for building fire safety and resistance to long (more than a few weeks) moistening.

Pic. 30. Brick

Pic. 31. Concrete

Рис. 32. Foamed concrete

Pic. 33. Woodmass

Рис. 34. Adobe

Pic. 35. Geokar

XI. Statistics of houses which were built from straw in Ukraine

Pic. 36. House of straw near Odessa. The owner of the house and the author of the project Anatoly Lukian

Pic. 37. House of strawbales near Kiev. The owner of the house and the author of the project is Artem Domashenko

Pic. 38. A frame house with straw insulation under Poltava. Andrei Konyuk, Radion Khovanets, Oleg Ivanenko worked on project of the house and its construction.

Pic. 39. Straw house in Chernivtsi. The owners of houses and authors of the project are Maria Shutak and Victor Nitsovic.

Pic.40. The Straw House near Kherson.The author of the project and the owner of the house is Yuri Vaysblat

Pic. 41. House of straw in Kiev region. Construction of the house was handled by Valery Gomenyuk and his team

XII. Straw is the future of Ukrainian power engineering

The energy intensity of straw in pyrolysis modes (and now the equipment works exactly in this mode) is quite comparable with coal. According to experts, in average about 1.5 tons of straw per hectare per year are received by farms after harvesting. Of this volume, at best, 5-7 percent is spent on economic needs, forage, litter for livestock.

Technology of use for power engineering. Straw, not used in the farming, is burnt in specially constructed boilers. But the cost price of heat energy produced on straw in the boiler room is almost two times lower than

the boiler house on natural gas: 87.1 UAH / Gcal and 187.1 UAH / Gcal, respectively. The heat generating plant on straw with a capacity of about 0.5 MW consumes an average of 450 tons of straw (equivalent to an energy consumption of 6,800 GJ). Presumably, it will replace the fuel oil boiler with an efficiency of 80%. Incidentally, we note that the investment effect should also take into account 25% of the savings in thermal energy. Such boilers burn bundles (briquettes) of cereal straw, which makes it possible to provide schools, kindergartens, enterprises and other facilities with heating and hot water supply. Energy saving is obvious.

I suggest to consider the following tables:

TABLE 1
WEIGHT OF STRAW BALES DEPENDING ON SIZE. KG

Small square straw bale		15
4 x 4 (square)		150
5 x 4 (square)		240
8 x 3 x 2 (square)		150
8 x 3 x 3 (square)		450
8 x 4 x 3 (square)	2,4m x 1,2m x 0,9m	500-600
8 x 4 x 3 (square, consolidated)	2,4m x 1,2m x 0,9m	700-800
8 x 4 x 4 (square)		625

TABLE2.
PARAMETERS OF STRAW BLOCKS

Length of straw blocks	from 300 mm to 1200 mm
Width of straw blocks	460 mm
Height of straw blocks	360 mm

TABLE3.
ENERGY VALUE OF STRAW OF DIFFERENT CROPS IN HUMIDITY 15% PER TON (ACCORDING TO DATA OF TEAGAS)

Type of straw	Caloric content, MJ/kg	Energy content, kW.year/t	The equivalent of oil burning, l	Ash content, kg/t
Wheat straw	14,4	4,032	396	57
Barley straw	14,7	4,116	406	48
Rape straw	14,3	4,004	393	62
Hay	14,3	4,004	393	71

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MEMST

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Ways of Improvement of Productiveness of Vibratory Tubular Conveyors

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Abstract – The principle of construction of two-mass lengthy tubular conveyors of coaxial type with electromagnetic oscillations exciter is considered. The dependence for determination of the conveyor productiveness is substantiated. The design diagrams of tubular multi-tube conveyors of two- and three-mass vibratory schemes are proposed and the efficiency of their implementation in order to increase the productiveness of bulk and lump products feeding due to the use of all tubular elements as transporting ones is substantiated.

Keywords – vibration, conveyor, tube, mass, armature, electromagnet, frequency, amplitude, speed of transportation, speed factor, productiveness.

I. Introduction

Vibratory tubular conveyors are the effective means of transporting bulk and lumpy products and piece parts. Using the separate machines (modules), the lengthy lines of required length (up to 50 m and more) may be constructed. The lengths of separate modules are 2…6 m. The most effective models are the models with two-mass oscillation scheme, coaxial placement of tubes of symmetrical structures and two-cycle electromagnetic oscillations exciter [1]. Their main advantage is the low power consumption and the absence of friction pairs. They are fed from AC power source using the frequency converters with the most expedient operating frequencies of 25 Hz, 16.7 Hz or 12.5 Hz. At these frequencies, it is possible to achieve greater lengths of transporting elements for one drive. During the operation of conveyors and lengthy transporting lines, there is practically no noise for these frequencies.

II. Models of tubular conveyors

One of the models of tubular conveyor is presented in Fig. 1. In the following conditions: the operating frequency of the conveyor oscillations of 25 Hz, the maximum horizontal amplitude of the oscillations of the conveyor tube of 5.0 mm, the maximum speed of the vibratory transportation of 600 mm/s, while transporting dry sand, the conveyor provides the maximum volumetric capacity of 14 m^3/h with an internal diameter of the tube of 116 mm, consuming up to 0.4 kW and providing the feeding of products at the distance of 3 m.

a

b
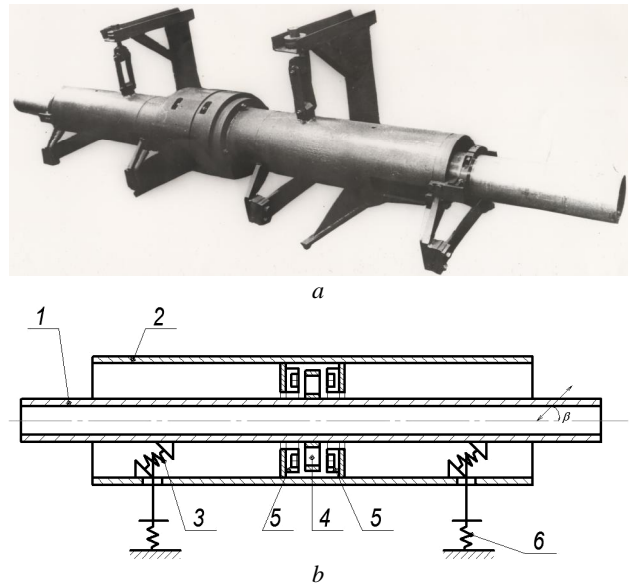
Fig. 1. Vibratory tubular conveyor: a – general view; b – structural diagram; 1 – working transporting tube; 2 – reactive non-transporting tube; 3 – elastic system; 4 – armature; 5 – electromagnet; 6 – vibrations isolators

Since the transporting element of these conveyors is only an internal tube, and the external tube performs the function of the reactive (balancing) mass in the two-mass oscillatory system [2], the productiveness of the conveyor depends on the internal diameter of the conveying tube, on the amplitude of its oscillations and on the operating frequency of the conveyor. It is known that the volumetric productiveness Q of a conveyor may be calculated by the dependence (1) [3]:

$$Q = 3600 \cdot v \cdot s \quad (m^3/h), \qquad (1)$$

where v is the speed of vibratory transportation (mm/s); s is the area of the cross-section of the product being transported (mm^2).

The speed of transportation may be determined by the following formula [3]:

$$v = 2 \cdot \pi \cdot \upsilon \cdot A_\Gamma \cdot k_{III} \quad (mm/s), \qquad (2)$$

where υ is the operating frequency (Hz); A_Γ is horizontal component of the oscillations amplitude (mm); k_{III} is the speed factor.

The optimal mode of vibratory transport will take place in the case, when the throwing motion of the products coincides with the oscillations of the transporting tube, i.e., when $k_{III} = 0.635$ [4]. During the vibratory transportation, loose products occupy approximately 50…60% of the internal cross-section of the transporting tube. If the product being transported occupies 60% of the tube internal cross-section, the productiveness of the conveyor may be determined by the formula (3):

$$Q = 1{,}1 \cdot 10^{-5} \cdot \upsilon \cdot A_\Gamma \cdot d^2 \cdot k_{III} \quad (m^3/h), \qquad (3)$$

where d is the transporting tube internal diameter (mm).

The experimental investigations of a number of models of two-mass tubular conveyors shows that the maximum amplitudes of oscillations of such machines operating at a frequency of 25 Hz reach $A_{\Gamma max} = 6…7$ mm. Tubes diameters for the main range of conveyors are within $d = 100…200$ mm, which is limited by the own frequencies of the transporting tubes and their lengths [1]. It has been experimentally determined that k_{III} is larger

than $k_{III} = 0.635$ and reaches $k_{III} = 0.8…0.85$ at maximum amplitudes of oscillations. After analysing a number of models of conveyors while carrying out the investigation of their real constructions, we conclude that, it is necessary to modernize their structural diagrams in order to ensure the significant improvement of the productiveness of such machines. The most significant improvement of the productiveness will be in models, in which all oscillating masses made of elongated transporting tubes will be transporting ones and their number will be two or more.

The most common ones are two- and three-mass design diagrams of vibratory conveyors. Multi-mass diagrams (with four or more masses) are not widespread because developers are always facing a dilemma: the conveyor should be as simple as possible while designing, manufacturing, installing, operating, and ensuring a prescribed productiveness.

In this publication, we will take into account only two- and three-mass structural diagrams. Fig. 2 shows the structures of tubular transporting elements of modernized devices. Elastic restrictions allow oscillation of the transporting elements along their axis with the vibration angle ensured by the flat elastic elements. The diagrams of Fig. 2, a and b, have two oscillating masses m_1 and m_2 which are placed parallel to each other. The centres of the oscillating masses O_1 and O_2 are not concentric, but due to the significant moment of inertia of the transporting tubes and the multi-block elastic planar system, parasitic oscillations around the reduced centre of mass O will not occur in the longitudinal plane. The diagrams of Fig. 2, c and d, consist of four tubes forming two oscillating masses which mass centres are reduced to point O. This structure completely balances the oscillating masses and prevents parasitic oscillations. The diagrams of Fig. 2, e and f, consist of three oscillating masses with three (Fig. 3, e) and six (Fig. 3, f) transporting tubes. Systems with a larger number of masses and transporting tubes, may be constructed similarly to those presented in Fig. 2 using the method of combining of multi-mass systems.

Conclusions

The proposed structural designs ensures a significant improvement of productiveness, since each tubular element is simultaneously a transporting one. The possibilities that will be laid in the structural and dynamic diagrams of such conveyors will be used almost at 100%. Experimental studies of some of the proposed models have shown that the filling of tubes while transporting products may reach 95%...100% unlike the models presented in Fig. 1. Therefore, this will significantly increase the productiveness of the conveyor. At the same time, due to the uniform loading of the oscillating masses, which will have approximately the same values, the field of oscillations along the length of the tubular lengthy elements will be uniform [1]. This will ensure the uniformity of the vibratory transportation. The effect of loading on the operation of the devices will be negligible if one carries out the designing according to the theory of self-stabilization of oscillations described in [2]. In addition, since the angles of vibrations of such conveyors are within the range of $\beta = 10º…30º$ and the main component of the amplitude of oscillations is horizontal one, the loading effect in the modes with throwing will also be negligible. The further research in this field may be reduced to the development of models of conveyors with lengths of transporting elements of L = 3…8 m and of lengthy lines constructed of these modules.
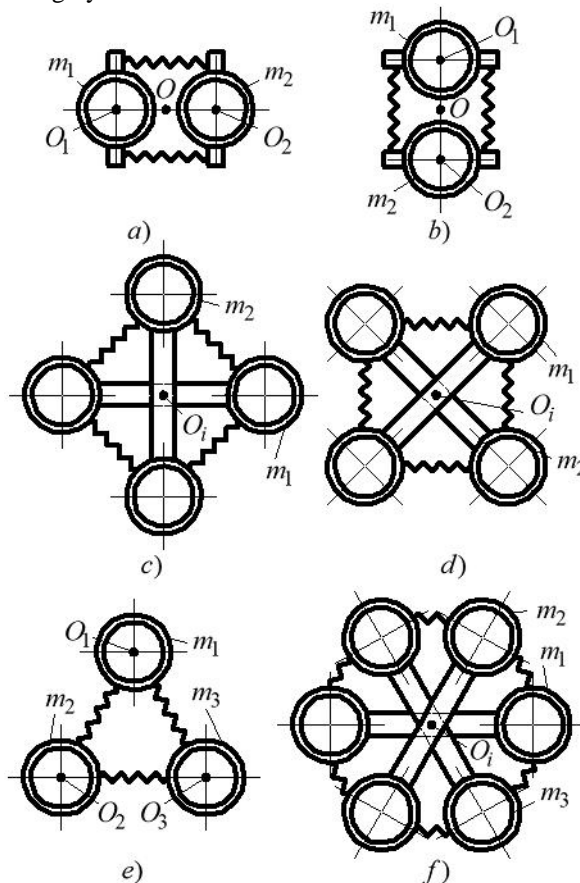
Fig. 2. The design diagrams of tubes of modernized tubular conveyors: a, b – two-mass two-tube ones with non-concentric mass centres; c, d – two-mass four-tube ones with concentric mass centres; e – three-mass three-tube one with non-concentric mass centres; f – three-mass six-tube one with concentric mass centres

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Impact of Processing Modes and Parameters of the Working Part of the Instrument on the Surface Quality of Flat Parts During High-Speed Friction Hardening

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Abstract – Impact of processing modes and parameters of the working part of the tool-workpiece on the quality and surface precision of details during high-speed friction hardening of flat details is developed.

Keywords – surface precision, surface roughness, oscillation, precessional motion, high-speed friction.

I. Introduction

Increasing the requirements for the precision and quality of the surface layers of details during processing and the high speed of the tool disk creating periodic forces makes the problem of oscillations very important during the consolidation process. In addition the high quality of the surface layer of the workpiece is strongly influenced by the intense heat fluxes was formed during processing [1].

During friction hardening when the technological system "machine tool–tool–detail" is fluctuating there are such processing errors as wavelengths and deviations from geometric shapes. These fluctuations have moderate intensity in the energy plan and a random nature. Fluctuations of the dynamic system developing in the process of hardening affect on the change of force in the contact area and temperature difference. [2-3].

To reduce the oscillations and vibrations of the elastic system of the machine to its nodes is put high requirements of dynamic quality. This is especially true for spindle machine nodes.

To ensure high process parameters, it is necessary to choose the ratio of the width of the groove to the length of the working disk of the disk and the number of grooves. As the maximum amplitude of oscillations of an elastic system arises when coinciding the eigen frequencies of a system with perturbation frequencies then it operates in resonance mode. The large amplitudes of oscillations are undesirable not only because of the possibility of an elastic system in the resonant mode but also because of the deterioration of the surface layer quality. During the work of the machine tool in a non-resonant mode the oscillation amplitude decreases and the process of hardening normally takes place. So the change in the excitation frequencies is caused by a periodic change in the amplitude of oscillations which leads to unstable operation of the machine. Besides when working at frequencies close to the resonance frequencies of an elastic system, the process of consolidation proceeds in adverse conditions [3-4].

II. Main Material Presentation

On the formation of the quality parameters of the treated surface is significantly influenced by the dynamic processes that arise in the contact area of the tool-detail with their friction hardening.

As the process of friction hardening occurs at high speed friction tool on the treated surface (60-80 m / s) in the area of contact of the tool with the workpiece arise shock loads, so consider mandrel system-spindle machine tool as a gyroscope that spins at high speeds.

The spindle of the machine tool is located on two elastic supports A and B. We denote the forces acting on the spindle with the tool and determine the coefficient of stiffness of the supports in the directions for the left support. Denoted the forces acting on the spindle with the tool and determine the coefficient of stiffness of the supports in the directions for the left axis support $y - c_{1y}$ and axis $z - c_{1z}$ and for the right axis support $y - c_{2y}$ and axis $z - c_{2z}$.
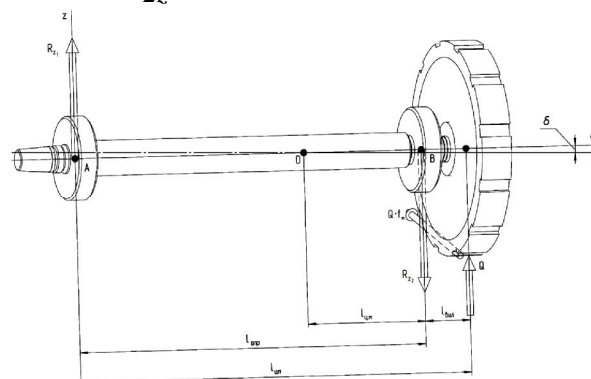
Fig.1. Scheme of strength in a plane with precessional motion of a spindle.

Where Q – the active strength in the plane XZ; R_{z_1} – strength of the reaction of the support A in the plane XZ; R_{z_2} – strength of reaction in the plane XZ.

For the simulation of a gyroscopic phenomenon in the precessional motion of a spindle during frictional processing of rigidly fixed parts, a program in the Matlab/Simulink environment was developed.

The precessional movement of the spindle of the machine with the frictional hardening of flat surfaces is modelled when angular velocity changes from ω = 200 rad/s to ω = 600 rad/s with the application of a constant force Q = 1000 N (Fig. 2). The obtained results show that the external and internal radii of the cone, which are

described by the end of the spindle of the machine in the process of strengthening, increases with increasing processing regimes (increasing the angular velocity at different pressures) (Fig. 2).
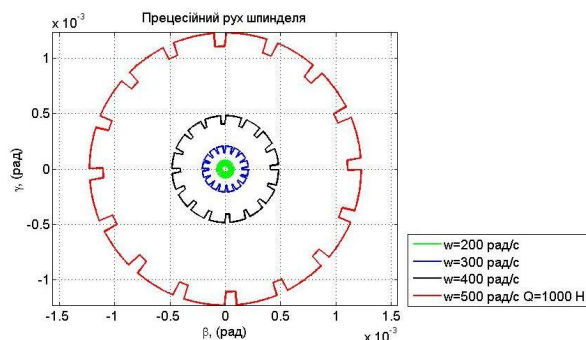
Fig.2 – Precessional motion of the spindle of the machine with friction hardening (Q = 1000 N).
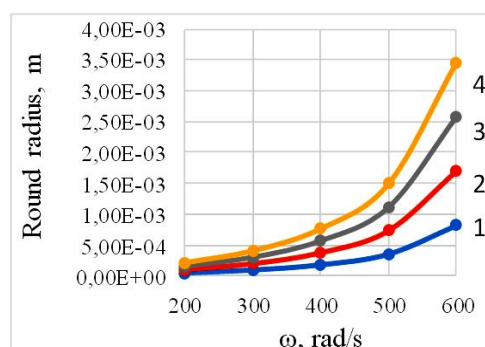
a
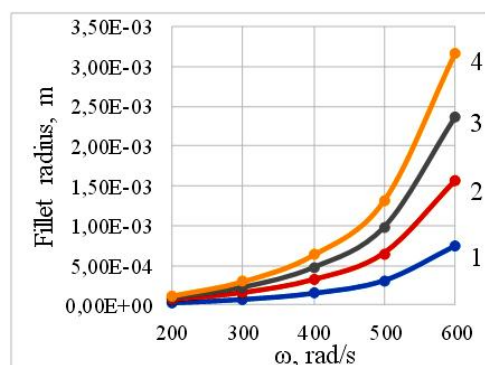
b

Fig.3 –The dependence of the precessional machine on the change of angular speed and clamping force (external radius (a) and internal radius (b)): 1 – Q = 500 H; 2 – Q = 1000 H; 3 – Q = 1500 H; 4 – Q = 2000 H.

To determine the influence of the diameter change of the strengthening tool was modelled the process of hardening on two different diameters, namely, 200mm and 360 mm (Fig. 3). The obtained results of the dependences of internal and external radii of discs of different diameters

in the precessional motion of the spindle of the machine with a change in the force of the clamping show that the change in the diameter of the disk at different forces does not significantly affect their relationship in the processing, and they don't essentially increase during the precessional motion of the deflection of the end of the spindle of the machine tool. The results of simulation of the strengthening process with the change in angular speed from ω = 200 rad/s to ω = 600 rad/s also show that the change in the diameter of the tool doesn't significantly affect the ratio of their radius in the precessional motion of the spindle, deviations are insignificant.

Conclusion

The obtained results in the process of modelling precessional motion of a spindle during superficial friction strengthening have shown that in the process of cutting a tool into a workpiece, the spindle begins to oscillate under the action of gyroscopic moments and reaction forces. The spindle oscillation amplitude decreases by the exponential curve, and the oscillation amplitude coefficient increases with increasing spindle hardness and stabilizing action of gyroscopic moments.

From the results of the research can be concluded to increase the stabilization action of gyroscopic moments, it is necessary to increase the angular speed of the spindle, moments of spindle inertia and tool hardening. In order to improve the quality of the surface to be treated, it is necessary to reduce the static and dynamic imbalance of the spindle with the frame and the strengthening circle, to reduce the outflow of the frame, to increase the gyroscopic moment from the precessional movement of the spindle-frame by increasing the angular speed and rotation of the spindle-frame with the tool hardening, increasing the mass and the middle radius of spindle and tool hardening, increase the stiffness of the spindle-frame.

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Improving the Quality of Technology of Pressing the Tungsten Carbide Inset Cutter in Roller Cone Bit

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Abstract — The analysis of the nature of the damage to the surfaces of the openings revealed traces of the action of the compressive forces arising along the axis of the tungsten carbide inset cutter when squeezing it into the rock face. Also found traces of deformation from the action of bending to the tungsten carbide inset cutter, depending on the orientation of its slip on the face. Fixing and rubbing, fretting-corrosion, damage to the local areas of the walls of the holes caused by scrolling the tungsten carbide inset cutter around its axis in the opening of the rolling-cutter teeth row. In the case of the use of tungsten carbide inset cutter with symmetrical exacerbation of the breeding part, the orientation of the creature's impressive head of the tungsten carbide inset cutter is determined by an effective angle to the axis of the crown of the tungsten carbide inset cutter pick. Calculations show that an angle of 45° is optimal.

Keywords — tungsten carbide, fretting-corrosion, rolling-cutter, crown, roller cone, cutter bits.

I. Introduction

Three-cone rock drilling bit with tungsten carbide inset cutter – equipment have been widely used in the construction of wells of various purposes [1]. The production of such roller cone sets before the chisel construction system new conditions to materials, construction, selection of steels for roller cone, parameters of carbon saturation and heat treatment, technological operations of moulding of holes and assembly of "cone – tungsten carbide inset cutter" connection. The plug-in breakdown equipment is exploited under difficult conditions and often fails due to imperfections in the design and technology of manufacturing roller cones. Therefore, studying ways to improve the quality of inserted rope-destructive equipment at the stages of creating roller cones is an urgent and topical task of the chisel construction [2].

During the rotation of the roller cone around the axis of the tungsten carbide inset cutter which deeper into the spectacular part of the rock, deformation and destruction of the breed are made. When entering the rock of the striking part of the next tooth, the twisting of the chopped rock is preceded by a tungsten carbide inset cutter [3].

The analysis of the nature of working out and loss of working capacity of the inserted rocks destroy the equipment, the facts of loosening, scrolling of the teeth around their own axis, and the change in the orientation of their impressive part, deflection and loss of tungsten carbide inset cutter were established.

The instantaneous load on the tungsten carbide inset cutter can be 80-85% of the total load on the roller cone [4].

II. Formulating the purpose of the article

The analysis of the mode of failure to the surfaces of the holes revealed traces of the action of the compression forces arising along the axis of the tungsten carbide inset cutter when squeezing it into the rock face. Also found traces of deformation from the action of bending to the tungsten carbide inset cutter, depending on the orientation of its slip on the face. Fixing grinding in, fretting-corrosion, damage to the local areas of the walls of the holes caused by scrolling the tungsten carbide inset cutter around its axis in the hole of the rolling-cutter teeth row.
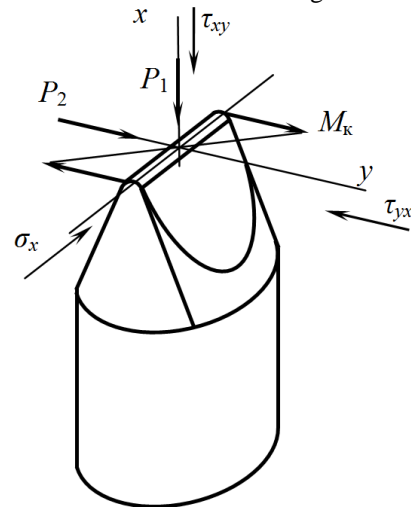
Fig.1 The mode of the stress action on the top of the tungsten carbide inset cutter

If we analyse the mode of the stresses occurring in the tungsten carbide inset cutter, we will use the theory of elasticity [5] and advances in the field of material mechanics [6]. In the orientation of the impressive part of the along the creature tungsten carbide inset cutter, there must be such tensions between the existing tensions [7]:

$$\begin{cases} \dfrac{\partial s_x}{\partial x} + \dfrac{\partial t_{xy}}{\partial y} = 0 \\[2mm] \dfrac{\partial s_y}{\partial y} + \dfrac{\partial t_{yx}}{\partial x} = 0 \end{cases} \quad (1)$$

According to the hypothesis of plane sections of the mechanics of materials, we have the following calculation formulas:

$$\begin{cases} s_x = -\dfrac{P_1}{2xd_3} + \dfrac{P_2 y(x - r_0)}{2x^3 d_3} \\[2mm] s_y = 0 \\[2mm] t_{xy} = t_{yx} = \dfrac{3P_2(x^2 - y^2)}{4x^3 d_3} \end{cases} \quad (2)$$

The calculation formula for the tangential stresses will look

$$t_{xy} = -\frac{P_1}{2x^2 d_3} y + \frac{3P_2 r_0}{4x^2 d_3} + \frac{3P_2\left(2 - \dfrac{3}{x} r_0\right)}{4x^3 d_3} \quad (3)$$

whereas

$$\frac{\partial s_y}{\partial y} = -\frac{\partial t_{yx}}{\partial x} \quad (4)$$

$$\frac{\partial t_{yx}}{\partial x} = -\frac{P_1}{x^3 d_3} y + \frac{3P_2 r_0}{2x^3 d_3} + \frac{9P_2\left(1 - \dfrac{2}{x} r_0\right)}{2x^4 d_3} y^2 \quad (5)$$

$$s_y = -\int \frac{P_1}{x^3 d_3} y \, dy + \frac{3}{2}\int \frac{P_2 r_0}{x^3 d_3} dy + \frac{9}{2}\int \frac{P_2\left(1 - \dfrac{2}{x} r_0\right)}{x^4 d_3} y^2 dy \quad (6)$$

$$s_y = -\frac{P_1}{2x^3 d_3} y^2 + \frac{3P_2 r_0}{2x^3 d_3} y + \frac{3P_2\left(1 - \dfrac{2}{x} r_0\right)}{2x^4 d_3} y + C_3 \quad (7)$$

In the case of the use of the tungsten carbide inset cutter with symmetrical aggravation of the rock-destroying part, the orientation of the creature's impressive head of the tungsten carbide inset cutter is determined by an effective angle to the axis of the crown of the roller cone. Calculations show that an angle of 45 ° is optimal. The development of drill bits with such a construction of rocks destroyed the equipment showed an increase in the efficiency of the destruction of the rock in the face, which positively influenced the rates of the passage of the bit.

Consequently, the value of tension in the connection must satisfy the condition

$$\Delta \geq \frac{0,5 M_\text{к} b^2}{p\, Ehf\left(0,25 b^2 - r_3^2\right) r_3} \quad (8)$$

Proceeding from the data presented in [8] consider the conditions to ensure the reliability of the connection "shank of the tungsten carbide inset cutter – hole of roller cone" from the bending moment to the tungsten carbide inset cutter.

When loading the connection, the bending moment M on the uniform pressure diagram of the fit superimposes the pressure diagram, characteristic for the bend. At the same time, 0,5M has an affecting part of the tungsten carbide inset cutter, the same magnitude of the moment falls on the opposite side of the base of the shank of the tungsten carbide inset cutter.

The value of the allowable torque to ensure the reliability of the connection "shank of the tungsten carbide inset cutter – hole of roller cone" can be taken

$$M = 0,2\, p d h^2 \quad (9)$$

Let's assume this

$$p_1 = 0,75 p \quad (10)$$

Conclusion

The allowable moment is proportional to the square of the height, so the connections of the exposed bending moments can not be performed with small values of the diameter and height of the chisel shank of the tungsten carbide inset cutter.

In the future, practical interest is in the need to simulate the variants of stress distribution (contact pressures) with different roughness parameters of the conjugated parts, as well as variants of stress distribution (contact pressures) in the crown of the roller bearings at different distances from each other tungsten carbide inset cutter.

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Improvement of Structural Diagrams of Vibratory Separators with Electromagnetic Drive

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Abstract − The features of construction of structural schemes of vibratory separators based on vibratory conveyors with electromagnetic drive are considered. The structural diagram of the vibratory separator developed on the basis of three-mass oscillatory scheme with the possibility of transporting the mixture and the separated component by vibratory transportation in opposite directions is proposed, and the device operation is substantiated. The main criteria of separation efficiency are presented. The possible directions of effective implementation of vibratory separators are suggested.

Keywords − structural diagram, vibratory separator, armature, electromagnet, vibration angle, elastic system, separation efficiency.

I. Introduction

In a number of industries (packaging, food, woodworking, etc.) there is a great need for efficient means of separating lump and piece products. This is due to an increase in production volumes and underdeveloped means of production for these operations. As it is known [1], the separation of the mixture into components (two or more) is carried out mainly by two types of machines: passage separators and classifiers. These machines are vibration-type devices, which ensure that the product is sized in fractions by means of single- or multi-component vibrations. The simplest and the most effective structural scheme of the separator is presented in Fig. 1 [2]. It has been developed on the basis of two-mass vibratory conveyor with electromagnetic exciter of oscillations and directed oscillations.
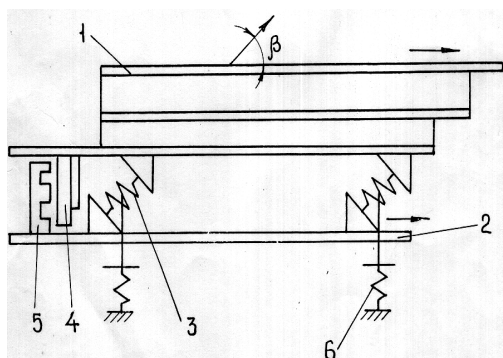
Fig. 1. Structural diagram of two-mass vibratory separator with single-directed transportation

The product is fed to the upper mass 1, which can be equipped with one or more sieves, and due to vibrations directed at the angle β and generated by the electromagnet 5 with armature 4 and by the elastic systems 3 is being effectively transported with throwing along the direction of vibrations. This ensures the effective separation into different size fractions and transportation into different containers (the arrow shows the direction of vibratory transportation). The lower mass 2 takes the smallest parts of the product and transports them into the container. Vibration isolators 6 ensure effective vibration isolation of the separator.

The separators developed on the basis the diagram (Fig. 1) may have a maximum overall size of sieves of 800x500 mm. In order to develop larger machines, it is necessary to use other structural diagrams.

II. Three-mass vibratory separators

The task of development of separators, in which the separated parts of the product are to be transported in opposite directions, is quite often set for engineers. In order to solve this problem, the structural diagram presented in Fig. 2 has been developed.
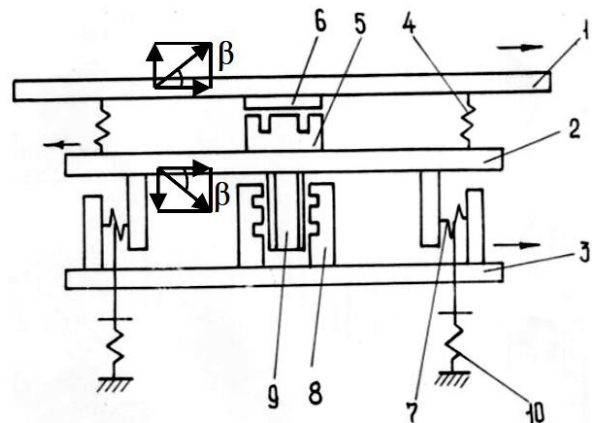
Fig. 2. Structural diagram of three-mass vibratory separator with opposite-directed transportation

The separator consists of three oscillating masses 1, 2 and 3, an elastic system 7 of horizontal oscillations and an elastic system 4 of vertical oscillations. Horizontal vibrations are excited by two-cycle exciter 8, 9 of horizontal oscillations. Vertical vibrations are excited by one-cycle exciter 5, 6 of vertical oscillations. Using the shock absorbers 10 mounted in the zones of the smallest oscillations of the elastic system 7, the separator is mounted on the base. Taking into account only horizontal vibrations, the reduced mass of bodies 1-2 and the mass 3 oscillate in the antiphase. Taking into account only vertical oscillations, the mass 1 and the reduced mass of bodies 2-3 also oscillate in the antiphase. After summing the vectors of oscillations, we obtain different directions of the angles of the vibrations of masses 1 and 2, which will ensure the vibratory transportation of parts by masses 1 and 2 in opposite directions. The product, which is fed to the sieve of the mass 1, will be transported in the direction opposite to the separated parts that will be sift

on the mass 2 (Fig. 2). This separator should be used to separate the mixture into two components, if it is necessary to transport them in different directions.

The efficiency of the vibratory separation depends on the mode parameter W [3], on the operating frequency of oscillations, on the overall dimensions and on the sieve parameters. The following conditions are the most effective for vibratory separation: the parameter W = 2…8; operating frequency of vibrations 50 Hz, 25 Hz, 16.7 Hz or 12.5 Hz. The smaller frequencies are used for large-sized separators (with sieve sizes of 1000x600 mm or more). The most widespread types of sieves are the sieves of bar-, hole- and string-type. The separation efficiency is characterized by the separation quality coefficient, by the mass separation quality factor, and by the separation productivity [4], which may be determined experimentally.

The implementation of the proposed devices may be especially effective for automated machines of vibratory treatment [1], since their design features require the distribution of abrasive processing elements and the machined parts into different zones, which will allow the use of devices for automatic charging of abrasive and transporting of machined parts.

Conclusions

The development of highly-efficient separators with feeding of separated parts in opposite directions will allow to use them in a variety of technological equipment for the mechanization and automation of production and for development of flexible production systems.
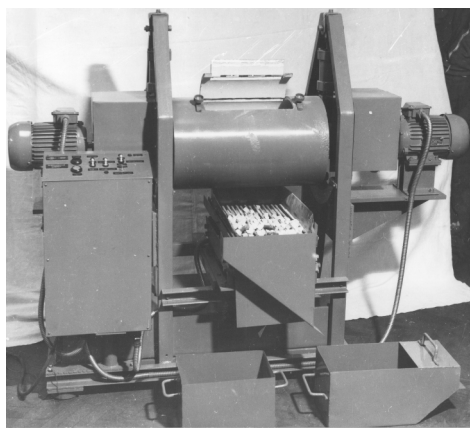
Fig. 3. Unbalanced vibratory machine with the separator and two drives

The unbalanced vibratory machine with the separator designed according to the diagram of Fig. 1 is presented in Fig. 3. This machine may be automated using the separator designed according to the diagram of Fig. 2.

One of the models of two-mass vibratory single-directed separator with electromagnetic drive, which has been designed and manufactured in the Department of Mechanics and Automation Engineering of Lviv Polytechnic National University, is presented in Fig. 4.
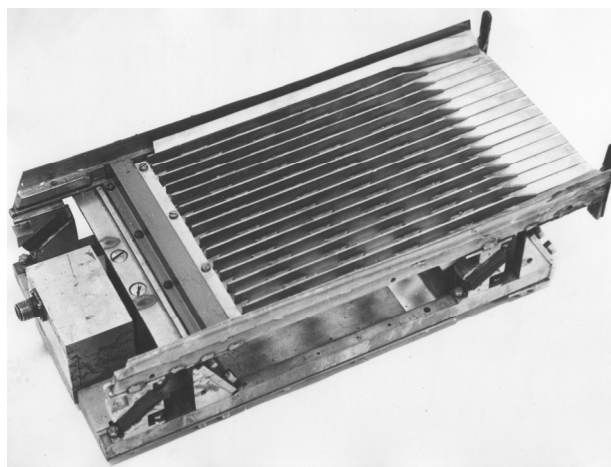
Fig. 4. The model of two-mass single-directed vibratory separator

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Substantiation of Parameters of the Mechanism of Initial Orientation of the Package

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Abstract – The work is focused on solving the urgent problems of the packaging industry – the orientation of packaging. Structural and solid-state model of the mechanism of orientation is developed. The kinematic and force analysis of the primary orientation mechanism was carried out.

Keywords – kinematic analysis, force analysis, motion analysis, 3-D model, structural scheme.

I. Introduction

Increasingly popularity is gaining soft packaging, which is presented on the market to a wide range of products. According to its physical and mechanical characteristics, the materials used in the formation of soft containers are very different. In connection with this, one can not get a generalized scheme of forming a cargo unit when using this group of materials. Therefore, the work is focused on solving the problem of the initial orientation of soft packaging when leaving the working area of the machine.

The key factors that complicate the automation of the production process when using soft packaging is the change in its geometric parameters when the product is filled. It is this feature of soft packaging that requires the use of innovative approaches to orientation and stacking compared to products, parts and workpieces with a clearly expressed geometric shape.

Taking into account the sharp growth of the food industry in Ukraine, even when solving the above mentioned problem, the designed equipment can not be competitive. This is due to the flexible packaging system of food products, since several food products with different weight and geometric parameters of the package can be packed on the same equipment.

Solving this problem is possible with the modular design of the mechanism for the formation of group packaging. However, the most rational solution is to design modular units with a certain permission to change the geometric parameters of the package and its mass.

II. Description of the mechanism

The mechanism shown in Fig. 1 operates as follows: from the working zone of the machine 2 (shown schematically), the package 1 on the guide plane falls into the stop mounted on the guide plate 3. For the transfer of the package 1 from the detent 3, a directional lever mechanism is used that is a link 6, mounted on the hinge and vacuum holders 4. This link is attached to the stem of the pneumatic actuator 5, which is hingedly mounted to the support. The pneumatic drive 5 is mounted with the help of a hinge to realize the turn of the link itself at an angle necessary for moving the package to the working plane of the conveyor 10 in a circle radius R.
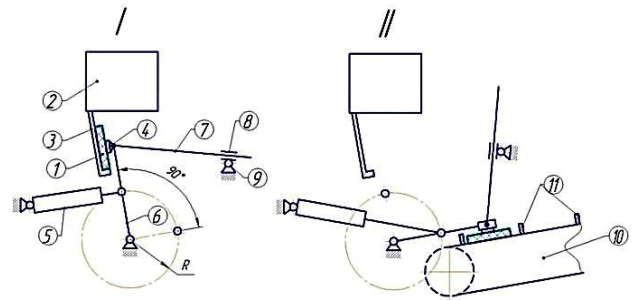
Fig.1 The basic scheme of the operation of the primary packing orientation node

In order to reorient the package in the process of moving the link 6, a link 7 is mounted to the end of the link that moves along the slider 8, which has the ability to rotate thanks to the hinge 9. The revolution of the packet is implemented gradually after the movement of the piston rod 5. This is done for that purpose. , so that when turning the package it does not stop the elements of the machine and does not deform during contact with the detent 3.
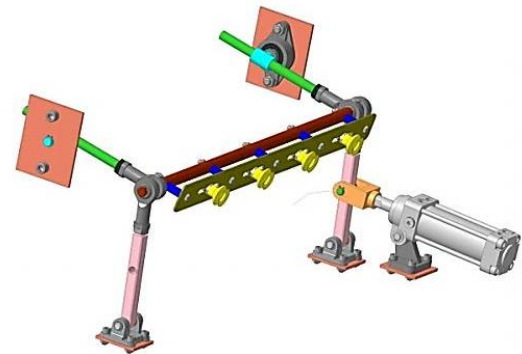
Fig.2 3-D model of the primary orientation mechanism
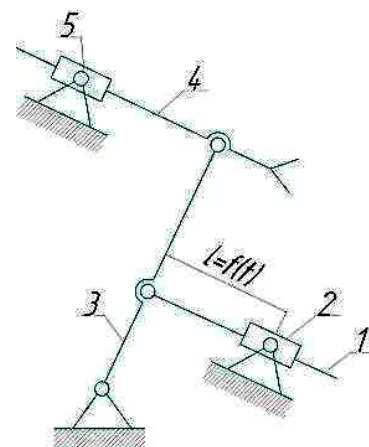
Fig.3 Structural scheme

Figure 2 shows the 3-D model of the mechanism used in determining the centre of mass of the constituent elements of the mechanism and on the basis of which the structural scheme of the mechanism is developed (Fig. 3).

Determine the degree of freedom of the mechanism by the formula of Chebyshev:

$$w = 3n - 2p_5 = 3 \cdot 5 - 2 \cdot 7 = 1. \qquad (1)$$

According to formula (1), the degree of freedom of the mechanism is 1, which means that the position of all parts of the mechanism determined by changing the position of the stock.

III. Kinematic and force analysis

For power and kinematic analysis SolidWorks software was used. The initial parameters for modelling the mechanism of the mechanism were: the positioning time of 1.5 seconds and the displacement of the stem 80 mm. The simulation takes into account weight effort. SolidWorks Motion application is used for motion analysis.
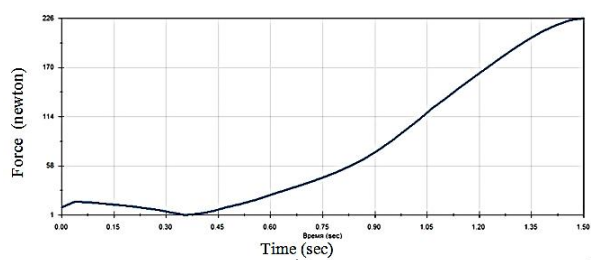
Fig. 4. The driving force
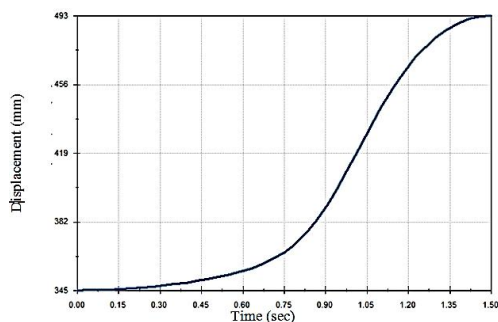
Fig. 5. Displacement of vacuum grips
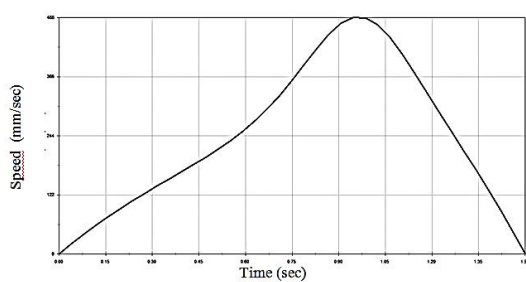
Fig. 6. Speed of vacuum grips
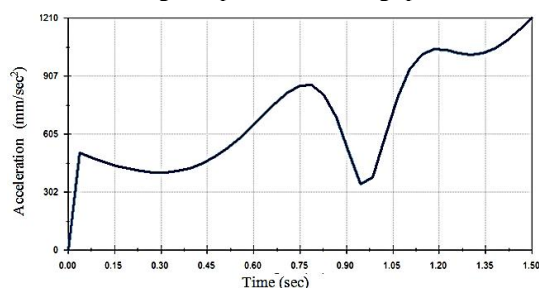
Fig. 7. Vacuum grips acceleration
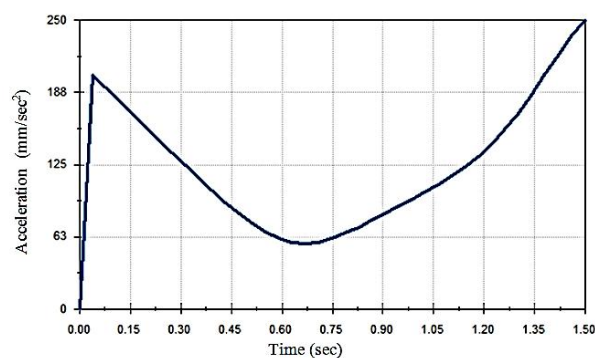
Fig. 8. Stock acceleration
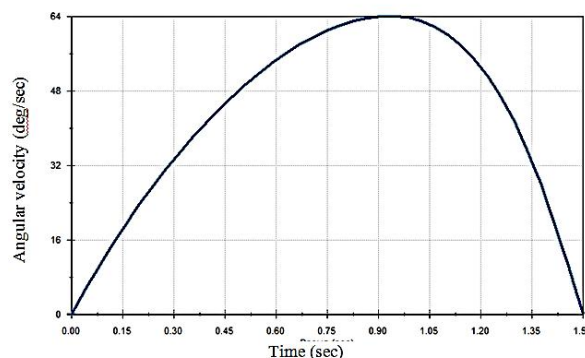
Fig. 9. Angular speed of the connecting rod
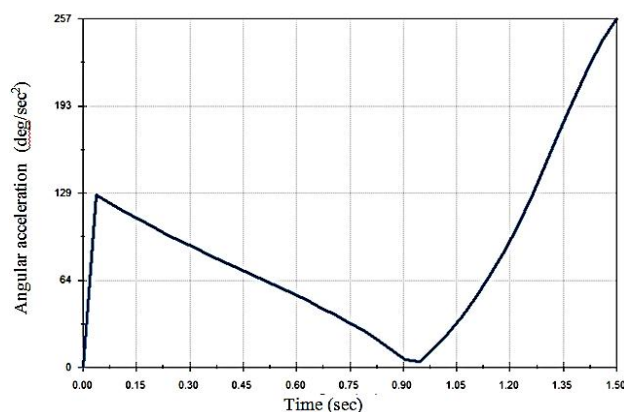
Fig. 10. Angular acceleration of the connecting rod

Conclusion

When developing the packaging orientation mechanism, a flexible system of production is taken into account. Using the computer simulation, the kinematic and power parameters of the mechanism are determined. The structure of the mechanism is analysed and the degree of freedom is determined

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Research of Pneumatic Systems of Automatic Dosing of Liquid

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Abstract – The theoretical generalization and given practical solution are important national and economic significance of the scientific and technical problem of creating a competitive single-type liquid dosage equipment for automation of the technological process containing contours of the dosage of liquid supply. The paper presents research materials and proposes structural and circuit design solutions for the creation of a complex of pneumatic systems for the automatic dosage of liquids with dose measuring on indirect parameters, representing a new original technology in this area.

Keywords – dosage, dosing device, automatic control system, automatic dosing system, technological process, actuator, control unit, object of management.

I. Introduction

In scientific work is solved a large scientific and technical problem, which has an important national economic significance, – the creation of a competitive dosing equipment of the same type for the automation of production technological processes (TP) containing contours of dosed fluid supply. In connection with this, a new technology for the construction of automated dosage systems (ADS) of liquids, which is considered as a set of dispensing devices (DD) as an object of control and control devices (PU), which provide management of executive bodies of the DD for a given algorithm The design of ADS is based on the use of methods of measuring the dose by indirect parameters, equipment of industrial pneumatic automation in the control units and sensors of flow parameters of bubble-type fluids.

II. Actuality of work

1. A significant part of the TP of chemical, petrochemical, food, textile, perfumery, paint and varnish, packing (liquid products in the packaging) and other industries is characterized by the presence of operations for which implementation of the automatic submission to the control object (CO) is required to be established by the technological regulations doses or costs of liquid components. At the same time when designing the equipment it is necessary to take into account the diversity of physical and chemical properties of the dosage compositions, provide a fairly high accuracy and wide range of dosage.

The task of automation of dosing operations is complicated if it is necessary to implement an automatic regulation system (ARS) of TP parameters, the effect of which is achieved by introducing into the OM dose of a fluid. In this case, the ADS should be considered and, accordingly, projected as an actuator in the ACS, in which, in addition to the means of automatic control and regulation of the main parameters, the control circuits of the actual processes of the dosing should be contained.

2. Among the above-mentioned productions, connected with tasks of automation of processes of dosing of liquids, packing production occupy a special place. This is due to the fact that in the last decade Ukraine has been developing the packaging industry. A number of small and medium-sized businesses that produce and package liquid products in packaging form. In connection with this, the problem of creating high-precision, inexpensive, reliable and compact import-packing equipment, which takes into account the specific conditions of small-scale production, becomes extremely urgent.

III. The purpose of the work

Research and development of principles of construction, design techniques and hardware implementation of the ADS system of wide-use fluids, including the following systems.

1. Universal ADS for the construction of ADS TP with a resettable structure for Om, having inertial latency and parametric non-stationary (for example, OM processes of purification of industrial waste water galvanic production).

2. Universal autonomous ADS for the automation of processes of partial and continuous dosage of liquids in the quantities set by the technological regulations.

3. High-precision, low-cost and compact import-replaceable grease for packing of liquid products into containers for small industries, including typical ones with manual installation of containers for the position of infusion, and built on the basis of typical – individual systems built into conveyor belts with wide functional capabilities. on the operational adjustment of both the dose value and the range of dosing.

4. Systems of multicomponent dosage.

IV. The scientific novelty

The scientific novelty of the work consists in the development, substantiation, analytical and experimental study of new original technologies and circuit decisions based on the methods of measuring the dose by indirect parameters for the creation of a complex of liquids. This generalized formulation of the scientific novelty of work is revealed by the following innovations:

1. A new classification of ADS has been developed on the basis of the presence or absence of sensors in the system of control of its initial parameters and methods of control of these parameters, on the basis of which developed rational principles for the organization and construction of ADS.

2. On the basis of the proposed new method of portioning of liquids, a new class of closed universal SAD with a single output parameter – the current value of liquid flow at the output of the remote control, is transformed into compressed air pressure.

3. The methodology of the analysis of systematic errors of the processes of a portion dosage of liquids is proposed, and it is also acceptable for the analysis of metrological characteristics of similar processes.

4. The principles of construction, methodology of designing and nomenclature of typical SAD on indirect parameters for small manufactures on the basis of the use of sensors of flow parameters of bubble-type fluids and equipment of industrial pneumatic automation are developed.

A new classification of ADS has been developed. The basis of which is the indication of the presence or absence of control of its initial parameters and methods of control of these parameters in the system of data-chips. At the same time, in the case of ADS, adapted for work in the structure of ACS with a resettable structure, the principle of dosage is better, based on the use of closed systems according to the initial parameter. This principle corresponds most to the ADS on the basis of the remote control with a single output parameter.
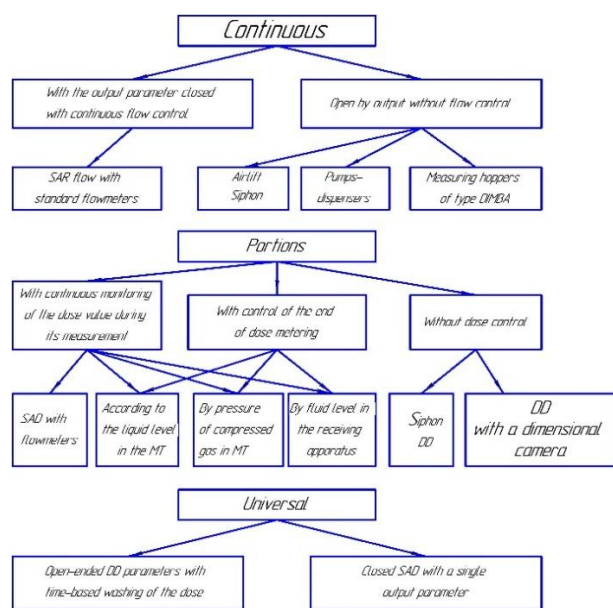
Fig. 1. Classification of SAD

Conclusion

As a result of our research and experiments, we can significantly simplify the design and reduce the cost of designing and manufacturing ADS, as well as provide them with a number of positive qualities, including:

– the possibility of construction of uniform unified standard dosage systems in the form of a set of technological elements of the DD, forming an OM, and a pneumatic (or pneumatic) control device (CD);

– Simplicity of providing the necessary accuracy and wide range of dispensing;

– admissibility of dosing of liquids in containers of different volumes and configurations;

– the possibility of using the same type of equipment on liquids with a wide range of changes in physical and chemical properties;

– smoothness of regulation and operative setting, both the dose and the upper limit of the range of dosage;

– absence of "interoperative" drop formation;

– implementation (on their basis) of multi-channel and multi-threaded dosing systems and their combination with conveyor lines;

– fire safety when using only pneumatic tools, simplicity and safety of service.

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Optimization of Damping Parameters of Self-Oscillations of Multifrequency Oscillatory System

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Abstract − Developed and researched mathematical model four-mass scheme autoclave machine tools. Influence of parameters of internal friction is analysed in the joints of structural elements machine-tool on relative amplitude of vibrations the cutter and detail. The ambiguousness of influence of parameters of damping energy of vibrations is shown on relative amplitude of the vibrations a cutter and detail.

Keywords − self-oscillation, structural damping oscillations amplitude, frequency oscillations, the quality of the workpiece surface, the stability instrument.

I. Introduction

The existent methods of reduction of amplitude of self-excited oscillations can be broken up on two classes – technological and construction. To the technological methods it follows to take such as a choice of the corresponding modes of cutting and angle of sharpening of instrument [5]. To the construction is an increase of resistance in the oscillating system and use of dynamic vibration dampers [4], and taking into account a that circumstance, that self-excited oscillations take place in resonance, where influence of fading plays a large value, increase of resistance the oscillating system is not only a ponderable factor in reduction of amplitude of self-excited oscillations but also factor of possibility of their uprise in general, in fact if energy of friction will be anymore from energy of excitation, then auto-oscillation in general not will not arise up.

II. Main Material Presentation

For research the self-oscillations in the MDTD system, we will compile a system of differential equations of the four-mass oscillation scheme, which consists of (fig. 1) from the support, the cutter, the part and the spindle, which are interconnected with the base of the machine by elastic bonds with the damps corresponding to the classical scheme lathe, mass frame which is much greater than the mass of its individual components, so they consider fluctuations relative to conventionally fixed frame. Four-mass oscillatory scheme is characterized by its versatility, since if you replace the mass of the spindle with the weight of the table, and the mass of the support on the mass of the spindle, then this will be the scheme of the milling machine, similarly, you can describe the vibrational scheme of the machined centre.
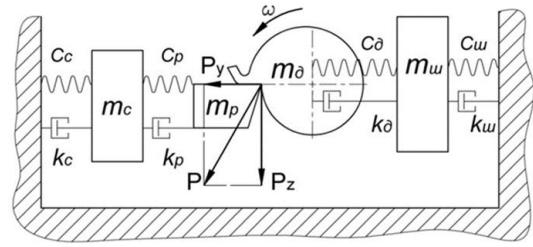
Fig. 1. Four-mass oscillation scheme of the machine tool

For simplify, consider the oscillation scheme in only one coordinate, namely – Y:

$$\frac{d^2 y_p}{dt^2} m_p + c_p(y_c - y_p) + k_p\left(\frac{dy_c}{dt} - \frac{dy_p}{dt}\right) + P_y = 0 \quad (1)$$

$$\frac{d^2 y_\partial}{dt^2} m_\partial - P_y - c_\partial(y_\partial - y_{uu}) - k_\partial\left(\frac{dy_\partial}{dt} - \frac{dy_{uu}}{dt}\right) = 0$$

$$\frac{d^2 y_{uu}}{dt^2} m_{uu} + c_\partial(y_\partial - y_{uu}) + k_\partial\left(\frac{dy_\partial}{dt} - \frac{dy_{uu}}{dt}\right) -$$

$$- c_{uu} y_{uu} - k_{uu}\frac{dy_{uu}}{dt} = 0$$

where y_i – the movement of the i-th element of the scheme (a support, a cutter, a part and a spindle); m_i – the mass of the i-th element; c_i – stiffness of the i-th element; P_y – horizontal component of cutting force; k_i – coefficient fading of the i-th element of the scheme.

$$k_i = \frac{m_i d_i w}{p}, \quad (2)$$

where δ_i – logarithmic decrement of oscillations of the i-th element of the oscillation scheme, which characterizes the temperature of the fading oscillation process; ω – angular frequency oscillation.

The horizontal component of the cutting forces on the theory Sokolovsky A. [5] is represented as follows:

$$P_y = P_0 - ry + a_1 b\frac{\&}{V} + a_2 b\left(\frac{\&}{V}\right)^2 + a_3 b\left(\frac{\&}{V}\right)^3, \quad (3)$$

where P_0 – value of the cutting force in the absence of vibrations, y – relative displacement between the cutter and the detail, r – coefficient of rigidity of cutting, $r = kb$, b – cutting depth, k – specific force of cutting ($k = 2000$ MPa), V – cutting speed Constant cutting a_1, a_2, a_3 – are determined by the least squares method by the experimental diagram.

For the case of our oscillation scheme (Fig. 1), f. (3) will take the form of:

Constant component of cutting force P_0 will decrease in the compilation of the system of differential equations (1), that is, we obtain oscillations relative to the constant component.

For the case of not very significant viscous resistance, when $k_i / (2m_i) < w$, the logarithmic decrement of

oscillations is defined as the natural logarithm of the ratio of two neighbouring amplitudes of fading oscillations [3]:

$$d_i = \ln \frac{A_n}{A_{n+1}} = \frac{k_i}{2m_i} T = \frac{p k_i}{m_i w}, \qquad (4)$$

where T – period of oscillations; $T = 2\pi/\omega$.

a

b

c

d
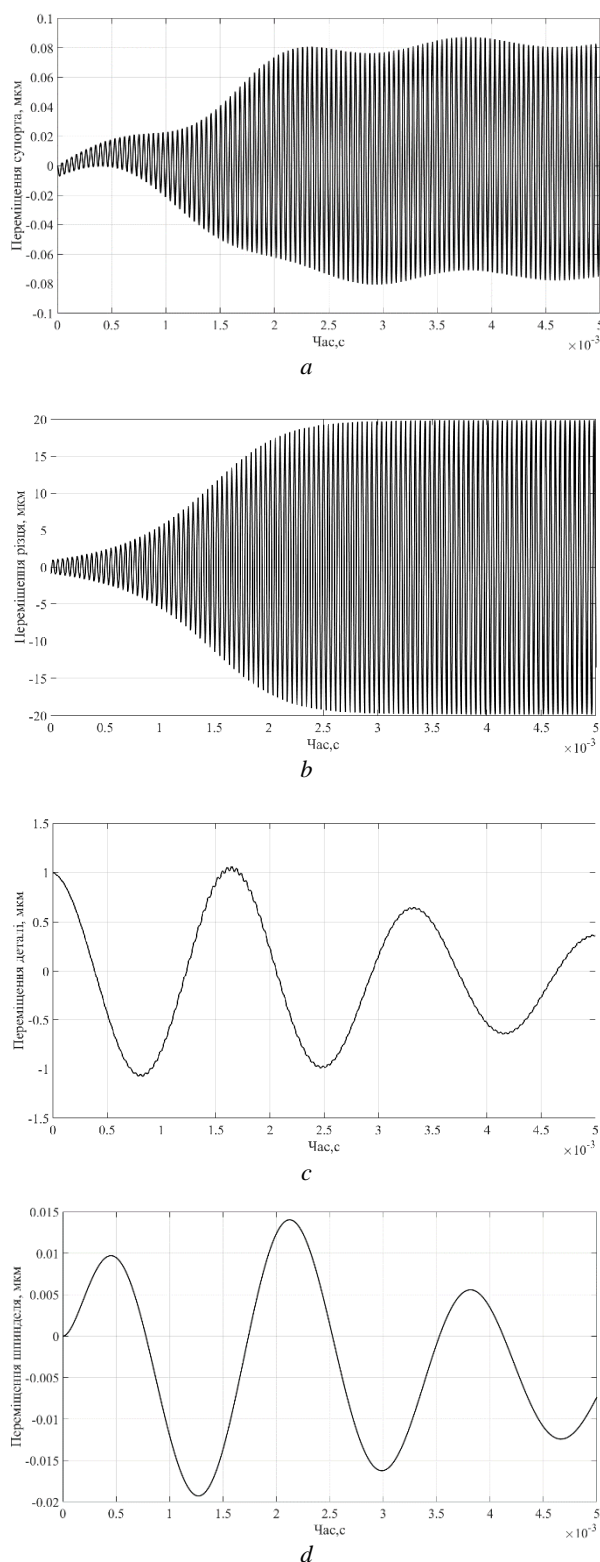
Fig. 2. Self-oscillation of working parts of the machine and detail with low damping

We find numerical solutions of the system of differential equations (1) for values $m_p = 0,1$ kg; $m_{\partial} = 1$ kg; $m_c = m_{uu} = 25$ kg; $c_p = 2\times10^9$ N/m; $c_{\partial} = 1\times10^7$ N/m; $c_{uu} = c_c = 1,5\times10^8$ N/m and we will build their time graphic dependencies. Coefficient the fading will be determined from the known values of the logarithmic decrements of oscillations: $\delta_p = 0,01$ (for steel 45); $\delta_{\partial} = 0,005$ (steel 14X17H2) $\delta_c = \delta_{uu} = 0,15$ (taking into account the existing structural damping elements in compounds lathe [4]).

Solutions of the system of differential equations (1) are presented in Fig. 2. In Fig. 2 (a), present the transfer of support in time, in Fig. 2, b – moving the cutter, in Fig. 2, g – moving of the part, and in Fig. 2, d – spindle.

As can be seen from the drawings, at the time t = 0, the coordinates (movement) of the support, the cutter and the spindle are equal to zero, and the displacement of the part is equal to 1 microns. This is the excitation of the system. And if the system was stable, then the oscillations of its elements (masses) caused by this excitement would have extinguished to zero. Since the system is unstable, then it generate self-oscillation. The oscillation amplitude of the support is less than 0.1 microns, the cutter is 20 microns. Oscillation of the part and spindle – even smaller. The relative amplitude of the oscillations of the cutter and the part is determined mainly by the oscillations of the cutter and is 20 microns. From the analysis of rice. 2 it is possible to set the frequency of oscillations. Period T = 4.405 × 10-5 s. Then the oscillation frequency f is equal to 22.7 kHz, and the angular frequency ω is 142628 rad/s, which approximately corresponds to the highest frequency of oscillations of the quadratic oscillation system with the parameters adopted for the study of the system.

Changing the material of the tool bit holder (steel 45, $\delta_p = 0,01$) on gray cast iron GCI 20 ($\delta p = 0,05$) we get a slightly lower (30%) amplitude fluctuations details, which will improve the quality of the workpiece surface [1] and the stability instrument.

Conclusion

Use of the tool bit holder from alloys of increased damping leads to a decrease in the high-frequency component of the amplitude of self-oscillations system MDTD. However, for some sub-optimal parameters of the system, this can lead to low-frequency self-oscillations with significantly higher amplitudes, the elimination of which is an extremely difficult task.

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Experimental and First-principle study of TmNiSb half-Heusler Alloy

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Abstract − The studied TmNiSb alloy crystallizes in the MgAgAs structure type (half-Heusler phases) and according to the results of DFT+U calculations revealed the presence of bandgap (Eg = 359 meV). Spin magnetic moment of Tm atoms equals 2.16 μB confirming its Tm^{3+} state. Calculated elastic properties as well as Vickers hardness of TmNiSb alloy was defined semi-empirically and equals 15.98 GPa. Experimentally determined microhardness is within the range of 2.90 – 4.06 GPa with the exception of TmNiSb phase.

Keywords − thermoelectric material, DFT+U modeling, half-Heusler phases, spin magnetic moment, mechanical properties

I. Introduction

One of the most significant current discussions in the energy sector is power generation from renewable sources. In this regard, the number of scientific papers (devoted to research more efficient thermoelectric materials) experienced steady growth. The research to date has tended to focus on highly effective thermoelectric materials to which belong half-Heusler alloys containing rare-earth metal. *R*NiSb compounds aren't completely investigated, so the profitable TmNiSb alloy which crystallizes in MgAgAs structure type [1] was chosen. The Curie-Weiss behavior for TmNiSb alloy is revealed [2]. From the point of electrical properties, the majority of *R*NiSb compounds are narrow-gap semiconductors. It should be pointed out that good mechanical performance is quite essential for the practical application of thermoelectric materials. In order to investigate structure peculiarities of TmNiSb alloy the X-ray diffraction, metallographic analyses and theoretical modeling of energetic, mechanical, and magnetic characteristics of Tm—Ni—Sb alloys were performed.

II. Computational Details

Crystal structure optimization was conducted using Elk [3] and Exciting [4] software packages. Modeling of the electronic structure for pure equiatomic TmNiSb was carried out in the framework of the theory of functional density by the DFT + U* method, which is a combination of an exchange-correlation functional in local spin density approximation (LSDA) and the Hubbard parameter (*U*). The the *k*-point mesh size was equal to 10×10×10 for a single unit cell. Visualization of bulk data was undertaken under the program VESTA [5]. For the basic mechanical properties definition the program ElaStic [6] was applied. Maximum values of η_{max} (0.04) and the number of defective structures (31) were elected as input parameters for calculation each components which for TmNiSb alloy are: C_{11} = 156,1 GPa, C_{12} = 51,3 GPa, C_{44} = 86,4 GPa. For each option of deformed structure the calculation of the total energy of the system was carried out and used for further defining basic parameters of mechanical properties. Experimental determination was performed with a microhardness tester PMT-3, applying a stress of 0.196 N with a loading time of 10 sec. For each value a number of 5 measurements were performed and the average value was calculated.

III. Results and Discussion

The X-ray diffraction analysis showed that the majority alloys of Tm—Ni—Sb system are mostly two-phase and are composed of binary and ternary phases (Table 1). In samples of the following composition $Tm_{30}Ni_{40}Sb_{30}$ and $Tm_{34}Ni_{33}Sb_{33}$, except binary phase TmSb (*ST* NaCl), ternary phase – TmNiSb (*ST* MgAgAs) is also presented. Increasing of Tm content causes the appearance of another ternary phase Tm_5Ni_2Sb (*ST* Mo_5SiB_2). Among all samples there was only one single-phase – $Tm_{50}Ni_5Sb_{45}$, the basic phase is TmSb (*ST* NaCl). Ternary phases was not observed in the samples with Sb contain more than 50 at.% Sb. All attempts to get single-phase $Tm_{34}Ni_{33}Sb_{33}$ alloy which corresponds to the structure of intermetallic TmNiSb (*ST* MgAgAs) were failed. This is due to the presence of impurity binary phase – TmSb which formation temperature (2293 K) is higher compared to the formation temperature of a TmNiSb ternary phase. Thus, for alloy TmNiSb with the least amount of impurity phase TmSb, the furnace should contain more Ni content.

Metallographic analysis showed that low-containing Tm alloys (e.g. $Tm_{25}Ni_{20}Sb_{55}$) are characterized by a three-phase area: dendrites, matrix and grains that form agglomerates, but increasing of Tm content causes porosity augmentation and its irregular distribution (e.g. $Tm_{65}Ni_{20}Sb_{15}$).

Realization of the DFT+U method required to find the optimal setting of Hubbard parameter. Defined value of Hubbard parameter is U = 0.4 Ha and following conditions are satisfied: 1) minimum total energy value → 5.71452 eV (E_0 = -586 972 eV); 2) adequacy of theoretical spin magnetic moments of Tm atoms ~ 2 μB (term $_3H^6$) → 1.93 μB.

Crystal structure optimization was conducted using software packages Elk, Exciting and optimization parameter of unit cell are 0.6191 nm and 0.6075 nm, respectively, which is close to the experimentally determined (0.6240 nm). The calculated value of the spin magnetic moment of atoms Tm is 2.16 μB which is close to the theoretical Tm^{3+} ion (2 μB) and is in comparison with experimental studies of TmNiSb magnetic characteristics in literature data [2].

TABLE 1

CRYSTALLOGRAPHIC CHARACTERISTICS OF ALLOYS OF TERNARY TM—NI—SB SYSTEM

Alloy	Phase	Structure type	Space group	Lattice parameters, *nm*		
				a	*b*	*c*
$Tm_{65}Ni_{20}Sb_{15}$	Tm_5Ni_2Sb	Mo_5SiB_2	*I4/mcm*	0.7472(7)	-	1.324(1)
	Tm_3Ni	Fe_3C	*Pnma*	0.684(2)	0.926(3)	0.596(1)
$Tm_{50}Ni_{20}Sb_{30}$	TmSb	NaCl	*Fm-3m*	0.6086(8)	-	-
	TmNi	FeB-b	*Pnma*	0.690(2)	0.4090(7)	0.5370(9)
$Tm_{30}Ni_{40}Sb_{30}$	TmNiSb	MgAgAs	*F-43m*	0.6240(1)	-	-
	TmSb	NaCl	*Fm-3m*	0.6112(9)	-	-
$Tm_{50}Ni_5Sb_{45}$	TmSb	NaCl	*Fm-3m*	0.6086(5)	-	-
$Tm_{25}Ni_{20}Sb_{55}$	TmSb	NaCl	*Fm-3m*	0.6092(1)	-	-
	NiSb	NiAs	$P6_3/mmc$	0.3914(1)	-	0.5138(4)
$Tm_5Ni_{45}Sb_{50}$	NiSb	NiAs	$P6_3/mmc$	0.3908(1)	-	0.5120(3)
	$Ni_{0.15}Sb_{0.85}$	Po	*Pm-3m*	0.3040(2)	-	-

The analysis of the distribution of DOS (Figure 1) showed that the TmNiSb alloy is characterized by the presence of a band gap (Eg = 359 meV), which has a Fermi level and should have semiconductor properties.
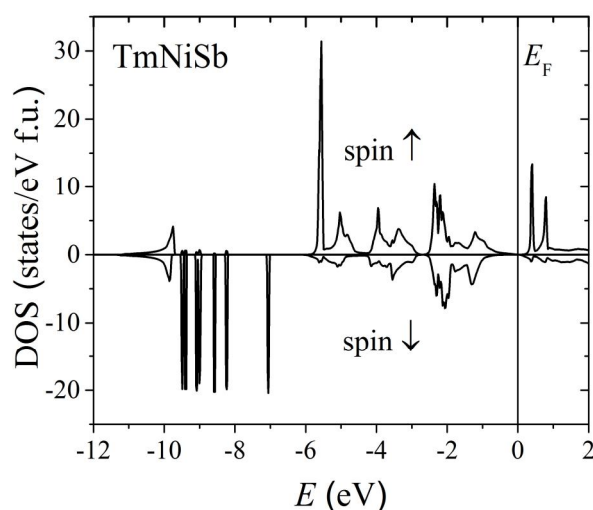
Fig.1. Distribution of the total and partial electron density of states (DOS) in the TmNiSb alloy.

Distribution of electron localization function (*elf*) revealed its localization between the atoms of Ni and Sb (Figure 2), indicating a significant contribution of the covalency into the Ni-Sb bonds. Spherical electron localized distribution around atoms Tm as polar intermetallic compound with positively charged ion Tm^{3+} and negatively charged sublattice $[NiSb]^{n-}$.

The 3*d*-shell of Ni atoms is completely filled, so atoms of the rare earth elements are in a R^{3+} state and are the source of TmNiSb magnetism.

Mechanical properties of alloys of Tm—Ni—Sb system has been investigated for the first time, so it was important to determine the order of hardness value.
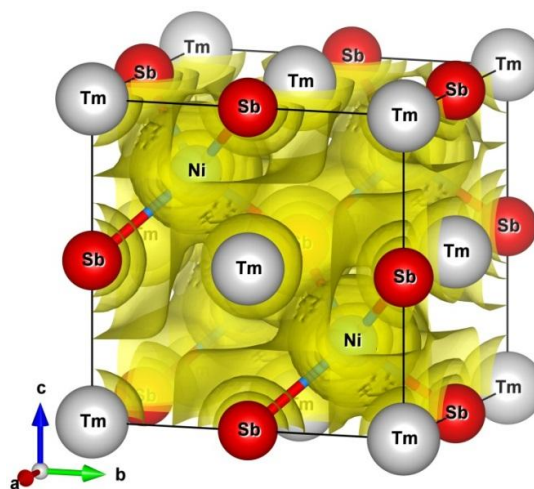
Fig.2. Distribution of the electron localization function in the TmNiSb alloy.

The experimental data showed that the value of microhardness is in the range 2.90 – 4.06 GPa. Samples inherent brittleness increases with Sb amount rising. Table 2 shows the fundamental parameters of mechanical properties of TmNiSb alloy computed by ElaStic and experimental data for $Ti_{0,50}Zr_{0,48}Nb_{0,02}NiSn_{0,98}Sb_{0,02}$ thermoelectric alloy, both intermetallic compounds are characterized by MgAgAs structure.

TmNiSb alloy is characterized by the low values of shear modulus, indicating a low resistance to deformation shift and the ratio $1/B$ together with Poisson's ratio v define poor fracture resistance, thus the material is brittle.

MECHANICAL CHARACTERISTICS OF
THERMOELECTRIC ALLOYS WITH MGAGAS-
STRUCTURE TYPE: BULK MODULUS, B (GPA),
SHEAR MODULUS, G (GPA), YOUNG'S MODULUS,
E (GPA), POISSON'S RATIO, N, B/G RATIO, AND VICKERS
HARDNESS, H_V (GPA)

Mechanical parameter	TmNiSb	$Ti_{0.50}Zr_{0.48}Nb_{0.02}NiSn_{0.98}Sb_{0.02}$ [7]*
B	86.3	146,9
G	70.7	70,1
E	166.6	181,5
v	0.18	0,294
B/G	1.220	2,095
H_V	**15.98**	10,78

*Experimental.

According to the Pugh rule [8], the critical value of B/G ratio which separates ductile and brittle materials has been evaluated to be equal to 1.75. The B/G ratio equals 1.22, (B/G <1.75) and defines a brittle behavior of structure which is consistent with experimental results.

Based on the calculated values of bulk modulus and shear modulus for TmNiSb Vickers hardness value was defined semi-empirically and equals 15.98 GPa. This result close to hardness value in the highly effective thermoelectric material [7].

Conclusions

The X-ray diffraction analysis showed that alloys with the composition close to equiatomic contain except the TmNiSb main phase an impurity one – TmSb. In order to reduce its amount in alloy a higher Ni content in the sample is required. Metallographic analysis revealed that alloys of Tm-Ni-Sb system are characterized by dendrite structure. The disorder of structure is defined by the number and distribution of pores. The electronic structure modeling of TmNiSb alloy showed that spin magnetic moment of Tm atoms equals 2.16 μB and confirms Tm^{3+} state. The distribution of the density of electronic states predicts semiconducting properties of TmNiSb.

The microhardness of alloys with the exception of TmNiSb phase is within the 2.90-4.06 GPa range.

The modeling of mechanical properties showed that Vickers hardness of TmNiSb alloy equals 15.98 GPa that is close to the value of another $Ti_{0.50}Zr_{0.48}Nb_{0.02}NiSn_{0.98}Sb_{0.02}$ Half-Heusler alloy with high ZT. Brittle behavior from B/G ratio indicates a significant impact of covalency in the chemical bonds between Ni and Sb in TmNiSb.

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Prospects for the use of nanomaterials and nanocoatings for high-speed spindles

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Abstract – Much attention in the field of research and use of nanomaterials and nanotechnology has led to the fact that this area of science has become more relevant. The special qualities of nanomaterials that provide unique strength, thermal conductivity, electrical properties, tribotechnical properties with minimum dimensions and mass of products have become the goal of many scientists. The main types of nanomaterials are identified. One of the differences between nanostructural depositions on the surface is their strength under static loading and hardness as compared to materials from ordinary grain sizes. Increased hardness and wear resistance as a result of deposition of such coatings opens the prospects of using them in high-speed spindle units.

Keywords – nanomaterials, nanocoatings, strength, thermal conductivity, electrical properties, thermal conductivity, high-speed spindle unit.

I. Introduction

Recent years in Ukraine and the world, much attention is paid to research in the field of nanomaterials and nanotechnologies. The reasons for this attention are the special qualities of nanomaterials that provide unique strength, thermal conductivity, electrical properties, tribotechnical properties, and the like. with minimum dimensions and weight of products.

II. Page Setup

One of the first researchers in this direction of science was the Nobel laureate R. Feyman, who in 1959 drew attention to the possibility of creating new materials by composing small objects – atoms, molecules and their groups [1].

Nanomaterials were also considered in the works of N. Taniguchi [2,3], who proved the possibility of creating materials with grain sizes less than 100 nm. The useful additional properties of such structures in comparison with traditional microstructural materials were determined by the scientist G. Glater and presented in his works [4-7], and later he introduced such concepts as: nanocrystalline materials, nanostructured, nanophase and nanocomposite, etc. [8-11].

The development of fundamental and applied ideas about nanomaterials and nanotechnologies in the coming years can lead to cardinal changes in many spheres of human activity: in materials science, power engineering, electronics, computer science, engineering, medicine, agriculture, and ecology.

This field of science has developed in Western Europe, but now in most other countries the majority of scientists work in this field because of the possibility of solving many important production problems.

The following main types of nanomaterials stand out:
- nanoporous structures;
- nanoparticles;
- nanotubes and nanofibers;
- nanodispersions (colloids)
- nanostructured particles and films;
- nanocrystals and nanoclusters.

III. Research of the efficiency of the use of nanomaterials and nanotechnologies

Nanoclusters are private sizes of 1...5 nm and contain up to 1000 atoms. Plastic particles can contain more atoms, their properties remain characteristic of nanocrystals. When a nanoparticle has a complex shape and structure, the non-linear size of the fraction is considered, and the size of its structural element is a nanostructure (linear dimensions greater than 100 nm).

An important limitation for the use of nanostructured structural materials is their tendency to intergranular corrosion due to the very large volume fraction of grain boundaries. In this regard, they can not be recommended for operation in conditions conducive to such corrosion (diffusion from the surface of the interstitial elements and elements diffusing along grain boundaries, high temperatures in combination with corrosive effects, radiation, alloy composition prone to changes in chemical composition along the grain boundaries etc.). Another important limitation is the instability of the structure of nanomaterials, and, consequently, the instability of their physico-chemical and physical-mechanical properties. So for thermal, radiation, deformation, etc. effects are inevitable recrystallization, relaxation, segregation and homogenization processes, as well as the phenomena of decay, phase transformations, sintering and swimming of nanopores and nanocapillaries, amorphization or crystallization [11]. For example, carbon nanofibers intended for the transfer of liquids can be damaged by vibrations and the structural instability of carbon excited by the flow of liquid. When molding products from nanopowders, the problem of clumping (sticking of nanoparticles) into agglomerates quite sharply arises, which can complicate the production of materials with a given structure and distribution of components

The main advantages of nanomaterials are:

1) very small sizes of layers that are applied, which allows them to penetrate into parts of micromachines and devices that are inaccessible to other materials;

2) a large surface area interacting with nanomaterials and the medium in which they are located;

3) absence of point defects, increases the strength of nanomaterials.

Such qualities make it possible to increase the stability of steel and other metals by applying a layer up to 10 nm.

A significant difference of nanostructural depositions on the surface is their strength under static loading, and also hardness in comparison with materials from ordinary grain sizes [6-8]. Therefore, the main direction of their use today is the use of high-strength and wear-resistant materials and coatings. Composites reinforced with carbon nanofibres are promising materials for work under shock dynamic loads [8].

Conclusion

Increased hardness and wear resistance in comparison with conventional steels [8] opens up prospects for using nanocoatings in high-speed spindle units. The superstructures of films of complex composition based on carbon and titanium having very high or ultrahigh hardness have very well proven in sliding friction and under impact conditions, it is important at the time of starting and stopping the high-speed spindle. Also an advantage is their self-lubricating qualities.

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Study of Comfort Pedestrian Traffic Conditions

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Abstract – Urban transport system can not exist without the infrastructure for pedestrians. The needs of pedestrians should be considered when designing new roads or reconstruction of existing roads. Unfortunately, in many cities of Ukraine have many problems related to sidewalks and other items pedestrian facilities, so they must be evaluated and reconstructured if necessary. The focus of this study is to show the existing methods of assessing the level of comfort of pedestrians successfully used worldwide.

Keywords – sidewalks, pedestrian comfort level of service, evaluation methods, qualitative factors.

I. Study of Comfort Conditions

Comfort is a positive emotional reaction to the external environment or the situation [1]. The comfort of pedestrian traffic conditions can be considered as a certain emotional reaction to the external environment in different situations.

Separately distinguish the notion of physical, physiological and psychological comfort of pedestrian traffic. Under the physical comfort of the pedestrian movement, the minimum amount of effort spent traveling is understood, which is manifested in such parameters as adequacy, continuity and unimpeded design of the sidewalk, its convenience for certain categories of people, the state of coverage, and the availability of protection against adverse weather conditions. The psychological comfort is provided by the ability to maintain the desired speed of movement, as well as the ability to use the surrounding infrastructure. In addition, the level of noise and pollution determine the physiological state of pedestrians.

All these types of comfort are interconnected and the overall feeling of comfort depends on the positive reactions of the pedestrian on all three levels.

Methods for estimating pedestrian traffic conditions can be divided into three types:
- those based on pedestrian flow characteristics;
- those based on the characteristics of the host environment;
- assessment based on the perception of pedestrians.

Methods based on pedestrian flow characteristics are based on the methodology for estimating transport flow rates. In this method, personal perception of pedestrian traffic conditions is not taken into account, and the indicator of comfort in the overwhelming majority is calculated from the value of the accessible personal space of a person.

The methods based on the assessment of the host environment take into account the factors that have a positive and negative impact on the pedestrian during the movement. Such methods give a wider assessment of the conditions of movement, but often are not quantitative but qualitative, and therefore the results are directly dependent on the particular situation and the person who conducts the assessment.

The pedestrian-based assessment reflects pedestrian-friendly information on driving conditions. Such an assessment is carried out by the method of sociological research. The results are directly dependent on the respondent person.

The most common methods for assessing pedestrian traffic conditions include:
- assessment of pedestrian traffic conditions according to HCM (Highway Capacity Manual) [2];
- a method for assessing the comfort of pedestrian traffic developed by Sheila Sarkar [3];
- assessment of pedestrian conditions Nicole Gallin (Nicole Gallin) [4];
- The assessment of pavement quality was carried out by the staff of the Georgia Institute of Technology [5];
- assessment of the conditions of movement B. Landis (B. Landis) [6];
- estimation of comfort conditions of traffic conditions by the method of survey of pedestrians [7].

The assessment of pedestrian traffic according to HCM (Highway Capacity Manual) is determined by the LOS (Level-of-Service) level for sidewalks based on the results of calculating pedestrian velocity, available personal space and pedestrian flow intensity to the effective width of the sidewalk. That is, this method considers the pedestrian flow in the same way as the traffic flow, determining speed, density and intensity. Conditions are considered comfortable for movement when the pedestrian has a sufficiently individual space to choose the desired path and speed.

The method of assessing the comfort of the pedestrian movement developed by Sheila Sarkar distinguishes three different types of comfort: physical, psychological and physiological. These three species are interdependent and a sense of overall comfort is achieved only when combined with all three types.

Nicole Gallin's pedestrian traffic assessment is based on the Level-of-Service (LOS) level method for highways. In this paper, a number of factors were distinguished into three categories:

1. Constructive factors: pavement width, pavement surface quality, obstacles, pedestrian crossings, lawns, fixtures, which should provide normal lighting and auxiliary equipment such as: placement of appropriate road signs, traffic lights, and other engineering devices to ensure traffic safety.

2. Factors of location and environment: connectivity, pavement environment and the possibility of conflicts with cars.

3. Factors associated with pedestrians such as the intensity of the pedestrian flow, the flow structure and pedestrian protection.

Also, the assessment of pavement quality was carried out by the staff of the Georgia Institute of Technology. The purpose of this project was to develop and test the method of automatic data collection on the condition and quality of the pavement surface. A special AndroidTM software called Sidewalk SentryTM was developed.

The automated paving system quality and pedestrian safety assessment have been implemented in this project to help communities assess the pavement and compatibility of Sidewalks and the Americans with Disabilities Act (ADA). The results helped researchers find priorities, as well as improve sidewalks and pedestrian infrastructure.

The first step is to improve the pedestrian infrastructure and improve Walkability, which assesses the current quality of the infrastructure. Prioritization improvement requires:

Knowledge of the current state of the system – Georgia Tech Institute (Georgia Tech) The research team has successfully created a new Android application for pavement qualities:

(Appendix) to collect the Global Positioning System (GPS), sidewalk video and Android recordings on a gyroscope tablet and an accelerometer to use this data when assessing the quality of pavements and the road network. Video processing, previously developed by researchers at the Georgia Institute of Technology (Georgia Tech) for tracking vehicles, researchers were able to process videos captured using GPS to estimate the width of the sidewalks, identify cracks and potholes that require maintenance, and record the localized presence of obstacles. on the respective sections of the route. Although the research team was unable to fully automate the program, but it significantly reduces labour costs for assessing the quality of sidewalks and video GPS helps detect the condition of the road network and the state of the processing system as a whole.

The assessment of the conditions of B. Landis aims to study the conditions of motion and determine the main factors affecting the pedestrian during its movement, and also, based on these data, to form a mathematical model that will be needed for the planning of new streets and reconstruction. already existing. The main difference of this technique from many others is that the presence of sidewalks is a prerequisite for assessing the conditions of movement, which is that it can be used in places where there is only a road without sidewalks.

The assessment of the comfort of the conditions of the movement by the method of survey of pedestrians is based on the theory that comfort is a certain positive emotional reaction to the external environment in different situations, it can be assumed that this feeling is temporary. This technique was used in this study, called PROMPT (PROMote Pedestrian Traffic), which has been tested in European countries such as Belgium, Finland, France, Italy, Norway and Switzerland. Having analysed the previous studies, it was concluded that the feeling and degree of comfort depends on the environment, a particular situation and personality. The list of questions to include all factors that have an impact on the pedestrian was impossible, so it was decided to include the following questions about the following factors: thermal comfort, visual comfort, acoustic comfort, tactile comfort, odours, air pollution, ease of travel and a sense of safety. Pedestrians had to evaluate each of the factors on a scale from 1 to 7, where 7 – the highest score, as well as how important each of them is to each particular factor. As it turned out, for most of the interrogated feelings of safety and security is the most important factor affecting the comfort of travel. As a result of the study, the degree of dependence between feeling of comfort and factors of influence was determined.

Conclusions

Each of the above methods can certainly be used separately, but taking into account the fact that the influence on the conditions of pedestrian traffic are flow factors, environmental factors and those related to the pedestrian state can be concluded that a more accurate assessment of pedestrian conditions will be when combining all methods of evaluation.

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The change of bus driver's functional condition, moving in the plain road

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Abstract − The driver's functional condition is one of the indicators that reflects his readiness to perform professional tasks. At the same time, the driver is forced to work in different conditions in terms of complexity. Some of these are motion the flat conditions of motio. Studies show that these conditions can be attributed to the simplest according to the impact on the drivers body.

Keywords − psychophysiological indicators, driver, functional state, traffic conditions.

I. Introduction

One of road`s traffic management main tasks is road safety. In this case, this indicator depends on the driver's actions. So, today it's not enough to use only the traditional methods of traffic safety level improvement. Also, there are increasing the analyzing methods importance, that describes the reliability of link "driver" in "driver-vehicle-road-environment" system. This is due to the fact, that the safety of all traffic participants depends on driver`s actions and on the state of his organism. Therefore, by studying these issues, we can increase the road safety level and decrease the probability of accidents.

II. The driver's functional state and methods of its research

Nowadays physiological studies of drivers get new techniques. Each year, researchers from different countries are offering modern and advanced means of determining the drivers functional condition . To choose the method , and then to develop an application method based on it, it is necessary to determine what indicators we need.

As you know, the human condition is examined using an electrocardiogram, an electroencephalogram, or a skin-galvanic reaction [1].

The latter method makes possible to assess the emotional status of the driver as a vegetative reaction of the central nervous system, which is manifested in the change in the electrical properties of the skin. The results of the leather-galvanic reaction give an opportunity to assess the driver's reliability not only in the emotional status, but also in the reflection of such mental processes as readiness for future action, level of vigilance, intensity of attention and degree of overwork. As a drawback, it should be noted that the skin-galvanic reaction fading as soon as the stimuli lose the properties of novelty or significance for a person [2].

Electroencephalogram – a record of electrical activity of the brain, which allows you to identify some characteristics of neural areas activity in natural conditions. In the analysis of electroencephalograms, first of all, the frequency, amplitude, form, duration, character of the distribution of its waves are taken into account [2]. This method is very informative, since it shows direct changes in human psycho-emotional reactions to the environment. The disadvantage of this method is, first of all, the cumbersome – the measuring device must be constantly connected to a personal computer, and 32 leads to the head of the subject should be pressurized, which creates discomfort. Besides, the quality of the signals that the device handles the surrounding electromagnetic fields.

Using the electrocardiogram can test the functioning of the cardiovascular system, which is a functional system with multi-level regulation. The ultimate result of its activity is to provide a given level of functioning by the whole organism. As a result, the blood circulation system can be considered as a universal indicator of adaptive activity. This leads to the fact that the researched values are powerful indicators of the general human body condition or its response to any external influence, use an electrocardiogram [3].

Electrocardiogram – a graphical record of changes in the difference in electrical potentials arising on the surface of the body as a result of the heart [4]. To assess the psycho-physiological condition of a person, most often, analyze the change in pulse, the shape of the apexes and the ratio of intervals between individual complexes. In this case, the relative changes in these characteristics of the electrocardiogram do not depend on the number of sensors used with this or that device [2, 4]. This investigation can be considered the most convenient method for determining the functional condition of drivers in real conditions. This is due to the fact that such an analysis gives quantitative indicators, the limits of which are determined for one or another driver's status, which means that the analysis of the data is fast enough. Also, the convenience of using an electrocardiogram is due to the portability of used devices, which does not prevent the explored drivers from moving and do not interfere with the control of the vehicle.

Heart rate variability (HRV) is one of the most advanced methods for studying the mechanisms of the cardiovascular system based on the records of the electrocardiogram. Using this method, one can describe the condition of regulation tools, that manage physiological oscillations in the human body [2, 4, 5]. One of the basic methods, providing complex evaluation of functional condition based on electrocardiogram analysis is regulatory systems activity (RSA) index. The determination of this indicator is possible using the next algorithm [5]:

$$ПАРС = |А| + |Б| + |В| + |Г| + |Д| \qquad (1)$$

The RSA index is a heart rate variability complex value and displays level of driver's functional condition. This indicator is measured with the ten-point scale: from 1 to 3 – means regulatory systems condition being optimal. in

normal stress; 4 and 5 – medium stress which demands the body to additional reserves for better adaptation to the environment. This body shape is observed during the adaptation to working activities in the start of working day or and under the emotional stress; 6 and 7 – pronounced regulatory systems stress, within it, the body's defense mechanism is able to be activated; from 8 to 10 –, failure of regulatory systems adaptation. This condition is characterized by reducing of regulatory mechanisms activity when the accumulated tiredness and nervous strain are observed. The protective and adaptation body tools cannot carry out the impact of environmental factors.

III. Results of full-scale research

The research was conducted on buses with different technical parameters. Taking into account their specific power, all of them are divided into three groups: 1 group – from 11 kW/t to 13 kW/t; 2 group – from 13 kW/t to 15 kW/t; 3 group – from 15 kW/t to 17 kW/t.

The highways that lie in the plain conditions were characterized by a large number of straight road parts with a considerable length. In such conditions, the driver's work becomes monotonous. Often the drivers said that such conditions didn`t lead to the appearance of fatigue. The results of the research are shown in Fig. 1
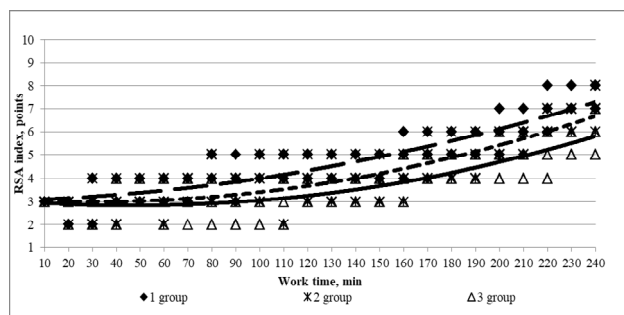
Fig. 1. The change of driver`s RSA
index while driving different buses:
— — — – 1 group;
— — — – 2 group;
————— – 3 group.

According to the Fig. 1, the driver`s RSA index during driving the bus on the road in plain conditions increases to 6 – 7 points. It depends on the parameters of the bus. Founded that while driving a bus from the first group, the driver`s RSA index varies in the range of 7 points, the second and third groups – 6 points. Also driving a bus from the third group, the driver`s functional state starts to increase only after one hour of the work.

It was found that the functional state of the driver's organism in this conditions didn`t move to the state of regulatory systems adaptation failure. Also made the analysis of the driver's RSA index data while he was driving the bus in these conditions. The results of distribution are shown in the histogram (Fig. 2).
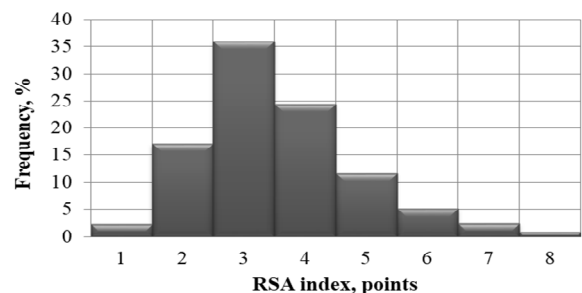
Fig. 2. Histogram of bus driver`s RSA index distribution

Investigated that the driver`s RSA index during driving the bus on the roads that lie in the plain conditions is varying from 2 to 5 points.

Conclusion

Studies show that the drivers body in such motion conditions is usually in optimal and moderate tension of regulatory systems. The results of researches show that in 89% of the total work duration, drivers body is ready to perform assigned professional tasks. Such cases as 1, 7 and 8 points of RSA index value does not exceed 6%.

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Investigation of transport noise on the streets of Lviv depending on the type of road surface

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Abstract – In the work of the study of transport noise in the city of Lviv on different streets in different characteristics. Thus, it is established that the noise level in the streets where the tram carriages travel exceeds the permissible norm. To reduce the noise of the street, it is necessary to arrange the noise protection screens and create a protective barrier of trees and shrubs.

Keywords – level of transport noise, type of coverage, tram cars, speed of movement.

I. Introduction

Noise pollution of the environment by automobile transport has local nature and with every year enlarges, which negatively impacts on environment in districts of the largest transport highways. Transport noise creates by means of engines, wheels and aerodynamic features of separate vehicles and this, in its turn directly depends on speed, intensity of traffic, road surface type etc. Noise pollution is very dangerous for human health, because doing your everyday business and duties it is almost impossible to avoid it.

II. Problems of noise pollution

By contemporary views noise affects the most important systems of human organism: central and vegetative nervous systems, endocrine, cardiovascular, immune systems etc [1]. Noise prevents verbal connection, sleep, strikes organs of hearing, causes physiological and psychological problems, impacts on social behavior of people, can devalues real estate, ground sections [2]. Therefore very actual is investigation of transport noise level depending on impact of speed, intensity of traffic, composition of traffic flow, road surface types on the cities road networks.

There are exists a lot of various methods of noise level measurement, but the range of researchers, having analyzed all these methods, came to the decision that field measurements are the most precise [3]. Critical impact on the noise level has speed of movement, it is proved that the higher speed the vehicle develops the bigger noise it creates. This is due to the fact that the noise level of engine, transmission, body and wheels of vehicle enlarges.

Noise pollution is determining by 12-point system [4], which is given in table 1.

TABLE 1
CHARACTERISTIC OF ZONES
AND LEVELS OF NOISE POLLUTION IN CITIES

Point	Characteristic of noise pollution zone	Noise level, dB
1	Noise pollution is absent	35 and less
2	Very weak	40
3	Weak	45
4	Imperceptible	50
5	Small	55
6	Moderate	60
7	Big	65
8	Perceptible	70
9	Strong	75
10	Dangerous	80
11	Very dangerous	85
12	Extremely dangerous	90 and more

Also it is already investigated oriented noise from different types of vehicles, which is emitted by them in the environment (table 2) [5].

TABLE 2
ORIENTED VALUES OF NOISE DEPENDING
ON VEHICLE TYPES

Vehicle type	Noise level, dBA
Cars	75 – 85
Freight diesel-fuelled vehicles	92 – 100
Freight vehicles with carburetor engine	82 – 86
Diesel-fuelled buses	90 – 96
Buses with carburetor engine	80 – 86
Trolley-buses	76 – 90
Trams	76 – 96
Motorcycles	88 – 98
Motorbikes	84 – 102

Questions, which are connected with the noise during vehicular and tram movement on the streets of cities, were raised by a lot of specialists. The majority of specialists claim that on the streets of Ukrainian large cities with every year the more clearly visible the trend to the increasing of transport noise factors, level of which approaches to critical.

II. Investigation of transport noise on street sections with different road surface types

Field researches were carrying out in Lviv city on Horodotska, Stepana Bandery, Shevchenka, Siajvo and Luhanska streets. Streets were chosen depending on surface type, distance to the residential space, intensity and speed of movement, and also were took into account presence of trees near the automobile road and placement of tramroads. Noise level measurements were held with the help of noise-meter model SL-814, which measures noise level in the range from 40 to 130 dB. Research results of transport noise on the roads with different surface types are given on fig. 1. For noise level comparison, which exists near the roads, research is

carried out depending on distance to the edge of carriageway. On Horodotska, Stepana Bandery and Shevchenka streets the type of surface is block stone, and on Luhanska and Siajvo streets – asphalt.
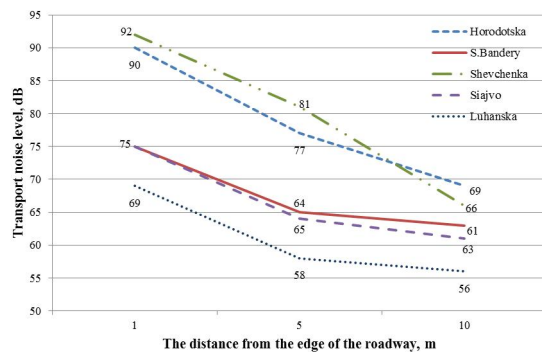
Fig. 1. Noise level change depending on the edge of road carriageway of different types

Analyzing fig. 1 we can claim that notable higher noise level is observed in close to automobile road, maximum value is observed on Shevchenka street – 92 dB, on Horodotska street – 90 dB. Such high noise values are conditioned by movement of tram carriages in composition of general traffic flow and by the absence of green plantation between the road and the pavement. On these streets during the day time exists significant traffic intensity, because these streets are main streets of city significance. On St. Bandery street significant noise pollution is caused by unevenness of block stone, unsatisfying condition of tramroads and significant intensity of public transport movement. On Luhanska street are observed the lowest values of noise level from 56 to 69 dB, even despite of the fact that speed of movement is quite high, and low values are observed for the reason that the street is narrow and near the road are placed the trees, which decrease noise pollution into neighboring territory. On Siajvo street is observed moderate level of noise pollution. The street belongs to main street of district significance. There are two lanes in

every direction on the street and there is trolley-bus movemet. Such imperceptible noise pollution on this street is observed within movement lane divider, on which trees and bushes are planted, and also between carriageway and the pavement are present green plantations, which serves as peculiar absorption barrier between traffic flow, pedestrian flow and residential area.

Conclusion

It is stated that noise level on the streets of Lviv city is greater than permissible levels. It is caused by the high intensity of movement on the streets with block stones, presence of tramroads and movement of tram carriages in general traffic flow. During vehicular movement on those road sections where is observed absence of green plantation, lane divider and exist road unevenness, transport noise level exceeds 70 dB, which characterize the road and roadside environment as zone of heavy noise pollution. For decreasing the noise level in cities and increasing the comfort of pedestrian movement and residence of people it is necessary to limit vehicular speed in cities, set noise absorbing screens and make green streets and pedestrian zones.

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Analysis Of Factors Which Define Time Losses In Traffic Flow

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Abstract − Reviewed geometric and planning road network parameters which impact on delays of movement in traffic flows, and also organizational questions, connected with them. Analyzed factors, which reduce vehicular speeds and encourages traffic jams generation.

Keywords − time losses, traffic delays, road network, speed of movement, traffic flow.

I. Introduction

Currently in large and especially large cities quite critically appears problem of traffic flow delays. The main reason is essential increase of motorization level, which enlarges traffic intensity, demands provision of urban space for temporary and permanent car storage (parking), decreasing amount of road lanes, and, therefore, capacity. This problem especially complicates because, despite of intensity growth, movement conditions practically do not change, especially in cities, where existing buildings do not allow to broaden width of existing roadways and build new streets and roads. Increasing of delays in movement comes from periphery to the center and also strongly depends from road network configuration and parameters, fraction of transit flows and specificity of building public transport lines.

II. Definition of traffic flow delays

Traffic flow delays are time losses on intersections, and also on areas between intersections, which are caused by different factors [4]. In general, for one vehicle movement delay is difference between actual and calculated speed of movement [1-3]:

$$t_\Delta = \int_{l_1}^{l_n}\left[\frac{1}{v_\phi(l)} - \frac{1}{v_p(l)}\right]dl , \qquad (1)$$

where v_ϕ and v_p – accordingly actual and accepted calculated speed of movement, m/sec; dl − elementary road section, m.

General delay for traffic flow will make [1-3]:

$$T_\Delta = N_a \cdot t_\Delta \cdot T , \qquad (2)$$

where N_a – traffic flow intensity, units/hour; T – duration of observation, hours.

III. Analysis of geometric and planning road network parameters

Let`s consider geometric and planning parameters which have significant impact on traffic flow delays. To geometric parameters belong horizontal and vertical curves, type, configuration and crossing angle of intersections, from which depends distance of visibility, as insufficient visibility encourages reduce in speed of movement; insufficient roadway width and number of lanes complicates or makes impossible performance of overtake maneuvers at all. Negative phenomenon is abrupt narrowing of roadway, which also encourages formation of traffic jams. To the planning belongs scheme of city road network: optimal scheme is rectangular-diagonal, but in majority of old cities exists free scheme, which complicates choose of optimal route of movement, thus enlarging load on certain city streets, and during generation of traffic jams emerges problem in implementation of detour.

Great problem is that majority of cities have existing buildings and very often it is impossible to affect the factors which were mentioned before. Often the generation of delays in traffic flows contributes their dissimilarity, presence of public transport in them, especially trams and trolley-buses, as their average technical speeds are inconspicuous (15-20 km/hour), and public transport stops are unequipped.

One more factor, which impacts on traffic flow delays, is type and condition of road surface, and also its quality. Unsatisfactory road surface condition reduces speed of movement, especially in rainy or snowy weather, because tire-to-surface friction coefficient in such conditions is much lower. The most dangerous in this regard are streets, which are covered with block stone, which, despite of low tire-to-surface friction coefficient, can be laid improperly, which significantly lowers speed of vehicle movement. As for the roads with bituminous-concrete surface, then existence of road unevenness and potted surface also forces drivers to maneuver, with reducing speed of movement.

IV. Reviewing of organizational approaches

As for organizational questions, there are exist factors which impacts traffic flow delays, that can appear on intersections and on areas between intersections.

If the intersection is unregulated, then there are in general appear movement delays in minor direction because of absent or insufficient intervals between vehicles, which move in the main direction, that are necessary for performance of maneuver.

In case when the intersection is regulated, delays appear because of insufficient duration of permission signal in certain direction. Especially acute this problem appears in peak periods.

As for areas between intersections, then on them delays most frequently appear in the presence of unregulated pedestrian crossings and high intensity of transport and

pedestrian flows, presence of parked vehicles on the edge and in the middle of roadway.

Unlike the geometrical and planning factors, actions for traffic organization can be and must be optimized, because in existing conditions this is one of the main ways for reducing traffic flow delays.

Conclusion

In consequence, going out of analyzed factors, which cause time losses of vehicles, it is expedient to carry out field research for definition the amount of traffic flow delays and basing on the research develop actions for traffic organization for reduce of these delays.

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Dependence of public transport service quality indicators priority from the respondent`s age

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Annotation – the existing level of passenger transportation by public transport doesn't meet the present requirements, which belong to the quality of passenger transportation. Transportation of passengers by public transport has to be carried out with as much as possible conveniences, safe and also with a smaller waste of time. In the thesis, the most important indicators that affect the quality of transportation are highlighted which influence the quality of transportation and their importance depending on a passenger age is analysed.

Keywords – quality of public transport service, traffic safety, comfort, information support on transport.

I. Introduction

According to many researchers in order to take measures on expedient use of vehicles on a route, improvement traffic schedules, safety and providing passenger comfort, it is necessary to carry out the public transport service quality analysis.

The degree of public transport service quality is characterized by the quality of public service indicators system. For people of different age categories unequal criteria for evaluation the quality of public transport service are in a priority.

II. Indicators of public transport service quality

Quality of public transport service is not only the quality services are provided by public transport, but also a complex of methods and means for resource managements of transport networks. Improvement of public transportation quality is one of the major directions for the development of city public transport. The city public transport services quality assessment were investigated by: O. P. Artynov, M. D. Blatnov, G. A. Varelopulo, V. A. Gudkov, E. P. Volodin, A. V. Shabanov, V. K. Dolja, I. S. Efremov, Yu. S. Liguma, V. V. Skaletsky, I. V. Spiryn, M. B. Ostrovsky, A. M. Bolshakov and other scientists.

V. A. Gudkov has suggested to estimate the quality of transport service of the population using a quality coefficient. It is determined by the relation of time expenses size on a trip at theoretically set absolute comfortable trip conditions to actual time expenses on a trip in real conditions [1].

A. M. Bolshakov in his thesis defines the quality of public transport indicator on the basis of accounting such indicators [2]:

- the standard of time which is spent by a passenger on a trip, min.;
- time which a passenger actually spends on a trip, min.;
- the standard filling coefficient, which is recommended for transportations within a city;
- the actual value of a filling coefficient;
- the indicator of traffic regularity.

E. A. Kravchenko has suggested estimating the quality of public transport service using a coefficient which considers various indicators systems. However, her considerable drawback is bulkiness as it is necessary to define relative statistical weight of private indicators with the help of tables made on the basis of personal researches. Unfortunately, a few authors take into account such indicators, as the information load on passengers during their stay in the vehicle; information support on traffic and intervals; the hygienic and aesthetic condition of a rolling stock, devices and registrations of a stopping place and qualification of personnel [3].

A. V. Shabanov in his thesis has developed the comprehensive assessment of public transport service quality. It takes into account [4]:

$$S_{service} = S_1^{k1} \cdot S_2^{k2} \cdot S_3^{k3} \cdot S_4^{k4} \cdot S_5^{k5} \cdot S_6^{k6}, \qquad (1)$$

where S_1 is the reliability of movement precisely according to the traffic schedule (travel time); S_2 – accessibility (frequency of public transport service); S_3 – safety (probability of non-failure public transport service); S_4 – comfort (travel quality); S_5 – cost index (value of transport tariff); S_6 – indicator of the information support level; $k_1 ... k_6$ – degree indicators that characterize the ponderability of a corresponding quality level indicator.

According to the normative document [5], to the public transport service quality indicators one can refer:

- the free area in buses;
- the filling coefficient of buses;
- the traffic regularity;
- the density of route network;
- the standards of saturation by the rolling stock of 1 km route network in rush hours;
- the coefficient of changes;
- the time expenses of one passenger on a trip;
- the average distance of a trip;
- the distance to public transport stopping places.

Other indicators which need to be considered at determination of public transport service quality were offered by G. A. Varelopulo [6]:

- accessibility;
- comfort of a trip;
- minimum time expenses travel around the city;
- high reliability of a rolling stock;
- regularity of connections taking into account requirements regarding transport safety.

III. Interview results

To determine the degree that characterizes the ponderability of the corresponding quality level indicator an interview was conducted. In this survey, the respondents were suggested to set estimates for each of the indicators that characterize the quality of public transport service. The estimates were divided from 1 to 5, where 1 was the least important indicator, and 5 – the most important indicator.

Travel time, traffic regularity, safety, comfort and information support were chosen as indicators. 150 people have passed the interview. The distribution of its results is shown in Fig. 1.
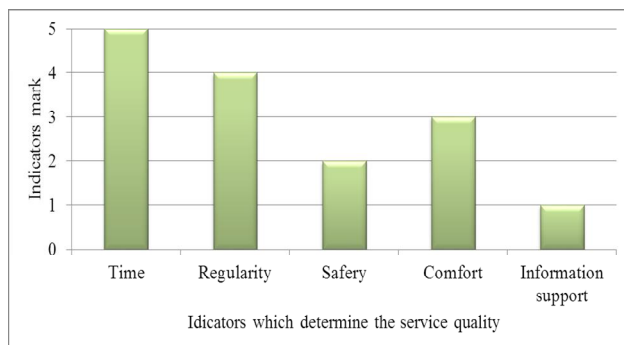
Fig. 1. Distribution of the attractiveness of public transport service quality indicators

The respondents were divided by age into 5 categories:
- from 16 to 25 years old;
- from 26 to 35 years old;
- from 36 to 45 years old;
- from 46 to 55 years old;
- from 56 to 70 years old.

The interview was conducted using both online resource of Google Forms and by the blank method. Having analysed the received values, the following distribution was established:
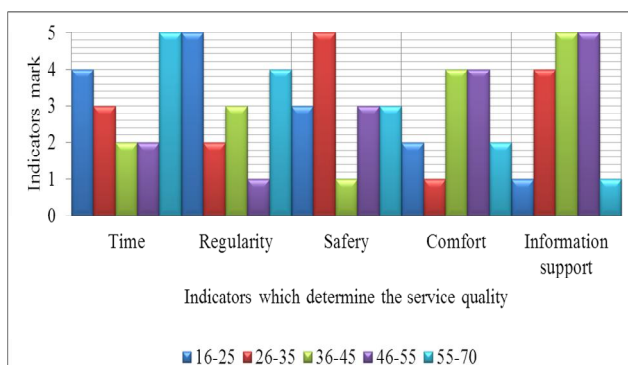
Fig. 2. Interview results

As of the interview showed, people aged from 16 to 25 and from 55 to 70 prefer the indicator "time". The interviewed people of this category also give primacy to

"traffic regularity". As for the respondents of 26-35, they choose "safety" and "information support" before taking on a vehicle. The most important indicators are "comfort" and "information support" taken by people from 36-45 and 46-55.

Conclusion

According to the results of the interview, the attractiveness distribution of public transport service quality indicators has been created. So it has been established that passengers pay more attention to the duration of a trip and intervals between by-pass vehicles.

A similar distribution has been created taking into account the respondents' age groups. The received data suggest that the attractiveness of these indicators depends on the respondents' age, too.

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Impact Of Unregulated Pedestrian Crossings On Road Network Capacity

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Abstract – There are reviewed the main factors which impact road network capacity in zone of unregulated pedestrian crossings. Carried out experimental research on definition of "aggressive" vehicle drivers proportion, which break the rules of passage through unregulated pedestrian crossings. Determined pedestrian flow density on unregulated crossings, at which practical capacity of multi-lane roadway is maximum.

Keywords – capacity, road network, unregulated pedestrian crossings, pedestrian flow intensity.

I. Introduction

The main problem with which faces today automobile transport in city – is transport delays, which appear because of range of reasons. One of the main reasons is growth of vehicles amount and transportation volumes, which causes increasing of traffic intensity on the city road network, resulting in decrease of streets and roads capacity. This is due to the fact, that city infrastructure goes behind in development with the same intensity as vehicles amount grows. [1].

Construction of roads of high quality with multi-level junctions – is the task of top priority. For solving the problem of increasing the road network capacity it is necessary to build relief roads, bridges, tunnels, underground crossings, overhead roads, detours around the city. But building of new roads is costly and labor-intensive process which demands large capital investments and time [1; 2]. So, to the foreground walk out organizational arrangements, in particular – implementation of modern technologies, resources and traffic control systems with the purpose of increasing road and streets capacity and decreasing transport delays in pedestrian crossings zone. Correct prognoses of capacity and its comparison with existing (or expected) traffic intensity are important conditions of placement ground pedestrian crossings, and therefore rational use of capital investments.

II. Detection of influence regularities of traffic and pedestrian intensity on road network capacity volume

The most important factor, which characterizes transport-operating qualities of city road and street network, is its capacity. Under street capacity mean the maximum amount of vehicles which can pass through the street per unit of time providing necessary speed and road safety. On its volume have impact roadway parameters, technical-operating characteristics of vehicles, type and amount of traffic regulation technical means, separate elements of environment totality etc [2 – 4]. Very important in this proportion is choose of rational ground pedestrian crossings scheme placement under different roadway geometric parameters, with the purpose of satisfying the requirements in safe pedestrian movement and traffic flow delays minimization.

Pedestrian movement inevitably connected with crossing of streetway. Such crossings can be in one level with the roadway (unregulated and regulated crossings) and in different levels – with the arrangement of above-ground and underground pedestrian crossings. Suppress amount of pedestrian crossings are above-ground: they are arranged on all intersections, on street sections, near buildings and constructions which generate pedestrian flows.

For determination of impact pedestrian crossings on road network capacity it is necessary to know pedestrian speeds of movement at crossing the roadway, method of traffic regulation on the street, and intervals between vehicles in traffic flow, which are accepted by pedestrians for crossing.

Vehicular movement in the flow on the road network in unregulated pedestrian crossing zone can be examined on the base of mass service theory, which allows determining capacity of the road section with the formula [3]:

$$P = \frac{1}{\Delta t_i} e^{-N_\Pi \cdot t_\Pi} \ , \qquad (1)$$

where P – road capacity, auto/sec; N_Π – – intensity of pedestrian movement, ped/sec; Δt_i – minimal interval between vehicles, sec; t_Π – minimal time, which pedestrian spend at crossing of one lane (critical interval), sec.

On the road network capacity volume in general significantly affects fraction of drivers which break the rules of passage through unregulated pedestrian crossings. In this time, amount of road accidents with the participation of pedestrians with every year increases. Due to statistical data, road accidents with pedestrians are happening in next places: in zones of public passenger transport stops – 35%; on unregulated pedestrian crossings – 30%; on unregulated intersections – 20%; on regulated pedestrian crossings – 10%; on regulated intersections – 5%.

From given data can be done conclusion, that in residential places the largest amount of road accidents (to 75%) happens on road sections between intersections. Therefore, we can assume that such typical accidence is explained by certain peculiarities of human behavior, which cross the road, breaking the road traffic rules by drivers, and also "aggressive" driving manner.

Fraction of "aggressive" drivers is calculated by formula [4]:

$$Q_{агр} = \frac{q_{агр}}{N_{тр}} \ , \qquad (2)$$

where q_{agr} – intensity of "aggressive" vehicle drivers, auto/hour; N_{mp} traffic flow intensity, auto/hour.

Then, taking into account fragment of "aggressive" vehicle drivers road capacity will look like [4]:

$$P = \frac{1}{(1-Q_{agr})}\left(\frac{1}{\Delta t_i} e^{-N_{\Pi} \cdot t_{\Pi}}\right), \qquad (3)$$

For determination of roadway capacity in zone of unregulated pedestrian crossings, for different pedestrian flow density, at modeling traffic flows of network it is necessary primarily to receive information about existing traffic intensity on road network sections.

III. Results of field research

For assessment of necessary and enough information about traffic flow characteristics it is advantageous to use sampling traffic record, methods and probability of which depend on earlier received regularities of distribution characteristics in time and space.

During research were defining such indexes: length of pedestrian crossings (width of the street); density of pedestrian flow; amount of vehicles which broke the rules of passage through unregulated pedestrian crossings; time of crossing the roadway by pedestrians; traffic flow intensity through the crossing.

On the next stage, during modeling the impact of pedestrian crossings on road network capacity, such limitations were made:

- traffic flow intensity – 1200 auto/hour;
- intensity of "aggressive" vehicle drivers – 120 auto/hour;
- minimal interval between vehicles – 2,5 sec;
- pedestrian speed – 1,35 meter/sec;
- one lane of roadway width – 3,75 meters.

Results of modeling road capacity volume in zone of unregulated pedestrian crossings, depending on pedestrian flow density, is given on picture 1.

It is known that with the enlargement of pedestrian flow density on unregulated crossings essentially decreases road network capacity. General tendency and volume of such decrease: under enlarging of pedestrian flow density from 100 to 1000 ped/hour decreases road capacity approximately on 6-8% under the same traffic flow intensity. Moreover, decrease of capacity is the same for multilane roads.
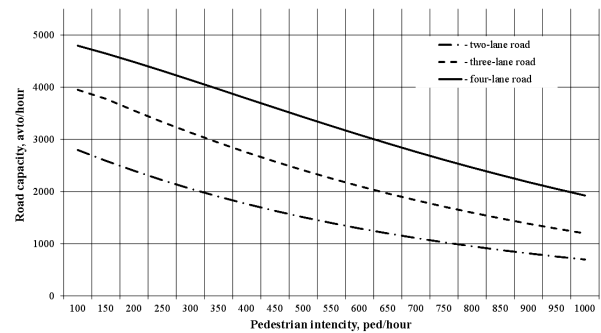
Рис. 1. Dependence of road capacity from pedestrian movement intensity on unregulated pedestrian crossings

Conclusion

For results of modeling there is stated pedestrian movement density on unregulated crossings, for which practical multilane roadway capacity is maximal, so regime of traffic flow movement, despite of obstacle presence, will be optimal. The purpose of further research in this direction is development of software, which allows defining optimal distances between pedestrian crossings and city streets intersections, and also consideration of parking impact, for which will be reached optimal conditions of traffic flow movement and high efficiency of transport service.

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Evaluation Of The Introduction Of Public Transport Movement Priority On The Regulated Crossroad

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Abstract – In this paper various methods of prioritization of public transport movement were considered, and the influence of prioritization on delays in the private transport movement in the adjacent streets was investigated. An estimation of the introduction of prioritization on a specific example has been carried out.

Keywords: traffic delay, traffic light control, public transport, methods of prioritization.

I. Introduction

Currently one can observe an increase in the number of both private (PrT) and public (PT) transport in the city streets. It leads to the increase in traffic intensity, and as a result to delays and traffic jams in the street-road network (SRN). Taking into account that most of the population moves by public transport, cities are now trying to prioritize PT movement in every possible way. However, it is not always appropriate, and often causes damage to other road users [1].

II. Methods of giving priority to public transport

There are several methods of prioritization of PT movement, however, some of them are irrelevant under different conditions. For isolated crossroads, all methods are divided into three groups, namely[2]:

1) Priority in space;
2) Priority in time;
3) Spatio-temporal priority.

Such division into groups is, to some extent, conditional, since the implementation of priority in space can not but affect the change in parameters of traffic lights control on a crossroad, which is its time aspect of functioning. However, to determine the advantages and disadvantages of prioritization it was convenient to classify them.

Ensuring of the full priority of PT travel on a regulated crossroad, that is, a travel without stopping, is best achieved by the introducing separate lanes of motion and activating the desired traffic signal at a certain moment.

However, to use one of the methods of PT movement prioritization as an optimal for all crossroads is inappropriate, since each of crossroads has different road and transport conditions that require a separate approach for each road section.

For example, for the appropriate setting of separate lanes, there should be a high intensity of PT motion in

this SRN section [3]. Also, in order to call the desired signal of the traffic light, it is necessary to take into account the influence that occurs on PT movement in adjoining streets, if it should create delays and traffic jams [4].

That is why it is expedient to use a combination of several methods from different groups of the proposed classification.

III. Object of research

This problem was considered at the example of the crossroad of Chuprynky and Horbachevskoho streets in the city of Lviv.

The existing motion scheme and the cyclogram of the traffic lights in the absence of a tram at this crossroads is presented below.
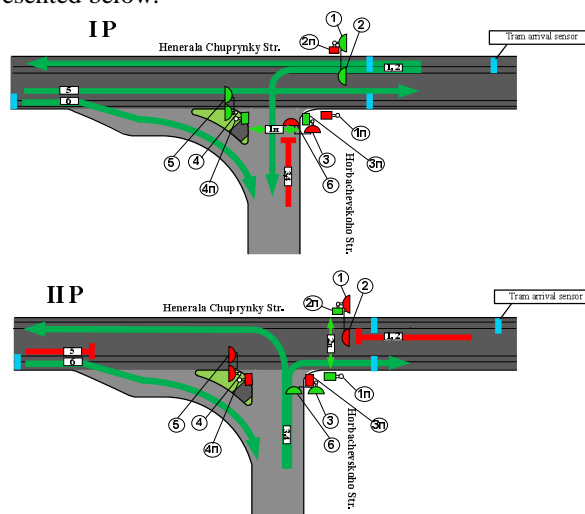
Fig. 1. Phase pathway at the crossroads of Chuprynky-Horbachevskoho Streets

№	Signal timing, $T_c = 100 s$.	Signals duration		
		G	Y	R
1,2,4,5		39	6	55
3,6		55	6	39

Fig.2. Cyclogram of traffic lights at the crossroads of Chuprynky-Horbachevskoho Streets

When a tram is comeing near the crossroad (what is fixed by the sensors), the green signal of the traffic lights № 1,2,4,5 is automatically turned on and therefore the red signal of the traffic lights №3,6, which lasts longer than the standard one and varies depending on whether or not a tram has passes the crossroad. The previous time of the green signal of traffic lights № 3,6, which also varies depending on the time of a tram entrance to the crossroad is not taken into account. After the modified cycle, the traffic lights return to the usual regime, while not compensating the delay in moving along Horbachevskoho street.

Horbachevskoho street is blocked because the traffic lights "can not cope" with such a number of cars. This phenomenon can be estimated by a parameter – saturation coefficient, determined by the formula:

$$W_{(t)} = \frac{N_c}{N_{cr}} \ , \qquad (1)$$

where:

- $N_{niд}$ is the number of the cars that came to the traffic lights,
- N_{np} is the number of the cars that crossed the stop line at the green light.

At $W_{(t)} > 1$ a queue is formed. The dependence of saturation change on the duration of traffic signals is depicted on the graph.
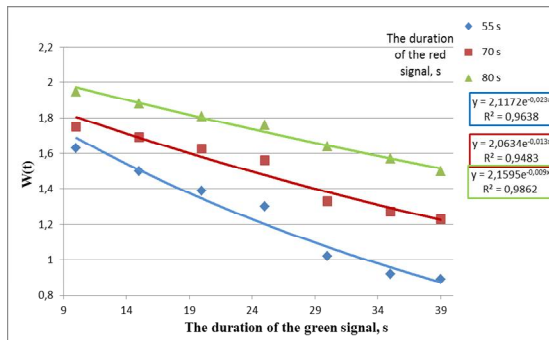
Fig.3. The dependence of the saturation coeficient on the duration of the traffic light signals

In this graph, it can be noticed that at an increase in the duration of the red signal till 70 s, the saturation coefficient is greater than 1, even at the green signal duration of 39 s. We revealed also other dependencies, which show the need to increase the duration of the green signal of traffic lights after the tram passing, for traffic flow in Horbachevskoho street, to normalize the queue and reduce the saturation factor for the improvement of the comfort in passing this crossroad.

Conclusion

There are several variants to solve this problem:

1) Proportional method.

Using this method, the duration of the green signal of traffic lights, closest to the tram passage, is supplemented by the number of seconds for which the tram completely crosses the crossroad, and it is determined proportionally how much seconds must be added to the duration of the green signal on the adjacent street to compensate the delay and level the queue that was formed. So, the green light for the tram is not automatically turned on and it does not create such a large delay in PT movement in adjacent streets, but the passage of the crossroad at the nearest green signal of the traffic lights is guaranteed.

2) Correction after Webster formula

By this method, you can try to correct the motion by changing the duration of the intermediate signal. However, this will entail a change in the duration of the cycle, which is not a desirable consequence.

3) Analytical method

This method suggest to determine the desired duration of the green signal of the traffic lights by, for example, the method of interpolation according to the exponential law of the above mentioned data. At interpolation the time of the green signal, at which $W_{(t)} \leq 1$, is determined.

There are two variants of the establishment of the traffic lights cycle, namely, the automatic activation of the green signal for the tram or the rigid cycle.

Which of the proposed methods is the best may be determined by research and simulation modeling of various options.

Therefore, the further direction of research should be the determination of the ways of movement optimization, the choice of the method of prioritization of PT movement so that it does not create discomfort for the movement of PrT.

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Research methods of service quality on public transport

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Abstract − The set of criteria reflecting the level of satisfaction of passengers in the provided transport services is considered to be indicators of the quality of passenger transportation. Taking into account the stable development of transport, the establishment of complex methods for defining these indicators becomes increasingly relevant. At the same time, nowadays, there is a large number of methods for determining the quality of transportation in road transport, by both domestic and foreign scientists.

Keywords − quality on public transport, bus, passengers, comfort, traffic safety.

I. Introduction

Quality of service on urban public transport (UPT) is a very important indicator. It affects a large number of indicators, such as the intensity of population movement, population productivity, various economic aspects, the ability to easily reach from one end of the city to another, and so on. The methodology for assessing and determining the quality of urban passenger transportation services allows you to assess the level of service in a particular city and determine what adjustments need to be made to improve them.

II. Service quality on public transport

The work of public transportation should be socially effective, which manifests itself as the provision of high-quality transport services. To assess the quality of passenger service, not only quantitative but also qualitative indicators such as: network length, number of rolling stock, number of transported passengers, etc. should be used. A more complete list of characteristics to be present during the analysis of transportation services would look as following [1]:

- traffic safety;
- reliability;
- availability of tariffs;
- waiting time;
- minimum number of changes;
- level of filling of transportation vehicle;
- time enroute;
- microclimate in the cabin;
- comfort of passengers.

Today, there are many different opinions about the quality of urban public transportation. Basing on a large number of criteria, A.V. Shabanov proposed a comprehensive assessment of the level of quality of the functioning of urban passenger transportation. To do this, they formulated the corresponding formula [2]:

$$S_{обсл} = S_1^{k_1} \cdot S_2^{k_2} \cdot S_3^{k_3} \cdot S_4^{k_4} \cdot S_5^{k_5} \cdot S_6^{k_6} \qquad (1)$$

where S_1^{k1} – reliability of movement in accordance with the schedule of movement (travel time); S_2^{k2} – accessibility (frequency of public transport movement); S_3^{k3} – safety (probability of non-failure work of public transport); S_4^{k4} – comfort (travel quality); S_5^{k5} – cost indicator (the amount of transport tariff); S_6^{k6} – indicator of the level of information support.

According to the research conducted by V. A. Gudkov, the quality of transport services for passengers is estimated using the quality factor ($K_я$), which is determined by the following ratio [3]:

$$K_я = \frac{t_{nep}^3}{t_{nep}^ф} \qquad (2)$$

where t_{nep}^3 – time spent on a trip for given theoretically absolute comfortable travel conditions; tfper – the actual time spent on a trip in real conditions; $t_{nep}^ф$ – the actual time spent on a trip in real conditions.

A. M. Bolshakov in his work suggests to determine the indicator of the quality of transport services of passengers in cities in the following way [4]:

$$K_н = \frac{t_н}{t_ф} \cdot \frac{y_н}{y_ф} \cdot R \qquad (3)$$

where $t_н$ – normative duration of the passenger's trip, min.; $t_ф$ – actual travel time of the passenger, min.; $y_н$ – normative factor of filling, which is recommended for traffic within the city (on average it is no more than 0,3, and in peak hours – 0,8); $y_ф$ – the actual value of the filling factor; R – indicator of the regularity of the movement.

E. A. Kravchenko in his work evaluates the quality of transport services for passengers using a coefficient that can be determined in the following way [5]:

$$\bar{K}_n = \frac{\sum_i^n K_i \cdot P_i}{\sum_i^n P_i} \qquad (4)$$

where K_i – quality indicator; P_i – the relative static weight of partial indicators.

Indicators that characterize the quality of passenger transport services according to work are [6]:

- coefficient of transportation vehicle appearance on the line;
- coefficient of filling of the cabin;
- coefficient of time used in duty;
- conveyance speed;
- traffic intensity;
- interval of the motion of transportation vehicle;
- coefficient of regularity of motion;
- service efficiency indicator;
- coefficient of cost efficiency;
- a generalized transport service quality indicator.

At the same time, all these indicators have their normative values for the corresponding routes of movement.

III. Indicators that represent the quality of service on public transport

With regard to indicators that reflect the quality of passenger service on vehicles, each of them has a definite influence on this value. For example, researchers assume that the time spent by people for the transportation is one of the most important criteria for assessing the quality of transport services of the population [7].

Also, it should be noted that indicators of service quality and regularity of the movement – are interrelated and inherent from each other. This is explained by the fact that when traffic increases, the volume of transportation increases, passengers are distributed more evenly, the possibility of timely payment of travel, etc., is provided. When the regularity of the movement is disrupted there is overfilling of the bus cabin or, conversely, then the route becomes unprofitable. Uneven loading leads to time spent on boarding and landing passengers, which, in turn, creates delays at stops, resulting in disturbed bus mode, reduced speed of traffic and traffic safety, etc. [1, 8].

The level of security of passenger transportation must be considered as a function of the parameters that must be provided to the organizers of transportation. The indicator varies depending on compliance by the carrier with the transport security conditions [2].

The main criteria of comfort are [2]:
- convenient location of passengers (number and location of doors, seats, hand-rail, etc.);
- visibility;
- heating efficiency in winter;
- air conditioning efficiency in the summer;
- lighting;
- possibility of rest on the road;
- informational services (announcements of stops in transport, warning about changing the route, etc.);
- vibration

The main characteristics of the quality of information support are [2]:
- availability;
- reliability;
- speed;
- completeness;
- accuracy.

At the same time, the indicator of the information service is the ratio of the level of information provision of a certain type of transport on the route to the maximum possible level of security on the same transport.

Conclusion

The functioning of public transportation in a modern city should be, first and foremost, socially effective. To ensure the population with high-quality transportation services, it is necessary that all the quality and comfort indicators highlighted in this work are fulfilled. All of them are very important because their influence impacts the productivity of society and the functioning of the economy of the country, which provides the vital activity of society. Compliance with all indicators of the quality of services is a fairly important way of regulating the interests of different parties, in particular: carriers, public authorities interested in the priority development of public transportation in the city, and citizens. Since there are a lot of factors that affect the comfort and quality of transportation, so there is a large number of different opinions about the questions which indicators are more important and which methods are better to make calculations. Therefore, there is a need to create a new comprehensive methodology that will take into account everything.

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Application of forecast methods to determine the functional condition of the driver

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Abstract – this paper presents the results of the driver's functional condition study moving in such road conditions as city, plain and mountains. The indicators of the functional condition give an opportunity to estimate the tension and difficulty of the driver's work.

Keywords – psychophysiological indicators, driver, functional condition.

I. Introduction

Functional condition (FC) is a complex multicomponent characteristic of functional systems for an organism that directly or indirectly interact with the performance of activities. The indicators of the drivers body's FC give an opportunity to assess the tension and difficulty of the driver's work. Due to the increase of traffic intensity on the roads, the problem of ensuring traffic safety became relevant. To solve it there is not enough information that can be obtained only by traditional methods of studying the mode of movement, in which the driver acts in an implicit form [1].

II. Methods of FC research

Over the past half century, a large number of methods have been developed for the study of driver's psychophysiological qualities, such as [1]:

- electrocardiogram (ECG);
- electroencephalogram (EEG);
- electrooculogram (EOG);
- electro-galvanic reaction (WGH).

A number of researchers believe that the main factor describing the behavior of the driver on the road is his reaction to various stimuli. For such researches, methods of the skin-galvanic reaction determination and electrooculogram are less commonly used. Indicators obtained by such methods describe the reaction of the body to change the road environment, EOG records the movement of the eyes, so it is possible to determine the greatest stimuli attracting drivers attention.

Recently, attention is increasingly drawn to the study of FC drivers. Most scientists working on the problem of psychophysiology of drivers tend to the fact that human FC is a decisive factor determining its behavior when driving a vehicle [1]. We know many methods for evaluating human FC. Research of this kind is used in sports and space medicine. The basis for such studies is the methods for assessing the human heart rate variability based on an ECG (ECG) analysis.

Heart rate variability (HRV) is unevenness of the heart rate due to the influence on it of various regulatory processes in the body. Currently, there are several methods for evaluating heart rate variability. Among them there are three groups: time domain methods – based on statistical methods and directed on the study of general variability, frequency domain methods – the study of periodic components of HRV, integral indicators of HRV (include autocorrelation analysis and correlation rhythmography). Statistical methods are based on the measurement of RR intervals, as well as on the comparison of the calculated indicators. They give a quantitative assessment of variability.

FC analysis of a driver in movement makes it possible to determine the main factors that influence it in different road conditions, which can reduce the reliability of its work [1].

To assess the FC driver were selected two indicators. This is the regulatory systems activity index (RSA) and the stress index (SI), they are determined by the analysis of the electrocardiogram.

SI of regulating systems is determined on the graphic distribution basis of cardiointervals – histograms. In the norm, SI ranges from 80 to 150 conventional units. This indicator is very sensitive to the tone of the sympathetic nervous system. A small load increases it by $1{,}5 – 2$ times, with considerable loads it can increase by $5 – 10$ times [1].

It was important to obtain the value of SI in different traffic conditions. That is, FC was determined separately by the driver on the plain, in the mountains and when driving through the city. Such studies served as the basis for predicting the drivers FC when passing all sections with different conditions in one route. Separately collected data was stored in one general dependence for all conditions and was compared with the results of the experiment, which consisted in the continuous movement of the city, plain and mountains. Such studies, in their comparison, can illustrate the difference between the real dependencies that were observed and the prediction.

Forecasting was done by the method of weighted moving average and determined seasonal components. The weighted rolling average is calculated in such a way that the last values before the predicted period have the greatest weight [2]:

$$P_j = \frac{\sum_{i=1}^{n} k_i \cdot P_i}{\sum_{i=1}^{n} k_i}, \qquad (1)$$

Where^ k_i- weight of significance over time periods *i*.

The seasonal component is determined by the formula:

$$I_s = \frac{y_t}{\bar{y}}, \qquad (2)$$

Where: y_t – row lewel; y – middle level.

III. Results

The first step was to determine the dependence of change and SI from the time spent driving in urban settings. The research was conducted in Lviv on a street-road network length of 4.3 km. 25.8 km overall distance. The results are shown in Fig. 1. The highest value of the stress index reaches the point of 175, and the smallest – 90.
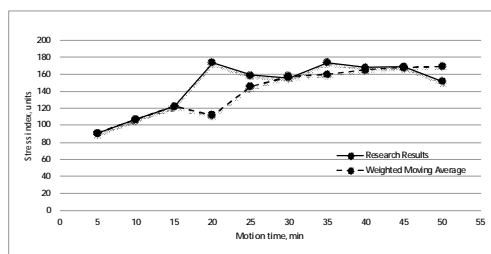
Fig. 1. Results of studies in the city

Studies on plain conditions were conducted on the Lviv-Stryi route 62 km long. This area passes the area, which fully corresponds to the definition of the plain. The results are shown in Fig. 2. The highest value of the stress index reaches the point 180, and the smallest – 95.
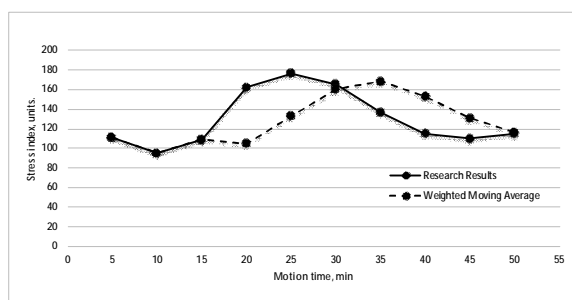
Fig. 2. Results of studies in plain terrain

In order to determine the impact of mountain conditions on the change in the functional state of the driver were conducted research on the route Skole – Lower Gate 58 km long. The results are shown in Fig. 3. The highest value of the stress index reaches the point 410, and the smallest – 240.
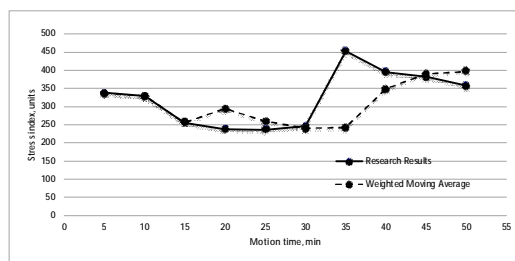
Fig. 2. Results of research in mountainous terrain

In order to compare the values on individual segments with prediction, additional research was conducted. They consisted in the fact that the driver was moving along the route which goes through all three conditions of movement. During the movement, the conditions changed from city to mountain and vice versa. The length of the route on both sides was 530 km. He passed through the following settlements: Lviv – Stryi – Dolyna – Khust – Mukachevo.
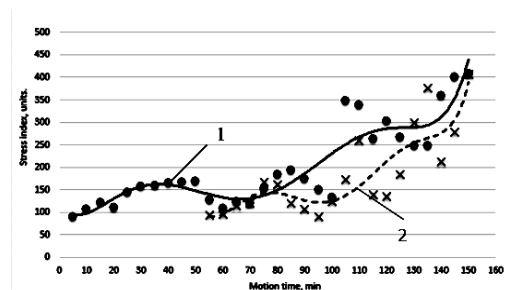
Fig. 4. Forecasting of change of index of driver's tension during traffic in urban, plain and mountainous conditions. 1 – actual data; 2 – data obtained using the prediction method

Conclusion

According to the results of the work, the driver of the engine has been determined in different road conditions (mountain, plain, city) and the dependence on the duration of the movement is determined. According to the research, it is established that during continuous continuous movement in the mountainous area drivers are in a state of stress and exhaust much faster than in urban and plain conditions, while the voltage index increases by more than 2 times. With the help of the method of the weighted average moving and seasonal component, a change in the driver's stress index, which moves along the route "city – plain – mountain", is predicted to be relative to 15-25% relative to the results of research on a similar route under continuous motion, which is within the normal range.

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Methods of the passenger`s functional state research

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Abstract – The research of the functional state (FS) of the passenger is important for assessing the quality of service of transportation by public transport. Analyzed techniques can be used during research of human's FS. The advantages and disadvantages of different methods of evaluation of FS are established.

Keywords – functional state, psychological and physiological parameters, electrocardiogram, heart rate variability, RSA index.

I. Introduction

Functional state is a set of indicators that characterize the ability of a person to perform the necessary functions under certain conditions. In addition, it is an opportunity to maintain the necessary level of efficiency in the adverse environmental impact [1-5].

For a passenger, it is important how its functional state changes after the trip by public transport and the subsequent ability to perform the necessary work correctly.

N. Gulev notes that the formation of FS is influenced by psychological indicators (they demonstrate changes in psychological processes), and physiological (changes in human body systems) [2].

II. Analysis of literature

Today, there is a large number of methods for identifying, analyzing and characterizing the passenger's FS. The most complete description of them is in the source [1]. Many methods used in psychophysiology were borrowed from sport's medicine and professional selection and training of astronauts [3].

Among the psychological methods of determining the FS is distinguished an analysis of changes in the structure of the visual process and the solution of problems in accordance to Derevyanko, as well as various questionnaires and tests [1-3]. The most widespread of these are: the "clock" test, aimed at the study of spatial imagination; questionnaire of Eysenck, to determine the type of temperament; red-black tables of Schulte-Platonov and "proof-reading test" used for research of attention [3].

However, physiological methods have become more widely used. Possibly, there is an estimation of the FS on the frequency and depth of breath (electropneumography), that is, with extraneous influences, the number of breaths-exhalations per minute increases and depth decreases. One of the methods also considers an indicator such as blood pressure. Its elevation indicates that the body is experiencing some stressful influence. The critical flashing frequency estimates the state of the visual analyzer when a person ceases to notice the individual light streams that flash with a certain increasing frequency and begins to see a continuous flow. An electromyogram demonstrates the potentials of the muscles when stimulation is spreading by muscle fibers [1].

The most used methods for determining the FS are [1,3]:
- electroencephalography;
- skin-galvanic reaction;
- Electrocardiography.

Electroencephalography (EEG) evaluates the processes occurring in the pasamger's brain. The removal of indicators occurs in stationary conditions using special electrodes, which are fixed on the human's head. The assessment consists in determining the potential difference between the two points of the brain. The most effective use of this method is in the study of a single factor, because in another case, different areas of the cerebral cortex will be affected, which can lead to distortion of the results. EEG displays the biopotentials of the brain, expressed by some rhythms. Exactly the change in these rhythms shows the transition of man from one state to another. The disadvantage of the method is the inability to use it in the process of passenger's movement due to the need for no movement during the experiment [1, 3].

The skin-galvanic reaction consist in assessing of the electrical conductivity of the skin of the passenger. The essence of this method is also to determine the difference in potentials with an increase of sweating, electrical conductivity of the skin, which is observed when a person develops nervous activity. The advantage is the simplicity of registration, as well as the independence of the subjective factor. And disadvantage is insufficient informativeness [1, 3].

The most common and studied is method of research of the FS by an electrocardiogram (ECG) analysis. The basis of the analysis is the investigation of the record of potentials that occur during the excitement of the heart muscle. These potentials while recording are displayed in the form of teeth. Their amplitude, frequency, duration, distance between them are the main characteristics of the work of the heart [4].

One of the methods for assessing the relationship between the work of the heart and the nervous system in general and the reflection of the process of adaptation of the organism to the environment is the variability of the heart rate (HRV) [4].

III. Heart rate variability and its indexes

There are many methods for determining and analyzing HRV, but the most comprehensive assessment is given by the regulatory systems activity index (RSA index) implemented by R. Baevsky. This is the sum of conditional points, which are determined on the basis of different indicators of HRV [2, 3, 6]:

- mathematical expectation (M, rNN) is the average of all R-R intervals in the sample. Its elevation reflects the high functionality of the cardiovascular system, and the decrease – activation of high levels of regulation of the heart rate;

• mean square deviation (δ, SDNN) – characterizes the state of regulation mechanisms, inversely degree of activity of the sympathetic part of the autonomic nervous system (ANS);

• mode (Mo) – shows the number of R-R intervals that are most commonly encountered, the most likely level of operation of regulatory systems;

• variational sweep (VS, dX) is the difference between the largest and the smallest value of the cardiointerval, the index of the maximum amplitude of the regulatory influences of the ANS;

• Mode amplitude (AMo) is the percentage of cardiointervals that correspond to the mode range. The increase points to the growth of the activity of the sympathetic nervous system (SNS) and the high mobilization of the circulatory system, while the decrease is due to the predominance of the parasympathetic nervous system (PSNS) and the weak centralization of cardiac rhythm control;

• coefficient of variation (CV) is a normalized estimate of the mean square deviation. The increase demonstrates the shift of the vegetative equilibrium towards the growth of the activity of the PSNS;

• spectral power in the range of very low frequencies (VLF);

• spectral power in the range of low frequencies (LF);

• spectral power in the range of high frequencies (HF).

In addition, to determine the RSA index it is necessary to calculate the tension index (TI), which can serve as an independent index of passenger FS. It characterizes the state of the central contour of regulation, the activity of sympathetic regulation mechanisms and is calculated [3-5]:

$$TI = \frac{AMo}{(2dX \cdot Mo)} ; \qquad (1)$$

This indicator is extremely sensitive to the effects of the SNS. For significant stresses can grow in 5-10 times. Normally, it is 80-150 conventional units.

From the indicators above you can calculate RSA index [3, 5]:

$$RSA\ index = |A| + |B| + |C| + |D| + |E| \qquad (2)$$

A – the total effect of regulation (rNN);
B – function of automatism (SDNN, dX, CV);
C – vegetative homeostasis (dX, AMo, IH);
D – stability of regulation (CV);
E – activity of nerve centers (VLF/TF, LF/TF,HF/TF).

The value is expressed in conditional balls from 1 to 10 and describes a certain functional condition of the passenger [2, 3]:

• 1-3 points – the state of optimal stress or physiological norm;

• 4-5 points – moderate tension, to adapt to irritants additional functional reserves are required;

• 6-7 points – the state of intense stress, active mobilization of protective mechanisms;

• 8-10 points – state of exhaustion (asthenization), failure of adaptation. The body does not cope with stress, the activity of control mechanisms decreases, signs of pathology appear.

Conclution

Each of the analyzed methods provides important information about the passenger's FS.

The most accurate and easy to use is the calculation of RSA index of Baevsky with the help of indicators determined on the basis of the analysis of the recording of the electrocardiogram.

However, for the sake of completeness of the information it is expedient to use the considered methods in the complex.

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Hardware and software for road user`s functional state research

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Abstract – The work describes the features of studying the functional state of road users by recording an electrocardiogram. Reviewed different methods of research. Presented requirements for modern cardiographs and devices that meet these requirements. Also was conducted a brief description of the software for the processing of research results.

Keywords – electrocardiogram, cardiograph, functional state.

I. Introduction

The development of technology facilitates human work in all spheres of its activities. It also affected the scope of research. So, for example, earlier, to find out the level of alcohol in the blood of the driver, was conducted a blood test. This process took a lot of time. Instead, modern devices can do this in less than 1 minute. The speed and quality that modern devices and programs provide is a very important factor in conducting various types of research.

II. The driver's functional state and methods of its research

Functional state (FS) – indicator that shows the level of vital activity of the organism and the level of its adaptation to the environment [1]. If consider the FS, as an indicator of the reliability of the work of road users, including drivers, it can reflect their effect on road safety and the ability to perform their duties.

There is a significant number of electrophysical methods for evaluating FS. The most common of them is [2]:

- electrocardiogram (ECG)
- electroencephalogram (EEG);
- electromyogram (EMG);
- galvanic skin response (GSR);
- electrooculogram (EOG);

In transport research, the most commonly used method is ECG analysis. Electrocardiogram – a graphical record of the appearance and change of electrical phenomena that arise in the heart muscle during its activities.

The first experiment, which became a prerequisite for the emergence of modern techniques for recording ECG carried out in Cambridge in 1912 by professor Willem Einthoven [3]. There are 2 methods for recording ECG at the moment:

1. The method of short records;
2. Holter's method;

The method of short records is made in a darkened room and the subject under study are asked to stop any activity during 15 minutes before the experiment starts. Registration itself lasts 5 minutes (300s) [4].

It should be noted that the modern cardiograph should meet the next requirements [4]:

- the presence of an analog-digital converter for digitizing the ECG signal;
- to ensure the highest accuracy of the location of the peak of the R wave at the level of 0.5 ms, the quantization frequency should be at least 1000 Hz;
- The software tone localization algorithm R should be sufficiently reliable to avoid inaccuracies, especially in the case of low-quality ECG recording, presence of network drives (50.0 Hz), artifacts and other obstacles;
- Should be anthremore and other filters of high and low frequency. They serve to eliminate network cues, electrical signals from muscles and other noises;
- the construction of a software algorithm for calculating heart rate variability (HRC) parameters should be carried out in accordance with the standards;
- the program should provide access to manual correction of records in order to exclude from the analysis, if necessary, individual extrasystoles;
- The program should be easy to use and have an accessible interface so that medical personnel can easily read the recording data of short ECG periods regardless of the level of skill.

Holter's method, named after the American researcher Norman Holter. He was the first ho conducted a long-term ECG registration. This method made possible to detect disturbances in the work of even a healthy heart through the influence of harmful factors. As a rule, monitoring is carried out from 1 to 7 days. For this moment, there are two methods of this research [5].

1. Full-scale monitoring;
2. Fragment method.

With full-scale monitoring, the measurement lasts from 24 to 72 hours. Today it is used most often and is quite informative. It enables the most complete assessment of the cardiovascular system. It enables the most complete estimate of the cardiovascular system work.

The fragment method is used when there are failures in the work of the heart and they are irregular in nature. Then measurements can be made longer, or only at a time when the subject is feeling discomfort. In such cases, the patient clicks the button by activating record by himself. It is also used during research when measurements are made in certain periods of time. It is this method that is used in the research of FS of road users. Because it gives a detailed description of the heart rate variability (HRV) changes and the moments when it departs from the norm.

III. Hardware and software for research of functional state

When ECG is recorded by method of short records next devices are used: Mobile ECG «Mosquito» (Fig. 1. a), Digital 12- channel electrocardiograph (Fig. 1. b) etc.

Mobile ECG «Mosquito» – created for personal use by patients and doctors. It is compact and synchronized with any phone on the Android operating system [6].

Digital 12-channel electrocardiograph – is one of the newest devices for registration. He is able to record an ECG by the method of short recordings and Holter's method. So, it can be considered multifunctional [6].
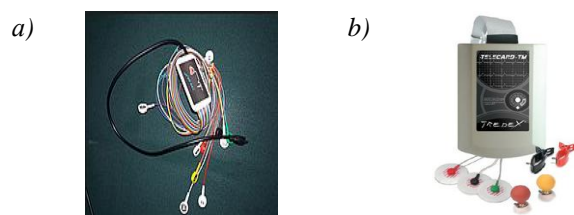
Fig. 1. Devices for recording ECG using the short record method

When ECG is recorded by Holter's method, next devices are used: SDM3, Polar smart H7, ECGpro etc.

"SDM3" – capable of monitoring up to 48 hours. Built-in compatibility with the Android operating system, Allows you to connect this device with a smartphone to recive fast the results (Fig. 2. a) [7].

"ECGpro" – fast, professional, with a complete set of techniques, cardiology complex. It is equipped with a screen for monitoring the change of HRV and edit the way of submitting information before printing (Fig. 2. b) [8].

"Polar smart H7" – combined Heart Rate Monitor, designed to record heart rate during exercise or active rest. Compatible with most programs for HRV analysis , which are working on the basis of the android operating system (Fig. 2. c) [9].
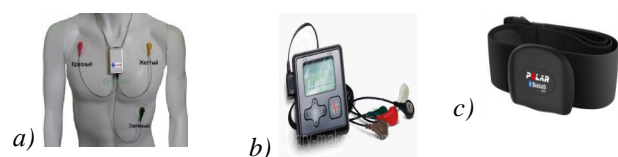
Fig. 2. Devices recording ECG by Holter's method

For synchronization with devices such as SDM3, Polar smart H7, can be used next programs: HRVxt, HRV monitor, HRV lite. Characteristics of these programs are listed below [10]:

TABLE 1

SOFTWARE FOR ROAD USER`S FUNCTIONAL STATE RESEARCH [10]

Name	Characteristic	What indicators determine
1	2	3
HRVxt	Output parameters by user choice. Synchronization by using Bluetooth with Polar devices	HR, RR, SDNN, RMSSD, SDSD, pNN50, SD1, IД2, SD1/SD2, LF, HF, LF/HF
HRV monitor	Ability to export data to different programs Synchronization by using Bluetooth with Polar devices	RMSSD, SDNN, SDSD, pNN50, SD1, SD2, Pulse, Power of LF&HF-Band with FFT Livespectrum, ØLF- & ØHF-Frequency and Poincaré-Plot

CONTINUATION OF TABLE 1

1	2	3
HRV lite	Ability to record HRV without time limit. Also ability to show the level of stress. Synchronization by using Bluetooth with Polar devices	MPB, SDNN, RMSSD, pNN50

All these programs run on the Android operating system.

Conclusion

Results of the literary analysis shows, ECG is one of the ways to study the FS of road users. It is determined that for this kind of research Holtree method of recording ECG is best suited. It allows to get more accurate data in real-world conditions. This is due to the fact that it is ECG that can accurately show the slightest changes in the state of the body of the road user.

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Stages of the process for the choice of investment strategy

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Abstract – In this article analyzes the process of choosing an investment strategy of enterprise and stages of that process.

Keywords – investment, investment strategy, investment process, stages of investment process, sequence of the investment strategy selection process conference.

I. Introduction

Investigation of the issues of investment activity is constantly in the field of economic doctrines. This attention is explained by the fact that investments concern the potential possibility of growth of capital, ie, determine the process of economic growth in general. The process of activating investment activity is one of the most effective mechanisms for the development of a market economy, accelerating the process of technical progress, structural transformations of the national economy and improving the indicators of economic activity. Effective investment activity is able to solve a number of problems inherent to countries with transition economy, in particular, such as the unsatisfactory level of fixed assets of enterprises, the state of production, social and environmental problems and provide opportunities for structural changes in the national economy. Thus, investment activity is the basis for the development of enterprises and the economy as a whole. An effective investment strategy for an enterprise can be an effective instrument in ensuring the investment activity of an enterprise in the conditions of dynamic development of the national economy and significant changes in the environmental factors of its functioning. Issues related to the development and implementation of investment strategies were domestic and foreign economists: Fedorenko V.G., Kozachenko G.V., Mayorova T.V., Khrushch N.A., Meshko N.P., Cherep A.V., R. Acoff, I. Ansoff, I.O. Blank, A. M. Bogatyryov, S. Schmidt, A.B. Irdysov, I.V. Lypsits, V.V. Kossov, B. Carlof, W. King, D. Klyland, P. Mass., A.R. Sterling, A.A. Thompson, A.J. Strikland, V.D. Shapiro, N.M. Gulyaev, A.A. Peresada, D. Chervnov and others. [1-7]

II. Page Setup

Consequently, an investment strategy is a set of long-term investment activity that is directly dependent on the overall development strategy of an enterprise, as well as a set of the most effective tools for its achievement. Since the investment strategy directly depends on the overall strategy

for enterprise development, then of course it can not go against the mission and objectives of the enterprise. An investment strategy can be presented as a long-term plan of investment activity of the enterprise, which defines the priority areas of investment, the form of investment, the source of investment resources, criteria for the selection of investors, as well as the sequence of stages of securing long-term investment objectives of the enterprise.

Understanding the relationship of the investment strategy with other important elements of the overall strategy of enterprise development, such as: marketing strategy, market strategy of the enterprise, financial strategy, advertising strategy, allows to make more effective the process of its development.

The effectiveness of developing an investment strategy of an enterprise depends on certain conditions, in particular the dynamics of the factors of the external investment environment, both direct and indirect action. The constant change of the main macroeconomic indicators associated with investment activity of enterprises, the tempo of technological development, fluctuations in the market conditions of investment resources, the variability of state investment policy and forms of regulation of investment activity do not allow to effectively manage investments of enterprise based only on previously accumulated experience and traditional methods.

After analyzing the process of choosing an investment strategy, we propose the following stages (Fig. 1):

1. Determination of the mission of the enterprise: The mission of the organization is the key ideological pillar of strategic planning, which forms the basis for the effective functioning of the enterprise both in the current period of time and in the future. [8]

2. Formation of enterprise goals: considered as setting the parameters of the expected most acceptable state at a fixed time point (for a certain period of time) in the process of its development, taking into account the dynamics of the environment and the production potential of the enterprise. [9]

3. Analysis of the factors of the internal and external environment: it is the process of determining critical elements of the external and internal environment, which have an impact on achieving the goals of the enterprise.

4. Determination of the objectives of the investment activity of the enterprise: the objectives of the investment strategy may be different, in particular: profit, saving or capital gains, updating of fixed assets of the enterprise, support of liquidity of the enterprise, prevention of bankruptcy risk, etc.

5. Development of versions for an investment strategy: involves the development of several alternative strategies to maximize the effect and achieve the goals.

6. Harmonization of investment strategies with other elements of the overall strategy of enterprise development: provides for the establishment of interconnections with such elements as: marketing strategy, market strategy of the enterprise, financial strategy, advertising strategy, etc.

7. Specificization of investment strategies: involves refining the data and taking into account the duration of this investment strategy.

8. Formation of alternative directions of development: this clause is foreseen in the event that none of the presented strategies is not able to provide goals that were set before it.

9. Selection of an investment strategy: involves the choice of the least costly and most effective investment strategy.

10. Realization of the investment strategy: provides implementation of all set tasks and achievement of the formed goals.

11. Assessment of the effectiveness of the investment strategy: involves comparing the actual indicators with the plans.
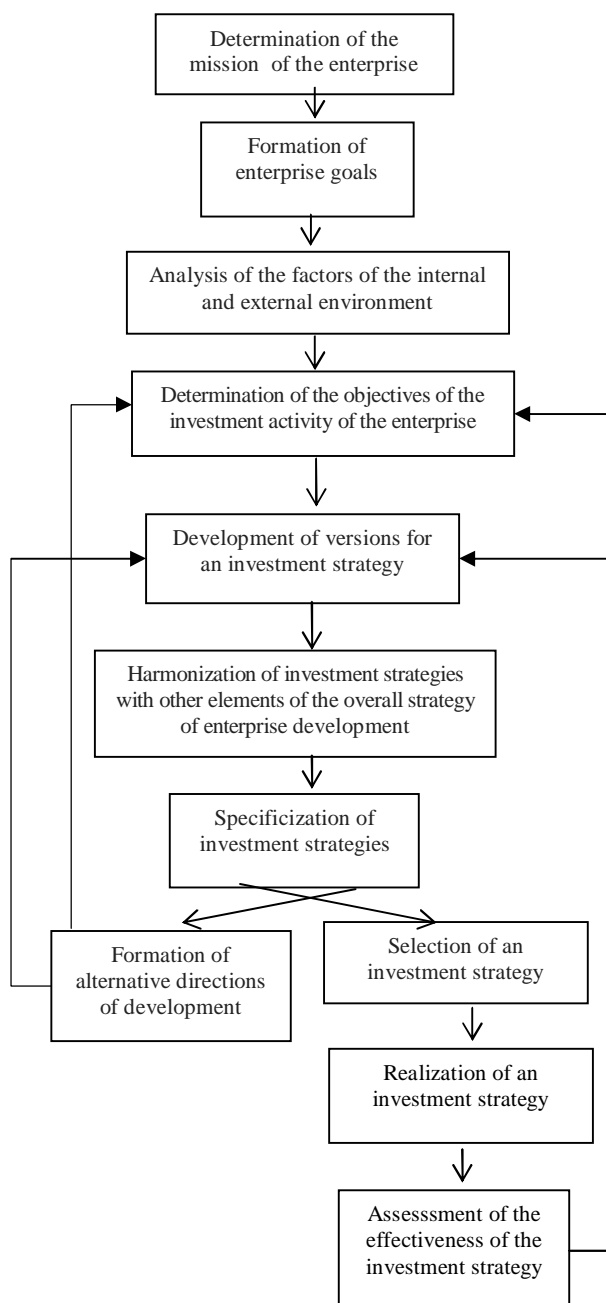
In the process of developing an investment strategy, the enterprise should receive a clear idea of the parameters that characterize the possibilities and limitations of the development of the investment activity of the enterprise, namely: the level of strategic thinking of owners and investment managers of the enterprise; level of knowledge of investment managers about the state, future dynamics of the most important elements of the external investment environment; prospects of formation of investment resources of the enterprise, their anti-inflationary protection; compliance of the level of investment activity of the enterprise with current and perspective requirements of its development, completeness of its investment potential; the presence of an integrated strategic concept in the company in the form of a mission, general strategy, system of strategic development standards and its structuring in the context of separate units; efficiency of investment analysis, planning and control systems of the enterprise and their orientation towards solving strategic problems; conformity of organizational structure of management of investment activity of the enterprise to the tasks of its perspective development; level of investment and organizational culture of the enterprise.

Conclusion

The process of choosing an investment strategy must pass certain mandatory steps, but in the dynamic environment, under the influence of various factors, and depending on the enterprise, the number of stages can be reduced or expanded.

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Formation and implementation of an innovative program at cause-and-effect approach

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Abstract – The article examines methodic aspects of the formation and implementation of innovative programs. Basic stages of these processes are defined. The essence of the concepts of "innovative idea" and "innovative intention" is considered. The essence of the concepts of "project utility" and "project efficiency" is revealed. The model of the formation and implementation of the innovative program at the cause-and-effect principle, which is based on primary preconditions, motives and stages, is proposed and scientifically reasoned.

Key words: innovative program, innovative project, innovative idea, innovative intention, innovative potential.

I. The essence of the formation and implementation of innovative programs

Efficiency improvement of national enterprises is impossible without a systematic and comprehensive introduction of innovations. Innovative activity at the enterprise is carried out through the process of the formation and implementation of innovative programs.

In our opinion, the cycle of the formation and implementation of innovative projects consists of three basic stages (intention, development and, in fact, implementation), which are based on structural and functional preconditions (idea, utility, potential) and are determined by motive reasons (intention, feasibility, possibility). It enables the introduction of the formation and implementation of the innovative project as a set of phases(stages), primary preconditions and motives (Fig. 1).

Each element of the proposed model is further considered in details.

II. Formation of the innovative intention

An innovative idea is a form of theoretical knowledge, understanding of certain phenomena and processes for their further practical transformation considering certain regularities and relations. The idea has a well-defined purpose which at the initial stage is not supported by a concrete understanding of the further course of its implementation.

Sources of innovative ideas, according to P. F. Druker, are the following:

– an unexpected event (for an enterprise or industry) – unexpected success, unexpected failure or unexpected external event;

– incongruity– the discrepancy between reality(as it really is) and our perception of it ("as it should be");

– innovations based on the need of the process (its drawbacks and weaknesses that are to be eliminated);

– sudden changes in the structure of the industry or the market; demographic changes;

– changes in perception, mood and value guidelines;

– new knowledge (both scientific and non-scientific) [1, p. 48].

However, the production of an innovative idea does not always happen, based on rational considerations but also spontaneously, under the influence of internal impulses, regardless of exogenous factors. Motivation can be diametrically opposite – from altruistic (public goods, caring for the well-being of others) considerations to exclusively selfish (money reward, recognition, career growth). That is why the effective management of the innovative process involves not only the study of opportunities for the search of innovations, but also the provision of conditions for the generation of ideas by initiative, creative, innovatively-active employees. One of the possible mechanisms for achieving this goal, created by modern science, is entrepreneurship.

The activity of entrepreneurs can cover the entire management cycle at the enterprise and relate to the generation of innovative ideas aimed at technology development, human resource management, marketing, material support, logistics, etc. The creation of comfortable working conditions, implementation of incentive programs, formation of the necessary resource support are the priority tasks of management and support of innovatively-active personnel.

There is no universal method for generating ideas of an innovative nature. In scientific works, several dozens of them have been developed. Among them, the most used in practice are the following: brainstorming, heuristic, matrix, cost analysis, poll, etc. All of them have a common disadvantage associated with the creative component of the formation process of an innovative idea, which is often poorly structured, largely irrational and cannot be formally described.

In contrast to the idea, the intention contains an indicative plan of actions for the implementation of an innovative idea in practice. The idea belongs to one particular innovatively active and creative person, while the comprehension of the intention is carried out through the interaction of the author of the idea with the creative group. As a result, the innovative idea is specified, acquires the characteristic features, correlates with the individual experience of each of the group members.

According to P. Sheko, the innovative intention is the basis of the process of making an innovative decision. It is formed by talent, not so much under the influence of demand and economic conditions, as by the actions of specific components of intuitive forecasting, a potential portfolio of perspective developments that are in the field of vision of the entrepreneur, and ways to promote innovation on the market [2]. Thus, the intention is a concretized innovative idea, but it is not substantiated by analytical evidence of the possibility and feasibility of a project.

III. Calculation of the expediency of the formation and implementation of an innovative project

The feasibility of implementation is a direct consequence of the utility that the project will bring to the society as a whole, and enterprises in particular. The utility relates to the ability to meet the specific needs of the end-user of innovations

Innovative idea	→	Intention	→	Innovative project intention
Project utility	→	Feasibility	→	Innovative project development
Innovative petential	→	Possibility	→	Innovative project implementation

The basic preconditions for the formation and implementation of an innovation program | *Stages of the formation and implementation of the innovation program* | *Motives for the formation and implementation of the innovation program*

Fig.1 Cause-and-effect approach to the formation and implementation of the innovative program

The utility of an innovative project seems to be always determined by the utility of the final result – an innovative product, technology, organizational and managerial mechanism, etc. However, the utility of the innovative project and the final result of the implementation of the innovative program relate to each other as general to partial. That is, the creation of a useful innovative product is always a result of a successful innovative project, while the reverse statement is not always true. A negative result in the current period can lead to positive effects in the future. For example, failure of one innovative project can give impetus to new developments in a radically different direction, and they will be much more beneficial. Consequently, the notion of "utility of innovation" and "utility of an innovative project" should not be identified. The first term concerns the already developed product or measure and is determined by its consumer value. The second one concerns the organizational mechanism for achieving the goal of development and is determined by the outcome of the project. The latter may be positive (the goal was achieved), negative (goal not achieved) or conditionally negative (the goal was not achieved, but individual results may have practical value). Moreover, any innovative project, regardless of its result for a particular enterprise, brings some benefits in civilizational, industrial or regional dimensions, since it minimizes costs and allows acquiring the necessary experience to prevent mistakes in the future.

In our opinion, the notion of "project utility" and "project efficiency" should also be distinguished. The first is determined by the level of achievement of the final result, and the second – by comparing the result with the used resources. The phrase "useful but not effective" in this context will mean that the project has received a positive result (e.g. in the form of a finished innovative product), but the cost of its production exceeds the potential benefits of commercialization. That is why the feasibility of project implementation is determined not only by its utility but also by efficiency.

IV. Assessment of the ability to form and implement an innovative project

The development of an innovative project contains a number of stages, among which are the following: goal's formation; scientific and technical reasoning; technical section of the project; parametric analysis of experimental and industrial production; implementation of experimental and industrial production; feasibility study of industrial production; adjustment works; administrative support; marketing and advertising.

The ability to develop an innovative project is determined by the innovative potential of the enterprise. In turn, each successfully implemented project ensures its growth. The assessment of the innovative potential remains a complex theoretical and practical problem, since it requires the analysis of a large number of diverse criteria that are summarized in the following components: technical and production (availability and efficiency of the use of fixed assets, production and sales, material resources), financial (financial condition of enterprises), personnel (number and qualification of employees), marketing (competitive position in the market), information and communication (the presence of modern information technologies), etc. In any case, the study of components of innovative potential should provide an answer to the question of the possibility of the formation and implementation of an innovative project.

Implementation of an innovative project involves the implementation of a set of measures aimed at achieving the goals declared in it. At this stage, it is important to carry out intermediate and subsequent monitoring of the project implementation, as well as to timely adjust the planned indicators in response to changes in environmental conditions.

Conclusions

Summarizing all above-mentioned information, it can be noted that the process of the formation and implementation of innovative programs at the enterprise requires a clear understanding of the essence of all components of the innovative program and the observance of the sequence of stages, the basic preconditions and motives for its implementation. The suggested model of the formation and implementation of innovative programs in this article allows formalizing, structuring and organizing the process of innovative activity at the enterprise, from the origin of the innovative idea and finishing with the implementation of the innovative project. Compliance with the principles of the proposed model is intended to provide enterprises with the maximum effect and utility of the implementation of innovative programs.

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Export operations to the EU markets and advices of how to do it right

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Abstract − Ukrainian business face new age in its growth, which means international competition inside the country and abroad. Making business international is not a regular operation for the business at the beginning and require extra efforts undertaken by the company. The article contains advices which help exporters become more efficient and consistent to achieve sustainable growth of export operations to the EU.

Key words − foreign markets, international operations, EU market, foreign partners, international business, expanding business, international strategy, export consulting.

I. Introduction

Start export operations, turn the company to international operations is one of the biggest challenges for the management of the company which requires extra knowledge, foreign markets insight, extraordinary team management, good marketing and technology. The article provides a combination of scientific research and personal experience as an export consultant for those companies Ukraine who are brave enough to become international.

II. Purpose of the article

The purpose of the article is to provide advices and insight for Ukrainian companies to help them turn intentions to become international to successful export contracts.

III. Research results

Export consulting is not only about services provided to the companies but also about providing insight and expertise which help them do it more successfully even by themselves. Previous publication was dedicated to the key issues should be considered before launching the search of export partners in the EU, difficulties Ukrainian company can meet and forms, Ukrainian company may apply while entering EU market [1]. Here are advices tailored on the basis of scientific research, insight and experience in the EU market:

1. Choose the most promising foreign market. The best foreign market for the company will usually be the country where the products of the company will be in most demand but may be one where the company has additional advantages and access benefits, for instance, an existing strong personal or commercial connection. Good advice is to use a "structured research" approach to identify the best market for you to target. This will mean that company have to do the easy, inexpensive, "secondary" research to short-list the countries, and then limit the more expensive and time-consuming "primary" research to a few markets on your shortlist.

2. Make your company international starting from one market only. Entering a new market can be very demanding in terms of time and money. To be successful, it is wise to limit yourself to one new market at a time. Focus on specific markets and opportunities: don't take the shotgun approach. Successful companies concentrate on one new market at a time. They move on to the next based on their success in the last.

3. Invest enough time and money (if needed) to collect and analyze all information required. Sometimes companies will attempt to enter a foreign market without doing all the necessary research. This can lead to many different problems: regulatory problems at customs, health and safety standards, labeling requirements; marketing problems including offending cultural sensibilities, inappropriate advertising, use of the wrong distribution channels; competition problems including inappropriate pricing, dominant competitors, cartels; cost problems including unexpectedly high transportation, insurance or stocking costs, and many others. The company have to make sure to do all the necessary research on your proposed market and your product's place in it.

4. Entering foreign EU markets may be extremely profitable for the company in Ukraine, so there is no reason to non-rational minimizing expenses for the process of internationalizing. Setting up export operations with the partner from EU may be much more expensive than the same process with the Ukrainian partner (foreign trips, meetings, translation, legal issues, negotiations, different prices and market infrastructure). International trade and market research can be very intimidating to a new exporter. It can be expensive if simply handed over to a research company and time consuming if you do it yourself. But, export to EU may be much more profitable than domestic operations, and this extra profits will cover the costs for setting export operations. However, whether done in-house or with the help of consultants, there are ways to structure a research project to minimize cost and time taken and maximize effectiveness. The company have to take a course in international trade research and do the research itself, or contract to a researcher who you have made sure will work with you to minimize research time and costs while maximizing useful information obtained.

5. Spend enough efforts for search really good partner abroad. It is unreasonable to expect that company will find the perfect agent for its needs through one and only trip to the market [2]. The company have to choose its export partners with care by making sure to invest ample time and effort to locate and secure the commitment of really good agents, distributors, customs brokers and other local partners in your target country.

6. Use all the range of assistance that is available to support the company's export launching. There are many sources of help available to exporters. These include government programs, trade associations, foreign embassies and consulates, libraries, websites, freight

forwarders, trading houses, customs brokers, consultants and other exporters. Use expert specialists to help the company succeed. Do everything yourself is not a good way to do the company international.

7. Going ahead with the full commitment of senior management. Entering a new market is a demanding activity that is unlikely to be successful if not started with the full support and commitment of the company's senior management. The company needs to appoint a leader of internationalizing for the new market [3]. This person could be a senior manager who has freed up enough of his/her time to drive the project. Alternatively, an up-and-coming executive who will respond well to a challenging assignment could fill the role. In this case, the CEO should remember that the champion is, in effect, the chief executive of the export endeavor, and needs the necessary level of help and attention to make a success of the project.

8. Study the culture of the new market and customers. Although it is quite clear that people in foreign countries speak different languages and have different cultures, some would-be exporters ignore this obvious fact and expect foreign customers to accept their product as-is, unmodified and delivered exactly as delivered in Ukraine, with no concession to language or cultural considerations [4]. This may work if your foreign distributor can modify the product and delivery methods to suit local needs and still make a profit. However, a well thought-out approach by the exporter to meeting the reasonable needs of the foreign buyer will always result in more sales, bigger profits and longer-lasting relationships. The company need to be aware of the differences in culture and language between Ukraine and company`s target market. Find out more information about the country or find a website detailing their cultural differences. Learn a few phrases in their language and use them when you meet. Make a point of celebrating the cultures of the countries you deal with. Visit their country and have your agents and distributors visit you and meet as many of your people as possible. Then, when planning product or packaging changes, or planning any marketing initiative, seek advice from natives of that country. People you meet will appreciate you for the effort you make to learn about their country and culture.

9. Adapting company's products or services to the needs and tastes of the foreign market. However universal a product may be, there are bound to be differences in the way it is sold in other countries and other cultures. Packaging, labeling, sizes, weights and measures, languages used or required, spelling variations, product names, colors, logos, local tastes, cultural sensitivities, distribution channel structures, will all differ from market to market. Modify products and services to meet the needs of the foreign market. This is one more reason to have a good marketing plan based on thorough research, starting with a checklist of all the above variables and more. Familiarize the company with laws, regulations and restrictions native to the country or countries you're exporting to. Follow up any prospects with due diligence –company want to work with distributors, suppliers and other partners that may be trusted after all.

10. Pricing of the products for the new market has to be appropriately and marketing strategy have to be tailor-made for the specific market. There is no general reason that prices need to be the same in the new market as they are in your home market. Determine the total size of the market in the country or region and the percentage of it that you need to succeed. Decide your market entry strategy. Establish the costs of taking company's products to the market. Decide the appropriate price for products or services in view of all the above factors.

11. Company should not sell too wide a range of products or services in a new market. This minimizes the cost and complexity of the initial entry to the market and gives them a base of distributors who can help with market research for other products as they go along [5]. For each different product, company introduce to the market you need inventory, promotional materials, training for your marketing and distribution partners, and education for your customers. The fewer products you introduce at the same time, the lower the cost and complexity of the launch will be.

12. Monitor industry fairs and exhibitions in a foreign market which may give you an opportunity to reduce the costs for launching export and make it easier to approach potential foreign partner. Participation in the industry fairs gives the company opportunity to approach potential partners there but attending meeting at the fair a week before. It gives the company in Ukraine more chances to set a meeting, introduce the product and offer to the customer or partner.

13. To master the risk of doing business with far away customers or suppliers. Doing business always involves risk: non-payment of receivables, non-delivery of goods, contractual default of partner companies, bankruptcies, loss or damage to goods in storage or in transit, unexpected changes in consumer tastes, new competitors or competing types of products and many others. All of these apply in foreign markets, just as they do in the home market, but the difficulties of dealing with them are exacerbated by distance. In addition, foreign activities can involve new risks such as exchange rate variations, political instability, cultural differences, unexpected costs of setting up and doing business, customs regulations, repatriation of profits or investment, ownership rules, laws regarding agency agreements, and so on. Proceed with due caution. Seek advice. Allow for additional costs when budgeting and setting prices. There is very good proverb in planning risks of business: "estimate your costs and double them; estimate your revenues and halve them. If the project will still be profitable on this basis, proceed!"

14. Commit enough time and money needed to be successful. Exploring a foreign market often takes much longer and costs more than expected. Significant expenditure of time and money for personal visits, market research and product launches is nearly always required. It will take time to build your sales in the new market. If you don't commit sufficient cash, human resources and time, you may well give up when you are just about to succeed. Management of the company needs to commit

dedicated resources to the target market. Plan to visit the market several times, attend several tradeshows, follow up on all leads. Don't reduce your efforts because you suddenly become busy in your domestic market, and thus waste all your marketing effort to date. It is wise to allow for at least one year before expecting the new market to be profitable.

15. Developing a group of partners (including international) to help exploit the new market. Some sophisticated product/service combinations require partnering with other internationally active companies, each of which will provide part of the total customer solution. Develop partnerships with other companies in Ukraine or other companies in the EU or with whoever and wherever there are people Ukrainian company can combine with to provide a total solution to your prospective clients. For instance, selling consumer good in the EU require importer as a partner, because supermarkets or small sellers have no possibility to import by yourself. So, making the partnership with the importer make it easier to Ukrainian company to enter foreign market.

16. Stay familiar with main conditions of the contract, which are regulated by basic rules of INCOTERMS. Starting export operation company needs to negotiate issues about in what place and at what moment should the obligation to transfer the goods be handled by the seller; where and when the moment of risk transfer from the seller to the buyer occurs; how do responsibilities for the payment of fees and expenses should be distributed among partners, including customs duties and taxes; who will be required to issue export licenses or import licenses; which of the parties is obliged to conclude a contract of carriage; on which of the parties will be assigned responsibilities for the carriage of goods and carrying out cargo handling; determine the procedure for providing payment, shipping and other documents, as well as necessary notifications; which of the parties is obliged to conclude an insurance contract for the

goods transported; how does packaging process should be organized; how the inspection of the goods should take place.

Setting up export operations are becoming a huge challenge for all the companies who decide to meet the challenge. Taking into account advices provided above, it will be easier for Ukrainian business to expand operations to foreign EU markets, become more effective in making business abroad and cooperating with foreign partners.

Conclusion

Expanding business to foreign markets is very attractive and challenging process. It's lasting and tough. And if it was started by the one single company, opportunities and benefits are obvious. We believe that effective planning, solid investigation and resourceful execution will lead Ukrainian companies to success in EU market place and in other foreign markets as well.

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Efficiency Of Public Administration In Ukraine

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Abstract − Public administration sector in Ukraine was under the pressure of soviet system during 70 years which has dramatic influence on its efficiency in present Ukraine. Analysis of efficiency of public administration is step forward to make it more adopted to modern challenges. Analysis and deploying changes make the system of public administration more flexible, client oriented and strong to depreciation of efficiency.

Keywords − public administration, decentralization, organizational development, SIGMA, certification of public organizations, efficiency of management.

I. Introduction

The transition of Ukraine to a new stage in the development of economic, social and political relations after the Revolution of Dignity in 2013-2014 set new priorities and challenges for the authorities, business and the public. One of challenges is the development and improvement of public administration in Ukraine as a catalyst for the development of local communities, regions and the state in general, not only in terms of infrastructure, but also in the development of relations and dialogue between society, public institutions and business.

II. Purpose of the article

This publication is the short brief of a socio-economic research of the effectiveness of the interaction of the public sector with the society and the economic system of the country made by author. The purpose of the article is to highlight the consequences of inefficient state and regional governance in previous years and its impact on the welfare of citizens, Ukraine's place in the world community. The study also aims to develop practical recommendations for improving the mechanisms for managing the development of the public sector.

III. Research results

In the context of deepening of the integration processes, state governance activities require a clear definition of the basic principles and directions of its development, which is why the system of public administration should be based on the principles of openness and provide an optimal combination of principles, mechanisms, methods and tools for building an effective multilevel integrated management structure.

However, the current system of public administration in Ukraine remains ineffective, corrupt and intrinsically controversial, which is a significant obstacle to positive changes in society and the state. Insufficient level of transparency and openness in public administration, lack of clarity in the separation of political and administrative spheres, insufficient professional level of civil servants, lack of a unified system for assessing their competence, low level of disciplinary responsibility, imperfection of the mechanism of political and administrative control in the system of public administration – all these factors are destructive elements in the organization of an effective system of public administration.

Public administration involves the functioning of a universal organizational and legal mechanism for identifying, coordinating and implementing social needs and interests, forming the rights and responsibilities of participants in social processes and their relationship in the right field [2].

The integrated indicator of the efficiency of public administration is the level of citizens' trust to the executive authorities, local governments and positive trends, confirmed by the results of another assessment of the system of state administration of Ukraine on the basis of SIGMA (Support for Improvement in Governance and Management), since each state is interested in forming and the activities of such bodies that are in line with its national policies and are supported by the majority of the population.

The inefficiently constructed system of public administration has its consequences: the deterioration of macro-and microeconomic indicators of the state and increased distrust of state authorities. An important indicator of the assessment of the effectiveness of public government in the field of human activity is the Global Competitiveness Index, which is calculated within the framework of the World Economic Forum. In 2015, Ukraine ranked 79th among 140 countries. The dynamics are negative. Therefore, based on this indicator, we can affirm the ineffectiveness of the system of public administration in Ukraine. The number of civil servants does not turn into the quality of public administration and living standards of the population. There is a need for rotation and, possibly, deep reforms of the system of public administration, not only in the technical and technological aspect, but also in relation to changing the way and mechanisms of the organization of public administration in Ukraine.

In the sphere of public administration, as well as in any sphere of social relations, one of the key elements of the influence on the functioning of the system is the human factor. According to Bogdan Havrylyshyn, a public figure, Doctor of Economic Sciences, [6] in Ukraine, despite its current situation, the quality of human capital is very high, and this factor, with its reasonable use, can become the key to the development of the national system of public administration.

In this aspect, the personal characteristics of a civil servant, his level of culture and personal responsibility, internal sense of duty, moral principles, abidance of standards of service and management ethics play an important role. Increasing the indicators of compliance of civil servants with the general ethical standards would serve as a peculiar foundation for building citizens' confidence in the authorities at all levels and contributing to the creation of a positive image of the public administration.

Emphasizing the priority of human resources in public administration, it is important to maintain a high level of values and norms which will turn to the ethics of public administration [7]. Looking at the situation, the need for reforming the domestic public administration system becomes especially urgent. To this end, a new legislative framework in the field of public administration has been launched since 2015. The international experts and representatives of the public sector in Ukraine had prepared a draft Strategy for the Reform of Public Administration for 2015-2020, in which a new version of the Law of Ukraine "On State Service" [9] was drafted which regulates the basic principles, legal and organizational principles of the functioning of the public service.

The transformation of the public administration system should help to optimize the functions of state institutions, the allocation of authority and the definition of areas of responsibility with the use of effective management models, the implementation of which involves a new structure of relations: "authorities – civil society". The key priority is to the creation of an effective socially – oriented system of public administration, which task will be to provide high – quality administrative services to citizens on the basis of the European Union standards.

Following this purposes means the division of political and administrative areas, creation of a holistic and independent administrative judicial system, the establishment of a system of effective financial management with a clear regulation of liability for violating financial discipline, ensuring a high professional level of civil servants, optimizing the process of formation of personnel policy, improving the quality of service in public administration, ethical component enhancement.

The concept of new public management involves the decentralization of management by expanding the authorities and responsibilities of local government. The main task of the government is to give local communities the opportunity to independently solve their problems and to control the quality of the public services. This approach correlates with the basic values of local self-government – autonomy (decentralized management), democracy (citizens participation) and efficiency (brake the barriers between local authorities and civil society). The state government has to transfer the functions of providing public services to non-governmental (commercial and public) organizations, saving control functions and development of a general strategy responsibility. Such approach allows more flexibility of public administration, as well as stimulating competition between service providers, increase social responsibility of business. The disadvantage of the concept of a new public management is the emphasis on commercialization of the public sector and insufficient consideration of the role of socio-political participation of citizens.

The key task of the concept of leadership in public administration is the transformation of the internal and external relations of the traditional government in order to optimize the provision of services and increasing the participation of citizens, public and private structures in the process of making socially meaningful decisions as well. In accordance with this concept of public management – it is a permanent and active interaction between the state and the non-state sector, which provides adaptation of management mechanisms in the conditions of increasing complexity and dynamics of modern society, the diversity of social problems. Their interaction is based on the idea about the most effective solution of the problem. Civil society is well managed with diversity, the market – with dynamic aspects, the public sector (state) – with the complexity of modern social development. The main administrative task remains to determine the design and combination of these three main factors, due to the replacement of the center's dominance and a clear division of powers by the concept of multiplicity of factors and their interactions. There is a growing horizontal and vertical division of management actions and more effective forms of interaction. The modern process of public administration can be compared with the political mosaic of interconnected policies, programs and projects of all levels.

We believe that increasing the efficiency of public administration in Ukraine is possible through:

- decentralization of the functions of the state structure to the territorial level;
- organizational development of management of public organizations, in order to increase its organizational and social efficiency;
- establishing at the state level organizations that will certify public organizations for the implementation of the Code of Ethics and adaptation mechanisms for preventing corruption;
- wide exchange of experience of public administration with the EU countries (Poland, Lithuania, Latvia, Switzerland, Sweden) through holding public conferences on public administration, involving experts in public administration in retirement as consultants and trainers;
- simplification of regulatory legislation in the field of the economy, which, on the one hand, will reduce the bureaucratic burden on entrepreneurs, on the other hand, will eliminate the points of corruption that inevitably will be tied to various types of permits, certificates and orders;
- preparation of a new generation of highly qualified civil servants [11];
- increase of the material motivation of civil servants at all levels, which will increase the value of the position for the person – the public administrator.

The study of the effectiveness of public administration in Ukraine has made it possible to identify the causes and consequences of ineffective public administration at all levels, to identify the link between the efficiency of public administration and macroeconomic indicators in Ukraine. The final stage was the development of a recommendation on improving the efficiency of public administration in Ukraine. Such recommendations are of a rather theoretical nature, but their application in practice, with a rethinking of each of them in a concrete action plan and setting tasks in the hierarchy of public organization, will enable progressively to improve the quality of public management in Ukraine.

Conclusion

In the context of deepening of the integration processes, state-management activities require a clear definition of the basic principles and directions of its development, which is why the system of public administration should be based on the principles of openness and provide an optimal combination of principles, mechanisms, methods and tools for building an effective multilevel integrated management structure.

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The Role of the Institutions in Organizational Knowledge Replication – Lesson from MNC Investing in Emerging Business Environment

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Abstract − The development of business activities in complex conditions of contemporary environment is a challenge for many companies using traditional strategies. It is partly due to the so called institutional voids. As a result, business models adjusted to mature market philosophy may require reconfiguration. An essential condition is identification of environment morphology which may turn out to be difficult for enterprises from outside a particular market. The purpose of this article is to determine the role of institutions in the replication of the organizational knowledge. Investing in emerging markets creates a perfect opportunity for deeper comprehension of interactions between organizations and the environment. In order to achieve the goal, the objective the results of our own research based on the case studies, were used. In the conclusions guidelines for dealing with businesses under uncertainty of the environment were formulated.

Keywords − organizational learning, emerging markets

I. Introduction

One of the dominant trends in contemporary economic reality is the increase in uncertainty resulting from the still rising complexity of the environment. The diffuse nature of the actions that are appropriate for the multinational enterprise (from this site MNC) exacerbates its consequences only further. One of the sources of complexity in the global economy is the growing number of links between markets that previously did not have direct interactions, and the increasing role of less transparent norms and values. All those circumstances makes prediction of the future based on past patterns difficult or impossible, as causal relationships blur in the network of interactions. North describes this phenomenon as a non-ergotic world (North, 2005). A system is emerging, the effectiveness of which depends on the unrecoverable internal and external events of the organization. Fundamental uncertainty of decisions taken under similar conditions is determined by decisions taken in the context of open changes. Events resulting from such decisions have the potential to transform the system, which is the element and / or transformation of oneself (Stacy, 1993). In the case of open and partially closed changes, the way to deal with the complexity and unpredictability of change is organizational learning (Rokita, 2011).

In contemporary economy enterprises may avail themselves of unprecedented possibilities for development on a worldwide scale, however, paradoxically greater autonomy in activities makes them more dependent on technology, collaboration network, social and material constraints. It may be anticipated that due to its relationship with the environment the system may undergo transformation in two ways, i.e. either on the way to growth of complexity or complexity reduction. This view corresponds to two strategies of dealing with the complexity of phenomena, i.e. complexity reduction and complexity absorption (Boisot and Child, 1999). The aim of the first one is convergence, the latter one is divergent in a distinct way (Tsoukas and Hatch, 2001, p. 981).

Complexity gives systems features which happen to be described as "the life of the system" (Capra, 2002). Living organisations are dependent on their environment not only within the scope of matter and energy but also knowledge and information. From the perspective of the research subject, emerging markets (EM) create an interesting „research laboratory" since one of the features of complex systems is the fact that the system itself as well as its components, or agents, constrain one another (in organised systems the system constrains agents, whereas, in chaotic systems there are no constraints). Therefore, on the one hand, on the basis of the theory of institutional economics, lack of intermediary institutions is considered "a disability" and it is interpreted as limitations for the transparency of processes which take place in the environment. Poorly secured transactions, communication and transparency may create opportunities for opportunistic behaviours of partners and it increases uncertainty (Khanna and Palepu, 1997). On the other hand, in the view of assumptions of complexity not only cannot it be reduced by nature, but it should be absorbed since in this way innovations which guarantee the existence of the system emerge. The results of studies that are presented in the content of this paper were to answer the following question, in particular. How organizations develop activities in complex environment on the bases of its past experience?

The studies on enterprises investing on EM create a perfect opportunity for deeper comprehension of interactions between organisations and environment. Traditional literature on international business was created on the basis of experiences from the so called developed markets. However, environments of western markets were shaped by a relatively similar philosophy of market economy which gave the basis to similar rules of competitive game, whereas the possibility to recognise the influence of institutions on social structures and behaviours is difficult or even impossible if all our cases are embedded in the same or very similar conditions (Scott, 2001, p. 146).

II. Behaviours of MNE in the Conditions of Emerging Markets

The choice of EM as an empirical context for the studies was justified by the specific feature of these markets, i.e. institutional voids. Institutional limitations are one of the criteria which classify markets as emerging ones. An EM is a market where advanced institutions supporting transactions between the buyer and the seller on the market, labour or capital market do not exist or function in an inefficient manner. According to this structural definition, emerging markets are placed on the continuum between totally dysfunctional markets and

developed markets (Khanna and Palepu, 2010, p. 24-25). In this respect institutions shall be regarded as a "rules of game", i.e. as "socially created limitations which give a structure to social interactions" (North, 1990, p. 3). The role of an institution is "reduction of uncertainty by establishing stable (though not necessarily effective) structures in human interactions (…) institutions affect the results of the whole economy by means of their influence on the costs of exchange and production" (North, 1990, s. 5, 6). According to North, institutional framework consists of formal and informal constraints around individual and organizational behaviour. Formal constraints include political (and legal) rules, economic rules and contracts. Informal constraints include codes of conduct, norms of behaviour, and convention, which are embedded in culture and ideology (North, 1990, p. 36, 46).

Institutions differ in the extent to which they are formalised and evident, also in the possibilities of being recognised by external entities, such as MNE. On the basis of the theory it may be expected that in the conditions in which formal constraints fail, informal constraints begin to play their role (North, 1990; Powell, 1990; Scott, 2001; Peng and Heath, 1996; Peng, 2003). The thesis corresponds to the traditional theory from MNE. The so called pillars of the environment refer to this issue more deeply (Scott, 2001). A regulative pillar stands for institutions such as rules and legal regulations which exist to ensure order and stability within the society (North, 1990; Williamson, 1975; Williamson, 1991). Enterprises are obliged to operate in accordance with formal regulations, however, it does not rule out the fact that in a longer period of time they become deprived of influence on these rules. A normative pillar (exceeding formal norms or knowledge) is connected with legitimisation. Binding social norms, values and convictions set borders for actions regarded as desirable and proper (Zimmerman and Zeitz, 2002). It is a "level of cultural support for the organisation" determined by the correspondence of values represented by the organisation and environment (Meyer and Scott, 1983, p. 201). A cognitive pillar refers to cognitive social structures, convictions taken for granted, which are accepted and used by social actors (Di Maggio and Powell, 1983). This domain is connected with the field appendant to social psychology (Berger and Luckmann, 1967; Kostowa and Zaheer, 1999) and a cognitive trend of the institutional theory (Meyer and Rowan, 1977).

These pillars do not have to be treated separately, it can be quite the opposite. In a long period of stabilisation a state of complimentary correspondence between them is more probable (Scott, 2001). For example, values influence cognitive categorisation and in a long-term perspective, regulations. The latter ones, in turn, influence the values. Socio-economic processes, however, create a situation in which the environment of emerging markets is shaped by non-continuous changes (Peng, 2003). The result is not only a non-linear, sudden nature of the changes, but also a possible lack of correspondence between the pillars. It is a specific type of institutional voids existing on emerging markets.

Enterprises do not need to be doomed to passive adjustment but they may change their institutional environment through the development of strategic initiatives. In response to institutional framework, organisations decide for a number of strategic solutions which are the manifestation of their acquiescence, active affiliation or reluctance (Oliver, 1991). These theses give a wide scope for searching for ways of neutralising institutional voids. The ability to develop such initiatives happened to be identified with entrepreneurship and institutional entrepreneurs (DiMaggio, 1988). Institutional entrepreneurs are individuals who can unofficially lead interaction networks and in this very way antinomically organise support for innovation (Hargrave and Van De Ven, 2006; Raffaelli and Glynn, 2015). Policy entrepreneurs were also similarly depicted in the literature of the subject (Kingdon, 1984) as well as reformist leaders (Goldfinch and Hart, 2003). Framework for leadership that enables the learning, creative and adaptive capacity of CAS in knowledge-producing organization is Complexity Leadership Theory (CTL) (Uhl-Bien, Ross and McKelvey, 2007; Uhl-Bien and Marion, 2009). This framework "seeks to foster CAS dynamics at the same time enabling control structures appropriate for coordinating formal organizations and producing outcomes appropriate to the vision and mission of the system. It seeks to integrate complexity dynamics and bureaucracy, enabling and coordinating, exploration and exploitation, CAS, and hierarchy, and informal emergence and top-down control" (Uhl-Bien, Ross and McKelvey, 2007, p. 304).

On the basis of behaviours of the enterprises regarding these institutional voids the types of operating approach to organizational learning may be concluded. Dominant activity of particular functions of the approach may suggest probable directions of development of the enterprises. It should be emphasised that only a short-term perspective may be considered here since when developing new spheres of value creation or pioneering new institutions, human exercise choice, judgement, and creativity (Ackof, 1972). That way in context that are fundamentally uncertain, they may initiate a transformation of the system of which they are part, as well as transforming themselves. Moreover, the perspective of entrepreneurship brings innovation and self-organisation to the lower level of the hierarchy making the entity more responsive to the environment as mutual understanding among employees is amplified during interaction (Kaufmann, 1993; Stacey, 2011; Karakas, 2009; Scott, 2004).

III. Research Method

The results presented in the article are a part of broader study on strategies of international enterprises in the conditions of emerging markets. Qualitative approach with the use of a descriptive study case were used for the preparation of the presented research project (Yin, 2009). The group of research entities included deliberately selected enterprises operating on the international scale. All the enterprises belong to the same industry of manufacturers of parts for mining machinery. The selection of entities operating within one branch

eliminates a possible influence of specific industrial institution on the results. Head offices and branches of five small and mid-sized international enterprises were selected as research units. It is justified by the fact that such enterprises lack resources giving market power understood in a traditional way (Hymer, 1976). The selection was supposed to ensure the best possible access to data. Chief executive officers of both enterprises and branches, as well as employees who had acquired knowledge regarded as significant from the perspective of the research problem constituted the elements of the research. In the course of conducting field research empirical data were collected with the use of structured personal interview and unstructured personal interview.

Below are the results which are most significant from the point of view of the subject of this paper and which were obtained on the way of comparing the cases according to strategic effectiveness (operationalised as a level of achieving strategic goals, and the results above the expectations were also taken into account).

IV. Findings and Analysis

The perspective of complexity made it possible to consider the issue of institutions of EM and learning of the organisation in the new context of institutional environment in one conceptual framework. Such conceptualisation, in particular, made it possible to take a closer look at the relations between the agent and the system and to notice possible patterns within this scope. Table 1 contains the synthetic summary of the obtained results of field research.

In case of SME investing on EM the common elements were actions developed on the basis of applying in the greater scope of activity in a regulative domain of the environment. The observation is not surprising since each enterprise has its own legitimated system and is subject to (partially forcibly) the provisions of the law. It may be stated that each enterprise has its own orderly image. The differences observed between the investigated cases may seem to be more interesting. The most general conclusion that may be drawn from the analysis concerns two different ways of handling complexity. It becomes visible if we compare the cases of Companies Beta, Alfa and Gamma (i.e. the ones which conducted replication). Company Beta implemented practically whole adaptation on the basis of the regulative domain. The objectives and modus operandi were clear to all employees. The number of actions which corresponded to the characteristics of learning in normative and cognitive domain the was not high and they altogether aimed at levelling prospective influence of foreign market institutions, which could result in the change in the organisation. The way of configuration and development of the activity on the level of the whole enterprise and FDI unit corresponded to the image which is reinforced in classic literature on international business. It should be emphasized that it was the case of the largest company in the research sample. Company Beta reached its strategic goals to a satisfying extent (it belonged to the group of the largest companies on the international market within the scope of the activity selected for the study) by applying convergent strategy of handling the complexity of the EM environment.

TABLE 1

SUMMARY OF THE RESULT OF THE RESEARCH – REPLICATION*

Manifestations of learning in regulative domain	Manifestations of learning in normative domain	Manifestations of learning in cognitive domain
Company Alfa – Effective [1] Germany [2] China – JV / Own branch [3] 50/300 [4] 23/45		
- Application of legal protection of patents supported by hidden technical solutions - Mining law regulations as an element that encourages the company to adapt its products - Running current operational activity in the form of outsourcing	- Creating an image of an innovative company of a high standard - Introduction of local elements into the image of the company - Building strong relationships with clients - Limited placement of the most important elements of the activity on the foreign market out of fear of being copied	- "Controlled" collaboration with state R+D units, and collaboration with universities of technology - Internships for students which increase chances for winning employees of appropriate technical qualifications - Adaptation of own technical solutions to local requirements (trade and technical)
Company Beta – Effective [1] Italy [2] Malaysia – Own branch [3] 600/2800 [4] 128/323		
- Duplication of standardised solutions (lack of adaptation); lack of such possibilities was simultaneously considered a serious constraint - Negotiations with local authorities within the scope of the conditions for investment in the region - Application of standardised indicators in all (internal) areas of activity (regardless of the shortcomings noticed)	- Preservation of quality as an absolute value - Local organisation culture identified as one of the main barriers of the activity - In the course of the study it was revealed that only one case of adaptation which was the initiative "on one's own", i.e. the department CEO's "trick" implemented thanks to a great knowledge about procedures and personal relationship with board members	- One of the ways of levelling local constraints was to invite existing collaborators to co-invest abroad - Building a JV network according to a settled ex ante sequence and standardised criteria

TABLE 1

SUMMARY OF THE RESULT OF THE RESEARCH – REPLICATION*

Manifestations of learning in regulative domain	Manifestations of learning in normative domain	Manifestations of learning in cognitive domain
Company Gamma – Ineffective [1] Germany [2] China – JV [3] 25/160 [4] 11/63		
- Formal rules of market research and standardised rules related to contact with clients - Formal rules of assessment in each aspect of business activity, especially within the scope of collaboration with a foreign representative - Formal rules of project management (procedures, IT tools, documentation, meetings) - Application of formal agreements with all the partners - Application of the patent law as a form of protection	- Important decisions related to the local market consulted with other experienced companies from the home market - All rules established at the headquarters - Low level of resource engagement on the local market due to high risk - Adaptation understood only through adjustment of the product, however, there is also a declaration about the lack of need for change due to technical standard which is higher in comparison with the local one (only one, very little modification of the product under the influence of local demands was identified) - Scope of adaptation recommended by JV partner was assessed as too large, as a result of which the company withdrew from the market	- Sales present only on the local market, other tasks accumulated at the headquarters for their protection - technical teams set up at the headquarters for the purposes of implementation of important projects (each time on the basis of the company's CEO's decision) - Relatively free communication within the company, restrictive rules of sharing information outside the company - Goals set "from above", but employees may comment on them - Information about foreign markets gathered by the headquarters (also during annual meeting of the company's representatives from all over the world)
[1] Country of origin [2] Form of organisation of FDI – Location of selected FDI [3] Number of employees (FDI / the whole company) [4] Volume of turnover (FDI / company)		

Own research

* Replication is understood here as a transfer of core products and/or the whole business models which were developed on other markets (Leonard-Barton, 1999).

A similar approach did not prove to be successful in case of Company Gamma (which withdrew from the market). Company Alfa was regarded as efficient, however, in this case (on the contrary to Company Gamma) active actions in all three institutional domain were identified. Companies Gamma and Alfa are much smaller companies than Company Beta. Effective application of this strategy (convergence) requires appropriate market power. Reduction of complexity without appropriate market power (Hymer, 1976) (which in the investigated case was delivered by the accumulation of the capital) leads to strategic inefficiency. The observation may be summarised in the following way. The dominant role of learning on the bases of regulative domain leads to the reduction of complexity by the organisation.

Common for Companies Alfa and Gamma (and, at the same time, different in relation to Company Beta) was the fact that they did not have at their disposal traditional attributes of competitive advantage on the foreign market. It may suggest that lack of market power requires absorption of complexity (divergence). The cases in the research sample made it possible to notice various consequences of the absorption of complexity of the environment. Replication resulted in the fact that the ground for undertaking the action was first looked for in the scope appropriate for the regulative approach, whereas obstacles which would appear served as a call for action (in the normative domain) so that the existing "shortages" could be made up for in a creative manner (cognitive domain). The sequence therefore ran from the formal (legitimised system) to informal institutions (the shadow). Company Gamma withdrew from the market although it did not resign from their development plans. Nevertheless the company was considered ineffective. The observation may be generally summarised in the following way. The assumptions resulting from experience (replication) are first responsible for the selection of actions appropriate for either formal or informal institutions. Therefore experience shapes a cognitive filter which is close either to the categorisation model (framework precedes data) or sense-making framework (data precedes framework).

V. Summary

The application of the complexity theory in the sciences on organisation and management leads to reflection upon deeply rooted assumptions which are often accepted by the researches in a silent way. The content of the paper was devoted to a detailed exploration of the nature of organizational learning behaviours and its impact on organizational performance in SME in turbulent environments. Such perception of the research ground was the result of the fact that majority of the most prominent literature in the field was developed on the basis of results of the studies conducted within large enterprises. EM, due to their characteristic features, additionally create a very attractive context of research.

The cases of enterprises investigated exemplify two ways how the organisation may handle environment complexity. The first one consists in the reduction of complexity (convergent type), which corresponds to MNE vision reinforced in the traditional literature in the field of international business. The other one consists in the complexity absorption (divergent type), whereas the cases of enterprises which successfully apply such approach are young, small enterprises, also from EM, and therefore lacking traditional bases for an advantage on a global scale. The foundations of their success in development of actions in the conditions of emerging environment helped to emphasise the perception of learning from the perspective of the complexity theory. The applied theoretical framework made it possible to put the obtained results of the study in a clear order. However to explain the identified relationships more fully, the feedback[1] should be taken into consideration. In this context implementation of tasks of an legitimated (official) system, i.e. achievement of basic, current goals of the system in possibly most efficient way is based on negative feedback thanks to which status quo is obtained. Within its scope the nearest future of the system might be foreseen since it is characterised by regularity of behaviours, order and balance[2]. The shadow of the system is characterised by greater and different dynamics which, to a large extent depends on people's personality, their expectations and emotional states (Stacey, 2011). From this point of view, since learning on regulative domain is connected with the authorised system of the organisation, it may lead to the formation of more predictable trajectories of development than it is in case of adaptive and enabling leadership function. But on the other hand, unforeseen changes may appear to be very dramatic.

Footnotes

[1] Feedback is a circular proximate cause of connected elements where each element affects another one until the last one answers the first one, i.e. until the loop is closed (Capra, 1996). Feedback is a complex concept even when considered with reference to non-living systems. Negative feedback may balance the results of deviation which have the tendency to grow. Positive feedback develops when the system can no longer delete the deviation. Then it can be multiplied and lead to the so called escape (a kind of disintegration often observed in the physical world).

[2] The assumption about the functioning of the authorised system on the basis of the negative feedback shall be understood in relation to the assumed goals of the organisation. Again, it is a simplification which is to make the content presented clearer.

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Analysis of success factors in advertising

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Abstract – The essence of factors of the success of advertising campaigns is investigated. The stages of conducting and stages of evaluation of the effectiveness of advertising campaigns are determined. Also defined goals and objectives of advertising campaigns.

Keywords – advertising campaign, marketing, efficiency, trade, communication.

I. Introduction

The effectiveness of advertising – this is a crucial element in the marketing policy of the enterprise. Speaking of its effectiveness, it is necessary to know precisely what goals are set before it in a concrete case.

Properly organized advertising activity in a market environment affects not only the whole economy, but also enterprises and individual consumers. Effective advertising requires a competent, purposeful approach. Advertising will be effective if it is included in the process of creating and promoting it to the buyer. Each stage, from the moment of creation of products and ending with its sale, must be accompanied by an active program of advertising influence. Advertising efforts should be present both in the sphere of trade and in the sphere of production. It is necessary to conduct a constant evaluation of the advertising [1, c.1].

II. Main Results

Advertising can not exist on its own. For effective influence on the buyer, she must use the experience of other areas of knowledge: marketing, psychology, journalism, linguistics, literature, public relations, and others. Advertising should be viewed not as a system itself, but as a share in the overall marketing system. Here the interaction of advertising with a number of other activities is considered, which is extremely important for achieving the main goal of marketing – the constant receipt of maximum profits, while taking into account the satisfaction of the buyer's interests. [6, p.4]. Specialists highlight the economic and communicative goals of advertising. The first is directly aimed at the purchase of goods, while the latter are directed indirectly. To economical include: support for the sale of goods, the formation of the need for this type of product, incentive to purchase goods of a particular company, stimulating demand for a specific branded goods and sales, announcement of preferential sales, sales, lower prices, reducing the timing of the introduction of new goods on the market, incentive potential buyers to visit the store, exhibitions, etc., presentation of new properties of the goods, new design.

Depending on the goals determined by the specific market situation, advertising can effectively solve the following tasks:
– informing;
– persuasion;
– reminder [1, p.2]

Advertising campaign – a set of well-prepared, resource-intensive, consistently implemented in the form of advertising plans, events and promotions aimed at achieving long-term advertising goals and objectives. We can say that all advertising activity of the company is a complex of advertising campaigns. In turn, it is the main tool for the company to complete its advertising strategy, one of the elements of planning advertising activities. [3, p.1]

In marketing communications, there are ATL and BTL segments. ATL-advertising is the so-called traditional types:
– advertising in the media,
– Out Of Home (external and internal),
– polygraphic

The rest of the advertising options refer to BTL-communications.

Classification of advertising campaigns

Certificate of classification	Campaigns
Goal	- support for a specific product or service - forming a company image
Territorial coverage	- local (city, district) - regional - national - international
Terms of holding	- short-term (up to 1 year) - long-term (more than a year)
Direction	- Targets targeted at specific market segments - general orientation directed at the general public
Intensity	- uniform - growing - downhill

The purpose of advertising campaigns can be varied:
1) introduction of new goods and services on the market;
2) stimulation of sales of goods or increase the volume of sales of services;
3) switching demand from one product to another;
4) creation of a favorable image of the enterprise and goods;
5) ensuring the stability of representations from buyers and partners about a product or an enterprise.

Allocate the following key stages of an advertising campaign:
1. Analysis of the marketing situation;
2. Development of advertising goals;
3. Development of advertising strategy;

4. Determine the size of the advertising budget;

5. Identification of means of advertising, media planning;

6. Distribution of advertising budget for advertising measures;

7. Registration of the advertising campaign plan;

8. Development of advertising product;

9. Making and placing an advertising product;

10. Evaluation of the results of the advertising campaign. [2, p.12]

The marketer needs information about the volume of the audience to calculate potential advertising effectiveness. Data on the size and characteristics of the audience can be obtained from organizations for the study of media, printers or radio stations. In addition, the marketer needs to know the level of interest shown by the audience to one or another printing authority or station, as well as how closely the given audience closes with the characteristics of the planned market. [3, p.2]

There is a so-called "Algorithm for evaluating the effectiveness of an advertising campaign." Consider the main stages of evaluating the effectiveness of an advertising campaign. They include:

– assessment of compliance with marketing strategies;
– evaluation of the achieved results;
– assessment of achievement of marketing goals;
– assessment of the achievement of the goals of the advertising campaign;
– cost estimation for advertising campaign;
– assessment of the correspondence of the target audience;
– assessment of the success of positioning services;
– assessment of the realized idea and creative component;

– estimation of correctness of choice of channels of integrated marketing communications;
– formation of recommendations;
– general conclusions and recommendations. [4, p.1]

Conclusion

The most accurately determine the effect of the advertisement, it is possible only if the increase in sales of goods occurs immediately after the impact of advertising. This is most likely in the case of advertising of new goods of daily demand. Evaluating the effectiveness of the advertising campaign will obtain information on the advisability of advertising and the effectiveness of its individual tools, determine the conditions of optimal impact of advertising on potential customers.

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General Principles and Priorities of Economic Providing of Sustainable Development: Realities and Directions of Improvement

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Abstract – Author shown the model of the structural transformation on the basis of the analysis the aspects development of progress towards sustainable in many areas of economy. Its focus is not only on methods of promoting sustainable development and structural change but also on improving the economical potential. The reseach objective of the current research is to measure and analyze the key points for increasing the efficiency of the economical system development in Ukraine and to identify the economic and institutional grounds for sustainable development. The result of researche is the identifying of some points of the developing countries and of the countries with economical transformations.

Keywords – sustainable development, sustainable development goals, economic growth, innovation system, globalization, innovation.

I. Introduction

If the world is to eradicate poverty, address climate change and build peaceful, inclusive societies for all, greater efforts are needed to accelerate progress on the Sustainable Development Goals (SDGs). In the process of the transformation of Ukrainian economical system the structural aspect of sustainable development is becoming very important. It is shown by changes in quantity and quality in economy. Innovation is believed to be the fundamental source of significant wealth generation within an economy. The two ways to increase economic output within an economy are to increase the number of inputs in the productive process, or think of new ways to get more output from the same number of inputs. The latter is the essence of what is broadly meant by innovation, which is defined as the introduction of new or significantly improved products (goods or services), processes, organizational methods, and marketing methods in internal business practices or the marketplace. An important feature of an innovation ecosystem is that the resources available to the knowledge economy are coupled to the resources generated by the commercial economy, usually as some fraction of the profits in the commercial economy. Another feature is that the ecosystem is usually strategically developed around a specific technology. The usage of the main points of these theories and practical experience can transform the researches of economical systems into the new multi-science level with the aim of increasing resource support for economical capacity building worldwide.

II. The main research matherial

Using the most recent data available, the annual SDGs report provides an overview of the world's implementation efforts to date, highlighting areas of progress and areas of economy. While considerable progress has been made over the past decade across all areas of development, the pace of progress observed in previous years is insufficient to fully meet the Sustainable Development Goals (SDGs) and targets by 2030. Giving people in every part of the world the support they need to lift themselves out of poverty in all its manifestations is the very essence of sustainable development. Ending poverty in all its forms everywhere focuses on ending poverty through interrelated strategies, including the promotion of social protection systems, decent employment and building the resilience of the poor. Number of people living in extreme poverty fell significantly. Proportion of vulnerable populations covered by social protection systems is still low [11].

While nearly a billion people have escaped extreme poverty since 1999, about 767 million people remained destitute in 2013, most of whom live in fragile situations. Despite major advances, an alarmingly high number of children under age five are still affected by malnutrition. In 2016, an estimated 155 million children under five years of age were stunted. Between 2000 and 2015, the global maternal mortality ratio declined by 37 per cent and the under-five mortality rate fell by 44 per cent. However, 303,000 women died during pregnancy or childbirth and 5.9 million children under age five died worldwide in 2015. In the area of sustainable energy, while access to clean fuels and technologies for cooking climbed to 57 per cent in 2014, up from 50 per cent in 2000, more than 3 billion people, lacked access to clean cooking fuels and technologies, which led to an estimated 4.3 million deaths in 2012. From 2015 to 2016, official development assistance rose by 8.9 per cent in real terms to $142.6 billion, reaching a new peak. But bilateral aid to the least developing countries fell by 3.9 per cent in real term. Progress is uneven. The benefits of development are not equally shared. On average, women spent almost triple the amount of time on unpaid domestic and care work as men, based on data from 2010 to 2016. Economic losses from natural hazards are now reaching an average of $250 billion to $300 billion a year, with a disproportionate impact on small and vulnerable countries. Despite the global unemployment rate falling from 6.1 per cent in 2010 to 5.7 per cent in 2016, youth were nearly three times more likely than adults to be without a job. In 2015, 85 per cent of the urban population used safely managed drinking water services, compared to only 55 per cent of rural population. Empowering vulnerable groups is critical to ending poverty and promoting prosperity [12]. But more than 100 countries do not accurately count births and deaths. The births of nearly one in four children under the age of 5 worldwide have never been recorded. Only 13 per cent of countries have a dedicated gender statistics budget. Seventy-seven out of 155 countries monitored do not

have adequate poverty data, although there have been clear improvements in the last decade [13].

Over the years the Global Innovation Index (GII) has measured the innovation capacity of nations across the world and presented a comparative analysis to help in understanding the variation in national competencies. The findings of the last five years of GII rankings in its innovation input and output pillars demonstrate that certain countries are consistently doing better than their peers in the same income and region categories [7]. Two high profile examples of focused ecosystems are the Department of Energy's Innovation Ecosystem Development Initiative which is focused on speeding up the adoption of energy innovations and the European Innovation Initiative's Digital Ecosystem technologies. These national level strategic initiatives are just two examples; clearly innovation ecosystems can be structured around almost any subject matter. The Engineering Research Centers (ERC) program at the National Science Foundation is an example of smaller scale innovation ecosystems developed to push selected technology niches which are centered on transformative engineering systems. This program, originated more than 25 years ago within the NSF's Engineering Directorate has been very effective at initiating and maturing ecosystems that are stable enough for the Engineering Research Centers to continue operating after NSF funding sunsets at the end of 10 years. The current success rate for graduated Engineering Research Centers is 82% [8]. The rise of "micro-multinationals" – start-ups which operate across high- and low-cost locations, delivering to an international customer base – exemplifies the opportunities wrought by globalization, digital communications and the internet. The challenges for business leaders and policymakers are to empower such opportunities for entrepreneurs and to foster domestic and international innovation ecosystems, while mitigating an increasingly dysfunctional global labor market [9]. The global labor market is undergoing massive structural changes that will have potentially far-reaching implications for the workforces of the future. The structure of the economy can be analyzed according to the production and according to the dividing, exchange and consuming of the product from the point of view of the enterprises, branches, regions and others agricultural elements; separate structure-building factors and processes. In such conditions the industrial structure of the economy characterizes the comparativeness of investments from different industries in the creation of the GDP; the restrictive structure – is the turnover of the production factors; technological – comparativeness functionalized different technologies etc. The researches of the branch structure of the economy of different countries of the world in 2013 shows that the main sphere in the developed countries is the sphere of services, which provides the growth of the economy because of the growth of the workforce and the economy of the natural resources.

The type of work people across the world are doing is shifting. While agriculture still dominates in emerging markets such as India and Nigeria and manufacturing has taken hold in slightly more advanced economies such as China, the proliferation of the service sectors in developed economies such as the US, the UK and France (accounting for almost 80% of GDP in each) stands in stark contrast [9]. However, as the International Labor Organization (ILO) considers a person to be employed if they have worked at least one hour in 'gainful' employment in the most recent week, such figures could considerably underestimate the underemployment rate in many countries. Mature economies where economic growth has been less robust are also dealing with growing ageing populations – making them top-heavy and producing fewer young people to replace the generations who are approaching retirement or are already retired. France and the UK have the highest proportion of over-65s in their population (of the eight countries examined), whereas in fast-growing countries such as Nigeria and Brazil those aged over 65 account for a significantly smaller share – less than half that of France and the UK. This poses a problem, and identifies a potential opportunity for fast-growing countries; their economies are not maximizing the young and dynamic population available to the workforce, as demonstrated by the low labor participation rates [10]. Foreign Direct Investment Confidence Index, which assesses likely foreign investment decisions by global business leaders, finds that investors are readily looking past emerging countries that boast low labor costs in favor of developed countries that are committed to – and can demonstrably show – continuous innovation. In fact, three-quarters of the top investment destinations are still developed economies. Although multiple factors are involved in this superior innovation performance, policy presents a major differentiating factor in the majority of cases [7].

The result of his researches is the identifying of some points of the developing countries and of the countries with economical transformations.

Firstly, it is the fundamental research of the structure including the general economy, industrial economy and institutional.

Secondly, the growing investment is seen as a necessary but not only condition of the economical growth and development.

On the basis of the differences between the countries in the internal and external factors of the sustainable development there is a substantial differentiation between the developing countries and the countries with the transformation of the economy in the conditions of the economical growth [2]. The structure of the economy can be analyzed according to the production and according to the dividing, exchange and consuming of the product from the point of view of the enterprises, branches, regions and others agricultural elements; separate structure-building factors and processes. In such conditions the industrial structure of the economy characterizes the comparativeness of investments from different industries in the creation of the GDP; the restrictive structure – is the turnover of the production factors; technological – comparativeness functionalized different technologies etc. The researches of the branch structure of the economy of different countries of the world in 2013

shows that the main sphere in the developed countries is the sphere of services, which provides the growth of the economy because of the growth of the workforce and the economy of the natural resources.

A fundamental human need—access to nutritious, healthy food—and the means by which it can be sustainably secured for everyone. Tackling hunger cannot be addressed solely by increasing food production. Well-functioning markets, increased incomes for smallholder farmers, equal access to technology and land, and additional investments all play a role in creating a vibrant and productive agricultural sector that builds food security. Investing in agriculture is widely recognized as one of the most effective ways to alleviate poverty, improve food security and reduce hunger and malnutrition. However, both foreign and domestic official investment in agriculture has been declining. The share of aid to agriculture in sector-allocable aid from member countries of the Development Assistance Committee of the Organisation for Economic Co-operation and Development (OECD-DAC) has fallen from nearly 20 per cent in the mid-1980s to only 7 per cent in 2015. It has remained at this level since the late 1990s, reflecting a shift away from the financing of infrastructure and production towards a greater focus on social sectors. Government spending on agriculture has not been proportional to the sector's share of gross domestic product (GDP) either. The global agriculture orientation index—defined as agriculture's share of government expenditures divided by the sector's GDP—fell from 0.38 in 2001 to 0.24 in 2013 and to 0.21 in 2015 [11].

Sustainable development is a branch of economics which deals with economic aspects of the development process in low-income countries. Its focus is not only on methods of promoting economic growth and structural change but also on improving the potential for the mass of the population, for example, through health and education and workplace conditions, whether through public or private channels [1]. Development economics involves the creation of theories and methods that aid in the determination of policies and practices and can be implemented at either the domestic or international level [2]. This may involve restructuring market incentives or using mathematical methods like inter-temporal optimization for project analysis, or it may involve a mixture of quantitative and qualitative methods [3].

Last year, the global statistical community laid the groundwork for successful monitoring and realization of the 2030 Agenda, with the UN Statistical Commission's inter-agency and expert group agreeing on 230 individual indicators to monitor the Agenda's numerous goals and targets. Covering the economic, demographic, social, trade, environment and energy areas – is facing an enormous task of responding to an unprecedented demand for high quality, timely and disaggregated data [13].

Effectively tracking progress on the SDGs requires accessible, reliable, timely and disaggregated data at all levels, which poses a major challenge to national and international statistical systems [12].

Conclusion

So, the choice of the ways of the innovation systems development in Ukraine needs the researches in the domestic practice of the systemic economical transformations, detailed study of the way of world development, generalization of the world experience in the adaptation in the industrially developed countries to the reality of the modern world market. The main hypothesis of the structural transformations theory is the development is followed by the growth and different changes that are equal to all countries. But there are some differences between the countries in the speed and forms of the development connected with several specific factors: the natural resources, the area of the country, aims, the ways of the governmental politics, access to the foreign investments and technologies, the external condition of the country. The tools of the modulation are the modern econometric methods.

The mechanism of the sustainable development in the agriculture is motivated now. These two types of the economical development comply with two different functions of the investments.

Goal Ending hunger, achieve food security and improved nutrition and promote sustainable agriculture – addresses a fundamental human need—access to nutritious, healthy food, and the means by which it can be sustainably secured for everyone. Tackling hunger cannot be addressed by increasing food production alone. Well-functioning markets, increased incomes for smallholder farmers, equal access to technology and land, and additional investments all play a role in creating a vibrant and productive agricultural sector that builds food security. Sustainable agriculture, along with investments to improve agricultural productivity and enhance food security, are key to ending hunger and lifting millions of people, including small-scale farmers, out of extreme poverty. Improving farm productivity, increasing the value added in agriculture, and integrating markets are all important strategies. The role of infrastructure and technology in this regard cannot be overstated. Transportation infrastructure, for instance, can connect farmers with existing markets and create new ones. Where poverty rates are still very high air travel and freight transportation are very limited. Information and communication technologies can help farmers connect with buyers, transfer money and acquire valuable information, including about weather conditions and market prices [11].

The process of the structural transformation according to this model is the self-based growth in employment, which is going on till all extra workforces in agriculture will transform into the production industry. On this stage there is a balance between the industry and agriculture, the structural economical transformation ends, the main resource of the local national product creates in production, the other factors of economical growth start working. They are connected with the scientific and technological, modern management, marketing, IT achievements. Development economics involves the creation of theories and methods that aid in the determination of policies and practices and can be implemented at either the

domestic or international level, which also aims to create partnerships and initiatives that harness for the public good and for the implementation of the new global development goals.

Foreign Direct Investment Confidence Index, which assesses likely foreign investment decisions by global business leaders, finds that investors are readily looking past emerging countries that boast low labor costs in favor of developed countries that are committed to – and can demonstrably show – continuous innovation. In fact, three-quarters of the top investment destinations are still developed economies. Although multiple factors are involved in this superior innovation performance, policy presents a major differentiating factor in the majority of cases [7]. Increasingly, public-private partnerships are enabling the use of big data and other non-traditional data sources in policymaking by mainstreaming their use in official statistics. This is made possible through various institutional arrangements, including in-house production of statistics by data providers, direct transfer of private data to end users, the transfer of private data to a trusted third party and the outsourcing of certain functions. It is crucial that national statistical offices, supported by international organizations, continue to advance the design and implementation of incentives and business models that encourage effective partnerships for improving the availability and quality of data for sustainable development [11].

In many areas, inclusive development strategies are the commonly accepted paradigm. Examples include drinking water, electricity and other basic services, where ensuring universal access is often an overarching objective and is now reflected in the SDGs. However, whether strategies succeed in reaching those left behind depend on many factors, from country-specific circumstances to their design, targeting methods and practical implementation. Available evaluations from different SDG areas all suggest that there are significant practical challenges in effectively reaching those left behind. Many criteria can be used to identify those left behind, whether within a country or between countries. Many SDG goals and targets directly relate to leaving no one behind and refer to specific objectives and actions as well as groups (of countries or people) that should be the object of sustained attention in this regard. This is particularly the case with goals that were within the scope of the Millennium Development Goals (MDGs), including poverty, gender, education, health, and means of implementation. In those areas, considerations of inclusiveness in a broad sense have long been part of the main development discourse and practice,

and actions and policies to address this dimension have become part of the standard development apparatus [14].

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Problems of Growth Competitiveness of The Enterprise

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Abstract – Authors shown the basic direction of formation and improvement of the system of managing enterprise's competitiveness. The result of researche is the strategic priorities of the management system for the development and implementation of long-term competitive advantages.

Keywords – competitiveness, economic growth, market analysis, price politics, methods of advancement analisis, strategic management of competitiveness of enterprise.

I. Introduction

The current problem of modern domestic theory and practice of management is a management of the competitiveness of the enterprise. International competition, globalization of markets, scale penetration of foreground tasks to the Ukrainian market It all is foreground jobs in relation to the competitiveness of the enterprise. If you successfully manage all these tasks, then it will provide a survival and development of enterprises in a new environment. Lack of competition's experience, difficult economic situation in the state, unsolvedness of plenty of methodological and applied problems of management the competitiveness of the enterprise need additional researches in this field. With the aim of achievement of competitiveness of the enterprise, range of problems of strategic management needs much attention today [1].

Competition is central to the operation of markets, and fosters innovation, productivity and growth, all of which create wealth and reduce poverty. However, markets do not always work well, and uncompetitive markets are often those that matter most for the poor [4].

II. The main research matherial

There are many different integral approaches to solving dominant management problems. For example, strategic management of competitiveness of enterprise. In order to solve this problem, you need to put such tasks that give an opportunity to educe key descriptions of competitiveness of enterprise. First task that functions in the conditions of market and arises up on an enterprise, it is a survival and ability to pay accounts, in other words providing of solvency. Such task, as a rule, is solved by taking extreme measures in relation to realization of already manufactured goods, by realization of row of marketing measures: market analysis, assortment, price politics, methods of advancement analysis. After an enterprise attained solvency, there is other task – achievement of profitable activity. On this stage marketing measures are complemented by economic measures, such as, analysis of charges on a production, analysis of prime price and pricing and organizationally – technological [2].

The second urgent issue for enterprises is to ensure financial and managerial transparency, which implies the existence of an enterprise financial structure, financial policies consistent with the international principles and accounting standards. Ensuring financial and managerial transparency is also achieved by timely and proper use of tools such as financial analysis and planning, crisis management, insurance, etc.

In the process of its growth, the company faced with the so-called growth problems. Symptoms at this level may be the complexity of the information, material and other flows in the company, deterioration in the financial condition, the reduction of the overall organization and the like. The problem arises, and with it another characteristic condition of the enterprise business management. To solve this problem it is necessary to introduce modern technologies. Then there is the need for coordination and organization of the integrated interaction of the many financial and management techniques, why in the enterprise and creates an archive of optimum administrative decisions, expert systems, decision support [3].

Competition, the process of rivalry between firms striving to gain sales and make profits, is the driving force behind markets. Efficient and fair markets are essential for catalysing private sector development and economic growth. Yet, while markets work fairly well much of the time, effective competition is not automatic, and can be harmed by inappropriate government policies and legislation, and by the anti-competitive conduct of firms. The problem of identifying where competition is weak, and how to foster more effective competition to encourage economic growth and reduce poverty, is challenging. Many developing countries now prioritize growth in their national poverty reduction strategies. Because effective competition is a driver of productivity, competition policy should be an essential component of any pro-poor growth strategy. Crucially, competition facilitates greater equality of opportunity by breaking down the barriers to fair competition that often help to protect incumbent elites. Barriers to competition are pervasive and harm innovation, productivity and growth – in developing countries. Fair competition matters, both for economic growth and for reducing poverty. Helping markets to work better, by removing unnecessary distortions to competition, can lead to significant reforms of the business environment.

These factors make competition policy and law a priority area for reform in developing countries. There is a need for a wider understanding at policy levels in government, in the business sector and by consumers, of

the beneficial impact of effective competition and of competition policy on an economy [4].

Another task pursued by the company, – providing investment attractiveness of the company. The solution to this problem will allow the company to increase its capitalization and, as a result, increase the cost of capital that was invested by the owners.

Future growth prospects are constrained by longerterm trends. Many economies around the world struggle with the double challenges of slowing productivity growth and rising income inequality, often exacerbated by rapidly aging societies. Stagnating and unequally distributed income growth in turn has opened the door to more inward-looking policies, mounting protectionist pressures, and a general questioning of the premises underlying globalization in many economies—most visibly embodied in the recent Brexit vote. At the same time, in emerging markets, the end of the commodity supercycle has led to an abrupt economic slowdown that has exposed the slow pace or lack of competitiveness enhancing reforms in recent years, which could increase polarization and threaten social cohesion.

Competitiveness Index (GCI) shows, to date, progress in building an enabling environment for innovation remains the advantage of only a few economies. Last but not least, future growth will also depend on the ability of trade and investment that has led to record reductions in poverty rates in recent decades. Today's competitiveness landscape is the outcome of developments stemming from the global financial crisis.The end of the commodity super-cycle and the sharp drop in prices, mainly of oil and minerals but also of food and agricultural products, reveals a close relationship between commodity dependence and competitiveness and provides lessons going forward. Innovation and business sophistication are more closely associated with income levels in general, and in emerging economies and commodity-exporting economies in particular, than they used to be. An open, trading economy generates incentives to innovate and invest in new technologies because firms are exposed to competition and new ideas and can benefit from the technology transfer that comes from imports and foreign investment. At the same time, firms can benefit from larger markets abroad. We define competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. The level of productivity, in turn, sets the level of prosperity that can be reached by an economy. The productivity level also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time [5].

A business capability is what an enterprise needs to be able to do to execute its business strategy. Enterprises should assess the capabilities in order to operate the business by examining the financial and strategic impact.

All capabilities are not created equal. Some contribute more to enterprise competitiveness and its value than others. Competitiveness of enterprise capability is the ability of an enterprise to offer products and services that meet the quality standards of the local and world markets at prices that are competitive and provide adequate returns on the enterprise capability employed or consumed in producing them. Competitive advantage means superior performance relative to other competitors in the same industry or superior performance relative to the industry average. Sustainable competitive advantage is a long-term competitive advantage that is not easily duplicable by the competitors. The sustainable competitive advantage is a long-term strategy or process that allows a business to remain ahead of its competitors.

Enterprises should assess the capabilities in order to operate the business by examining the financial and strategic impact. All capabilities are not created equal. Some contribute more to enterprise competitiveness and its value than others. Therefore, it is important for the enterprise to examine the linkage between its capability and competitiveness [6].

Conclusion

So, we take the insights that ensuring the competitiveness of the enterprise should be considered as one of the most important strategic objectives and financial position and particularly the financial sustainability of enterprises as a means of managing enterprise's competitiveness in the future.

In our opinion, the basic direction of formation and improvement of the system of managing enterprise's competitiveness should be emphasis on the strategic priorities of the management system because it ensures the development and implementation of long-term competitive advantages.

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Breaking organizational routines as a requirement for knowledge broker's leadership role

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Abstract – In the paper based on conclusions stemming from literature connected with organizational knowledge creation, territorial innovation models as well as knowledge intermediaries author tries to build hypothesis relating to the possibility of changing ways of both performing tasks and achieving goals. It is proposed that such kind of opportunity is related to the nature of the projects under realization reflected by the type of learning that occurs.

Keywords – knowledge brokers, types of learning, leadership

I. Introduction

It can be assumed that the task for knowledge broker aspiring for leadership role (knowledge leader to be continued) is to cause that mutual knowledge exchanges take place among interested parties (Krogh, Nonaka, Rechsteiner 2012). Hence, knowledge leaders need to operate in space spreading among different organizational contexts. It can be understood as multi-layered "Ba" (Nonaka, Toyama 2005, p. 423). Knowledge leaders are expected to perceive those networks from different viewpoints, e. g. human entity, team member, organizational member. Nevertheless, there is a necessity for them to take into account influences from institutional environment in region which might be decisive about the kind of solutions preferred in given sector, knowledge assets that are used as well as the kind of targets parties are to achieve. The last factor is explained in literature by means of two quite commonly used terms, that is explorative learning and exploitative learning (e. g. Gupta, Smith, Shalley 2006). Cooperation can have more explorative nature when involves searching for technologies or products new for partners or even for all sector. But when cooperation is directed at making improvements in existing products or production processes it can be said that it is more exploitative (Hermans 2013, p. 43). The leaders should also be able to be familiar with values system of knowledge creators with whom they try to cooperate (Nonaka, Toyama 2005, p. 420). The core of those processes is that external knowledge becomes a part of processes like socialization, externalization, combination or internalization (Lopez--Saez et al. 2010). The main issue here is to be able to say when common knowledge creation can occur.

II. Knowledge leaders and their practices

In general when knowledge creation happens some simultaneous processes are to be present. It was proved for example by Mason and Leek (2008). Their point of departure was Hamel and Prahalad (1994) definition. They identified two basic elements of business models discussed in literature: structure and routines. What is more, they assumed that dynamic business models can be conceptualized as emerging network structures built by the development of routines which are decisive about making the use of given ways of finding solutions to considered problems. As a result of this, they concluded, among three components of dynamic business models there were network structure, inter-firm routines as well as types of knowledge. Then it should be required that problems are currently solved in order to improve organizations on daily basis (Mason, Leek 2008). So, in order to analyse what the company's ability to both transfer as well as create knowledge could be, we can think through some examples.

In order to capture the essence of advantages that can be derived as a result of cooperation in multi-layered networks we can consider conclusions drawn by Harga-don and Fanelli (2002). They analysed how consulting companies that are specialized in the development of new products interact with their customers in order to produce something new. Here we have the situation that companies deliver new solutions to their customers who otherwise may perceive them as impossible whereas customers provide companies with opportunities to put into practice their ideas. It was not until customers began to cooperate with consulting companies that they became more open to new possibilities for knowledge creation.

Also during the Silesian Innovation Forum 2017 issues related to the introduction of innovations concerning technologies and business models were discussed. On the one hand, technological challenges were emphasized, e. g. in case of both airspace and aviation industry (Płonka 2017). On the other hand, the importance is attached to the change of point of view on region, e. g. there is a necessity to see a human being and its needs as the most important ones, which is why both quality advantage and innovation creation in networks of partners and clusters emerge (Ławniczak 2017). It should be undoubtedly stressed that it becomes visible that the impact customers' expectations have lead to the changes in business models in sectors hitherto focusing on technological issues (Płonka 2017). We may add that accordingly to views presented on brokers' roles played by many people in regions (Lawson, Lorenzen 1997) or later on so called collective bridges (Zhao, Anand 2013) in Silesia region there is a broad understanding of the role to be played by all people. Social nature underlying many modern innovations emerges, for example, in encouraging all habitants to take part in activities and discussions on intelligent specializations in region. Finally it should be possible that regional policy can be commonly built in a way that ensures that it is best suited to all people needs and expectations (ris.slaskie.pl). Innovation activities that are currently undertaken not only do need to be skillfully selected in order to contribute to the wealth of community (Open Innovation 2.0 Yearbook 2015, EC, Brussels 2015, p. 24) but also they need to cover new values popularized in societies (Nonaka et al. 2014).

III. Breaking routines hypothesis

In order to move on to our hypothesis we need to notice that theorists claim that in order to manage dynamic knowledge creation, leaders need to create necessary conditions which are as follows: (1) autonomy – related to the fact that all human beings should be rest assured that they have an autonomy to the extent that is possible under given conditions; it is assumed that thanks to autonomous activities undertaken by human beings, organizations increases probability that some unexpected but advantageous conditions begin to occur and at the same time people become more motivated to create knowledge (Nonaka, Takeuchi 2000, p. 101), (2) instability and creative chaos – they induce some interactions between organization and its external environment and are related to the fact that each time organization is more open to signals from the environment, it may take an advantage from its ambiguity, abundance or disruptions and make its knowledge system improved; it is assumed that together with the implementation of factors like instability within organizational boundaries, organizational members face with the challenge of breaking routines procedures, habits and cognitive frameworks (Nonaka, Takeuchi 2000, pp. 104-105) (3) redundancy – is related to the existence of excessive amount of information that is not used directly with relation to operational needs of organizational members, such kind of information is connected with tacit knowledge as well as makes it possible for human beings to understand all others who are trying to express their viewpoint; it is assumed that thanks to it human beings are able to exceed functional boundaries with ease and as a consequence of this to discuss different opinions (Nonaka, Takeuchi 2000, p. 107), (4) related variety – it connects with Ashby's law which says that in order for organization to be able to deal with demands imposed by environment, its internal variety has to be adjusted to variety and complexity that are specific for the environment; it is assumed that members are able to deal with many unexpected events under condition that they differ from each other to the some extent that is achieved due to the ability to match information quickly and flexibly as well as both to ensure that all organizational members have equal access to information (Nonaka Takeuchi, 2000, pp. 108-109) and there are safety, commitment or even love, care and trust (Nonaka, Toyama 2005, pp. 431-432).

Having considered the above-mentioned examples we may conclude that in order for effective knowledge creation induced by leaders could happen it is required that some routine procedures be broken. But in order to make our analysis more comprehensive we need to pay attention to the fact that companies may sometimes be more focused on rather incremental results (Maskell, Lorenzen 2004). Taking it into account we can try to build following hypothesis:

H1a: When cooperators' trials to both define and solve problems accompany knowledge exchanges undertaken by them, the participation of broker who operates inconsistently with the rules that are abided by others in region can be effective in case of more explorative projects. This is

because it leads to a break of routines related to hitherto practiced ways of cooperation and implies the implementation of innovative solution.

H1b: When cooperators' trials to both define and solve problems accompany knowledge exchanges undertaken by them, the participation of broker who operates consistently with the rules that are abided by others in region can be effective in case of more exploitative projects. This is because it leads to a break of routines related to hitherto practiced ways of cooperation and implies the implementation of innovative solution.

Conclusion

The above-mentioned hypothesis is based on the assumption inferred actually from three literature streams. The first one is connected with dynamic knowledge creation and it requires that we pay attention to a break of routine practices as the condition for knowledge creation. The second stream relates to territorial innovation models and let us imply that in order for regional actors to cooperate smoothly, the existence of some common practices in region is needed. The third stream of literature analyses a matter of the advantages that can be derived by brokers who connect ideas possessed by people who otherwise be unfamiliar with themselves. The question that arises is how in practice brokers try to encourage others to abandon their routine practices and whether they can achieve these advantageous results from the point of view of all community acting inconsistently with the ways which all are familiar with. The paper proposes that it can be related to the nature of the projects under realization reflected by the type of learning that occurs.

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Ways to combine the results of the analysis of employees activity of state authorities

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Abstract − The article demonstrates a factor model of due performance of all norms and rules by officials in a governmental body. It singularizes the following basic indices of the factor model: index of official's adherence to rules and norms and performance of them; index of adherence to rules and norms and performance of them during inspection in a governmental body by an employee of an organization, performing the inspection; index of safety of governmental bodies, covering the whole of statistic reporting regarding violations of this governmental body by an employee of an organization, performing the inspection; index of safety of governmental bodies, covering the whole of statistic reporting regarding violations of this governmental body. It substantiates the opportunity of using the factor model for assessment of governmental officials' activityresults.

Keywords − Governmental bodies, assessment of officials' activity results, factor model, official's adherence to rules and norms and performance of them,level of knowledge, level of violations.

I. Introduction

The issues of assessing governmental officials' activity were considered in the works of S.D. Dubenko [2], V.Ya. Malynovskyi [4], N.R. Nyzhnyk, O.V. Sliusarenko [8] and other prominent academicians. However, the issues of improving the governmental officials' activity results assessment system remained unexplored. Improvement and ordination of governmental service requires assessment of efficiency and effectiveness of a governmental official's professional activity.

While improving personnel security in the governmental sphere, we should realize that to achieve the best effect it is necessary not only to detect a problem and find its solution, but also to systematize and reflect the principle of processes change. The objective is to singularize factors for assessing governmental officials' activity results and developing the factor model. This will allow detecting periodically recurrent threats. In this case, there is a chance to develop a threat fighting program.

II. Page Setup

The society is interested in provision of quality governmental services, expects professional and efficient activity of governmental officials, irrespective of political influences or beliefs. Therefore, governmental officials assessment must be an important tool for assuring objective control over the results of authorities' actions, raising demands regarding assurance of clear connection between planned activity of the government, authorities and governmental officials.

The most efficient method that allows future assessing change in a resulting exponent while assuring personnel security of governmental bodies is development of factor model. Creation of this model will allow governmental bodies conducting deeper analysis and monitoring in the sphere of personnel security. The process of personnel security assurance in the governmental sphere is influenced by quite a many factors [2, 7, 8]. And every process must be improved over time.

An important factor in every improvement process is its persistence. The process of change in activity, depending on several factors, will always have a graph of parabolic curve for most objects and subjects. This is explained by human nature (for instance, a wish to get higher returns with lower investments, peculiar to human beings) [1, 3].

The governmental bodies search for ways of improving supervision and monitoring process, and the officials – on the contrary – search for more refined ways to escape responsibility for illegal actions (at this, funds for eliminating real problem are always unavailable) [3, 2].

The modeling is beneficial through the chance of constant analysis of change in both resulting exponent of personnel security and internal factors in depends on. Owing to the correctly developed model, there arises a chance of not only finding a reason why the problem occurred, but also, with account of factors interconnection, detecting a way of problem solution.

In should be mentioned that the built model will reflect the most important processes, and be a basis for assessing potential threats. To create a model that will further assist to its efficient performance, certain conditions should be met:

– adherence to rules and norms by the employees of corresponding governmental bodies;

– high level of knowledge of governmental employees and high quality of work, performed by them;

– consideration of all important impact factors.\

Thus, the factor model may be shown in a following way:

$$Y_{kb} = X_1 \times X_2 \times X_3, \qquad (1)$$

where Y_{kb} is an index of due adherence to all norms and rules in a governmental body. The higher is the index, the lower is the level of violations in a governmental body; X_1 – index of an official's adherence to rules and norms and performance of them; X_2 – index of adherence to rules and norms and performance of them during inspection in a governmental body by an employee of an organization, performing the inspection; X_3 – index of safety of governmental bodies, covering the whole of statistic reporting regarding violations of this governmental body.

Another important thing is that the graph will be represented as an equiangular hyperbole with y = a / x asymptotes. However, with account of reference axes characteristics (all exponents are shown in percent

measurement), it is impossible to use a part of graph below the reference axis.

We should mention that the function graph is a perfect model – that is, the graph provides directly proportionate dependence between the level of education and the level of violations by the employee of governmental division. However, in practice there are situations when this dependence is broken. Therefore, it is reasonable to singularize five basic situations for analysis of the activity of division's employee that confirm this.

The considered factor model belongs to a multiplicative models type. Further research requires description of a process and degree of each factor's impact on a resulting exponent.

The next step is presentation of basic situations during the analysis of activity of the division's employee:

1. situation of maximum knowledge, by the employee of the governmental body, of the norms, rules and processes, at which the level of violations is close to zero. The considered situation is actually a component of an ideal model, i.e. the higher is the level of development, the lower is the percent of violations.

2. situation when employee, having obtained a maximum score in testing, makes absolutely all violations on his/her position. Such situation is theoretically possible in the following cases: there were technical mistakes during the testing process; or the control event was performed by a non-qualified employee. In practice, the chance that this situation will emerge is close to zero.

3. medium percent of the level of knowledge and certain amount of violations. Such situation is peculiar to everyday practice, is graphically presented on fig. 1, and is a part of function.

4. absence of mistakes in service of an official with minimum level of knowledge. This situation looks absurd as it makes the very process of education and training questionable. However, a probability of occurrence of such situations in practice will state on mistakes in the assessment system, i.e. failures during the testing process or inadequate assessment by an expert.

5. situation when an employee with a minimum level of knowledge will make maximum amount of violations in his/her service.

Conclusion

Application of the considered factor model will allow performing efficient monitoring to every division of governmental bodies and organizations that will perform inspection of their activity. Presence of the explored factors inside the model points to the fact that the process of control is quite multisided and numerous objects and subjects are its participants. Further research regarding the index of safety is extremely important as it will be helpful not only for deeper analysis, but also favorable for increasing efficiency of work of governmental divisions. It should also be mentioned that the explored factor model will allow making detailed analysis during emergence of problems, related to personnel security of governmental bodies.

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Export Import Relations Dynamics between Ukraine and EU

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Abstract – Ukraine's commodity relations with the EU are considered. The analysis of dynamics of export-import operations on the basis of statistical data is carried out. The main directions of cooperation in the field of foreign trade relations are determined, which is one of the main factors of high level of economic development of the country. On the basis of quantitative indicators, positive and negative structural changes in foreign trade with the EU have been identified for Ukraine.

Key words: export, import, European Union, Ukraine, commodity relations.

I. Introduction

Over the past few years, significant changes have taken place in the Ukrainian economy, driven by the achievements of political and economic independence, as well as the transition to market relations. Ukraine has a process of European integration, which directly affects its foreign economic activity.

II. The main material

The relations between Ukraine and the European Union were launched in December 1991, when the Minister for Foreign Affairs of the Netherlands, as the EU Presidency, officially recognized Ukraine's independence in its letter on behalf of the European Union. With the signing and ratification of the Association Agreement between Ukraine and the EU in 2014, the parties' relations began to develop in a qualitatively new format of political association and economic integration.

At the signing of the Association Agreement on June 27, 2014, the President of Ukraine P.O. Poroshenko and during its ratification on September 16, 2014, the Verkhovna Rada of Ukraine made statements that Ukraine considers the Association Agreement to be an integral step towards the ultimate goal of European integration in gaining Ukraine's full membership in the European Union [1].

Among the main goals of the Strategy of National Security of Ukraine, approved by the Decree of the President of Ukraine on May 26, 2015, the ensuring of Ukraine's integration into the European Union was determined. According to the Strategy, the Association Agreement between Ukraine and the EU defines strategic guidelines for conducting systematic political and socio-economic reforms in Ukraine, and a wide-ranging adaptation of Ukrainian legislation to EU norms and rules.

On January 1, 2016, an EU-Ukraine Free Trade Agreement entered into force. Analyzing the above-mentioned facts, it is necessary to study the export-import relations of Ukraine with the EU. According to the Ministry of Economic Development and Trade of Ukraine, according to the results of the 1st quarter of 2016, the EU countries accounted for 38.5% of Ukraine's exports of services and goods, the share of the EU in Ukrainian exports in the previous year was 32.8%, and in 2014 p. 31.8%[2].

Exports of Ukrainian goods to the EU from January to April 2016, together with services, amounted to $ 3.7 billion. AIC products amounted to more than a third of commodity exports -35,6%, metallurgical complex production is 20,5%, machine-building-15,9%. In 2016, exports of five products increased, namely: timber, corn, furniture, sunflower oil, steel rods and bars of hot rolled products. The largest decrease was observed in such commodities as ferroalloys, juices, iron ores and concentrates, cake, rolled products and other solid waste. The share of total exports of services to the EU countries amounted to 30.5%. The largest volumes of exports of services were provided to Germany – 16.3%, Great Britain – 15.4%, Cyprus – 8.0%[3, 4].

The largest volumes of exports to the EU countries accounted for transport services – 37.5% of total exports of services to the EU countries, the processing of material resources – 22.6%, telecommunications, computer and information – 20.5%, and business – 12.0%. According to the results of 2016, the most active services were provided to the EU countries by the enterprises of Kyiv – 39.1% of total exports of services to the EU countries, Lviv region -10.4%, Odesa – 9.2%, Transcarpathian – 5.8% and Kyiv – 4.6%[5].

The largest share of imports in 2016 is made up of mechanical and electrical machines, mineral products, chemical products and related industries, transport vehicles, equipment and devices connected with transport, ready-made food products, precious metals and articles thereof , plastics. A large proportion of goods and services were imported from Poland, Germany, France and Italy. As shown in Fig. 1, in the total volume of import of services, the largest share was in government and government services, transport, business, travel-related services and financial services[6, 7].

The volume of direct investments (share capital) in the economy of Ukraine from the EU countries as of December 31, 2016 amounted to 26.1 billion dollars. The United States, accounting for 69.3% of the total investment in Ukraine. The main investor countries, accounting for 83.0% of the total investment from the EU, are Cyprus – $ 9.7 billion. (37.1% of total investment from EU countries), the Netherlands – 5.8 billion dollars. (22.0%), Great Britain – 2.0 billion dollars. (7.8%), Germany – 1.6 billion dollars. (6.2%) and France – 1.3 billion dollars. (5.0%). Significant volumes of direct investments from EU countries are concentrated on industrial enterprises (28.0%) [8].

- State and goverment services — 23,8%
- Transport services — 21,1%
- Business services — 14,8%
- Dispatch services — 10,8%
- Finance services — 10,6%
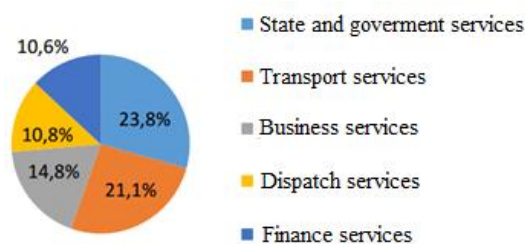
Fig.1 Structure of services imported from the EU,
as of 2016,%

22.6% of direct investments were accumulated in financial and insurance enterprises, 12.3% in wholesale and retail trade enterprises, repair of motor vehicles and motorcycles, 11.0% in organizations engaged in real estate transactions. The volume of direct investments (share capital) from Ukraine in the economy of the EU countries as of December 31, 2016 amounted to $ 6.1 billion, or 96.4% of the total volume of investments from Ukraine (as of January 1, 2016 – $ 6.1 billion, 96.8%). The largest volumes of investments on 31.12.2016 were directed to Cyprus – 5.9 billion dollars. The United States (97.1% of total investment in EU countries)[9, 10].

Conclusion

Thus, the total volume of trade in goods and services for the year between Ukraine and the EU amounted to 35.9 billion dollars. US, of which $ 30.6 billion The US accounted for trade in goods, and 5,287.5 for trade in services. During 2016, the European Union continued to strengthen its trade relations with Ukraine, and bilateral trade between Ukraine and the EU grew. Compared to 2015, the total volume of trade in goods and services between Ukraine and the EU amounted to 108.1%. In 2016, exports of goods and services to the EU countries amounted to 16.4 billion dollars. USA, imports -19.4 billion dollars USA. There was a negative balance in bilateral trade of $ 3,03 billion. USA.

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Formation of stock market trade networks model in modern condition

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Abstract − A precondition for countries' co-existence in the global financial area is a specific architectonics, i. e. a composition of the financial area that makes it possible to study the integrity of a phenomenon, its environment and inner structure. This financial architectonics of the stock market should be based on the infrastructure, or, rather, its segment – the one which is the likeliest to have the said characteristics. As a result, the stock market infrastructure will become a basis for the formation and development of a ramified system of strong but constantly evolving trading networks as superinfrastructures. The variety of stock market models makes it evident that the current views need to be modified. The current regulatory reforms and the development of information and communication technologies have boosted the competition among different types of institutions that specialise in financial instruments trading. The concentration of the stock market's trade networks increases the interdependence of its participants, but its impact on the volatility is less definite.

Keywords − trade networks, stock market, financial architectonics, infrastructure, institutional matrix, disintermediation, transaction costs.

I. Introduction

The widely-spread integration and globalization processes are characteristic of the modern development of economic relations worldwide, including financial ones. Accordingly, a nation's capital becomes global and starts functioning as a catalyst of global changes in international economic and financial relations and in the transformation of institutions involved. The systemic approach to the analysis of the international stock market involves analysing it as a complex economic system with a set of elements characteristic of this system. The interrelation and interaction of these elements are also to be studied. The interaction of the stock market as a system with its environment (which is, among others, represented by the international stock market being a segment of the international financial market) is analysed as well. It is worth mentioning, though, that, nowadays, the variety of connections among the system's elements, the character of these connections, and that of the relations resulting from them make it hardly possible to view all the processes globally.

The non-Marxist tradition in the economic theory often describes securities and the stock market as technical institutions whose functions are the redistribution of money, the mediation of movement and the valuation of the right of possession, the redistribution of risk and information among the business entities, etc. C. R. McConnell and S. L. Brue define the market as "an institution or mechanism that brings together buyers ('demanders') and sellers ('suppliers') of particular goods, services or resources". This definition holds true for the stock market, too, in the case of the commodity "Securities". Thus, Gregory Mankiw defines financial markets as a group of financial institutions through which people who wish to save can directly provide their resources to the lender on the bond market and stock market [1].

The technical vision of institutions of capital, market, securities was severely criticised from the standpoint of the historical school and institutionalism. The analysis of economic reality, including its financial constituent, is based on the 'community-conscious' behaviour pattern. It cannot be fully explained by an individual's 'natural behaviour.' It is based on expectations, customs, regulations, commonly shared stereotypes, instincts, and institutions that are beyond the economic man's rational behaviour in the neoclassical pattern [2].

The research made in terms of the historical school and institutional economics shows that the entity analysis of capital, securities, the determination of underlying factors influencing their circulation should be something more than just characterising them in reference to the relations of production they express [3]. Thus, the entity market is regarded as a system of institutions it is composed of: the parties of the exchange, the intermediaries, the institutionally organised markets and market infrastructure, the mechanism of their interaction (market technologies), and the merchandise – securities.

The greatest development of the network research has acquired in the social sciences. It should be noted, that the variety of definitions used by researchers to characterize a modern society, indicates the heterogeneity and ambiguity of the processes taking place in it. The concept of a network is used by a number of foreign scientists in their research: P. Bourdieu (2005) [4], J. Deleuze and F. Guattari (1998) [5], M. Granovetter (1973) [6], M.O. Jackson (2008) [7], M. Castells (1999) [8], P. V. Marsden (2002) [9] and others.

Combining the approaches of M. Castells (1999) and O. E. Williamson (1998) [10] in analyse of the current stage of stock market development and its place in the modern global space, it is logical to introduce the notion of stock market trade networks with its specific architecture. Thereby, we define the stock market trade network as a system of organizations and institutions of the non-material sphere of production (nodes) that provides communication of stock market subjects in order to minimize information asymmetry, transaction costs and risks in time and space (O. Kopylova, 2016) [11].

II. Methods and problems

The research into the evolution of entity market institutions involves, when necessary, a microeconomic analysis and the one dealing with macroeconomic indicators. In the former case, the proper tools for change analysis can be based on institutional and theoretical methods of economic analysis. Besides, they can be based on the approaches to the evaluation of significance,

capability, and efficiency of the institutions developed within the theoretical structure of the topical area.

In the latter case, more research is needed to reveal the characteristics of a continuous cyclic process. In this process, the range of the concepts of technologies, institutions, and reforms should be narrowed down to those only comprised by the financial market. In summary:

- the routine processes of self-reproduction would trigger the transfer of the features from one period to another in the course of the development of the existing institutional pattern;
- borrowing and copying technologies and institutions would mean keeping record of the events of transferring financial technologies and institutions that are already known in other countries;
- the reforms (including routinised search procedures) would be viewed as an implementation of unique financial innovations (which could be regarded as a mutation).

In the institutionalists' opinion, institutions, along with standard limitations described by the economic theory, create a number of possibilities for members of society. To make use of these possibilities, organisations are set up. As the organisations develop, they change the institutions. The resultant vector of institutional changes is formed, firstly, by the 'lock-in effect' that is due to the symbiosis (merging) of institutions and organisations on the ground of the motivation structure created by these institutions. Secondly, the vector is determined by the back effect of the changes in the possibilities on individual's perception and reaction.

The entity market directly correlates with the three-level model in O. Williamson's research [10]. The rules of this market belong to the institutional environment; the block of institutional agreements is represented by constructions and combinations of players forming the financial intermediation system and greatly helping other players and each other; a great many individual players (beneficiary investors, borrowers etc.) constitute the group of individuals.

When analysing information to make decisions, economic agents can face the following problems:

- there can be not enough information available to make a decision;
- there can be too much information available, so it is either impossible to analyse all the data, or too expensive;
- information can only be available to the narrow group of people who can take advantage of it.

So decisions are made in an uncertain situation and risk to be wrong. Institutionalists believe that market efficiency depends on how well the institutions of this market function, which is indicated by the level of transaction costs.

Notably, utility maximisation is not the primary goal for institutionalists. Besides market interest, there appears institutional interest on the market. It can be defined as targeting economic agents' actions at creating a structure of institutions that prescribe the standards and rules of

conduct on the investment market. In this case, the participants (economic agents) of investment relations try to avoid uncertainty and help create an institutional environment that establishes a certain code of behavior on the market, thus reducing investment loss risks. Institutional environment is a set of institutions and the system-forming rules of the game created by them. These rules make it possible for the agents who organize the investment process to trust one another.

So we can see that, to study the transformation processes on the entity market, we should pay attention to the merging of institutions and organisations for a proper institutional environment to be formed.

III. Transaction costs in stock market trade networks

To analyse the nature of trade networks from the standpoint of neoinstitutionalism, we apply the transaction costs theory. In this theory, the basic unit of analysis is an instance of economic interaction, an agreement, a transaction. So transaction costs are those of interaction, dealings between economic agents. In other words, as O. Williamson states, transaction costs can be compared to friction in mechanic systems [10].

It is generally admitted that transaction costs of the stock market fall into the following groups:

1) information search costs, namely: the collection and handling of trading information about financial tools, potential partners, peculiarities of local legislation, the procedures of re-registration of rights and performing calculations, etc. According to the classical view, before a commercial operation, one should have enough information on where to find potential buyers, sellers of the corresponding financial instruments. The expenditure is a combination of the time spent and different kinds of resources required for the search, and besides, the losses due to the incompleteness and inadequacy of information obtained. This sort of expenditure is found in the redistribution of property as there is a real need in collecting information.

2) negotiation costs. Preparatory work before the negotiation for the terms of the agreement, for entering into and signing a contract is an objective necessity of market economy. When redistributing property, it is quite difficult to stick to standard contracts in order to economize, as every transaction is individual.

3) costs of measuring a financial tool value. Every economic benefit is a system of certain characteristics. While keeping the exchange act, only a few of them will be considered. It is due to the fact that the estimate can be very rough. The most precise one should be based on supply and demand in the context of high competition. This category includes expenditure on expert assessment, analytical calculations, etc.

4) specification and property rights protection costs. The internal structure of this category can include expenditure on government officials (maintenance of judges, bodies of legislative and executive power), on reparation and restoration of violated rights. Here also belong losses from inexpert specification and

inappropriate protection of property rights. Some authors, Douglass North among them, add here expenditure on maintaining a consensus, as complying with informal rules and ethical standards is a more efficient tool of property rights protection than the formal protection mechanism.

5) opportunistic behaviour costs. It is the most many-sided and the most interesting of the cost items considered by the institutional theory. Opportunism (French 'opportunism' from Latin 'opportunus' – opportune, advantageous) is quite often understood as behaviour that makes it possible to gain something dishonestly. Paul Milgrom and John Roberts share this opinion [12]. They believe that opportunistic behaviour is self-interested behaviour not restricted by moral principles.

Opportunistic behaviour can take a form of fraud, theft, deceit (the simplest forms) as well as manipulating professional stock market traders' behaviour, creating 'soap bubbles', and even bringing the equity market to the state of crisis (the top forms). This results in anomalies that take time and effort to be repaired.

Transaction costs appear at different stages of relations. The first part of expenditure takes place prior to the actual contact (collecting the information about financial tools, potential partners, peculiarities of local legislation, the procedures of re-registration of rights and performing calculations, etc.), the second part falls on the moment of establishing and legalising relations (direct negotiation, entering into a contract). The third part is post-contract (precautions against actions that can harm a partner, measures to restore violated property rights, protection from a stock market trader's misbehaviour).

The problem should be specially mentioned of how transaction costs influence the volatility of market prices for financial tools. Theoretical studies speak very little on the connection between transaction costs and the volatility of prices for financial tools. Some economists, like Tobin (1978, 1984) [13], Stiglitz (1989) [14], Summers & Summers (1989) [15], Eichengreen, Tobin & Wyplosz (1995) [16], assume that higher transaction costs impede short-term investors' destabilizing behavior, being less expensive for stabilizing long-term investors. Higher trade expenses can grant benefits to operations based on long-term economic principles. Friedman (1953) argues this opinion saying that speculative behavior usually stabilizes prices regardless of the time horizon.

There are three aspects that make the problem of connection between transaction costs and financial instability so interesting.

Firstly, the legal, organisational, and scientific-technical progress reduced prices considerably. The financial liberalisation of the market in the 1980s lowered the trade commissions' level, and in the 1990s, electronic trading kept reducing exchange trade expenditures even more. At the same time, individual volatility of shares increased in the US.

Secondly, transaction costs influence the microstructure of market organisation. The introduction of small price networks (ticks) in the USA with a price increment of not $ 1/8 but $ 1/16 resulted in the reduction in operational expenditure for most investors. Decimal pricing introduced in 2001 caused the additional reduction of transaction costs for small traders on NYSE and NASDAQ [17].

It remains unclear whether the regulatory advantage from transaction costs is due to higher volatility of the prices of shares, or we obtain, at the same time, steadier prices.

Thirdly, sometimes transaction costs include a tax component. Though securities trading operations, as a rule, were lower-taxed in the 1990s, they are still important in some countries like Great Britain. Moreover, some anti-globalist groups have raised taxes on transactions with securities. Political debate about the financial market's stability may be based on personal conviction, not well-grounded reasons.

Statistical research allowed scientists to conclude that transaction costs impact on volatility positively and considerably, in both statistic and economic aspects. The general growth in volatility registered on US stock markets can hardly be explained by a considerable transaction cost reduction on the same markets during the last couple of decades. On the contrary, a more competitive structure of the tick size with lower reasonable changes of the minimum price can result in price volatility reduction. In political terms, transaction costs of contracts on securities are supposed to increase, not decrease volatility.

Perhaps, measures aimed at controlling volatility underestimate the destabilising role of taxes on securities services, as, unlike big ticks, they also reduce the liquidity-stabilising supply. In the light of proofs and reasons on the part of the supply of liquidity, the tax on securities services is considered counter-productive. High transaction costs impede short-term speculations. This can be an explanation why, according to Friedman's theory, volatility goes up every time transaction costs increase.

Douglass North's solution to the transaction costs problem is innovations. Those reducing transaction costs are traditionally considered to include: organisational innovations, tools, specific procedures of making agreements, and control mechanisms for the observance of agreements [3].

IV. Institutional matrices and stock market models

The stock market's fundamental principles are not formed by stand-alone institutions but by institutional matrices functioning in their totality. Matrices appear in early days of a financial system and remain unchanged throughout all its history. Today, an institutional matrix is understood as a form of social integration in society's main life spheres: economy, politics, and ideology. An institutional matrix underlies fluid empirical conditions of a certain society and is constantly reproduced. Concerning people's actions, it is invariant. It reveals itself, though, in different institutional forms that never stop developing in the course of people's activity and are determined by the cultural and historical contest. A matrix is a system of rigid horizontal and vertical interdependence. Horizontally, it interrelates economical and

political institutions and social behaviour. Vertically, it is downward-directed, into the microenvironment, and determines there fixed patterns of market member's behaviour.

An institutional matrix is able to support itself, thus creating a lock-in effect. This ability comes from organisations' dependence on the institutional framework they appeared in, and from the further appearing of structures that accompany these organisations. Institutional limitations, both formal and informal, result in the creation of quite certain organisations, and make social interaction structured. These organisations are spurred into existence by the impulses present in the institutional system. So the efficiency of their work depends on this system.

The prohibition on foreign ownership, the absence of national institutional investors, and the restricted access to the stock exchange are constraining factors on the market for most people. But the institutional reasons for all this vary greatly. Historical isolation or predominant religious beliefs can create a strong informal institutional matrix that controls stock market operations and results in a specific historical development. When these informal institutions prevail, they intensify altruistic or collectivist tendencies in society, making it indifferent to the borrowed neoclassical institutions that support financing the stock market. It consists of the three institutions that are traditionally necessary and make it possible for the market to function properly. In the centre of this matrix, there is a financial tools institution, constantly evolving, but always within legal environment. It is a two-way connection: historically, first the new financial institutions were created and evolved to satisfy society's needs, and only later the rules of play were legislated for. In the course of time, legislative institutions developed to so high a level of power that new financial tools stopped appearing spontaneously but needed to be licensed [18].

Different institutions – trading and organisational (involved in securities trading), clearing and settlement, depositary and registrar, estimating and analytical, informational and consulting ones – are more and more inclined to establishing strong and unbreakable bonds, if not full integration. Usually, all this is due to the organisers of securities trading.

Institutional matrices are classified into X (eastern, administrative) and Y (western, market-oriented) ones. But this classification is not reasonable for institutional allocation of financial markets. Theoretically, the following basic institutions are characteristic of an X-matrix:

– in the economic sphere: redistributive economics institutions that should always be mediated by a centre of movement of values, services, and rights to produce and use them;
– in the political sphere: unitary political order institutions;
– in the ideological sphere: communitarian ideology institutions, whose idea is the superiority of not individual, but communal, corporate values.

The X-matrix is dominant in Russia, most Asian and Latin American countries.
The Y-matrix is, respectively, formed of:
– in the economic sphere: market economy institutions;
– in the political sphere: institutions of federal political order;
– in the ideological sphere: subsidiary ideology institutions where individual values are superior to those of higher level communities.

Y-matrix institutions are dominant in the social order of most European countries and the USA.

Thus, it would be but logical to find deep and pronounced chasm between the institutional matrices of stock markets of the groups of countries mentioned above. But the stock exchange and other equity market institutions existing today are market-oriented in their essence. They function in compliance with the principles of subsidiary ideology, and this classification is not applicable to them.

To explain this inconsistency, the concepts of dominant and complementary institutions were introduced. Dominant institutions are those that prevail in the main matrix, and complementary ones prevail in the subordinate matrix. Complementary institutions' role is auxiliary, they secure the stability of institutional environment in this or that social sphere. Basic institutions determine the character of institutional environment forming in society. They restrict and limit the functioning of auxiliary complementary institutions. If non-market institutions prevail in an economy (market ones existing along but not performing all their functions), which means that an X-matrix is under formation, the pressure by complementary institutions is nevertheless very likely [19]. For example, the considerable drop in stock indices and the outflow of foreign investments had a negative effect on Ukraine's economy at the end of 2008, the stock market being very weak.

This argumentation is typical of S. Kirdina's followers. They strongly support the institutional division into the two matrix types, which justifies the use of relevant methods of governmental control and the state order.

As there are a number of endogenous and exogenous conditions of a country's economic system formation, it seems unreasonable and narrow-minded to distinguish only two matrix types, especially for financial markets. The existing variety of stock market types makes it necessary to modify the traditional view.

With the stock market's infrastructure institutions constantly evolving and transforming into supranational formations, the main factors of this transformation should be determined.

The key factor of what direction of evolution will be chosen is, in our opinion, the current pattern of corporate property:
– when property is concentrated, the role of infrastructural institutions performing their functions occasionally and inefficiently becomes less important. It holds true for the former USSR countries and is associated with the pseudo-continental model of the financial market;

– in the context of the mixed polarity of property (the controlling interest of joint-stock belongs to a small group of shareholders, and the non-controlling one is distributed among a great many minority shareholders), influential and multifunctional institutions appear. It is typical of the countries that are traditionally considered to belong to the continental model. The property being dispersed, the most powerful institutions of the stock market are formed. It is explained by the variety of tools, a high degree of liquidity, and involving the widest circle of investors. It is peculiar to the Anglo-Saxon model, and is the most inclined to rapidly evolve towards the formation of supranational institutions – trade networks.

VI. Disintermediation as the modern factor of trade networks forming

Today's factor that determines the evolution of the stock market's infrastructure institutions is disintermediation. It is a process when market participants do not turn to financial intermediaries, primarily banks, for traditional services that are provided by means of non-standardised (individualised) financial tools (basing on a facility, or deposit agreement). Instead, the market members turn to the equity market and its professional participants. The universalization of financial intermediaries' activity is characterised by a wider list and types of services provided by the professional participants, banks among them, on the financial market. There takes place a still more broad-scale global technical re-equipment of financial markets, which helps establish direct contacts between suppliers and finance holders, no matter where they are located. Technologisation and computerization lead to the fall in the scale of 'parquet trade' and to the creation of new electronic trade systems. It changes the institutional environment – traditional forms of financial tools trade. Besides, it helps bring down the price of services and increase the number of financial market participants [20].

However, according to a MiFID Directive, disintermediation is reducing the role of banks and financial institutions as intermediaries on the financial market, which results in the outflow of money from the banking system. Disintermediation can be a consequence of firm's refusal to have banks as their intermediaries on debt capital markets in favor of issuing securities directly. Disintermediation can also be a result of existing and potential customers' giving up bank deposits in favor of alternative financial instruments that are generated by financial markets, stock ones among them.

Financial disintermediation under present circumstances can take the following forms:

1) bank business models in their development moved towards object-oriented financing on wholesale markets. This process involves the development of complex-structured innovation financial tools to replace traditional forms of bank operation (deposit taking, lending transactions). It resulted in the sharp increase of leverage and counterparty risk.

2) new banking rules (Basel III) have a negative effect on banks' ability to secure long-term financing.

3) disintermediations and the growth of capital markets have led to a shift in all financial sector structure. The main suppliers of long-term capital are now such institutional investors as retirement funds, insurance companies, mutual investment funds, and, recently, sovereign welfare funds. Though the disintermediation process is the most active in developed countries, the reorganisation of the bank role and capital markets in financial systems is a global tendency. Disintermediation has seriously touched the countries where markets are forming and which are mostly bank-oriented.

Financial disintermediation creates risks and uncertainty about financial stability. Historically, transborder bank flows were a very easy source of external financing, closely connected to global financial conditions. The influence of severe global financial conditions on bondholders and borrowers is becoming less predictable in the course of time. Such factors as soft monetary policy in the countries with developed economy can only be temporary. The consequences of the financial stability of a possible international financial disintermediation process will depend on such aspects as investors' risk profile, the investment horizon, or leverage.

Conclusion

It is worth mentioning that for some non-financial corporations, capital markets can be an imperfect substitute for financing through transborder banks. Access to capital markets is often more limited for small and medium enterprise. There is little evidence of positive dynamics of greater access to international financial markets due to disintermediation. Their ability to involve more capital should be verified.

As a result, the two processes, opposite by their nature, take place at the same time. They are: the reduction of the role of the stock market's intermediary institutions (banks and non-bank institutions), and growth in electronic trading systems and the volume of retail investors attached to them. On the other hand, global and transcontinental stock exchanges are created, and stock and commodity exchanges merge with derivative markets. In other words, the processes of intermediary institutions' concentration take place. It can be explained by the need in the redistribution of risks on the equity market, and by the network approach to analysing the equity market infrastructure. Today's regulatory reforms and the development of information and communication technologies have increased competition considerably among different types of institutions specialising in financial tools trade. It results in two-dimensional fragmentation of institutional environment. Firstly, there is considerable fragmentation of trade between stock exchanges and off-exchange platforms (alternative trade systems – ATS's) and multilateral trading facilities (MTF's). Secondly, the fragmentation deepens between hidden trade (not displayed publicly) and open trade (displayed publicly). Off-exchange trade and hidden trade are often regarded as a way for investors of reducing the

influence on the market, which can happen if they place big orders on the stock exchange. But fragmentation has no substantial effect on the distribution of big and small companies' stock trading. Besides, this distribution is quite alike in countries with fragmented trading platforms and those with concentrated institutional environment. As a result, the main criterion of choice is the possibility of investors' access to the previous information (on organised markets) or 'playing blind' (on an unorganised market).

The concentration of institutions does not always mirror the general uptrend: concentration becomes bigger on some markets and smaller on others. As a result, markets become more and more interdependent: a small group of united financial institutions dominates more and more on different markets, politically as well as geographically. A risk or the depth of financial instability do not only depend on the level of institutional environment concentration, but also on whether market participants can quickly move over into a more stable market segment.

For further research, we find it reasonable to try to find out and analyse indicators of the efficiency of trading nodes' internal arrangement. Also we consider prospective analysing the synergistic effect and transaction costs optimisation.

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Development of Innovative Entrepreneurship in Ukraine

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Abstract – In this paper the organizational aspects of innovative entrepreneurship development are reviewed, along with the emerging synergy effects, social spillover effects, improvement of institutional environment, along with regulatory and financial aids, instrumental to the processes of fostering growth of innovative entrepreneurship.

Keywords – innovation, innovative entrepreneurship, entrepreneurship, innovative development, institutional infrastructure, synergy effects, social partnership.

I. Introduction

Ukraine possesses considerable potential for innovative economic development with regards to governance and regulation at the national level, as well as locally. Ukraine's versatile economy is witnessing a dire need for implementation of effective mechanisms that could underlie further innovative economic development. A peculiar need for innovative development is observed in the markets for energy efficiency improvements and energy efficiency management. Due to the lack of consideration for regulatory assistance the innovative aspects of the development of energy efficiency sector is lacking. Thus, the goal of the paper is to determine and summarize the experience of implementing innovations on the regional and municipal level, as well as suggest possible improvements to the financial mechanism of implementing and wider adoption of relevant innovation. Such innovation will lead to a more effective resource allocation.

II. Main Results

Current research by Ukrainian scholar Fedulova L., suggests that the main obstacles to the processes of development and implementation of a stimulating economic policy aimed at fostering and spreading innovation are: policy efficiency gaps dictated by a technological policy that is considerably vague; a lacking institutional environment and imperfect competition within the markets; an inefficient and incomplete support from the government; an intermittent and fragmented nature of cooperation of government authorities and bodies with economic agents pertaining to implementation of innovations; low efficiency of the policies that are currently in effect [1] (no consideration for cyclical nature, as well as mitigation of risk associated with implementing innovations; inefficient communication between the stakeholders of innovative practices; a lack of institutional support for implementation of economic policies aimed at spreading innovation, including greater cooperation between scientific and research institutions with market agents that provide innovative technological solutions.

The Ukrainian scholar Kutsenko T. addresses the issues of researching theoretical underpinnings for effective development of strategies of fostering and encouraging innovation. The auhor is comparing Ukraine's strategy to similar innovative strategies concerned with breakthrough, innovation adoption and innovation and technology transfer from across the globe [2, 3]. Ukraine's strategy in its essence might be summarized as aimed at maintaining market parity and inertia, while at the same time creating provisions for the inflow of foreign capital, slowing inflation and limiting government support for investments [2]. While most of the existing policy measures could be regarded as adequately present, the same thing cannot be concluded of inflation. According to the forecasts, inflation is expected to not only slow down, but gain momentum, along with the associated negative social and economic effects.

Ukrainian scholars and researchers Ischuk S. and Sozanskiy L. are studying practical implication of implementing economic innovation in Ukraine and Poland. The authors analyze innovative development and its effect on competitiveness of regional economies and their respective economic clusters [4]. According to their research, Polish regions were 1.9 times more active in terms of engaging in innovative economic activity in 2015, while the average for the whole period stands at 2.2 times. The most drastic difference was with the proportion of innovation-related expenses in the overall value of capital investment expenses. This proportion of innovation-related expenses in Poland, dwarfed the relevant Ukrainian statistic by 4.75 times in 2014. At the same time, in 2015, the difference has fallen to 2.62. Overall, revenue from innovative products with Polish industrial sector is almost double, as compared to that of Ukraine. At the same time, the proportion of enterprises implementing innovation in Ukraine grew to 15.2% in 2015, as compared to 12.1% in 2014. The relevant values for Poland stood at 16.1% and 15.8% in 2015 and 2014 respectively [4, p. 74-75].

Researches have shown that implementation of effective innovations is strongly linked to the following positive economic consequences:
- managerial and technological efficiency;
- resource allocation efficiency;
- economic, manufacturing and technological activity;
- growing investment and rising exports [4].

While choosing a growth strategy for development and implementing innovation for Ukraine's economy, the following factors should be taken into consideration:
- certain historical irregularities of regional distribution of economic sectors;
- a subpar implementation of previously announced government innovation policies and measures aimed and adoption and spread of relevant economic innovation [3, 4, 5];
- poor planning and ineffective localization of domestic institutions for innovation, as well as centers for international and inter-sectorial economic cooperation;
- complete stages of national strategy of innovative development, concerned with attaining innovation-

driven economic growth have been ignored in the period of 2004-2015;

– lowering the priorities of development through innovation is often associated with the negative effects of Russian military aggression, and growing military expenses that draw away from the policies and programs aimed at stimulating economic growth.

There are a number of factors that exert an influence on the economic development through implementing innovation. Among them are the following: globalization processes; international economic integration; considerable rate of the increase in price of natural resources, which stems from both, economic and political underpinnings; a very limited understanding of importance of innovation on part of the government officials and bodies and thus limited budget availability when it comes to innovative economic policies and programs; a decrease in the rate of domestic savings and therefore a decreasing rate of investment activities; a low volume of foreign investment designated for innovative economic projects; an increasing rate of inflation and a downward dynamic of turnover for economic agents engaged in innovative activity; poor institutional environment and high inertia of existing values and practices.

Innovative development of Ukrainian economy should be based on comprehensive adoption of innovation within domestic institutions and entrepreneurship practices and culture. Such development should become a priority at every level of organizational hierarchy, while also being acknowledged through resource allocation. Such goals are attainable long-term, but if there exists a worthwhile instrument of facilitating this endeavor, it must be government policy.

The following organization and institutional changes should be addressed for a more effective advancement of innovation and economic growth:

– Improvement of legislation as a platform for innovative growth;
– Drafting and implementing innovation support programs;
– Improvement and spread of innovative infrastructure;
– Adoption of innovative technologies, best practices and know-how with medium and small businesses;
– Creating and culture and innovative mindset as well as a favorable institutional environment for implementing organizational and technological innovation with the management and personnel;
– Training, appointment and motivation of managers, as the drivers for change, within the organizational structure of economic agents;
– Taking into consideration the peculiarities of managing engineers and highly skilled personnel through the adoption of concepts and best practices of talent management;

– Keeping in mind the peculiarities of implementing innovation in varying fields and sectors [4].

Fostering innovative development strategies and entrepreneurship is also highly dependent on the availability of funding through specialized loans, as well as venture and capital funds.

Conclusion

The context of innovative development policy realization has a synergy effect that is closely related to institutional development, creating a social infrastructure and social partnership between stakeholders. The end result of the above mentioned policy measures should be a wide-spread adoption of organizational strategies and institutional change that will serve as a platform for seeking a more effective and active innovation-driven culture of entrepreneurship.

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Motivation In The Modern World

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Abstract . Human resources are the most valuable asset for every organization. In light of this, the efficiency and effectiveness of using this resource are one of the most important and complicated tasks. That is why the study of motivation is continuing.

The strategy of motivation should be built on the combination of already known motivation's theories, the modern environment challenges and special features of the organization. The intrinsic motivation as a core of motivation system that leads to the professional development of employees and achieving organizational goals. Motivation like an important part of human resources management is directed at encouraging employees to better performance.

Keywords: motivation, needs, drivers, goals, human resources, rewards, motivation theories, organization, rewards, punishment.

I. Introduction

Every organization throughout the world uses economic resources in its activity like labour, capital and natural resources for making goods and services in purpose to achieve different goals (profit, widening the markets, social goals etc.). The common thing in all organizations is human resources, people, personalities. They moved organization ahead or back, they manage it and they organize any activity and share the results. People are the incentive resource of enterprises and whole economic system in every country and in the whole world. So it is obviously that human resources are the most valuable asset for the company which defines the future of everything. At the same time, it is the most expensive, treasurable and delicate factor because it is human beings. Unfortunately, not every organization understand it and as a result, underestimates its employees. That is one of the reasons of failures in the business world and any other sphere of life.

How to use the human resources efficiently? What can we do for stimulating their activity or preferable behaviour? It is very complicated questions that never will be the complete and absolutely verified answer but some of the successful managers and entrepreneurs are very close to that answer. Firstly, we should determine what can motivate employees and what it is a motivation?

II. Conceptual clarifications

Motivation may be defined as psychological forces that determine the direction of a person's behaviour in an organization, a person's level of effort, and a person's level of persistence in the face of obstacles (Ruth Kanfer) [1].

Accordingly to Mullins (2002), motivation is a driving force within individuals by which they attempt to achieve some goal in order to fulfill some need or expectations [2].

Armstrong [3] said that motivation is concerned with the factors that influence people to behave in certain ways

and consist of the three components, listed by Arnold et al (1991):

- direction – what a person is trying to do;
- effort – how hard a person is trying;
- persistence – how long a person keeps on trying.

So, we can assume that motivation it is external and internal reasons for doing something. These reasons could be obvious for a person or hidden, unknown, unconscious which have an influence on the final results and of course on work efficiency.

III. Theoretical framework

Generally, all organizations have a lot of different plans for different time terms: from short-term plans to long-term plans, mission and vision. If management of any organizations wants to achieve its mission they have to realize the plans that are concreted in goals. Who meet the goals in organizations? Of course, human resources. Absolutely obviously is that organizational's goals are not personal goals for employees. So if you want to achieve the goals you need to motivate workers and look on their needs and goals in this organization.

The motivation process for individuals are basic and for the organizations (Fig. 1). The difference is: organizations are working to achieve the goals and individuals – to satisfy their need. But only in the cooperation both sides meet their goals.
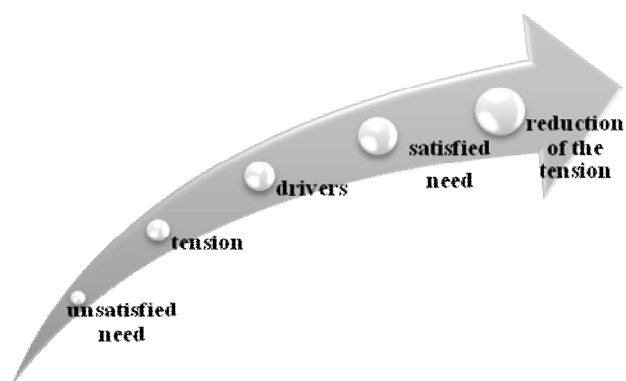
Fig.1 The individual motivation process [4]

From old times people think how to make others doing what you need. And the first approach to motivation was described like "stick and carrots" – *instrumentality theory*. If your worker, student do not want to work or do it badly – punish him and it will motivate him to work better. If it is opposite situation – reward people. But nowadays we understand that such type of motivation is not good for people. It is proper for training animals, domestic or in the circus. People are more complicated creatures and they need a special attention and approach to their motivation. It does not mean that punishment and regard are not used anymore in our time but these instruments have a very short influence on work behaviour and legislation frames, and sometimes it more demotivate people.

The next level of development of approaches to motivation built on researches of psychologist, sociologist

and management researchers. According to the psychological approaches to understanding motivation, researchers defined two groups of motivation theories (Table 1):

• *content theories*, which are based on needs;

• *process theories* – focus on the psychological process which affects motivation by reference to expectations, goals and perception of equity.

TABLE 1

Content Theories	Process Theories
Maslow´s Hierarchy of Needs	Expectancy Theory of Vroom, Porter and Lawler
Herzberg´s Motivator-Hygiene Theory	Atkinson´s theory of achievment
Tugan-Baranovskyi´s Theory	Adams's Equity Theory
Alderfer's ERG Theory	Latham and Locke's Goal Theory
McGregor's X and Y Theory	Reinforcement Theory
McClelland's Need Theory	
Theory Z of Ouchi	

The authors of motivation theories have made a great contribution to research and development of motivation in organizations. The understanding of the employees needs in a particular time period and giving them the possibilities to satisfy its needs – is one of the possible approaches to employee´s motivation. The second approach is how motivation happened and is concentrated on the process of motivation. Furthermore, the motivation theories are still working but now they are modernized according to nowadays issues and to the achievement of technical progress.

Among the most popular and modern motivation's strategies are autonomy of employee in his/her sphere of activity, taking part in decision making, flexible working hours, the possibility to improve skills in important matters and become a part of something bigger than themselves etc.

Conclusion

Motivation as one of the most important functions of human management is very complicated in its realization on practice. Managers should obviously know the psychology nature of a person and be very good in communication. This knowledge and skills will help them to find the right motivation for every employee and as a result, to achieve planned organizational goals.

In general are defined two sources of motivation: intrinsic and extrinsic. The organizations could influence on extrinsic motivation (different kinds of rewards and punishment) but it will have an only short-term result. The most effective and long-term motivation is based on intrinsic factors that nowadays are decisive. It were mentioned by Dan Pink [5]:

• autonomy – the desire to direct our life;

• mastery – the desire to get better at something that matters;

• purpose – the desire to serve something bigger than ourselves.

As always we do not have a universal motivation strategy for any organizations because the world is complicated and we could not find in it the same enterprises or exactly the same people, even twins are different internally. Nobody knows the organization and its workforce better than their management and only they can build a complex motivation strategy for their employees in general and for everyone in a particular way.

The organizational motivation depends on the sphere of organizational activity, its size, structure, location, mission and values, cultural and legislation conditions etc.

Furthermore, employees are the basis of any organization and of their quality, their input depends on the organizational output and the place of the organization on the market. Only by building cooperation between management and workers on win-win strategy could lead to success, the further development, efficiency and effectiveness of the organizational activity.

In conclusion, we define the most general motivation tasks for managers of any kind of organizations [6]:

– to enable employees to be high performers;
– encourage them to improve their mastery;
– let workers some autonomy in making decisions;
– rewarding employees in multiple ways;
– creating a fair, stimulating, comfortable and creative work environment;
– treating employees like the highly capable individuals.

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Analysis of the dynamics of sales volumes of the domestic machine-building complex

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Abstract –The development of the machine-building industry for the last 5 years has been analyzed. The research of scientific sources on this issue was conducted. Trends in promising changes are revealed. The problems of functioning of machine-building enterprises are detailed and methods of their solution are proposed.

Keywords: competition; competitiveness; demand; investment attractiveness; engineering; innovative activity; modernization.

I. Introduction

The domestic economy is characterized by a decline in production and incorrect proportions of development over the past 5 years. This situation leads to the crisis situation of the most important industry – machine building. The state and the quality level of the production machinery of the country depend directly on the state and functioning of machine-building enterprises. That is why the need for constant control over the situation in the industry becomes urgent. In the early 90's machine-building went into decline, and was in a crisis situation. The products have ceased to be renovated, the depreciation of fixed assets has reached 50%, there has not been a recruitment of new personnel, the average age of workers has come close to 50 years. Only about a quarter of new technologies corresponded to the world level. Since the Soviet Union, many technologies have not been changed, unlike other countries of the world, which has reduced their competitiveness.

II. Main material

Machine building is an important and promising branch of the Ukrainian economy. The modern machine-building complex comprises 11 073 enterprises, of which 136 are large, 1750 medium-sized, and 9187 are small-scale production of machinery, equipment, devices, equipment, vehicles [1; 2]. The analysis of statistical data of the development of Ukraine's machine-building industry in 2007-2014 showed (shown in Table 1) that from 2007 to 2009 there was a recession. In 2010 – a rapid growth, the indicator was higher than the value of 2007. But from 2010 to 2014 there was a gradual decline.

Another reason for the decline in the profitability of the enterprises of the machine-building complex of Ukraine is a decrease in the volume of production. The volume of production of machine-building enterprises on the market is given in the table. 2

TABLE 1

INDICES OF VOLUMES OF MACHINE BUILDING PRODUCTS (AS A PERCENTAGE OF THE PREVIOUS YEAR) FOR 2009-2016

Years	Indices of volumes of machine building products (as a percentage of the previous year)
2009	119
2010	100,3
2011	55,1
2012	136,1
2013	115,4
2014	96,7
2015	86,4
2016	79,4

TABLE 2

DYNAMICS OF VOLUMES OF SOLD INDUSTRIAL PRODUCTS IN UKRAINE FOR 2013-2016 (MILLION UAH)

Indexes	Years			
	2013 p.	2014 p.	2015 p.	2016 p.
Volume of sales of industrial products of Ukraine, UAH million	1065850,5	1331887,6	1400680,2	1354130,1
Volume of sold production, UAH million	99270,5	133469	143533,1	117301,9

Finding markets is a major problem in the machine-building industry in Ukraine. Distribution markets in this area are characterized by high competition, which requires high quality goods, the introduction of new technologies and high efficiency of manufacturing. At present, products of the machine-building industry are often morally outdated, due to the use of outdated technologies, wear of equipment by 60-80%, and a small level of innovation implementation. The machine-building complex of Ukraine has more than 20 specialized branches, that is, almost all [4; 5]. The objective reason for the downturn is the decline in economic and investment activity at the domestic level the market and at the same time the reduction of sales on the key for the Ukrainian machine building Russian the market As you know, the leadership of the Russian Federation for several years has led to an active policy of import substitution, and products of foreign, in particular Ukrainian producers, are systematically pushed out of the Russian market. This The process was particularly strong in 2013, when Ukraine was only about to sign an association with The European Union However, Russia still remains the main consumer of domestic machine-building products enterprises. For comparison, it should be noted that exports to the EU today account for 21% of the total the volume of export, and sales to the Russian market – 52%, in the CIS countries – 14%. By separate groups of goods, the dependence on the Russian Federation is even more significant: the share of exports of products energy and transport machine building on the Russian market is 75% and 60% respectively

The main problems of the enterprises of the machine-building complex of Ukraine are as follows:

1. Outdated production assets.

2. Lack of funds from enterprises. The low amount of highly liquid funds leads to the fact that enterprises are not able to calculate with contractors, which reduces their solvency and their competitiveness.

3. Innovative activity of Ukrainian enterprises at a low level, low investment attractiveness [6; 7; 8].

4. Not a number of high-tech spheres in Ukraine. Most importantly, there is a shortage of those that set the export positions of machine building. It is the IT industry, the manufacture of medical equipment, research equipment and advanced passenger cars.

5. Not the competitiveness of many types of domestic production.

6. Lack of skilled workers. At a low level of youth labor remuneration specialists do not have the desire to work in this area, and the vast majority of employees with experience have retirement age. Losing qualified professionals who are discharged or go to retirement, machine-building enterprises can not prepare for them a worthy substitute that has its own reflection in low quality performance.

Conclusion

Summing up all the above, it can be summarized: during the years of the Ukrainian economy's development, the machine-building industry has undergone a long devastating crisis with large-scale losses of production and personnel potential, with a double reduction in the share of machine-building products in production, and reduced innovation and investment activity. Despite the scale of the crisis, the development of the industry is practically impossible without significant investment. Today, outdated equipment reaches about 70%. With shortages, the problems of restoring the industrial potential of the industry are being solved slowly. The country's leadership should make significant efforts to stimulate the investment activity of the machine-building industry and the development of science. The priority development of the industry should be: overcoming the scientific and technological regression from the industrialized countries, increasing the level of scientific developments in this area, supporting the innovation activity of enterprises, creating conditions for increasing the volume of production of high-tech products [1; 3; 7].

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Commercialization of scientific and technical researches of universitiees

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Abstract – The main directions of commercialization of scientific and technical researches of universities in the world and domestic market of educational services are considered (in particular, on the example of Lviv Polytechnic); the main problems of the development of university science and the ways of their solution both at the national and regional levels, and at the level of individual universities.

Keywords: scientific and technical research, commercialization of science, university, scientific potential, cooperation.

I. Features of commercialization of educational and scientific activity of universities in the world and in Ukraine

In the global market for educational services, a regular teaching university has long been transformed into a so-called intellectual entrepreneurship entity, which not only provides high-quality educational services, but also greatly contributes to the intellectual provision of innovative development of the country's economy. This is a university that not only cooperates with companies-representatives of industry, but also is able to monetize the results of its scientific and technical activities, to profit and attract additional financial resources

In developed countries, the share of knowledge value in the total cost of manufactured products exceeds 50% (1).

An example of universities that enable faculty, students and graduates to enter global markets with their innovative companies is the Stanford and Berkeley Universities, which, by executing orders from major corporations and the Pentagon, actually created a world-class high technology center, known as the Silicon Valley . (1)

As the foreign experience shows, the commercialization of the educational and scientific activities of universities is a formula for the successful development of universities, so it is extremely relevant and important. In Ukraine, in terms of modernization of higher education, the scientific component of the university's work is growing, but due to the lack of budget funds, there is a need to find additional sources of funding (2). Commercialization of scientific developments of universities becomes the basis of their competitiveness and the possibility of obtaining such necessary financial resources from different "channels". The issue of commercialization requires research and further harmonization, taking into account the requirements of today: integration of education, science and business; cooperation with international organizations; implementation of the model of the "triple spiral" and the model "pentapiral". The results of such activities will be useful for universities, public authorities and business representatives.

Although the topic of commercialization of scientific developments and their implementation is not new, it remains an actual problem of further growth of the national economy of Ukraine.

Solving issues of modernization of industry, new industrialization, ensuring innovation development, reasonable growth depends on the availability of scientific and technical developments (2). At the same time, university science has significant intellectual resources, many scientific developments and technologies, but they are not used in practice, and the market for scientific products and technologies is not well developed.

II. Some aspects of commercialization of scientific and technical research in Lviv Polytechnic

Commercialization of scientific and technical research is one of the key priorities of the development of Lviv Polytechnic. Scientific activities at the University are conducted in the key areas of the development of science and technology of Ukraine, while taking into account the challenges of today and the relevance of research. Every year, joint projects are implemented under interstate agreements.

One of the aspects of the commercialization of scientific and technical research is the active participation of Lviv Polytechnic in the work of a number of international university associations, both regional and global (Magna Charta Universitatum; European University Association; Alliance of Universities for Democracy; Association of Carpathian Region Universities; Board of The European Student of Technology, the Association of National Academies of Sciences of Europe, which enables the University to build new contacts, find partners for the preparation and implementation of international projects, and develop academic and scientific mobility.

Another vector of commercialization of the University's scientific and technical research in the global market is the scientific, educational and cultural cooperation within the framework of more than 100 comprehensive agreements on cooperation in scientific and educational activities with more than 75 leading universities and research institutions and companies in Europe (France, Great Britain, Poland). , Czech Republic, Slovakia, Germany), America and Asia. Within this framework, Lviv Polytechnic is involved in the implementation of international projects, grants, business contracts; cooperates with foreign higher educational establishments and institutions within the framework of cooperation agreements; Participates in competitions for international grants (individual and collective), etc.

The dynamics of the number of international projects and grants in the framework of international scientific cooperation is presented in Fig. 1.
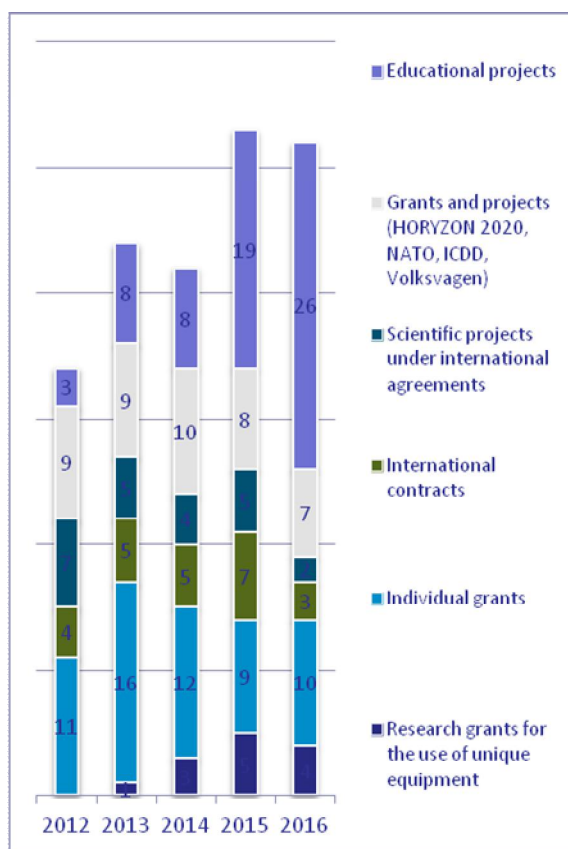
Fig.1 Dynamics of the number and structure
of international projects and grants

In 2016, the volume of revenues from the implementation of research projects under international projects, grants is 611.5 thousand UAH.

One of the priority areas for cooperation is the participation of scientists in European science and technology and innovation programs, among them the European Union Framework Program Horizont 2020, the Poland-Belarus-Ukraine Cross-Border Cooperation Program, COPERNICUS, and others. Successful implementation of the projects allows not only to increase the skills of the workers and to update the material and technical base, but also to commercialize the university's scientific developments. Among the priorities of international activities are the participation of scientists and teachers in the preparation of

international educational projects, especially in the Tempus, Erasmus Mundus, Erasmus +, etc. Programs

Thanks to the positive dynamics in 2016 compared to 2015, the number of applications submitted for international grants has increased by 4 times, and the result of this is a positive decision on the financing of the Horizon 2020 program (type of action "Exchange of Scientific and Innovative Personnel") of the project " Innovative optical / quasi-optical technologies and nanoengineering of anisotropic materials to create active cells with significantly increased energy efficiency. The cost of the project is 1 million 692 thousand euros, duration of the project – 4 years. The consortium includes SMARTMEMBRANES (Germany), Czestochowa Polytechnic University (Poland), KARAT (Ukraine), University of Angers (France), Warsaw Polytechnic University (Poland), SoftPartners (Ukraine), LLC FORSCHUNGSZENTRUM JULICH »(Germany), Energia Oze Ltd (Poland). Lviv Polytechnic is the first higher educational institution in Ukraine, which acts as the coordinator of the Horizon 2020 project. The start of the project is scheduled for February 2018. It is important to attract representatives of small and medium-sized businesses to submit applications for international grants and, of course, their direct participation in the future.

Conclusion

Successful commercialization of scientific and technical research is not possible without providing a clear mechanism for managing the field of intellectual property in the "state-university-production" system. Today, the main problem faced by Ukrainian universities lies in the limited use of accumulated innovative potential. For many universities, the lack of orientation of research in accordance with the global trends in technology development and a clear focus on the end user. The policy of a modern innovation university should be aimed at achieving a high level of investment attractiveness through the development of new areas of science and technology and the establishment of cooperation with leading industrial companies in Ukraine and the world.

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The concept of sustainable economic development of Ukraine on the basis of "green" economy

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Abstract – The research objective of the article is defining the peculiarities of the development of "green" economy in Ukraine. The study object is the sustainable economic development in Ukraine on the basis of "green" economy. During the research there were used such methods as: structural and logical analysis – to develop theoretical and methodological principles of the implementation of sustainable economic transformations based on the concept of a "green" economy in Ukraine. New directions of "grenning" different economic sectors of Ukraine and main tools of transition to "green" economy are systematized.

Keywords – sustainable economic development, "green" economy, sustainable economic transitions.

I. Introduction

All countries are looking for development, stability and security. Sustainable development involves stabilization, preservation «status quo». The main problem that hasn't been solved for twenty years was that most countries do not want to stay in the socio-economic situation in which they now reside. Because only 1 of 8 billion earthlings are satisfied with their standard of living. So long as during the global economic crisis were not formulated the principles of "green" economy as a mechanism for implementing the strategy for sustainable development of all types of political system and level of economic development.

II. The concept of "green" economy

According to the report "Our common future" by Ms. Harlem Brundtland, sustainable development is defined as "the development that serves needs of today's generations and does not place possibilities for their usage by future generations under the threat" [3].

Such economically developed countries like Germany, Japan and the United States have moved significantly towards sustainable development. Other countries in this still very far, unfortunately, Ukraine is among them.

That's why the main issue of this work is to research general ways how to facilitate Ukraine to continue its own way of transition to sustainable economic development and to find a solution of major problem that delay this difficult process.

It is necessary to mention, that Ukraine has already done such important steps to accelerate the transition to sustainable development. Ukraine joined the UN Framework Document "Agenda for the XXI century", taking on international obligations, including the development of concepts and strategies for sustainable development, institutionalization and coordination with the public and business.

Ukraine has already adopted the Strategy for Sustainable Development "Ukraine 2020". Ukraine is a member of the United Nations Framework Convention on Climate Change, introducing the main provisions of the Kyoto Protocol and ratified the Paris agreement governing the transition to sustainable development [6-7].

The strategy of sustainable development involves a combination of economic efficiency, social stability and environmental safety.

The concept of "green" economy does not replace the concept of sustainable development, but now increasingly widespread recognition that the achievement of sustainable development depends almost entirely on creating the right economics. Sustainable development is an important long-term goal, but to achieve it we need to make our economy "green" [4].

The green economy is defined as an economy that aims at reducing environmental risks and ecological scarcities, and that aims for sustainable development without degrading the environment.

III. The inclusion of Ukraine into the global process of social and economic activity greening

To elaborate, the developed world focus of green economy includes increasing resource efficiency, using technologies that reduce carbon footprints, reduce GHG and pollution emissions, promote energy conservation in buildings and industrial processes, sustainable transport, water conservation, and advanced waste management on the 3Rs (reuse, recycling, reduce) pattern. In developing countries, the focus is more on the need to include existing natural resources based livelihoods, promote green jobs, address concerns relating to food security, livelihood security and poverty alleviation, development of indigenous people and local communities, their cultural heritage and traditional knowledge, including those of ethnic groups, maintenance and improvement of the ecosystem services and enhancement of inter and intra-generational equity.

Facilitating innovative collaborations between business, government and civil society (like public private partnerships, business value chain engagements and collaboration with academia and consumers) and their collective action could be another step in the direction. These collaborations can be used to step up education efforts that can bring about the required changes in the mindsets and behavioral aspects needed to drive the required innovations in the direction of a green economy. Their collective action can further help develop the required skills for green jobs and capacity for policy reforms [2].

One of the most significant reason for ineffective process of the implementation of sustainable development and green economy in Ukraine is outdated post-Soviet industrial economy. There is also the problem of outdated equipment and technology in factories and industries that

are not only ineffective, but also pollute the environment. Ukraine is rich in natural resources, it is only necessary to learn to use them effectively.

The main reasons for the slow-pace inclusion of Ukraine into the global process of social activity greening are:
– the priority of economic purposes over ecological ones;
– the inefficient, industrial use of natural resources;
– the low level of scientific and technical progress;
– the imperfection of mechanisms for the attraction of the general public to the ecological information.

Below there are new directions of grenning different economic sectors of Ukraine:

1. Energetic sector: – hydropower; – wind power industry; – solar power industry;- bioenergy.

2. Food sector: – the development of organic agriculture.

3. Social sector: – adaptation of economy and population to climate change; – energy efficiency of housing; – formation of a system of sustainable consumption.

4. Industrial sector: – "green" building, energy saving technologies and materials produced from minimized damage to the environment; -the development of "green" tourism; – the introduction of "green" technologies.

5. Transport – the development of "green" transport - trolleybuses, trams, electric cars, bicycles.

Greening the economy, the social sector (education, science, culture, health) of geopolitics and competent defense national environmental interests requires coordinated action by the interconnected state, businesses, and communities.

There are a wide range of tools to go to the "green" economy:
– the introduction of the policy of "green" rates, which implies a rejection of inefficient subsidies, imposing additional taxes on polluters;
– public procurement policies that encourage the production of environmentally production and use of relevant principles of sustainable production methods;
– reforming the system of "ecological" tax, which means the transition from tax on labor to taxes on pollution;
– increase public investment in infrastructure environment (public transport, renewable energy, energy efficient construction) and natural capital;
– targeted government support for research and development associated with the creation and introduction of environmentally friendly technologies;
– social reforms in order to ensure coherence between social and economic spheres of society [3].

It is necessary to mention, that the government of Ukraine have already done a lot of the most important steps to change Ukrainian society and economy in "green" way. For example, adoption of Program to promote green modernization of the Ukrainian economy 2014-2018 and State policy of sustainable development based on "green"economy. All of these factors mean that we are on a right way.

Conclusion

Today, the main objective for Ukraine to achieve a reasonable combination of economic and environmental interests, to change our industrial using of resource into green approach. But first of all, we need to change the type of ecological consciousness of Ukrainian society, which reflects the currently existing ideas about the relationship between human and nature.

Nowadays, the formation of "green" economy is a new way to provide security economic state. Serious problems require attention to poverty reduction, controlling the use of natural resources, increasing the number of jobs. The use of market mechanisms recommended combined with national and international regulation of economic processes. Improving the environmental situation ceases to be a string of expenses of the state budget, and is in fact the essence of the new economic system. Thus the state creates new economic business conditions that attract investment is the development of new "green" industries and environmental transformation traditional economy.

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Economic costs of corruption development in Ukraine and ways to overcome them in terms of European integration

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Abstract – *The article represents the present state and level of corruption in Ukraine according to key international corruption ratings. On this basis the urgency of Ukraine's fight against corruption is proved in terms of European integration. In the article it is emphasized on the present and future economic costs of corruption development in Ukraine. As the result, the key tasks of Ukraine's fight against corruption are identified.*

Keywords – corruption, economic costs, fight, Ukraine, European integration.

I. Introduction

Ever since antiquity, corruption has been one of the most widespread and insidious of social evils. Corruption continues to be a big challenge for Europe – a phenomenon that costs the EU economy around 120 billion euros per year. Europeans are deeply worried about corruption – 76% of them believe that corruption is widespread according to a recent Eurobarometer survey [1]. Nowadays corruption is one of the most dangerous problems across the whole world at different levels beginning from the international scope, passing through the national dimension and ending with the human factor.

According to different international corruption ratings today Ukraine is one of the most corrupted countries in the world. For objective measurement of present corruption level in Ukraine we have chosen several well-known international corruption indexes and compared with corruption levels in other countries of the world. So, all of investigated indexes (the International Country Risk Guide (ICRG) Corruption Index, the Corruption Perception Index (CPI), the Corruption indicator from the World Bank Governance, and the Enterprise Survey data on Bribery incidence) have indicated that corruption is much more prevalent in Ukraine than in other lower and middle income countries. The gap was starker when Ukraine was compared with Central, Eastern and Southeastern Europe countries and in particular with European Union countries. All data sources have provided a remarkably consistent picture about the severity of the corruption problem in Ukraine [2-6].

Transparency International divides the cost of corruption into four main categories: political, economic, social and environmental. Economically, corruption depletes national wealth. Corrupt politicians invest scarce public resources in projects that will line their pockets rather than benefit communities, and prioritize high-profile projects such as dams, power plants, pipelines and refineries over less spectacular but more urgent infrastructure projects such as schools, hospitals and roads. Corruption also hinders the development of fair market structures and distorts competition, which in turn deters investment [7].

That's why it is important to identify key economic costs of corruption development in Ukraine, especially in modern terms of European integration. Because at the present stage of European integration Ukraine must show real efforts in its fight against corruption and represent itself as an European developed country. So, it would be as a huge alarm about the present and future danger of corruption for economic wealth of Ukraine.

II. Main part of research

Many negative phenomena caused mainly by high level of corruption already exist in Ukraine.

For the first, it concerns the low level of country's economic growth. According to the results of econometric analysis that was done by specialists of the International Monetary Fund (IMF) higher CPI values (that denote lower corruption) are associated with higher GDP per capita. The econometric analysis also suggests that an increase of the ICRG index by one unit may raise per capita GDP growth by about 1 percent. Another result that was received within the econometric analysis of the IMF suggests that increasing the ICRG corruption index by one unit is associated with a statistically significant increase in the growth rate of investment by 4 percent. By the way, according to the estimations of Ukrainian Centre for Economic Strategy, if the level of corruption in Ukraine decreased to the level of corruption in Poland – GDP per capita over the last 10 years would be higher by up to 2824 dollars per capita [8-9].

Corruption also hinders the effective business development in Ukraine. According to the Global Competitiveness Report, 2016-2017, corruption has become the most problematic factor for doing business. It should be noted, that according to the Global Competitiveness Report in 2013 corruption was on the second place among the top ten problematic factors for doing business [9].

Government expenditures are inefficient in corrupted countries. In particular, less money is spent on health care and education, and more is spent on military projects. Furthermore, today our country needs to increase military spending, but transparency and budget control are necessary to monitor such expenses as they are highly exposed to corruption [9].

Budget revenue in corrupted countries is lower because of tax evasion. In Ukraine, 62% of enterprises avoid paying taxes while almost half of them give bribes. For example, according to researches of Ukrainian Centre for Economic Strategy it is possible to assume that the annual volume of bribes in retail industry in Ukraine is no less than 8 billion hryvnias [9].

The next important channel is private investments. Corrupted countries have lower inflow of private investments because of higher risks and higher capital value. In the structure of international funding of

corrupted countries, foreign direct investments have lower part compared to international loans. This creates additional risk of currency crisis [9].

The quality of governance also suffers from corruption. Instead of spending time on dealing with social issues, government officials try to find ways to become rich. In addition, corruption strengthens political instability, red tape and regulatory barriers. This, in particular, results in a larger size of shadow economy. In Ukraine, 41-46% of economy is in shadow. One of the most significant costs of corruption is reduction of economic efficiency, for instance, through the increase in the cost of capital or decrease of its productivity [9].

However, the consequences of the corruption are far deeper. Corruption hinders the development of state institutions (especially in less developed countries), because corrupted government is interested in this. Finally, corruption has no only economic consequences, it also affects citizens' welfare overall. Country's social functions are harmed due to corruption (for example, medical care and education), as the level of poverty increases, income inequality strengthens and the level of trust in the society decreases [9].

Conclusion

Based on the results of conducted investigation we have identified the most urgent Ukraine's tasks of fight against corruption:
– full and satisfactory implementation of anti-corruption tools and recommendations of international organizations;
– active and fruitful participation in different international initiatives against corruption;
– development and implementation the unified, transparency and effective anti-corruption legislative basis and its complete harmonization with international legal standards and norms;
– improvement the existing anti-corruption package on the basis of complex regulation of corrupt behavior in all sectors of economic, social and political life;
– increasing responsibility for corruption activity in all spheres of society, especially in private sector;
– open, rational and goal-oriented use of public funds and international financial support;
– enlargement of the system of anti-corruption law enforcement and prosecution bodies (empowerment of the National Police of Ukraine, the State Bureau of Investigations, prosecutor's office);
– establishing the special anti-corruption courts that will be characterized by openness, honesty and trust among civil society;
– increasing the transparency, independence and effectiveness of all anti-corruption law enforcement and prosecution bodies on the basis of providing necessary financial, material resources and adequate human resources, as well as enough empowerment in concrete areas for objective and openness decision-making;
– strengthening the criteria of independence and irrelevance during the election and firing of

management of anti-corruption law enforcement and prosecution bodies;
– increasing the effectiveness and transparency of financing of political parties and election process;
– strengthening the struggle against oligarchy in cooperation with foreign law enforcement bodies;
– minimization of political pressure on the activity of all anti-corruption law enforcement and prosecution bodies;
– providing further guarantees and incentives for whistleblowers;
– rethinking and realizing the participation by every citizen at different levels of political, economic and social spheres in making corruption and starting the real fight against its own corruption from yourself.

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Agricultural Products in the International Market

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Abstract — Authors shown the basic direction of agricultural product in the international market. The result of researche is the strategic priorities of the raw orientation of Ukrainian exports shows its sensitivity to fluctuations in prices in the world market.

Keywords — agricultural production, international market, market analysis, price politics, organic sector, sustainable development.

I. Introduction

Unfortunately, Ukraine's entry into the world economy was very painful. The unstable Ukrainian economy has become involved in international trade from the position of an outsider. Our country is an exporter of mostly semi-finished products, which, unlike the countries of Central Europe, does not benefit.

Today, the issue of studying the problems of ensuring the sustainability of the agrarian sector is studied quite actively, but some aspects of the problem highlighted are still understudied. The problem of sustainable and complex developmentof the agrarian sector is the most acute pronounced in rural regions of the country where this form of territorial organization of population and production is prevailing [7]. Fortunately, Ukraine follows the global trend "local+organic" and has already success stories of Ukrainian exporters with products having organic status and regional identity [6].

II. The main research material

The dynamics of the development of foreign trade of Ukraine's and liberalization of foreign trade (since 1994) provided the prerequisites for increasing the volume of export of goods and services. If you compare exports of Ukraine, in the last two years (2016-2017) the increase in exports was significant (against a background of lower domestic consumption and of real GDP). More effective is the restoration of lost cooperative ties and the study of new markets, including with former partners in agricultural sector [1].

Despite the long and deep crisis, Ukraine retains the prerequisites for creating a competitive environment in the economy and strengthening its positions in international markets – it is rich natural resources, as well as an advantageous geographical position, and a skilled and relatively cheap labor force, as well as the potential of the military-industrial complex, a high level of technological development, science and an effective education system.

According to the state enterprise "State Information and Analytical Monitoring Centre of External Commodity Markets", a priority direction for Ukraine in the structure of the export commodity turnover is CIS countries. Ukraine exports to CIS countries about 36% of goods. Ukraine supeplies 10% less produce to EU countries. Among the leading importers of Ukrainian products are also the Middle and Far East. They buy, respectively, 18% and 8% of products that are exported [7].

Over the past three years, the volume of foreign trade turnover, unfortunately, is declining. The structure of both exports and imports is deteriorating. Export of products of individual industries is often inefficient or simply superfluous. The raw orientation of Ukrainian exports shows its sensitivity to fluctuations in prices in the world market.

For the data of 2016, the total exports of goods from Ukraine amounted to about 70%, the remaining 30% – is the services. The trend of the last 5 years is a reduction in the proceeds from the export of goods with a simultaneous reduction in exports of agro-industrial products. Despite this, the overall negative trend, exports are declining faster than agrarian, while in 2016 exports of agricultural products were observed. A similar trend was observed in 2017. In the first half of 2017, agricultural exports totaled $ 8,7 billion. The US, which is 28,7% more than in the same period in 2016 [2]. Against the background of a decrease in total export earnings, the share of agricultural products increases. Over the past 5 years, the share of agricultural production in the structure of Ukraine's export revenues has grown from 26% in 2012 to 42% in 2016. In the first half of 2017, the share of agricultural products in the structure of Ukraine's exports is 42,2%. Still worth noting is that the basis of agricultural exports is still the export of raw materials – wheat, corn, barley and soybeans. In January-June 2017, the total share of crop production in the structure of Ukraine's agricultural exports was 49,3%.

The main market for Ukrainian agricultural products is the Asian market, which slightly reduced the share in the structure of Ukrainian exports. The main countries-partners from Asia were countries such as India, Iran and Turkey. On the second place are the member countries of the European Union, with 28,1%, where the main partners are Spain, the Netherlands and Italy. The top three countries are closed by the countries of Africa, which increased their share by 4,4%. The main partners from Africa are Egypt, Morocco, Libya and Tunisia. In the first half of 2017, one of the biggest partner countries for Ukraine was India, it was to this country that we managed to increase agricultural exports, by +414,1 million US dollars to 1 034,6 million US dollars, mainly due to increased supplies sunflower oil and dried legumes. The top three also includes Turkey +212,3 million US dollars to $484,6 million USA, which is one of the biggest

consumers of soybeans and sunflower meal. Also significantly increased shipments to Thailand (+208,3 million US dollars) to 587,5 million dollars USA), which are one with the main buyers of meat, poultry and corn. In the first half of 2017, shipments to China declined sharply (-221 million US dollars to 433.8 million US dollars), the main role in the reduction of supplies was played by the decrease in purchases of corn by China. It is also possible to trace the tendency to reduce the supply of agricultural products to Indonesia (-76 million US dollars to 52,3 million US dollars).

For the last years Ukraine has become a major supplier of organic products for the Western European market. More than 80% of total export of Ukrainian organic agricultural production nowadays is supplied to Western Europe. The two main organic export value chains from Ukraine are agricultural commodities (i.e. cereals, oil crops, pulses) and wild collection products (i.e. berries, mushrooms, nuts, herbs). In 2016 the biggest organic export volumes were achieved with raw materials including wheat, spelt, corn, millet, barley, oat, rye, soybean, lupine, flax, sunflower, rapeseed as well as some niche products as mustard, blueberry and walnuts. Export volumes of semi-processed and processed products are increasing fast, relating mainly to organically certified hulled millet, hulled spelt, flakes, birch sap. More and more Ukrainian operators intend to sell abroad not only raw materials but organic final products, what generates involvement of additional labor force, especially in rural areas, more added value remains in Ukraine and contributes to poverty reduction in the country as well as development of new value chains and green economy. In 2016 only clients of the leading certification body Organic Standard exported from Ukraine abroad 164,8 thousand tons of organic products, the value of which was more than 45 million euro, including 157,6 thousand tons to EU countries. Organic exporters from Ukraine benefit from the Association Agreement signed in June 2014 between the EU and Ukraine, which has reduced the trade barriers for Ukrainian exporters. Since January 2016 the EU and Ukraine have started applying the Deep and Comprehensive Free Trade Area (DCFTA) which forms part of the Association Agreement. At the same time Ukrainian exporters suffer from the new EU import rules applied to Ukraine since January 2016 and prolonged for 2017. The main importers of Ukrainian organic products are Germany, Switzerland, the Netherlands, Italy, Poland, UK, Austria, France, Belgium and Hungary. In addition Ukrainian producers are already exporting to the U.S., Canada, Australia and some Asian countries. So we can proudly state that Ukrainian organic sector is going global [6].

Analyzing the concept authors Kozlovskyi S., Grynyuk R., Baltremus O., Ivashchenko A. [7], increasing the sustainability of the agricultural sectors development is not possible without a agrarian reforms. Administrative and organizational measures should include the formation in of the elements of market infrastructure of the region, control of their work, licensing of agricultural activities, development and improvement of rural territories, veterinary and quarantine control, as well as control of farming and preservation of national agricultural land fund.

Conclusion

It can be concluded that Ukrainian agricultural products are sold less and less on the international market, although it is still in high demand. We believe that Ukraine's accession to the EU is changing the situation with Ukrainian exports for the better. Organic stakeholders including active organic producers, processors, traders and retailers improve the collaboration among themselves and together with the policy makers aim at organic market development in Ukraine.

Ukrainian organic sector is growing rapidly both as for the quantity of its operators and as for the quality of its products. Taking into account the common aspiration of the business, government and all other stakeholders to make Ukraine the global organic hub there is no doubt that Ukraine is and will be source of high quality organic products and strong partner in organicbusiness for international market [6].

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Marketing instruments of Ivano-Frankivsk oblast promotion in terms of cross-border cooperation

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Abstract – The instruments of Ivano-Frankivska oblast promotion on the examples of festivals are outlined. The Strategy of Ivano-Frankivska Oblast Development till 2020 is analyzed in terms of region's promotion. Practicability of choosing festivals among other marketing instruments, especially for youth target group is explained. The festivals MitOst-festival, Carpathian SPACE, Porto Franko 2017 and international photo festival are analyzed. The festivals are examined in the context of cross-border aspect, which allows combining neighbouring cultures and traditions, exchange of experience, bringing adjacent nations closer together and finding the areas of common interest.

Keywords – marketing instruments, promotion, cross-border cooperation, fest, tourism, cultural traditions.

I. Introduction

Regions the same as goods and services need professional marketing nowadays. The territories in modern economy compete for tourists, investment, location of the branches of multinational corporations, qualified staff and expansion of sales market for their goods and services. In the globalized environment with harsh competition terms only the territory with individual attractions and efficient spread of information about such competitive advantages among existing and perspective clients can win.

It is also worth mentioning that in modern world, where the consumer is oversaturated with different information and advertising messages with increasingly lower efficiency, it is of utmost importance to find instruments to influence target audiences. Segmentation and search for the most perspective target markets of consumers and marketing instruments most efficient for them are the key tasks for modern territorial marketing specialists. Indeed, youth is the largest audience eager to travel and visit new places.

II. Research results

Ivano-Frankivska oblast cares about the positive image of its territory as the touristic Mecca. At the same time the oblast positions itself the following way: «Ivano-Frankivska oblast is the region of tourism». Among the steps towards achievement ofthe abovementioned goal it is worth to mention: issuing the promotion materials about the region and its touristic features, maintenance of region's participation in touristic exhibitions, organization of introductory visits for mass media and travelagencies and conducting of roundtables, conferences and other events.

Regarding Ivano-Frankivsk city as the «visiting card» of the region, there is the developed and adopted 2016-2020 Program of Ivano-Frankivsk city promotion.

Oblast has the Strategy of Ivano-Frankivska Oblast Development till 2020. Marketing of touristic capacity is one of operational goals indicated in this document. The tasks of this operational goal are the following [1]:

- creation of oblast integral brand as the touristic one;
- creation of Ivano-Frankivska oblast positive brand at internal and external touristic markets;
- maintenance of increasing competitive ability of the region's touristic supply in accordance with worldstandards;
- forming of regional Internet -resource about tourism in Ivano-Frankivska oblast;
- creation and introduction of single touristic and informational system of the region;
- growth of the number of internal tourists;
- growth of regional touristic products sales volumes.

These tasks are accomplished through introduction of: promotion of local touristic products; maintenance of regional touristic marketing.

The fests and various feasts or events of different nature are one of the most wide-spread and efficient marketing instruments, which contribute to tourists and visitors attraction to the territory. They attract numerous tourists and new visitors, making significant positive impact on economic development. Moreover, the image of a territory as the place attractive for leisure and entertainment also improves. In perspective the larger number of tourists stipulates development of infrastructure and new investment, which again is of special importance for the territory.

The paper aims to research the fests on the example of Ivano-Frankivska oblast. Along with this, the cross-border aspect of these instruments will be emphasized. As a matter of fact, culture is not limited by state borders. Neighbouring nations have common customs, traditions, feasts and historic roots, having been closely intertwining for ages.

Festivals belong to the instruments of event-marketing. Their major tasks are:

- to create emotional link between the brand (festival and territory covered) and consumer,
- to improve the image of event place and to attract new visitors.

Therefore, emotions are the main task of festivals. Festivals in cultural sphere have certain peculiarity: they are characterized by specialsublime atmosphere of creativity, which absorbs you into special world and provides an opportunity to communicate with like-minded individuals.

Ivano-Frankivska oblast is known for its fests. There are approximately 15 fests in this oblast center annually,

including: International Fest of Smithcraft "Feast of blacksmith", Christmas Fest "Carol on Maizli", Fest of Pop Sport Dance "Fest-2016", Fest of Religious and Pop Song "Easter Bells", Nationwide Children Contest – Fest of Popular Music "Carpathian nightingale", Children Fest of Popular Arts "Colors of Childhood", Fest "Dovbushfest", Fest "Stanyslaviv Jam", Fest "Feast of Grapes and Vine", etc [2]. Such events attract attention of not only residents of the oblast, but of Ukrainian and foreign guests. Romanian and Moldovan groups and ensembles take part in them as the closest neighbours with existing tight cultural links. It is also worth mentioning that the fests are popular among young population. Therefore, it is the way to attract numerous groups of visitors to the territory – active, energetic and eager to learn something new. It is easier to influence this group than let's say the elderly citizens. Moreover, having obtained positive impressions, this target group has a chance to come back again and bring their friends and to pass along the information to next perspective visitors.

The fests are both of traditional nature with Ukrainian roots and of international scale. Ivano-Frankivska oblast held MitOst-fest – the place to meet people of different cultures, languages and communities. The task of the Fest is to create friendly environment for dialogue open to everyone. It is organized by international independent network of active people MitOst, which supports cultural exchange and citizen activism in Europe and neighbouring countries. This fest is held in different cities of different countries each year. In 2015 it was held by Ivano-Frankivsk and in 2006 in Timisoara (Romania) [3]. MitOst Fest focuses on urban planning, establishment of cultural relations in transformational period, ecology, human rights, migration, informal education, cultural heritage and modern arts.

Representatives of Carpathian region and other foreign countries take part in International Art Fest «Carpathian SPACE», which is held for the second year in Ivano-Frankivsk [4]. Artists from Romania and Moldova also represent their countries sculptures, paintings, theatre performances and concert programs. The countries of Carpathian region and neighbours also present their cuisines (Ukrainian, Romanian, Georgian, Lithuanian) and their cinema art.

Ivano-Frankivsk also takes part in International Photo Fest. Exhibition devoted to Euroepan integration and creative cooperation between the photo clubs is the part of European Photo Festival, which was held for the 6th time in 8 European countries – Moldova, Romania, Ukraine, Austria, France, Hungary, Serbia, Slovak Republic [5]. Ukraine took part in this event for the first time in 2017 as the final round of the Festival. Ivano-Frankivsk held it as the twin city of Romanian Oradea and Hungarian Debrecen. Photo Fest is the embodiment of friendly relations (lasting for more than 20 years) of Ukraine with Romanian Photographers Association, which was the initiator of this project.

This exhibition as the part of International Festival had already been shown in Romania in Oradea. After Frankivsk it will be presented in Debrecen. In Romanian Oradia it is planned to hold the "second round" of photo-exchange – the new exhibition inviting the Carpathian artists. Landscapes and portraits represented at the exhibition draw parallels between all three countries and show similar and different features of life.

Ivano-Frankivsk united creative people from all over the world on June 14 – 18, 2017 for the Porto Franko Festival. Numerous directions of modern art and culture were represented at the Festival, in particular theatre, cinema, music, poetry, dance, speech craft, art work. The slogan of the fest was «Porto Franko 2017 – open port», so the city was referred to as the port that invites crative people from the whole world. The art was not limited by closed premises and traditional forms. There were the exhibitions on house roofs, musical and theatrical performances, kinetic performances and «creative dream rooms», where everyone could embody their creative skills [6]. Romanian artists and Romanian group Subcarpati were the guests of the Festival.

Conclusion

Therefore, when summarizing the research of fests as modern marketing instruments, it is worth to mention the activity at the level of communities and individuals as well as joint interests and cultural traditions of neighbouring countries. Culture is the major driving force of establishment and maintenance of contacts among countries. Ukraine is open to establishing of cultural contacts and various fests conducting testifies to that. Ivano-Frankivsk oblast should share its positive experience in tourists attraction through holding various events, and other regions should adopt practical experience in order to improve the image of Ukrainian territories as places with rich historical and cultural heritage and tourism capacity.

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The expediency of using evaluation indicators of logistics processes effectiveness in the system logistics activities controlling

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Abstract – The importance and necessity of using logistics activity controlling for the purpose of increasing enterprise operation efficiency is substantiated. The need of formation and application evaluation indicators of logistics activity performance of the enterprise is argued, which create an important information data base of the enterprise necessary for effective planning, control and regulation of all logistics processes of the enterprise. The emphasis is on the impact of logistics services quality on the competitiveness and image of the enterprise, and, as result, on profitability and prospects for further development and improvement.

Keywords – image, competitiveness, logistics activity controlling of the enterprise, evaluation indicators of logistics activity performance, prospects for further development, return and complaint.

I. Introduction

Recent studies show that most of the customer's returns and complaints arise from the ineffective performance of the logistics functions of the company. An example is the customers dissatisfaction with long-term or late delivery of products – logistic functions of the company are responsible for timely delivery of goods; the return of products because of its delivery was in improper quality, that is, beaten, damaged or spoiled – it is to the sphere of logistics processes that the organization of delivery of products belongs not only on time but also with the preservation of consumer qualities of products. That is, the logistics department organizes the process of packaging and labeling products, chooses the appropriate type of transport, for example, cars with refrigerators, manages the processes of warehousing goods in the warehouse and moving from warehouse to transport, from transport to the consumer, etc.

Its subsequent image and competitiveness depend on the reaction of the company to the return and claim. The timely replacement of spoiled products or the timely delivery of quality products at a minimal cost can significantly improve the company's image, while indifferent or long-term responses to customer complaints can not only seriously damage the reputation and loose the client, but also launch a negative ad through the mouthpiece an insulted client.

Thus, there is a significant need for effective logistics processes that will allow them to work for a positive image and increase profits.

II. Research Result

Logistics activity controlling is a part of the enterprise management system aimed at ensuring the achievement of the logistic goals of the enterprise and the implementation of logistic functions, including optimization of the general level of stocks and the level of customer service, management of procurement procedures, purchases, transportation, production procedures, pricing, physical distribution, etc. in order to ensure the effective operation of the enterprise.

Based on the essence of logistics activities controlling, it can be argued that this is an auxiliary system that takes an important part in planning, controlling and regulating the logistics of the enterprise, which manifests itself in increasing the efficiency of the logistics processes of the enterprise.

However, it is logical that the planning stages, as well as the stage of control and regulation, are impossible without the formation of a list of controlled indicators, and, accordingly, the establishment of a methodology for their calculation.

On the basis of the research carried out in the study of the functions, goals and objectives of controlling and logistics, a list and methodology for calculating the indicators of evaluation the logistics activities performance of the enterprise is given in Table 1.

TABLE 1

THE LIST AND METHODOLOGY FOR CALCULATING THE INDICATORS OF EVALUATION THE LOGISTICS ACTIVITIES PERFORMANCE

Indicator	Methodology for calculating
Purchase cost in 1 order	$= \dfrac{\text{Purchase Costs}}{\text{Number of orders}}$
Number of operations per 1 employee	$= \dfrac{\text{Number of operations in warehouse}}{\text{Number of employees}}$
Share defects transactions	$= \dfrac{\text{Number of mistakes} * 100\%}{\text{Number of performed operations}}$
Fraction warehouse costs in the cost of production	$= \dfrac{\text{Warehousing costs} * 100\%}{\text{Cost of production}}$
Transportation costs for 1 product	$= \dfrac{\text{Transport costs}}{\text{Volume of transported products}}$
Transport productivity	$= \dfrac{\text{Number } \frac{\text{ton}}{\text{hours}} \text{ spent by transport}}{\text{Number of transport units}}$
Average transport costs per 1 t	$= \dfrac{\text{Transportation costs}}{\text{Transportation volumes}}$
Transport utilization rate	$= \dfrac{\text{Number of worked hours}}{\text{Maximum number of working hours}}$
The share of transport costs in the cost of production	$= \dfrac{\text{Transport costs} * 100\%}{\text{Cost of production}}$

Indicator	Methodology for calculating
Cost of the order for 1 item	$= \dfrac{\text{Cost of the order}}{\text{Quantity of products}}$
Share cost of the order in the cost of production	$= \dfrac{\text{Cost of the order} * 100\%}{\text{Cost of production}}$
Volume of goods in warehouse	$= \text{Admission to the warehouse} - \text{Shipment from the warehouse}$
Fraction returns	$= \dfrac{\text{Number of returned orders} * 100\%}{\text{Total number of executed orders}}$
The share of transport costs in sales	$= \dfrac{\text{Transportation costs in sales} * 100\%}{\text{Total sales costs}}$
The volume of logistics costs per 1 employee	$= \dfrac{\text{Total logistics costs}}{\text{Number of employees}}$

Source: own author's development.

Important when using the proposed indicators is not only the method of their calculation, but also a brief description, this makes it possible to simplify the process of understanding and perceiving the proposed indicators which is given in Table 2.

TABLE 2
CHARACTERISTIC OF THE INDICATORS OF ASSESSING THE LOGISTICS ACTIVITIES EFFECTIVENESS

Indicator	Characteristic
Purchase cost in 1 order	Shows the cost of purchasing costs for 1 order.
Number of operations per 1 employee	Shows the amount of warehousing operations per employee. Assists in determining the required number of warehouse personnel.
Share defects transactions	Shows the level of operations performance.
Fraction warehouse costs in the cost of production	Shows the share of warehouse costs in the cost of production. Assists in deciding on the amount of order and the amount of storage in warehouse.
Transportation costs for 1 product	Shows the share of transport costs for 1 product during its transportation. Assists in making a decision on the volume of the order.
Transport productivity	Shows the amount of worked hours per unit of transport. Helps in determining the traffic load and the required amount of transport.
Average transport costs per 1 t	Shows the proportion of transport costs per 1 ton carried by the available transport.

Indicator	Characteristic
Transport utilization rate	Shows the proportion of traffic load.
The share of transport costs in the cost of production	Shows the proportion of transport costs in the cost of production. Helps in making a decision on balancing logistics costs.
Cost of the order for 1 item	Shows how much expense does 1 order. Assists in determining the volume of the order.
Share cost of the order in the cost of production	Shows the share of cost per order in the total cost of production.
Volume of goods in warehouse	Shows balance on stock. Helps to control the work of the warehouse.
Fraction returns	Shows the level of customer dissatisfaction with the execution of orders. Allows you to decide on occasional and after-sales service.
The share of transport costs in sales	Shows what proportion of transport costs accounted for the total cost of sales of products.
The volume of logistics costs per 1 employee	Shows the amount of logistics costs, which account for one employee.

Source: own author's development.

Conclusion

In this article the importance of the logistics of the enterprise as a system of influence on its competitiveness and image through the effective organization of logistic functions and timely reaction to the return and customer complaints was established. The need to form an indicative list of indicators of evaluation the effectiveness of logistic processes and to determine the methodology for their calculation was identified.

The proposed list of indicators allows not only to evaluate the results of logistics operations, but also provides the opportunity to calculate the targets, which is an effective support for the logistic plans built, which further simplifies the process of control, the search for "bottlenecks" or disadvantages in planning and regulation.

Thus, the application of the proposed list of logistic indicators and the methodology for their calculation allows not only assessing the effectiveness of logistics activities of the enterprise, but effectively affecting the planning, control and regulation of logistics plans, which ultimately affects the competitiveness of enterprises, profitability and forms the prospects for further development and improvement.

Whistleblowing in the Enterprises and The Influence Of Whistleblowing On The Business Performance

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Abstract – Whistleblowing can be defined as revealing non-ethical behaviors or events in organizations. Whistleblowing, which can be stated as revealing or announcing the improprieties in organiztations, has recently begun to appear among actual subjects of media and management. Organizational success and continuousness depend on business performance. In this study, the concept of whistleblowing was explained and the effects of whistleblowing on business performance were tried to be explained.

Keywords – Whistleblowing, Business Performance, Enterprises

I. Introduction

Whistleblowing, which can be expressed as making or announcing the mistakes made in the workplace, has recently begun to be among the current issues of both the media and the business management.

Activities in the enterprises that are contrary to the laws, harmful to the human health or environment are seen in the news, especially in the media and such incidents create significant repercussions in all segments of society. Sherron WATKINS, Enron's Deputy Chief Executive Officer, who has been elected as the Person of the Year, noticed the accounting fraud within the company and reported the situation to the CEO of the company. When she had been appointed to a passive task upon this, she had reported the frauds within the company to the relevant authorities, quit work and thus started the process which will lead the collapse of Enron. Coleen ROWLEY, who was selected as the man of the year, informed his superiors that some suspects had received flight lessons in the US, and even Moussaoui was a serious suspect, months before 11 September, but nobody heard him, and once one of the biggest terrorist attacks in the history happened, he submitted the 13 pages of report he wrote to the Senate Intelligence Committee members. The reason why Cynthia COOPER was chosen as a person of the year was came to light as result of the process that started with a progress starting with her being a financial auditor and deputy-chairman of the world-famous WorldCom Company. COOPER found $ 9 billion illegality by falsifying the company's accounts and reported the situation to the auditor company Arthur Andersen. When the audit company ignored the incident, this time she informed the government and revealed corruption. As result of this incident, the WorldCom Finance Manager was tried for 65 years with imprisonment claim, and COOPER was promoted and her salary was doubled (Aydın, 2002: 80).

As result of these three separate whistleblowing circumstances and the experiences who revealed them caused studies concerning whistleblowing increase.

In this study, the concept of whistleblowing was explained and the effects of whistleblowing on business performance were tried to be explained.

II. Scope Of Whistleblowing

Whistleblowing is a concept that has emerged as a result of British police officers' whistling in order to warn people who are predisposed to commit a crime (Aktan, 2008: 1). The concept is used particularly in the Anglo-Saxon literature "to refer to public opinion when there is a common misconception" (Pitt, 1996: 393).

American advocate Ralph Nader has made the following definition of whistleblowing: "This is a provision of information by one who believes that the public interest takes precedence of the organizational interest, for the corrupted, illegal, fraud or harmful activities of the organization" (Lewis 2001:1).

Whistleblowing is the act of disclosing a behavior fow which an employee believes to be faulty or illegal to top management, non-business authorities or the public (Bouville, 2007: 1).

Different definitions have been made by various authors to explain the concept of whistleblowing. However, in the whole of the studies carried out on this subject, the definition made by Near and Miceli (1985) of "It is the disclosure made to individuals or organizations by members of the organization (formerly or still working) of illegal, immoral or illegitimate practices under the control of employers" is used.

People who commit whistleblowing is named as "whistleblower".

III. Factors That Cause Whistleblowing

The studies made in relation with the whistleblowing focus on five key factors that are likely to affect this behavior. These factors are (Özler et al., 2010):

• Psychological Factors: Psychological factors include concepts of organizational commitment and loyalty. For example, an employee who is more loyal to his organization reports the wrong practices in the organization more, so long as that creates an advantage for him.

• Cultural and Ethical Factors: There may be a difference between the perception of whistleblowing by people who have a certain culture and a certain nationality, and it has been revealed that such a difference exists in the studies made on this topic.

For example, employees in Asian countries (such as Japan and China) exhibit more whistleblowing behavior than Westerners (like America). In this context, collectivism, which is concerned with the supremacy of organizational interests over personal interests, plays a fundamental role.

• Structural Factors This factor includes legal regulations and policies related to whistleblowing. When an organization follows policies that encourage whistleblowing, an individual exhibits more whistleblowing behavior.

• Retaliation (Revenge): If an individual reports a wrong behavior and is faced with a severe punishment or is afraid to encounter certain consequences, he/she will give up whistleblowing behavior.

• Type of Wrong Applications: Whistleblowing also varies depending on the importance (seriousness) and the type of the wrong practices.

IV. Problems Encountered By Whistleblowers

From an employer perspective, "being exposed to the whistleblowing" is a very negative situation. For this reason, it should be ensured not to cause employees to be obliged to exhibit a whistleblowing behavior. Announcing the wrong behavior will create a negative image in terms of the firm / institution and will affect the future of the organization. This damage have to be prevented.

The typical approach of firms where ethical issues are addressed is to dismiss whistleblowers in order to prevent the bad image within the company caused by this behavior. This way, the best of both worlds is enjoyed: Whistleblowers are punished and other employees are ballyragged. Such an approach is neither effective nor ethically acceptable.

Typical reprisals and retaliations of employers or managers against whistleblowers can be categorized as follows (Gerçek, 2005: 33-34):
1. Attracting attention to whistleblowers:
2. Producing a weak record / history:
3. Forcing to remain silent by threat:
4. Leaving them alone or humiliating:
5. Preparing a ground for failure:
6. Filing a lawsuit:
7. Demolishing the career:

The distresses Whistleblowers encounter in the working environment are not solely attributable to employers or managers. The attitude of your colleagues can sometimes be very damaging.

In particular, it should be noted that those who are blamed for unethical behaviors, those who accuse whistleblowers of job disturbance, those avoid from being seen together with whistleblowers or those who play "ostrich" (see no evil, hear no evil, speak no evil) though they witnessed to misconducts may be. The most rational approach in this regard is not to worry too much, thinking that these people may have justified reasons for them.

V. Influence Of Whistleblowing On The Business Performance

The concept of operational performance is a concept that is difficult to define and measure (Snow and Hrebniak 1980) and, consequently, is viewed by researchers in different perspectives. When we examine the related scientific literature, it is understood that mainly two approaches are used, although it seems that there are a variety of perspectives such as short or long term financial or organizational performance (Sin et al., 2005). One of those is the subjective approach. In this approach, the performance of the businesses is generally assessed depending on their competitors, in other words, by making a comparison with

other alternatives (Golden 1992). In the second approach, in the objective approach, the performance of the enterprise is evaluated based on absolute performance measures, more clearly, numerical values (Cronin and Page 1988). However, the use of an objective approach may cause difficulties for reasons such as that the enterprises are reluctant to provide especially financial information about themselves, and even if they are eager to provide them, it is very difficult and time-taking to derive these information (Caruana and Pitt 1997), and the results announced by the enterprises sometimes do not reflect the actual situation (Phillips 1999).

Business performance measurement process is a really challenging process. Especially the measurement of non-financial elements include significant difficulties for enterprises.

When the previous studies are examined, the relationship between whistleblowing and enterprise performance has not been directly examined. The studies made are generally on the relationships between whistleblowing and ethics, morals, organizational commitment, and organizational culture. We can comment on the relevance of whistleblowing to business performance, by virtue of the organizational satisfaction, organizational trust, and organizational commitment contained in non-financial business performance indicators.

One of the most important factors affecting the performances of the enterprises is the satisfaction level of the employees. Because people want to get paid for their work. While some businesses satisfy their employees in the financial aspect, some satisfy both materially and spiritually. The right one is material and spiritual satisfaction. If the business is acting illegally, violating ethical values, etc., then the employees can not work spiritually comfortably, even if they are financially satisfied. They continue to work in guilt. This affects both individual performance and business performance negatively. Employees can choose a way to relieve their own consciences by referring to whistleblowing. However they may get into a dissatisfaction again due to the applications they will be subjected to as result of this.

As is seen, unethical behaviors in businesses are negatively affecting employee and business performance by reducing employees' job satisfaction.

In addition to job satisfaction, employees' commitment and trust to their organizations have a positive influence on the enterprise performance. (Mishra and Morrisey, 1990:444).

According to Reinke (2003); the level of trust between employees and their superiors is the strongest indicator of employees' acceptance of a new value system. Similarly, Condrey (1995) stated that managers with confidence in their organizations believe that their supervisors play a fundamental role in the process of change.

In terms of definitions, organizational trust is a concept that explains the confidence in employees' managers and busi-nesses. It is beneficial to explain the concept of organizational commitment together with organizational trust.

Meyer and Allen (1991: 67), who considered organizational commitment as a psychological state that reflects the relationship between the person and the organization, argued that this psychological state is decisive on the relationship between the employee and the organization and on the decision to stay or leave.

Despite being strongly associated with variables such as organizational commitment, the concept of organizational

trust is conceptually different. While organizational commitment is related to company goals and finding identity as well as evaluation of company goals, the organizational trust is related to the belief in employees' goals and leaders, and ultimately organizational action is believed to be beneficial to employees (Gilbert and Tang, 1998: 322).

The perception of just treatment and support exercised by the organization also affects the organizational commitment formed by the trust created (Neves and Caetano, 2006: 355).

In the context of definitions and organizational trust-organizational commitment, it is not difficult to understand how effective these concepts are on business performance. None of the enterprises can ignore these factors. Whistleblowing reduces trust and commitment in the enterprises. Employees do not trust managers who do not have ethical values, and their commitment to these enterprises is at an insignificant level. As a result, in the enterprises where whistleblowing occurs, the trust and loyalty decline, resulting in reduced individual and organizational performance.

Conclusion

Ethical and non-ethical, illegal and unconstitutional actions in enterprises affect both employees and society in a negative way. While employees often have to submit to these behaviors, the society is largely ignorant of these behaviors.

Thanks to whistleblowing, both the employees ensure these behaviors to come to an end and the society becomes aware of these behaviors and take necessary sanctions against such enterprise.

These non-ethical behaviors actually affect business performance negatively. Because even if it is not shared with the public, these behaviors make the employees unhappy and decrease their and the enterprise's performance. Because of these behaviors, job satisfaction, trust and loyalty decrease and therefore business performance is adversely affected.

In an enterprise where whistleblowing was occurred, the performance decreases anyhow. Because, also the people who are not employees of the enterprise but are not aware of the non-ethical behaviors learn about these behaviors and their performances and trust decrease as result of this. In addition, corporate reputation decreases because of the fact that society is aware of this, and performance in the financial sector so declines.

Whether or not they arise because of the reasons explained above, ethical and non-ethical behaviors at the work affect the enterprises negatively. For this reason, enterprises should give importance to ethical and moral values as much as possible, and should not be illegal and behave in contradiction to human rights.

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Growth of the role and importance of service industry in the modern global economic space

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Abstract: According to international experience, service industry has important role in economic growth of economies. Its main tendencies of growth were analyzed in domestic economy. It was offered to consider growth of service industry as main factor of Ukrainian economy in nearest future.

Keywords – service industry, outsourcing, economic development, national economy.

I. Introduction

The growth of the service industry is one of the main features of the most powerful economies for most of the XX century. If in 1950 the share of services in the US GDP 20%, then in 2000 it reached 78% [2]. This tendency is characteristic for countries with very powerful economy.

By the beginning of the XXI century, the level of development of the service industry in the USA, their technological support, investment parameters, exceed the similar indexes of the economy of any other country. After all, in countries with the most developed economy, the largest share of GDP is booked by service industry.

II. Main Results

The tab. 1 shows the share of revenues from services in GDP (in percentages) of different countries, which are united into groups.

Table 1

LEVEL OF DEVELOPMENT OF SERVICE INDUSTRY IN COUNTRIES (BY SHARE IN GDP), *COMPLETED BY AUTHORS*

Group	Countries	Share of revenues from services in GDP (%)
I	USA, Belgium, United Kingdom, France, Canada, Australia, Monaco, Luxembourg, Malta, Cyprus, Panama, Maldives, Greece, Japan.	More than 70
II	Austria, Finland, Italy, Spain, Portugal.	60-70
III	Morocco, Chile, Costa Rica, Ukraine.	50-60
IV	Ghana, Botswana, Mali	Less than 50

\According to the results of the tab. 1 you can see that almost all countries from I group have a powerful economy. Although there are some quite rich countries that are focused on industry because of their wealth nature resources, namely oil, gas and other minerals. These countries are focused on this perspective industry. This includes: Qatar, Kuwait, United Arab Emirates, Saudi Arabia, Bahrain...

Many countries from Group IV have weak economy because they probably are concentrated on agriculture that is not very perspective nowadays. Most of them are African countries.

Also, a bright example is Panama, small country between two oceans and share of service industry in its GDP is more than 90% because of Panama canal.

Picture 1. Panama canal

The Panama Canal Expansion was the largest infrastructure project since the Canal's opening in 1914. Considered and analyzed for a decade with more than 100 studies, the Expanded Canal provides the world's shippers, retailers, manufacturers and consumers with greater shipping options, better maritime service, enhanced logistics and supply-chain reliability [6].

To date, the Panama Canal, which connects the Caribbean Sea, the Atlantic and Pacific Oceans, is still considered one of the largest and, of course, the most complicated constructions in the history. The Panama Canal is a real benefit in the economy and shipping throughout our vast planet. It is worth imagining just how much the way for ships that go from the largest metropolis in the New York world to San Francisco has been reduced. The ships had to cross the distance of almost 23,000 kilometers between the two cities. Thanks to the human-made canal, this way was reduced to only 9,500 kilometers. In 2012, the New York Times newspaper, popular not only in the United States but around the world, has a list of places that are recommended to visit tourists and tourists for sure. Interestingly, this small list was headed by Panama [5]. Last fact means that the Canal is useful in shipment but also it is priceless because of tourism that is also considered as service insudtry.

According to the level of development of service industry, all countries can be divided into 4 groups. Almost all countries from I and II groups are powerful countries. On the example of Japan, it can be seen that this country is not so well-endowed with natural resources and often is stormed by hurricanes and earthquakes; instead, there is an incredible development of service

industry. As we see, now Ukraine is in Group III, which means that there is still place for growth.

Nowadays, Ukraine is a country with an economy that is developing, In Ukraine, the share of agriculture in GDP is 10%, industry – 31.2% and service industry – 58.8%[1]. Our country is also beginning to become more and more involved into service industry, as evidenced by an increase in the number of IT and outsourcing companies. In the world ranking of software manufacturers Ukraine took 15th place. There are about a thousand companies involved in software development in the country, about 25-30 thousand Ukrainian specialists are involved in the field. The president of the Alliance of software companies told that the annual share of Ukraine in global outsourcing was about $ 600 million.

Since 2006, Ukraine has become a full-fledged player in outsourcing. Previously, outsourcing companies were concentrated in big cities, and now this trend is actively developing in regions. In 2006, many Ukrainian young Ukrainian companies from the regions participated in the Ukrainian Outsourcing Forum. Most domestic companies are focused on foreign markets. 55-60% of our outsourcing is export products. According to representatives of Microsoft, the Ukrainian market is young and characterized by the features of all such markets: "It is characterized by piracy and a small need for software products in the domestic market" [3].

In 2016 Ukraine has risen in the ranking of Global Services Location Index in the market of outsourcing services and has taken 24th place. Data for 2016 shows that the number of employees in IT and outsourcing companies is growing quite fast. Moreover, in Ukrainian top10 companies are included 5 companies, whose offices are located in Lviv as well: "Epam", "SoftServe", "GlobalLogic", "Ciklum", "Eleks" [4].

Conclusion

After all, according to international tendencies service industry in Ukraine is rapidly developing and it will take an even bigger share in the national economy in the future. After all, if the IT industry has developed a bit in Ukraine, outsourcing is only improving. Development of service industry in Ukraine can significantly improve our economy in total.

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Virtual Organization as an Innovative Form of Business Management

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Abstract – This paper for proceeding contains the concept of virtual enterprise, also the peculiarities of functioning of virtual enterprises in the sphere of international and domestic business are considered and SWOT-analysis of functioning of virtual organizations is carried out.

Keywords – virtual organization, virtual enterprice, informative-telecommunication technologies, innovative structures, integration, synergetic effect.

I. Characteristic signs and examples of a virtual organization

The rapid pace of economic changes requires the creation of a new type of flexible and adaptive structures. Recently, virtual organizations are increasingly becoming such structures. They are voluntary informal forms of cooperation of several independent partners on the basis of distance cooperation and the unification of the information structure [1, p.122].

As a virtual organization, in essence, is a network that includes the pooling of resources of different enterprises and their integration with the use of computer networks, it allows participating companies to adapt to the dynamic environment as much as possible, which is especially relevant in the current conditions of the domestic economy.

Among the features of virtual organizations that distinguish them among all other forms of doing business, the main ones are [2, p.14]:

1. The absence of a geographical center, since such organization consists of separate units of different enterprises, which can be geographically separated from each other.
2. Lack of legal basis and legally enshrined rights and responsibilities of the participants of the organization, since companies cooperate only on the basis of mutual contracts.
3. An extremely important factor is the development of information technology, because cooperation takes place through the use of computer and telecommunication networks that provide response speed to market changes.
4. For virtual organizations there is no need to centralize management, since management, like production, is distributed.
5. The main task is to take advantage of the opportunities of the global economy to create products that as much as possible correspond to the development of science and technology.

6. Most of them are characterized by the rejection of mass production, because such organizations are created for the release of a unique product, produced in the form of individual specimens or small batches.

So we can see that this form of business organization is quite innovative and non-traditional. However, international business already has significant experience in the the practical functioning of virtual firms. The first areas of application of the so-called "virtualization" were consulting and outsourcing services. Over time, cooperation between enterprises expanded, diversified and, accordingly, new forms of integration appeared:

- Procter & Gamble, which supplies personal hygiene products on the Wall-Mart shelves;
- Michelin, which delivers automotive tires right to Accelerators for America's Future;
- American Airlines and the Hilton hotel chain etc.

In recent years, the European consortium "Airbus Industries", which combines the efforts of Apple and Sony, has been a well-known project based on virtual organizational forms. As for Ukraine, here, as N. Rud' testifies [3, p.202], Kharkiv Virtual Business Incubator «Kharkiv Technologies», Kiev Technopark «E.O. Paton Electric Welding Institute», Lviv Informational, Innovative, Educational and Educational Consortium (cluster) and other forms of innovative virtual organizations function quite successfully.. Therefore, we can say that such a form of business is gaining popularity both abroad and in the domestic market.

II. Analysis of the pros and cons of a virtual organization

Thus, a virtual enterprise is a mobile enterprise consisting of geographically separated groups, people, united for solving certain tasks, achieving a certain goal, activity of which is carried out with the help of information and communication technologies

So, it's necessary to determine what makes virtual organizations so popular and what can be the negative effects of such cooperation. To do this, we'll use the SWOT analysis shown in Table 1.

Table 1

SWOT-ANALYSIS OF THE VIRTUAL ORGANIZATION

Strengths	Weaknesses
1. The flexible structure allows you to use the resources you need as efficiently as possible and also this structure can be quickly restructured	1. The need to keep confidential information from unauthorized access 2. The need for control over the activities of participating companies
2. Quick production because of the labor specialization 3. Reduced rental, trans-port, as well as admi-nistrative costs, costs for legal registration of transactions, etc.	3. Lack of proper social protection and material support of partners, as a result of the rejection of traditional labor relations

Strengths	Weaknesses
4. A general informa-tion platform about part-ner agents, their functi-onal capabilities (com-petencies) and technolo-gical operations 5. Network infrastruc-ture allows the exchange of knowledge 6. Focusing on customer needs and the organi-zation for a comprehen-sive service through the joint efforts will lead to an increase in demand 7. The lack of entry barriers and the lack of standardized forms of co-work allows you to combine into rather large "hybrid" groups without losing flexibility 8. Such cooperation can lead to an additional synergistic effect.	4. Uncertainty about member-ship in the orga-nization and uncertainty in the planning of activities for participants 5. Excessively large infor-mation base, the complexity of systema-tizing information and quantitative survey of association activities 6. The need for specific skills of employees and managers, as well as the need for cons-tant up-dating of communica-tion tools 7. The complexity of deter-mining the boundary between the external and internal en-vironment as a result of deep informa-tional integration; 8. Excessive economic interdependence of part-ners, due to the narrow specializa-tion of the organization.
Opportunities	**Threats**
1. Search for partners without borders bet-ween countries, which complies with the pro-cesses of globalization 2. Partners' ability to mig-rate and rebuild ma-nu-facturing processes in vir-tual space as needed 3. The opportunity to redu-ce the barriers to entering new markets 4. Ability to adapt flexibly to environmen-tal changes 5. Efficient execution of market orders and pro-viding exclusive novel-ties to the market 6. Ability to attract highly skilled specia- lists regar-dless of their place of resi-dence	1. The psychological disso-ciation of members of the virtual enterprise can lead to distrust in the team or the emergence of conflicts 2. Uneven development of information systems in different countries 3. Psychological "unpre-pa-redness" of many sub-jects to intensive work in an artificial "virtual" space 4. The development of the legislative framework lags far behind the progress in the field of new technologies 5. Lack of interest of cre-ditors in financing intangible assets 6. Tax evasion charges

Table was made by author using source [4].

Conclusion

In conclusion we can note that virtual organizations in the conditions of the information economy attract more and more attention from the theorists and practitioners.

They achieve real competitive advantage in the market by saving time, reducing costs, internationalizing business, increasing flexibility and adaptability, and enhancing innovation activity. Getting the synergy effect on virtual enterprises becomes possible thanks to the integration of resources, knowledge and efforts of partners, their concentration on key competencies.

However, despite the significant benefits of such organizations compared to traditional enterprises, before realizing the idea of virtualization, it is recommended to explore the possibilities of the market for the activities of similar organizational structures. Therefore, the subject of analysis should be the degree of globalization of the industry, the size of costs, the possibility of flexible behavior, innovative potential etc.

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Main EU requirements for goods safety and quality

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Abstract – The analysis of educational and scientific materials on the subject of adaptation of the national technical regulation system to the requirements of the EU. The research of key features of the European standardization system has been conducted. The main differences between the quality control system in the EU and in Ukraine are presented. The ways of adaptation of the domestic technical regulation system to the European space are proposed.

In the conditions of the need to reorient the EU markets for domestic enterprises, there is a problem of finding opportunities to adapt the national system of standardization to European requirements. It updates the expediency of analyzing the basic requirements of the EU for the safety and quality of products, as well as finding solutions for the integration of domestic production capacities into the system of economic relations of the European Union.

Key words: standardization, goods, import, quality, competitiveness, adaptation, requirements, reorientation, safety.

I. Introduction

The European Union is one of the largest common markets based on a free trade area with relatively free movement of capital and services.

The main condition for the proper functioning of the single market for goods and services is the elimination of trade barriers, it free movement of goods. Trade barriers arise due to differences in international legal standards, testing, certification and quality control procedures in different countries.

That is why it is very important to create a continuous development of international standards and the consistency of their implementation and application at the enterprises in accordance with the requirements adapted to the European requirements by domestic legislation.

II. Main material

Therefore, goods imported into the EU must meet certain requirements aimed at ensuring consumer protection in terms of product safety and quality. [5].

These requirements are divided into three main groups:
- technical requirements;
- environmental requirements;
- requirements in the field of sanitary and phytosanitary measures;

In addition, certain types of products at EU level set marketing standards, and also apply import restrictions, which can also be considered as mechanisms of protection of the domestic market from imported goods, the quality and safety of which does not meet the requirements of the European Union. [4,7]

The main technical requirements for the classification of the goods are: labeling, packaging products and the field of technical standardization. Accordingly, the manufacturer and the distributor must comply with the following basic rules:
- supply to the market products that meet the basic safety requirements;
- provide information to consumers about possible threats from the use or use of the product;
- inform the relevant national authorities about the potential and immediate hazards of products and cooperate with these bodies in order to implement and take measures taken to protect consumers.

The Directive provides that product safety controls are imposed on the competent authorities of the Member States. In particular, such bodies are responsible for:
- onitoring of conformity of products to the requirements of safety standards;
- the life of the necessary measures in relation to dangerous products and the relevant information of the EC.

Also functioning at the EU level is introduced – «Rapid Alert Systems for Non-Food Products of Major Risk» – RAPEX (Rapid Alert Systems for Non-Food Products of Major Risk) created for the purpose of operational exchange of information between EU Member States and the European Commission in the event of product detection poses a serious danger. [8,10].

Basic environmental requirements to be met by the supplier and verified by law :
- To regulate and control trade in the content of hazardous chemicals and mixtures
- Check for organic pollutants.
- Record, give evaluation and permission
- Products can be placed on the market if they are classified, labeled and packaged. [11].
- Execute rules for environmental protection.

Requirements in the sanitary and phytosanitary sector.

These requirements are classified in the areas of food, feed, plant and public health. [2].

Food products imported into the EU must comply with the conditions, including:
- the basic principles and requirements of food law;
- registration by EU importers of suppliers of products from the country of origin of goods;
- the basic rules of food hygiene and special requirements for the hygiene of food products of animal origin;
- rules for pesticides, veterinary drugs, genetically modified food and feed;
- special rules for certain food products (frozen food and mineral water)
- food products intended for certain groups of the population (products for infants and children);
- specific marketing requirements and labeling

The importation of products of animal origin and animals is carried out in accordance with these rules:
- the exporting country should be included in the list of states authorized to export this category of products to the EU;

- products of animal origin may be imported into the EU if they were produced in approved processing facilities in the exporting country
- imported goods must have a health certificate issued by the veterinary authority of the exporting country by the Patent Office of the exporting country;
- products can be checked at the checkpoint where the EU customs border crosses[4,7].

In the event that an outbreak of a veterinary disease has been found in a exporting country that is dangerous to animal or public health, the European Union applies certain protective measures, including the temporary suspension of imports from all or part of the country. [3].

It should be noted that the established rigid norms and requirements for goods imported into the EU provide protection of the European manufacturer and difficulties for non-EU trading partners. (Table 1). [1.9].

TABLE 1

PERCENTAGE OF EU IMPORTS WITH NEIGHBORING COUNTRIES (%)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Belarus	22,6	21,8	21,8	23,0	21,7	18,9	20,0	24,3	31,6	19,2
Moldova	45,3	45,6	43,0	43,4	44,3	43,5	44,5	45,0	48,3	49,0
Ukraine	36,0	36,7	33,8	34,0	31,5	31,2	31,0	35,1	38,7	:
Armenia	31,4	33,2	29,7	26,4	25,6	26,0	23,8	24,4	24,2	23,3
Azerbaijan	30,9	29,3	28,8	26,7	25,4	32,4	27,7	35,1	33,8	:
Georgia	28,9	27,5	27,5	28,4	28,2	29,2	30,2	28,3	27,6	32,5

Thus, analyzing imports from EU countries to neighboring countries, we can conclude that the largest share of imports from the EU is Modov 49%, Ukraine 38.7%, Georgia 32.5% (Table 1)

Conclusion

As a result of the study of educational material on the subject of adaptation of the national product to the requirements of the European Union, the main criteria for classifying the requirements for import of goods, the rules on which should be guided by manufacturers of products and the dynamics of the import of neighboring countries from the EU.

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Marketing Logistics

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Abstract –The aim of the article is to show the need of the integration of marketing and logistics, their particular tasks, and issues connected with them. The paper focuses on showing logistics and marketing not as separate elements, but rather as an integrated management concept, that when utilized allows the enterprise to achieve success. The integration of different logistics processes and functions within logistics system and logistics management, as well as the integration of this system with the marketing system, within the scale of an enterprise and the market, is expressed in the integrated concept of marketing logistics management. This consists the basic dimension of modern business management.

Keywords: logistics management, marketing management, logistics, marketing, integration, management concepts, distribution, strategy, tasks, objectives

I. Introduction

Businesses currently operating on the market are forced to take interest and pay large attention to the matters of supply and distribution. The reason for this situation is the contemporary market, characterised by large dynamics within demand, technology, and competition. The result of these changes is the necessity to build strategies oriented for the final consumer. Therefore, any marketing activities undertaken by an enterprise, and regarding the product, the price, or the distribution are supported by logistics that allows business to increase the availability of their products on the serviced market segments. Thanks to the intermingling of marketing and logistics, the term "marketing logistics" was developed, which focuses on consumers' needs and expectations.

Logistics cover integrated systems of planning, organizing, leadership, and control over physical processes, cycles of resources, materials, and products, and the associated information in regard to the optimization of activities and objectives [4]. Marketing is the process of teaching consumers why they should choose your product or service over your competitors. Satisfaction of enterprise's customers is achieved through coordinated marketing activities which regard the product, the price, and advertising, as well as maximal utility of time and place offered by logistics [6].

II. Tasks and objectives of Logistics Marketing

Marketing Logistics is an integrated function of marketing and logistics, aiming at completing their respective objectives. Marketing and logistics management consists a kind of coupling and an integration of two management concepts, i.e. logistics – sectionally focusing on flows, and marketing – oriented towards the market.

The base for this is to meet the expectations and needs of the customers. Marketing Logistics contains both the elements of distribution logistics, and the elements of supply logistics.

The tasks of Marketing Logistics:
- fast and flexible response towards changes in demand and customers' needs,
- maintaining a high level of customer service,
- maintaining appropriate relations with customers and contractors,
- building competitive advantage,
- serving the clients at lowest cost possible.

The basic logistics and marketing objectives, analysed in regard to enterprises, include:
- shaping the optimal structure of added value and cost level along the logistics and marketing value chain,
- shaping appropriate level of profit in the long term,
- strengthening the enterprise's competitiveness on the market.

Considering long-term interests of enterprise, the marketing objectives connected with shaping appropriate conditions for the realization of exchange should be noted, as well the increase in market share as the foundation for enterprise's success. Also important is the orientation of logistic towards the rationalization of cost structure within the circulation of information and products, and discovering and creating new effectiveness potentials, present in the flow system [2].

A change in the approach towards the main objectives of logistics can be observed, and it takes the form of:
- highlighting the significance of logistics within shaping the optimal structure of relations in the flow systems,
- discovering and creating the potentials,
- shaping new structures along the whole supply chain,
- acquiring integrated marketing and logistics effects.

Marketing and logistics objectives, which indicate integration, as significant orientations in management, continuously more significantly and more effectively determine the general system of goals and values, in the scale of the whole enterprise, and at the same time the level and the structure of its market and economic results [3].

The basic phenomena and reasons resulting in the need of integration of logistics and marketing are the increase in the level of market diversification, increasing competition, integration of economic and decision-making processes, and the development of new technologies. The concept of marketing and logistics management is based on three elements:
- customer's satisfaction,
- integrated marketing and logistics activities,
- enterprise's profit.

The graphical representation of this concept is as shown on figure 1.
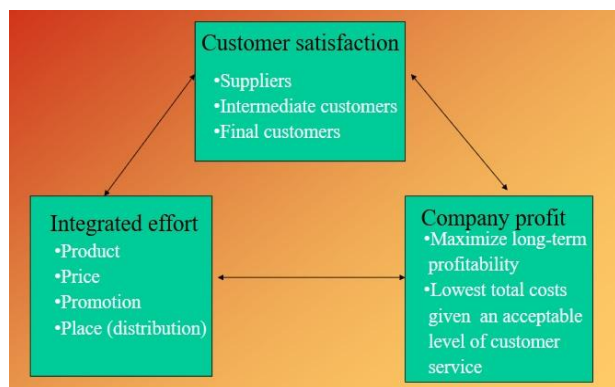
Fig. 1. The concept of marketing and logistics management.

At one hand, the satisfaction of enterprise's customers is achieved outside the coordinated marketing activities which regard the product, the price, advertising and distribution – through maximisation of the utility of time and place, offered by logistics.

On the other, achieving an acceptable level of profit in the long term is determined by a decrease in global logistics costs, achieved however with the assumption of a certain level of customer service [1].

III. Strategy of Logistics Marketing

Logistics is a strategic potential and an instrument that supports initiatives and components of market strategies in the long term. The level of effectiveness and impact of logistics as a strategic instrument depends on the level of integration with enterprise's marketing, and actual influence basing on the field of enterprise's impact. It also depends on the level of market orientation. The coordination function takes a detailed role here, particularly within the meaning of "contact points" between logistics and marketing. The field of contact points, in regard to a production enterprise, consists distribution logistics and supply logistics, together creating a joint structure of marketing logistics.

In order to avoid a situation in which these contact points could result in conflicts, or quite contrary, in order to make it possible to use logistics as a strategic potential and a determinant for results, it is necessary to integrate marketing and logistics in the general competition strategy [3].

When forming the strategy, one must be aware that only the long term and comprehensive creation and utilization of potentials, and marketing and logistics abilities can lead to simultaneous realization of mutual assistance of the mentioned objectives, within the structure of general objectives of an enterprise. In consequence, the total and the structure of values and market and economic benefits, generated and offered by the production field, are enriched and extended through the realization of proper programmes and marketing and logistics activities [2].

Integration of different processes and logistic functions in the framework of logistic system and logistics management,

as well as integration of this system with marketing system in scale of a company and market is reflected in an integrated concept of logistic – marketing management, constituting fundamental aspect of modern company management. Logistic – marketing management constitutes linkage and integration of two concepts, on one side – logistics as a management concept oriented on flows, and -marketing as a concept oriented on company management, on the other. Both mentioned management concepts meet on very fragile ground which is market, determining a strategy of company's acting on delivery and distribution market. Present logistics and marketing are treated as dual concepts of integrated company management. Logistics and marketing are defined as main orientations (criteria) of management in a company and interpreted in the real sense as significant (equivalent) spheres of functional and integrated processes in company. Preparing a strategy of a company, special attention should be paid to the relation between logistic and marketing strategies [7].

Conclusion

Customer's satisfaction, as the long term objective of marketing activities, consists an assumption for shaping the value chain. Logistics allow effective management over flows, and in consequence efficient and effective customer service. This coincidence of assumptions results in competent combination of marketing and logistics activities providing a greater result, compared to results achieved in separate utilizations of individual concepts. The concept of an enterprise of the future and the manner of its realization are tested by the market. The key problem is a thoroughly analysed, intelligent, and effective stimulation of changes in the conditions and environment of an enterprise towards such, which will prove as the most advantageous. This will allow sustainable development and prolonged market presence [5].

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Management of Investment Risks

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Abstract –Investment activity is oriented towards the future and is associated with a significant uncertainty in the economic situation. It is especially important for investors to identify, analyze and evaluate the possible impact of investment risks on investment activities in a timely manner. Effective investment risk management is a dynamic feedback process, in which decisions made require periodic review and analysis.

Key words: market economy, investment risks, effective management.

I. Introduction

In a market economy, risk is a key element of entrepreneurship. Investment activity is always associated with the emergence of a certain type of risk and is caused by a significant investment cycle duration. Investing is associated with large investments, so their ineffective use may negatively affect the financial results of the investor's activity.

II. Main Results

Investment activity is always focused on the future and is associated with a significant uncertainty in the economic situation [4]. Therefore, it is especially important for investors to timely determine, analyze and evaluate the possible impact of investment risks on investment activities. Investor comes primarily from the understanding of security when investing and only then – from the calculation of future profits. Ukraine has a significant industrial, agricultural, trade, scientific, tourist, and scientific and technical potential and has a high level of investment attractiveness.

Investment risks are the possibility of shortfall of planned profit in the course of realization of investment projects. The object of risk in this case is the property interests of the person – the investor who invests in the project in one form or another.

Investment risks can be classified according to several classification criteria:

1. Depending on the causes of the occurrence:
   – specific investment risks;
   – non-specific investment risks.
   – 2. Depending on the investment object:
   – risks of real investment;
   – risks of financial investment.

The essence of investing consists in investing own or borrowed capital in certain types of assets, which should ensure future profits. Investments can be long-term and short-term.

Investor can expect a number of problems when investing, namely [3, p. 59]:

1. Incorrect identification of risk and degree of its influence on the investment activity result.

2. Accounting the incomplete number of factors that influence the change in the risk level.

3. Incorrect assessment of the risk level for specific financial assets or the formation of a "non-optimal" investment portfolio.

4. Incomplete and false assessment of risk sources.

5. Lack of funds from the investor to form an optimal investment portfolio or management of risks that arose during the investment activity.

6. Technical issues: false registration of documents; problems with clearing in the trading system; inconsistency of the agreement terms; refusal to pay by the buyer of financial assets; incompetence of project management; refusal to supply securities by the seller; leakage of information; lack of authority from the intermediary or the person who concludes the agreement; errors in the registry; liquidity crisis in the bank or broker / dealer; errors during transfer of funds or transfer of securities, etc.

7. False estimation of the investment system associated with the underestimation of transaction costs, mistaken estimation of dividends, comparison with inefficient systems.

The process of investment risk management includes: anticipation of risks; definition of their probable size and consequences; development and implementation of measures to prevent or minimize risk-related losses.

It is very difficult to completely neutralize the investment risk, but it can be managed by pre-estimating, counting, describing and planning actions that can reduce the probability of occurrence of adverse events during the investment project implementation [1]. Such a activities complex is the content of the risk management process, which enables to assess the degree of negative consequences and reduce losses from their offensive. The process of managing investment risk allows either to completely avoid it, or to reduce the effects of its negative impact. If the internal risks of investment project can be offset and neutralized by improving the management process, then, as for external risks, it is only possible to minimize their negative consequences [2].

In general, the sequence of risk analysis is as follows:
   – dentification of internal and external risk factors;
   – analysis of their potential investment threat;
   – estimation of possible financial losses;
   – determine the sustainability of the project to the identified risks;
   – establishing the criterion of the permissible level of risk;
   – development of anti-risk investment management technology;
   – planning of measures to reduce the risk;
   – monitoring the behavior of risk factors during the investment;
   – making decisions on the neutralization of risk factors in the presence of a real threat to investment;
   – changes in investment plans to reduce or counteract the threat of a project;
   – planning effective (with minimal losses) forced exit from the project.

An investor can reduce the risk by complex actions, but it is difficult to completely eliminate it. In general, the

choice of an investment project is a compromise between the attempt to profit and the common sense of the investor (the level of risk and its assessment).

Identification of investment risks should be carried out in the following sequence:

– awareness of the need to identify investment risks;
– collection of information from the external and internal environment in terms of the need to identify investment risks;
– processing received information with further identification of factors that may affect the emergence of investment risks;
– assessment and analysis of the received information on the sources and causes of potential investment risks within the identified factors of influence;
– analysis and selection of investment risk assessment methods with a view to their more precise identification;
– coordination of the obtained results with the tasks set in the context of identifying investment risks.

In developing measures to minimize investment risks, first of all, it is necessary to determine in which of the three risk zones the identified risk is:

1. risk-free zone: the risk is insignificant, there is practically no financial loss, the guaranteed receipt of financial products in the amount of the expected amount of profit from the investment activity;

2. zone of permissible risk: average risk level, possible financial losses in the amount of the estimated amount of profit from the investment activity;

3. zone of critical risk: high risk, possible financial losses in volumes exceeding the expected estimated amount of profit from investment activity.

The most effective methods for minimizing the risks of investment projects are diversification, limitation, insurance, hedging of securities, preparation and certification of employees.

Diversification determines the process of capital allocation between different investment objects that are not directly related to each other. Diversification avoids part of the risk of distributing capital among diverse activities.

Diversification is the most justifiable and relatively less costly way to reduce the degree of investment risk. Diversification can be considered as scattering of investment risk. However, it can not reduce the investment risk to zero.

External factors relate to the entire financial market, that is, they affect the financial activity of all investment institutions, banks, financial companies, and not individual entrepreneurs.

The limitation involves setting a limit, that is, the marginal costs amounts, sales, loan to reduce the size of the loss. `For such activities and business operations that can constantly go beyond the limits of permissible risk, this risk is limited by establishing appropriate economic and financial standards.

The most important and widespread use of risk reduction is risk insurance, since the most serious risks are insured by external insurance. The essence of insurance is expressed in the fact that the investor is ready to give up a part of his income in order to avoid the risk, that is, he is ready to pay for the reduction of the risk to a minimum.

Hedging is a method of reducing the risk of transferring risks to a particular category of participants in the financial market in order to ensure the independence of the company's cash flows from non-core business risks.

Preparation and certification of specialists involves the training of highly skilled specialists in various fields of economy that would possess not only economic and mathematical methods of economic analysis, but also expert risk assessment systems, able to synthesize all available information, and also use system analysis methods. This method takes into account the human factor that provides the ability to manage redistribution and reduce investment risks.

That is why effective management of investment risks is a dynamic feedback process, in which decisions made require periodic review and analysis. Investor must periodically monitor new problems, because in the process of investing and changing the information contour, the problems also change, which leads to the adoption of entirely other management decisions.

Conclusion

Therefore, the widespread use of various forms of prevention and insurance of investment risks makes it possible to significantly reduce the size of possible economic losses in an unstable economy and frequent changes in market conditions. The risk is difficult to neutralize completely, but it can be managed. It is necessary to evaluate, calculate, describe, plan measures in advance, which should reduce the probability of unwanted events during the implementation of the investment project. Such a complex of measures is the content of risk management. It allows you to prepare for unwanted events and reduce losses from them. It is impossible to completely protect against risk.

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State Financial Support of Agricultural Products Producers

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Abstract –The problems of the state financial support of agro-food production in Ukraine are considered. Problems of credit provision of the agrarian sector of the economy are the lack of credit resources to ensure expanded reproduction, high cost of bank loans; complexity of procedures for obtaining loans; the impossibility of provision of land for agricultural purposes. It is necessary to improve the directions and mechanisms of state financial support for agricultural producers.

Keywords: state support, state regulation, financing, credit support

I. Introduction

The agrarian sector of Ukraine has a strong potential for development on a global scale, but the availability of potential does not mean its automatic realization, and aggravation of crisis phenomena in the industry requires the development of an effective agrarian policy based on the mechanism of effective state support of the industry.

II. Main Results

Agriculture in modern conditions is one of the most important sectors of the national economy. Due to the high sensitivity to the various negative factors of instability, agriculture needs state support. Its effective implementation helps to accelerate the growth of agricultural production and increase the competitiveness of the industry [3]. State support of agricultural production in Ukraine should be aimed at ensuring the profitability of production at such level, in order to ensure enhanced reproduction, creation of favorable social living conditions of rural residents and improvement of their families' well-being, formation of preconditions for the preservation and integrated development of rural territories, satisfaction of the needs of the population of Ukraine in quality and affordable food, expansion of export potential of the country.

The problems of development of state regulation and financing of the agrarian sector were investigated by the national scientists T.M. Ostashko, O.M. Mogylnyj, B.I. Paskhaver, I.V.Cobut and others. In their studies, considerable attention was paid to the assessment of the effectiveness of the policy of state support and its impact on the development of the agroindustrial complex of Ukraine.

One of the key issues that needs a fundamental solution at this time is the question of the appropriateness and mechanisms of state support to agricultural producers.

Today, most experts share the view that state support to agriculture, in the form in which it was provided in the Soviet and early post-Soviet times, was ineffective. However, the experience of developed countries and Ukraine's own experience since the launch of market-based mechanisms in the field of agriculture have shown that support for agricultural producers should become an indispensable element of public policy in the agricultural sector and in rural development. However, it is necessary to re-form the principles and mechanisms for its delivery, such that they would correspond to the laws of functioning of the market economy and the current conditions of development of the world market

The current state financial policy on the regulation of the rate of development of agro-industrial production does not ensure proper access of agricultural producers to the market of financial resources, formation of a favorable institutional environment and equalization of economic conditions.

The main problems of lending to the agrarian sector of the economy are the lack of credit resources to ensure expanded reproduction, high cost of bank loans; complexity of procedures for obtaining loans; impossibility of granting on a mortgage agricultural land plots or lease rights on them; absence of a guarantee mechanism in attracting credits.

Problems in the field of lending are due to the underdevelopment of the infrastructure of the agrarian credit market and the low level of creditworthiness of agricultural producers. The inability to attract loans secured by land for agricultural purposes or lease rights to them causes an increase in the deficit of working capital and capital investments in agricultural production.

The current land legislation of Ukraine practically does not contain legal norms aimed at ensuring the circulation of the right to lease land for agricultural purposes. The possibility of pledging land plots and rights to them directly depends on the possibility of their circulation. Therefore, because the legislation does not provide tenants with agricultural land the right to alienate the right to lease land on the basis of civil contracts – sales, mines, donations, etc., they have no right to use the right to lease farmland as collateral for obtaining loans at banks.

Under current conditions, the right of lease of land for agricultural purposes is carried out secretly – by alienating the corporate rights of tenant farms in such areas or by replacing the party (tenant) in the land lease contract, which renders the rental rights market opaque and unattractive for the bank sector.

Ukrainian banks are skeptical about the possibility of granting loans to agricultural enterprises under the bail of the right to lease farmland because of the low liquidity of this right and the lack of practice of its appraisal. The National Bank of Ukraine (Decree of June 30, 2016, No. 351) does not consider the right to lease land an acceptable guarantee of the return of loans provided by banks and does not even determine the coefficient of liquidity of the right to lease land. In the short-term prospect, the right to lease land will not be used as a pledge to obtain bank loans. Improbably that it will be

used as collateral, and in the long run, because the right to lease land is depreciated in proportion to the reduction of the term of the lease of land that is constantly expiring, and after the moratorium ceases to be practically lost its value. Therefore, the use of the right to lease as a pledge has no prospects.

The current state financial policy on the regulation of the rate of development of agricultural production does not ensure proper access of agricultural producers to the market of financial resources, formation of a favorable institutional environment and equalization of economic conditions due to the low level of knowledge of peasants about the possibility of receiving state assistance, a complex procedural mechanism and the lack of transparency of its receipt [1, P.37].

For 33.6 thousand farms, which are calculated of November 1, 2016, the law of Ukraine "On the State Budget of Ukraine for 2017", according to the budget program "Granting loans to farms", provided budget allocations in the amount of 65 million UAH, of which: 25 million UAH – at the expense of the general fund, 40 million UAH at the expense of a special fund [2]. It is obvious that the level of provision of credit resources of farms remains unsatisfactory.

Regarding direct financial support, in the budget of 2017, the state program "Financial support for measures in the agro-industrial complex" provided for a direct budget subsidy for the development of agricultural producers and stimulation of agricultural production in the amount of 4 billion UAH on a number of directions of the agrarian sector, in particular on animal husbandry, milk production, horticulture, viticulture, vegetable growing, berry growing, etc. This program was adopted to replace the VAT exempted on request of the International Monetary Fund.

January 01, 2017 is excluded from the Tax Code of Ukraine Art. 209 (special regime for VAT for agricultural producers). According to the amendments to the Law of Ukraine "On State Support to Agriculture of Ukraine" for the development of agricultural producers and the stimulation of agricultural production for agrarians whose main activity is the supply of agricultural goods produced by them on their own or leased fixed assets, a budget subsidy will be provided.

It is important to note that all these commodity positions do not have a significant share of exports. Therefore, it was for them that the tax and agrarian committees of the Supreme Council of Ukraine, the Ministry of Finance and the Ministry of Agrarian Policy and Food, with the participation of profile associations of commodity producers, developed and agreed upon the mechanism of direct budget support, which is being implemented in this program. Moreover, these are the most labor-intensive fields of production in the agro-industrial complex, they provide the largest number of jobs and provide employment for the population.

The developed mechanism will work in "automatic mode", which, of course, is very important. It will allow direct budget support to each producer of the indicated products for the next calendar month after submission of the tax return, indicating the actual amounts of VAT paid to the budget. After that, without tax verification, the automatic transfer of the amount of budget support for the actual paid amounts of VAT to the budget for the sale of this product will be carried out.

To receive state subsidies, agricultural enterprises must be entered in the Register of recipients of the budget subsidy (hereinafter referred to as the Register) in accordance with the Law of Ukraine "On State Support to Agriculture in Ukraine". To do this, they will need to submit an application to the controlling authority at the place of their registration for inclusion in the Register.

In addition to UAH 4 billion under this program, the Ministry of Agrarian Policy and Food of Ukraine allocated about UAH 2-2.3 billion, including cash for cattle (UAH 500 million), support in obtaining financing in the banking system, and the creation of a Guarantee Fund loans (UAH 300 million and UAH 700 million respectively), in support of domestic agricultural machinery (UAH 500 million). In the field of plant growing, oilseed processing, the VAT refund regime for exports is maintained, which will amount to about UAH 28-30 billion in 2017.

However, it is worth noting that the amount is insufficient to ensure an increase in production in the agroindustrial complex, which is much higher than in the previous two years and will help to eliminate the negative downward trends that have already developed in the entire sectors.

Conclusion

Improvement of the directions and mechanisms of state financial support should include the allocation of available budget support resources in accordance with the main strategic objectives of the industry in the following areas:

–formation of market infrastructure and stimulation of demand for agricultural products;

– direct budget payments to commodity producers in the order and in amounts that do not contradict the commitments made to the WTO;

– provision of development of rural areas, preservation of the environment.

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Factors of functioning and development of information technologies in the national economy

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Abstract − The development of the IT industry in Ukraine today is one of the most important prerequisites for the integration of the state into the European and world civilized community. With a sufficiently rich heritage of highly skilled scientists and engineers, Ukraine has managed to achieve good indicators of the level of development of the IT industry. The result of the study was a dynamic analysis of the level of development and the growth potential of Ukrainian society's informatization in international.

Keywords − national economy; types of economic activity; Information Technology; IT market; IT industry.

I. Introduction

The purpose of the study is to analyze and systematize the data of the State Statistics Service of Ukraine, statistical data collected from the initiatives of IT clusters of Ukraine, dynamics of development indices (according to the World Economic Forum). Based on the data obtained, make certain conclusions about the preconditions and prospects of growth of the IT market of Ukraine, as well as outline the existing problems.

II. Presenting main material

For many objective and subjective reasons, the analysis of which is not the purpose of the proposed study and is, apparently, extremely complex, Ukraine has continued to lose its position in world developmental rankings in recent years. Thus, after analyzing the data of the World Economic Forum for 2011-2015 (see Table 1), we can conclude that Ukraine can not rise to the first hundred of the rated countries (only 133-124 countries in the world in different years submit data for rating). A large number of significant indicators from the survey perspective remain in the downward trend (see Table 1).

TABLE 1

UKRAINE'S RATING IN SOME AREAS (ACCORDING TO THE GLOBAL COMPETITIVENESS REPORT [1 − 5])

Years	2011	2012	2013	2014	2015
Global Competitiveness Index	73	84	76	79	85
1 st pillar: Institutions	132	137	130	130	129
1.02 Intellectual property protection	120	133	129	120	125
1.21 Strength of investor protection	141	100	105	95	79
2nd pillar: Infrastructure	65	68	68	69	75
3rd pillar: Macroeconomic environment	90	107	105	134	128
3.03 Inflation, annual %	107	1	75	134	136

Years	2011	2012	2013	2014	2015
8th pillar: Financial market development	114	117	107	121	130
8.01 Availability of financial services	113	109	102	101	112
8.06 Soundness of banks	142	143	138	140	138
Rank out of	144	148	144	140	138

So Ukraine, having ranked 72 in the Global Competitiveness Index from 134 indexed countries, already in 2015 lowered its performance and ranked only 85th among 138 countries. In the category "Institutions" during the same years, Ukraine's position moved from 115 to 129.

The same situation is observed with the 3rd pillar index Macroeconomic environment: Ukraine moved from 134 positions (out of 141) to 91 positions in 2011, and slightly improved its performance in 2015 (128 out of 138).

Significantly better, although far from desirable, is the situation with regard to indicators related to education (see Table 2)

TABLE 2

UKRAINE'S RATING IN SOME AREAS (ACCORDING TO THE GLOBAL COMPETITIVENESS REPORT [1 − 5])

	2011	2012	2013	2014	2015
4th pillar: Health and primary education	62	62	43	45	54
4.09 Quality of primary education .	44	37	40	45	51
4.10 Primary education enrollment, net % *	90	94	31	33	57
5th pillar: Higher education and training	47	43	40	34	33
5.01 Secondary education enrollment, gross % *	49	54	41	39	53
5.02 Tertiary education enrollment, gross % *	10	10	13	14	11
5.03 Quality of the education system .	70	79	72	54	56
5.04 Quality of math and science education	34	28	30	38	27
5.05 Quality of management schools	117	115	88	87	93
5.06 Internet access in schools	62	70	67	44	35
5.07 Availability of research and training services	98	92	84	78	77
5.08 Extent of staff training	106	103	92	74	94
Rank out of	144	148	144	140	138

Ukraine's highest rating for 2015 has risen, ranking 11th, compared to all others, with only a percentage of tertiary education enrollment. The relatively high position (27th position), with a tendency for improvement (34th position in 2011), Ukraine is ranked Quality of mathematical and science education. However, in general,

the quality of the educational system, with a tendency to improve (70 and 56 positions in 2011 and 2015, respectively), is at a rather low level. It's hard to imagine that in the center of Europe there is a country in which schools of Internet access in schools are worse than in 34 countries of the world. True, in 2012 Internet access to schools was the best in 69 countries.

Thus, for many years the level of education of Ukrainian citizens has significantly outpaced the level of economic development of the state. This, according to the authors, has become one of the most important factors in the rapid development of the branch of economy that was able to develop, being at least dependent on the economic and political situation; level of corruption, inefficiency of management, problems of tax regulation, etc.

That is why, according to the authors, the development of the IT market began in Ukraine with outsourcing. And in a few years, some IT outsourcing companies based in Ukraine have grown to technological giants with offices around the world. Among these companies are Ciklum, DataArt, Infopulse, Lohika, Miratech, SoftServe. An example of rapid growth is AOG – a service IT company from Cherkassy, which attracted about 5,000 freelance engineers in less than three years of operation. Over the past 15 years, overseas outsourcing companies such as EPAM, GlobalLogic, Luxoft have created several offices in Ukraine that are now at the positions of the main R & D hubs (centers) for these global IT service providers. All outsourcing companies employs more than 50,000 engineers (about 60% of all engineers) living in Ukraine [6].

Experience in outsourcing has become the basis for start of rapid startup development in Ukraine. Between these internationally-oriented startups are BPMOnline, DepositPhotos, Grammarly, InvisibleCRM, Jooble, Looksery (Snapchat in September 2015), MacPaw, Paymentwall, Readdle, Starwind Software, and others. Some of them, such as Paywall and Grammarly, have grown into global companies, leaving their main R & D offices in Ukraine, that is, in their country of creation. The range of international funds in Ukraine includes, but is not limited to, corporations such as Almaz Capital, the EBRD, Intel Capital, Horizon Capital, Naspers, and local players such as AVentures Capital and TA Ventures [7]. Beginning its activities solely outsourcing, by 2015, the share of companies engaged in product development has grown to 28.5%, and companies – start up more than 4.5%.

An important factor in the growth of the IT industry in Ukraine is the breadth of localization of enterprises. Although 86% of all programmers work in one of five cities:

Kyiv, Kharkiv, Lviv, Dnipro and Odessa, however, all regions are covered in essence. High growth rates are demonstrated by Kyiv (more than half of all programmers) and Lviv. Distribution of employees by region is reported by [16] as of 2015.

Conclusion

The preconditions for growth of the IT industry are: high level of primary, secondary and higher education; the restoration of a high level of natural and mathematical training of specialists; stimulating tax policy; development of state and non-state research centers; wide introduction of information technologies in the public sector.

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Mobilization function of The ukrainian-polish migration system: local measurement

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Abstract – The modern development of border areas of Ukraine is characterized by a number of features, which is connected with historical, geo-cultural, socio-economic factors of the organization of social life of their inhabitants. In the western regions, which are geographically close to the border with the EU, the European integration policy of the Ukrainian state has an additional effect on the mobilization of labor migration. High migration mobility of the population is not only a reaction of the regional community to higher European social standards. It is institutionalized and overgrows with its own norms, rules, statuses of economic activity of the population. It becomes a source of new needs and ways to meet them. A cross-border lifestyle, together with the infrastructure that serves the migration mobility of the population, leads to the emergence of interstate territorial migration systems (TMS) − regional or cross-border labor markets, driven by additional agreements and contracts. Benefiting direct service users, these systems fulfill the mobilization function of developing both a traditional and a network economy. The emergence of new TMS functions requires detailed analysis. This can be traced also in terms of Sokal district in Lviv region.

Key words – migration, migration mobility of the population, territorial migration system, regional labor market.

I. Introduction

The basic feature of the current migration mobility of the population is that this process is institutionalized, evolving from a simple social movement into a structured social organism, and later − into a subject and a tool for regulating human economic activities. The potential of labor migration, which is gradually accumulating within the framework of the functioning of migration movements of the population, can "work" both in the forward and reverse mode. This is facilitated by institutionalized subjects of migration relations that interact with each other, build internal relations, find common interests, "produce" their own goals and objectives, "develop" the principles and forms of the organization of their activities and perform certain functions. They can lobby for the solution of migration problems (for example, the Law of Ukraine "On Foreign Labor Migration" of November 5,

2015, №761-VIII). Practically institutionalized subjects of migration become primary elements of *territorial migration systems (TMS)* [11].

In the special literature, TMS studies are conducted on the basis of various scientific and methodological approaches. It is well-known that they are interpreted as a *certain common space* in which countries of departure and destination are connected through migration (a "complex" migration theory) or as a *set of links of the migration sphere* at a certain level of the organization and development of relations of the population migration activity (different types), that is, as main elements in the overall network of higher-ranking systems, taking into account their forms of organization, functions, system-forming features (a legal status), and others. The position of Douglas Massey (USA), who in the framework of the "synthetic" migration theory (the end of the 20th century), conceptually approached migration as an ensemble of entrepreneurs, enterprises and services, that being motivated by aspirations for financial gain, facilitate and support international migration, deserves special attention [1]. He led the essence of the concept of TMS to regional labor markets, marked by the operation of additional agreements and contracts. The scientist from Switzerland Paolo Ruspini, having used a number of theories, namely, the theory of regional specialization and international trade (A. Smith, D. Ricardo), the theory of central places (W. Christaller), the ideas of spatial organization of the economy (A. Lösch), the generalization of regionalists (W. Isard, T. Rainer), the neoclassical approach (P. Samuelson, S. Enke), offered theoretical foundations of the organization of the European TMS [2].

In the *economy*, an institutional theory is a good foundation for the study of *TMS* that provides both macroeconomic and regional (local) analysis of transactional migration costs (indicating that the growth horizons of such systems will take place until the costs of their internal management exceed the cost of market transactions). The theory of a regional economy makes it possible to organize the internal structure of TMS, to determine its supporting framework (a set of places of concentration and localization of self-organized communities of migrants, their centers of organization, especially large and medium settlements, along with lines of communication between them), to distinguish the main spatial forms of the latter one. The TMS support frame acts as a combination of all its constituent parts (an integration function into a holistic system).

In Ukraine, which, according to the number of emigrants is among the first countries of the world, the TMS research has substantive content both at national and regional levels. The analysis of the state and factors of the formation and development of TMS at the local level as well, in particular, of cross-border nature could be significant and at the same time relevant in terms of the administrative-territorial reform in the state. Take, for example, the TMS of Sokal District of Lviv region (Ukraine) and Hrubieszów powiat (Hrubyshiv Disrtict) of Lublin województwo (Lublin province) (Poland) (Fig. 1).
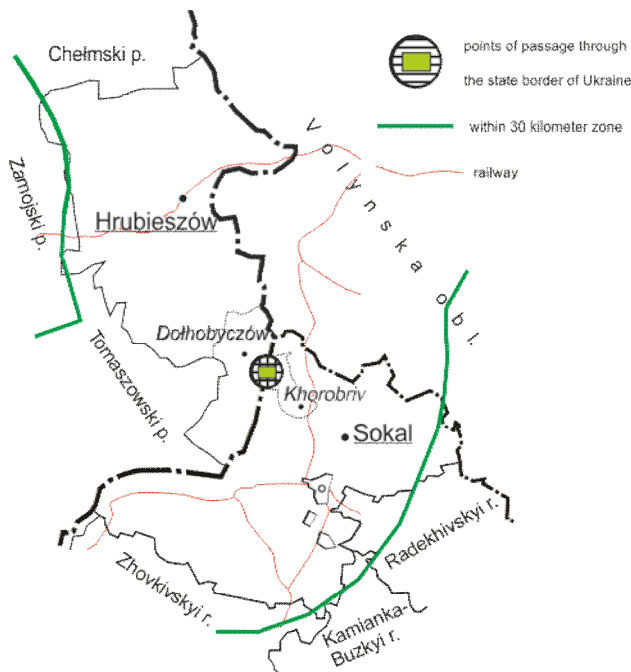
Fig. 1 Local territorial migration system (TMS):
Gmina Dołhobyczów (Poland) – Khorobriv village council
(Ukraine) [12, 13]

The study showed that both local social systems (regions) are rather large according to demographic parameters: Ukraine (district) accounts for 93 thousand inhabitants, while Poland (powiat) − 69 thousand people. The area of Sokal district is 1,573 km², and of Hrubieszów powiat −1,268 km². The level of the territory urbanization is respectively 36.3% and 26.7%. The sexual structure of the population is approximately the same – 52.5% in Ukraine and 50.9% in Poland. The economic parameters of these social systems demonstrate socio-economic and geospatial distortions. So, in Hrubieszów powiat the working population is 107 persons per 1,000 inhabitants, more than half of them (56.7%) are women. The officially registered unemployment rate is 16.1%. The industrial specialization is agricultural, although the light industry is developing [7, 9, 10]. In Sokal district, according to the authors' special survey, the employment of the economically active population in the formal sector of the economy is only 24.7%, the registered unemployment rate is 1.2%, the share of economically inactive population is 34.4%, while the share of the employed and the unemployed in the informal sector of the economy is 39.7% [3]. The area's specialization is coal mining, agriculture, light industry, abrasive materials production, woodworking and furniture production. The reduction in the places of labor application, which took place in previous years, resulted in a clear orientation of the Ukrainian population for the employment in Poland (mainly in construction, trade, agriculture). The motivational component is the following – the average monthly wage of one full-time employee in Sokal region is 6,004 UAH. (in 2016, the 9th place among the cities and districts of Lviv region). The average monthly wage of a regular employee in Hrubieszów powiat is 3,426 zlotys (25,065 UAH).

The situation described to a certain extent explains the conditions for "incorporating" the mobilization function of the Ukrainian-Polish TMS into work. The results of the retrospective analysis of the conditions of the formation and development of this system should be added to the above mentioned information. The fact that the territories located along the state Ukrainian-Polish border are traditionally characterized by a significantly lower living standard than those located far from the periphery. The analysis of indicators in dynamics shows that this situation in recent decades has provoked constant emigration of the population. Thus, based on the calculation of the synthetic indicator of living standards, it was established that, from the Ukrainian side, even at the time of the economic crisis (in 1998, when external centers of migration attraction of the labor force were losing their activity), the emigration of the labor force continued to correlate with indicators of the level of urbanization, the unemployment rate and the number of economic entities. At the same time, the situation changed quite a lot in the next years. Initially, Poland's accession to the EU became a factor in the change (2004). The next step was to simplify the rules of crossing the border (including the "Agreement between the Cabinet of Ministers of Ukraine and the Government of the Republic of Poland on the rules of the local border traffic of 02/25/2009" and "Simplification of the employment in the territory of Poland for citizens of Ukraine of June 11, 2017"). The number of Ukrainians who have been employed in Poland since the change in legislation is increasing [8]. There are special centers for servicing migration needs, the infrastructure of migration services of the local Ukrainian-Polish TMS is developing.

In general, the retrospective analysis of the mobilization function of the Ukrainian-Polish TMS made it possible to indicate the following features of its manifestation.

The natural environment on both sides of the border, caused by climatic conditions, surface relief, botanical features of the soil and forests, not only affects the functioning and productivity of agriculture and the network of settlements, but also acts as an attractive niche of the mobilization function of TMS. Tourist, natural areas with national and landscape parks have the potential of economic activation, provided being included in tourist offers as tourist products.

The low population density (in particular in the border zone – the powiat or the border district), in comparison with general indicators of the demographic location and population reproduction in distant areas, plays a twofold role: on the one hand, it indicates that the emigration potential is exhausted, on the other hand – it mobilizes its remnants to migration.

The level of economic activity of the population within TMS is a key factor in the transformation of Ukrainian-Polish migration socio-labor relations. The mobilization function of migration in this system works to deepen the internal specialization of the system of production and

labor division. The TMS promotes the development of the institutional architecture of TMS (forming specific horizontal and vertical social networks that have their own capital (communitarian and non- communitarian, active and inactive, material and non- material), their own institutional, socio-economic, financial infrastructure, which is determined by general principles of system organization. The mobilization function of TMS has an impact on the development of other systems of the public environment.

The implementation of the mobilization function of TMS requires monitoring of the migration situation at the Ukrainian-Polish border. For its formation, the ***author technique*** is offered, which provides the following steps: the typization of settlements by key features, criteria that characterize the presence, volumes of migration movements and their effectiveness (the identification of donor settlements and recipient settlements by the balance of migration); the characterization of the territorial structure of migration flows on the basis of building of the matrix of coefficients of migration potential distribution and the migration attractiveness of settlements; assessment and analysis of the uniform distribution of migration flows based on the calculation of localization coefficients and territorial concentration of the migration activity of the population of settlements; definition of an information base for the calculation of the efficiency of TMS processes.

Conclusions

The territorial migration system, which is currently being formed and is developing at the Ukrainian-Polish border, is overgrowing with its own infrastructure network and is also actively institutionalized. It performs the mobilization function of the population labor migration. From the Ukrainian borderland, factors influencing the action of this function are the following ones: economic (low living standards, unsatisfactory social and living conditions, rising cost of living, etc.), ecological (forced relocation from depressive coal mining zones), socio-demographic (high migration mobility of young people), social-professional (a loss of motivation to high-productivity work, a limited professional career, etc.). All these socio-economic and demographic processes negatively affect the study area sustainability. In the current situation, TMS is a kind of platform for the emigration of the local population first within the framework of this system (turning migration), and then beyond its borders (non- turning migration). The tendency growth of the migration scale is not just of interstate nature, but becomes a typical phenomenon for the socio-economic life of TMS inhabitants. The mobilization function of TMS works to establish the selective nature of the labor migration of the TMS population (a phenomenon caused by legal and other institutional barriers of countries with different levels of economic development, as well as new schemes for international movement (redistribution) of workforce). This function should be monitored in the security interests of national states (this refers to the growth of the educational and

qualification level of labor emigrants of the border area, as a result of learning new science and technology, the spread of the fashion for a second education among young people, moreover, of such that is financed from the budgets of parent-migrant workers; spontaneous illegal migration, which is the result of insufficient desire of government structures to go against monopolies and entrepreneurs rather than imperfect migration policy).

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Local government websites: making citizens be customers

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Abstract – In this article we will discuss the way electronic communication between local authorities and citizens influences on level of trust and quality of public services.

Keywords – local authorities, governmet, electronic communication, citizens, public services, electronic participation, website.

I. Introduction

Prerequisite for the successful functioning of the political system of any society is the political trust of citizens as one of the essential factors for the existence of democracy. Trust connects ordinary citizens with political institutions, raising both legitimacy, and the effectiveness of these institutions.

Governments are realising that achievement of this goal requires applying the same principles and technologies that are fuelling the e-business revolution [1, 2]. They have recognised the need to change the way they do provide services and information centred on the citizen. The result: the emergence of big city's functional websites with better quality and more accessible public services.

II. The measures to create and develop services to support broader electronic participation

The Ukrainian government is working on a system of informational communication with citizens. Yes, the National Program for Informatization was adopted, the Presidential Decree "On measures for the development of the national component of the global Internet information network and security wide access to this network in Ukraine", the project "Electronic Government of Ukraine" was developed, issued Decree of the Cabinet of Ministers "On the order of announcement in the Internet of information about activity of executive bodies".

On the Internet there are more and more sites of state bodies, party structures, numerical ones international and non-governmental organizations that contain a wealth of information that dramatically increases political awareness of citizens [3].

Today, almost all ministries and departments have their own websites, and there is a web presence became a mandatory requirement of the government to its structures. However, much of the official sites created primarily, formally, as a one-off event. It is needed to improve the quality of web sites.

Let's name some problems which, according to the definition of the International Renaissance Foundation, interfere development of e-governance and e-democracy in Ukraine:

1. Introduction of e-government technologies requires modernization, first of all, of the system public administration, effective administrative reform;

2. Incomplete procedures for the provision and receipt of administrative services through use information and communication technologies (ICT);

3. Lack of typical approaches and standard requirements for implementation of e-governance technologies;

4. The slowness of the establishment of e-democracy (the ability of everyone through ICT to take part in formation and implementation of state and local politics);

5. Lack of effective interaction between the executive authorities, local self-government bodies and non-governmental non-governmental organizations necessary for the development and implementation of specific plans with introduction of e-governance technologies;

6. Low level of awareness, motivation and training of civil servants and representatives non-governmental organizations, businesses and the public e-government technologies.

One of the main challenges underlying different Electronic Government forms is the provision of a quality public service. In the Local Government context, local authorities allow for an adjustment between the characteristics of public services and the specificities of local communities, letting populations define their own priorities, which vary from community to community based on objective elements but also subjective by nature. The quality of these services in their electronic format should be analyzed and taken into account to potentiate and elaborate a strategy capable of improving offered services, increasing the satisfaction of the recipient.

At the same time as people from big cities of Ukraine have already felt the benefits of providing services by government websites and have a role in making government decisions (fig. 1), the situation with the towns where population is less than 10,000 is different.
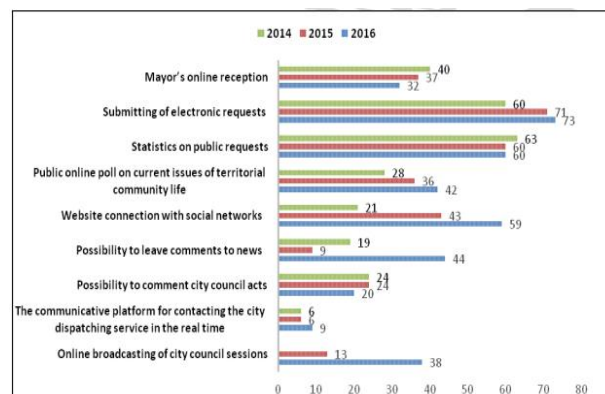
Fig. 1. The dynamics of using the feedback tools on the local government websites in 2014 – 2016

Little town's sites themselves, for the most part, perform representative and informational functions. Their

design resembles advertising. Their typical blocks are: history; management structure, news from the organization's life; an official press release, announcements of the organization of events; archive of documents.

Site and application will allow sending feedback about the situation in the town, selecting a problem area and send it for consideration and see the situation with the issues. The advantage of such a project is a simple way of communicating residents with the authorities, a sense of attraction to changes in the city, as well as the impact on the work of carriers. For the city council, this project will provide convenient visualized service, expanded statistics and rapid communication with the inhabitants.

Sure, for any local e-government project to be successful there needs to be some degree of e-participation and community development.

E-participation and citizen's feedback on the service delivery issues is beneficiary for local authorities' perception of their own activities and the use of the internet for citizen input to policy consultation and debate [4].

Summarized, local authorities should consider the following in their efforts to establish and develop services to support wider e-participation:

1) Produce a policy document for internal dissemination and use, setting out a clear best practice process for the conduct of all e-participation activities.

2) Draft a set of privacy guidelines to be read by all citizens before taking part in eparticipation activity.

3) Produce a marketing strategy that explicitly addresses the issue of how e-participation opportunities are to be brought to the citizen's attention [6, 8].

Local e-government is a way of vision at the local level, at the point where the vast majority of services are delivered. It gives citizens the opportunity to electronically make their views known. And at the same time, the internet allows the public sector to extend its role as a client-oriented service provider.

Conclusion

Functional web-sites are not a panacea to solve all local governance problems, but they have the potential for cost savings, streamlined processes and improved management information. Futhermore, it really helps government to understand the various public needs and opinions, giving them a great role making local governance decisions.

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Modern Terrorism: Consequences And Solutions

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Abstract – International terrorism has become one of the major threat to the humanity. Sharing this opinion I have made research dedicated to this topic as a step forward to develop tools of resistance to this threat.

Keywords – international relations, modern terrorism, global challenges, peacemaking, economic prosperity, social and economic freedom, human rights.

I. Introduction

Research of terrorism is not an easy task for the common researcher because this phenomenon combines different aspects of human experience in such areas as politics, economy, history, psychology, civil security, human rights, military strategy and even philosophy. Researchers Schmid and Jongman noted once that 90 percent of the literature on terrorism had been written since 1969. After 9/11 this phenomenon becomes even more «popular». In the introduction, I want to mention that terrorism has been changed during the years since its emergence. My research is dedicated to the transformation of terrorism to its modernity and solutions which may be taken into account while dealing with modern terrorism.

II. Purpose of the article

The key purposes of the article are the research of the modern terrorism in its core, define reasons and background on international terrorism and provide solutions, which might be applied by the national governments or international organizations to decrease the risk of terrorism worldwide.

III. Research results

Terrorism, as a social phenomenon, is familiar to the society of the civilized world everywhere and is associated with terrorist attacks, the Middle East, Muslims and terrorist organizations, for example, Hezbollah or Al-Qaeda. In the last 30 years, this phenomenon has become so significant that it is placed in the top five challenges of humanity, peace and security in the world. From 1970 to 2014, there were 141,966 terrorist incidents worldwide. Just over 23,000 occurred in North America and Europe. In 2014 alone, 13,463 terrorist attacks occurred around the world, causing at least 32,700 deaths and more than 34,700 injuries [1].

«Terrorism» the term of the everyday life are widely known through the news in the TV or newspaper articles. Nevertheless, the term is interpreted in different ways because of the numerous approaches and the spectrum of appearances during its history. By the opinion of Brian Jenkins, an expert in international terrorism, terrorism is the use or threatened use of force designed to bring about political change. As we may see, terrorism is about changing the political system in a violent way by the Brian Jenkins. Quite close opinion made by Walter Laqueur, who define terrorism as the illegitimate use of force to achieve a political objective. Both definitions tend to the origin reasons for terrorism. A lot of people who was claimed as a terrorist in the past became national heroes in the countries they were fighting for many years ago. Modern terrorism is different. Terrorism is the unlawful use of force or violence against person or property to intimidate or coerce on government, the civilian population, or any segment thereof, in furtherance of political or social objectives by the FBI approach. Official definition provided by US Department of Defence looks at the terrorism as the unlawful use of, or threatened use of force or violence against individuals or property to coerce and intimidate government or societies, often to achieve political, religious or ideological objectives. My own opinion is very close to the definition of C. J. M. Drake, terrorism is defined as the recurrent use or threatened use of politically motivated and clandestinely organized violence, by a group whose aim is to influence a psychological target in order to make it behave in a way which the group desires.

I want to add, that "politically motivated" in my opinion means not only fighting for the independence or change the government approaches, but based on the foreign policy of countries, geopolitics or policy of local governments, transnational corporations and international organizations. Majority of terrorist attacks of the last five years does not follow purposes related to achieving independence and changing own government policies. Terrorist organizations now have their own offices, representatives, negotiators, connections in the governments and politicians.

Despite terrorism are politically motivated, it has basic reasons which are the force and source of terrorism around the globe. Here are most relevant due to the research done:

1. Social and political injustice. People get offended and hurt by the injustice system that they choose to resort to acts of violence in order to protest the ongoing injustice. Groups of people apply terrorism methods when they are trying to right what they perceive to be a social, political or historical wrong – when they have been stripped of their land or rights. For instance, the Irish Republican Army (IRA) bombed English target in the 1980s to make the point they felt their land was colonised by the British empire.

2. The belief that violence or its threat will be effective. It is the belief that violence at the beginning will turns in the justice in the end. Many terrorists in history said sincerely that they choose violence after long deliberation because they felt they had no choice.

3. Illiteracy. Lack of education amongst the people has been put forward as a prime reason for terrorism. Uneducated person are easy to be persuaded to

commit the crime because they have no high ability of thinking. Many terrorists believe crazy things, they are more likely to do crazy things.

4. Instrument in geopolitics applied by the governments. Application of armed forces as terrorists to achieve geopolitical goals and tasks in cases, where application of "official" armed forces are impossible or inappropriate. In 21st century terrorism are widely used by governments as a tool to support of implementation of own policy abroad in the violent way. For instance, Donetsk people republic and Luhansk people republic in Ukraine created by Russian government using forces which can be defined as terrorists by the international law. Managed through Federal Security Service of Russian Federation and Chief Directorate of Intelligence of the Ministry of defense of Russian Federation their task is to create tools of influence to the independent state in international decision making by the Ukrainian government (i.e. EU integrations, joining to NATO etc.). Other cases: terrorist funded by the king of Quatar to save influence in the Israel, ISIS is also a tool to shape the policy in the Middle East and, might be, set up the influence onto the Iran or Israel.

5. The accidental guerrilla [2]. There is the theory developed by David Kilcullen which relies on the explanation that weakly governed areas are tend to support terrorists as their "protectors", who in fact are the reason of violence on the streets. Here is example by David Kilcullen. Kilcullen describes it as such: A terrorist organization moves into an area with poor government or that is conflict ridden (he uses Al Qaeda specifically), then uses this safe haven to spread their ideologies to other areas and as a base to carry out violent acts. When outside forces then intervene to deal with the threat posed to them by this group, this causes the local population to reject the 'foreign invaders' and ally with the terrorist group, thus creating more terrorists and popular support for terrorist movements.

6. Socioeconomic [3]. Different forms of deprivation may drive people to terrorism. For instance, poverty, lack of education, or lack of political freedom etc. The group Shining Path carried out a years-long campaign of violence against Peru's government in the 1980s and early '90s in an attempt to create a Marxist state.

7. Religious reasons. Perhaps the most commonly held belief today is that terrorism is caused by the religion. Thought it is not the main cause of terrorism, religion does play a significant role in driving some forms of it. Many terrorist get wrong understanding about religion.

Terrorism has its impact on the political, social and economic life of the country or region where it takes place. Here are the directions of the considerable impact of terrorism:

1. Economic impact: loss of life, spending to restore the infrastructures, destruction of business assets, losing workplaces, reduction of business activity and economic growth. Government spending on security are increasing versus spending to innovations, public needs and social purposes.

2. Business environment impact. Dramatic depreciation of assets, real estate, currency, economic instability, even crises (in case country or region are exposed to terrorist attacks during a long time). Business activity are falling, investment climate becomes unacceptable for the investors, who do not invest funds to the country. Trade decrease due to the huge risks. Business falls down around the region.

3. Society impact: create an atmosphere of suspicion, fear and panic all around. Terrorism poses a serious law and order problem and leads to the disintegration of society. The incident of murder, torture, mutilation, kidnapping, arson and extortion create an atmosphere of suspicion, fear and panic all around. Life becomes uncertain. The terrorist kill unnamed civilians including women and children

4. Politic impact. Terrorism makes world politics more complicated and difficult. This is because terrorism may cause important problems even through terrorist groups are not clearly linked to states. The presence of non-states actors who can have a real impact on the world makes world politics more difficult.

5. Demographic/migration impact. People are leaving the country to find safer place to live in, making a flows of refugees to the neighboring countries or other regions.

Terrorism may appear in those states and territories where the stability of the public administration institutions activity or fundamental law of the organization of the habitat of a certain ethnic group is violated, whether a humanitarian catastrophe or a food crisis takes place. This is in general conditions for the emergence of terrorism, which may be taken into consideration while analyzing the appearance of terrorism around the world. However, the causes of such a phenomenon are much deeper and more fundamental. Actually, understanding the causes of terrorism is the key to solving the problem of terrorism. N.Machiavelli has been compared the weakness of state governance with pulmonary tuberculosis. At the beginning, it is very difficult to detect, but it is very easy to cure such kind of illness. When the disease progresses in the body it can be very easily detected and identified, but it is extremely difficult to cure it. I think the same comparison may be provided to terrorism. If we will identify the causes of terrorism and eliminate them, it will prevent terrorist attacks, shootings and social collapse in the territories where conditions for terrorism has emerged.

Modern terrorism has increased dramatically during last decade. That is why governments and international institutions have to focus on this threat and deal with it in a complex. Making a research let me figure out key solutions have to be made in order to reduce the risk of terrorism and eliminate building blocks of terrorism.

There are several solutions for terrorism elimination, and here are they:

1. Education: education is a primary solution to terrorism. The government should educate the people to understand the differences in culture, religion, belief, and human behaviors. All people should think of the peace, freedom and equality of all human beings, not just "their group of people".

2. Redirect funding of international aid programs on education, healthcare and lifting people out of poverty. Solving the problem of access to fresh water and famine cases in extremely poor countries. Support people in different regions from humanitarian collapse are the efficient way to hit the root of terrorism.

3. Promote and support democratic transformations, human rights, rule of law and civil liberties as the keystone for the sustainable societies. For this purpose, support of democracy movements are crucial to start changes in the violent societies. Terrorists thrive best where there are chaos and instability. Nurturing democratic institutions and non-violent civil society are key to thwarting the growth of extremist movements.

4. Setting up a guaranteed penalty for the government and the country which support or has relation to terrorism. The same penalty should be applicable to the stakeholders who discourage and hinder ceasefire, support hostility by funding or provision terrorists. Existence of a guaranteed penalty as a "sanctions pack" for the country and business will prevent support of terrorists in many cases. Sanctions pack have to include political, diplomatic, economic, technological, military, trade, financial and migration components. As much country are involved in international trade, globalization and technology transfer as greater impact "sanctions pack" will provide.

5. Eliminate the root of terrorism by analyzing every particular case: killing terrorists by the government forces is inefficient way to destruct terrorism, behind each terrorist act are some reasons, motivation and techniques of how terrorists recruit new members. Finding out fundamental reasons of terrorism in each particular case are the key to solve the problem.

6. Enhance international information-sharing efforts. Efforts to increase information sharing between countries while improving interagency communication between anti-terrorist institutions and agencies are vital to protecting civilized world from the continued threat of terrorism. One of the central failures leading up to the attempted terrorist attack was the lack of sufficient information sharing between entities [4].

7. Think of the peace, freedom and equality of all human beings, not just "one group of people": The solution is to find out the problem why a terrorist does not feel guilty and why he was forced to be a terrorist. It may be some injustice done to him [5].

8. Monitoring of illegal money flows and international market of illegal weapon trade. If to apply the system approach to terrorist organizations, they have inbound resources and outbound consequences. Key inbound resources are manpower, financial resources, weapon and terrorist-intelligence. In other words, the terrorist organization has to have terrorist under control, finances to buy provision, weapon and own sources of information to know when and how to attack in order to achieve goals of the organization. Monitoring of money flows and weapon trade will help to resist more effectively to terrorism challenges.

Conclusion

International terrorism is a global threat to the peace, prosperity and security of nations around the world. That is why it is a need for governments and international institutions to be more systematic in fighting terrorism and do it step-by-step through analysis deep reasons of it. Monitoring such indicators as GDP p.c., poverty rate, unemployment, inflation, literacy, school attainment, political rights and civil liberties, economic freedom, property rights protection, incidences of conflict or crisis, ethnic or linguistic fractionalization, frozen conflicts among the states, temporal proximity to terrorism, government spending, regime stability will be the guide to societies which are under the risk of terrorism appearance. It will create a time lag option for international institution and government to eliminate roots of terrorism and to set effective policy worldwide to resist modern terrorism.

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The role of mass media in the process of settlement of social problem of people with disabilities in modern Ukrainian society

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Abstract – This article contains the results of research on the role of the media in the process of settlement of social problems of people with disabilities, the results of content analysis of periodicals on this issue, and the importance of social advertising (PSA) in this process.
Keywords – mass media, social problem, people with disabilities, social aspect.

I.   Introduction

The number of social problems in Ukrainian society is constantly increasing. And so, there is a debate in society about who, and how, should be involved in solving and settlement social problems. Various social actors, including the media, are involved in this process. The position, the level of emotional coloration of a material presented to illustrate the social problem in one way or another affects the perception of the mass consciousness of complex social circumstances.

II. Informing the public

The problem of people with disabilities is one of the critical social problems of modern society. Discrimination, prejudice and stereotypes are the negative manifestations of this problem. How media can help in the settlement of this problem? **First of all, it is important in this case to inform the public about the current state of the problem in society,** taking into account not only the medical aspects of the problem of people with disabilities, but also social aspects in the most. After all, often the "conditional" social barriers that establish a society for people with disabilities have the most negative consequences. At times, from the media coverage of the social problem of disability depends on what "conditional" barriers will exist in society in relation to people with this problem, which will be the public's attitude towards people with disabilities.

Content analysis of two periodicals: All-Ukrainian information-analytical weekly newspaper "Dzerkalo tyzhnia. Ukraina" and the Internet newspaper "Vysokyi zamok" for the period from January 1 to April 30, 2017 allowed to receive the following results: in the 16 issues of the weekly newspaper "Dzerkalo tyzhnia. Ukraina" found 8 materials relating to the problem of disability, and half of them, these are minor notes on the problem, while in the regional issues of the newspaper "Vysokyi zamok" found 20 materials that relating to the social problems of disability, it is from 120 issues of the newspaper, and in them only 25% are full articles about the problem.

III. "Degree" discussion of the social problem: the emotional coloring of materials

Second, the media can, through their publications, raise the "degree" of discussing the social problem. The study of emotional coloring of materials published in these issues and touching upon the problems of people with disabilities, has shown: the weekly newspaper "Dzerkalo tyzhnia. Ukraina": 37.5% – materials of positive emotional color, 25% – negative, and 37.5% – neutral; The publication of the newspaper "Vysokyi zamok": 45% positive and 45% negative emotional color and only 10% neutral.

That is to say, an analytical newspaper highlights the social problem of disability using more positively colored materials: certain achievements, victories, the same uses neutral information, and fewer publications, where the problem of disability appears in 'negative tones' (increased mortality, discrimination, tragedy). In the newspaper "Vysokyi zamok" the number of positive and negative information is the same.

IV. Creating Heroes

Thirdly, through the media in the process of settlement of social problems, appear a heroes and anti-heroes. In particular, the key heroes in text-based materials about people with disabilities are: 1) people with disabilities ("Dzerkalo tyzhnia. Ukraina" – 75%, "Vysokyi zamok" – 40%); 2) politicians or representatives of the government, that is, those who take on the role of resolving social problems ("Dzerkalo tyzhnia. Ukraina" – 25%; "Vysokyi zamok" – 55%); 3) "offenders", that is, those who harm these people ("Dzerkalo tyzhnia. Ukraina" – 0; "Vysokyi zamok" – 5%). This difference is explained by the peculiarities of various periodicals and their target audience.

Analytical newspaper "Dzerkalo tyzhnia. Ukraina" is more focused on the social problem itself than on politics or anti-heroes, because there is supplied analytical information about the problem of disability, it is a less emotionally colored. In the regional newspaper "Vysokyi zamok" a large percentage of publications contain information about politicians, who in one way or another try to solve the aspects of the problem in society and thus gain support, commitment of people. Such information is better perceived precisely in the regional newspaper rather than in the all-Ukrainian analytical newspaper, where attention is focused on other issues.

V. Social advertising (PSA)

Fourthly, through the media broadcast social advertising, which is intended to demonstrate the "recipe" of settlement of social problems. Last year there have been two vivid examples in the area of settling the issue of people with disabilities: this video "Disability does not limited. Limits discrimination!", created by the NGO "Generation of Successful Action" within the framework of an information campaign against discrimination, supported

by the International Fund "Renaissance" in partnership with the Ukraine Parliament Commissioner for Human Rights [1], and the social advertising "Life without Barriers", a video taken at the end of a two-year project with Italian and Bukovina partners "Social Rehabilitation and Inclusion of Children and with disabilities"[2].

The main idea of the first video is that it is that discrimination, not physical limitations caused a bigger problem in society. People with disabilities should have equal rights and opportunities in our society.In this video authors tried to draw people's attention to this problem and to change the social attitudes towards people with disabilities.

Another social advertising focuses on the barriers faced by people with disabilities, namely physical isolation, human compassion and bureaucratic indifference, and urge people to overcome these barriers, because in a society, in the state should be respect for a person, and accordingly, to ensure decent living conditions.

Conclusions

Consequently, the media play an important role in the process of settlement of social problems. They can provide up-to-date information on available social issues, can excite an emotional wave of public reaction to these problems, can as create barriers to overcoming problems, as destroy them. With the help of social advertising, the media affect people's minds and thus help of settlement of social problem that exists in society.

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Application of Big Data in Historical Science

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Abstract – The importance of the research is that it presents the usage of Big Data and history. The prospects and the main directions of the usage of the Big Data in historical science were analysed.

Keywords – history, historiography, techniques, Big Data, computing, the Internet.

I. Introduction

The exponential increase of electronic resources that is observed at the beginning of the 21st century opens new prospects for historical science and historiography researches. The Internet global computer network offers a lot of sources for historians: electronic copies of archival documents, scanned historical sources, materials of archaeological and ethnographic expeditions, collections of historical photos. Electronic journals, various scientific articles and books, and virtual conferences are accessible in "cyberspace".

However, the modern Ukrainian historiography lags far behind European and American trends. For example, the usage of the Big Data west methodological toolkit in domestic historical science is an elitist phenomenon.

II. Analysis of research and publications

There are several definitions of "Big Data" term. One of them describes Big Data as a volume of data impossible to process in a traditional way because of its amount. Another one says that it is a phenomenal acceleration of data accumulation and its complication. The third definition claims that it is a set of tools that allows working with data, regardless of its type and amount.

The Cambridge English Dictionary defines it as: «very large sets of data that are produced by people using the internet, and that can only be stored, understood, and used with the help of special tools and methods» [1].

Some methods and techniques of analysis of Big Data historians have already been successfully used in research activities. Practical methods for modeling historical processes are applicated by Russian scientist L. Borodkin. [3]. Approaches of mathematical modeling of long-term social and historical processes, of theoretical history, historical macrosociology, of creation and analysis of historical databases, of studies of social evolution, historical demography are combined by cliodynamics that develops mathematical models "of age" socio-demographic cycles [4]. As research and analytical tools in cliometric studies monitoring information systems are also used. Combining methods of economic theory, the use of quantitative modeling techniques lets describe and explain historical processes and phenomena in the economic development of the society in general and its communities living in certain administrative areas [5,6].

III. The prospects of the usage of Big Data in historical science

In the professional activity of a historian, a special definition of Big Data is used, namely various tools and methods of processing structured and unstructured arrays of information. Big arrays of information collected by a historian are presented in the form of unstructured data, such as text, images, photos.

Big Data provides a possibility of preservation of big arrays of information, allows preserving "all data", without worrying about what part of data is actual for the next analytical activity. To get useful information, you need to carry out processing of big arrays of information.

On the basis of application of Big Data tools and methods in processing structured and unstructured arrays of information, wide possibilities of optimization historical knowledge are being created.

Today, Big Data has the potential to become an important sector of the IT industry. Big Data has been developing for twenty years, and experts claim that it will be difficult to imagine our life without its application. We will see a new era of Big Data soon. History can be efficiently used in this process. The combination of historical science and this modern technology can help us find a new, prospect field of study.

Fig.1 Creation of Big Digital History.

Circle 1: "History" – the main object of the research, it contains a lot of information that should be processed quickly. The main component of the scheme.

Circle 2: "Big Data" – the data processing system that is connected with the first circle. It can process a lot of data for a short period of time. It is also a very important component. It includes large communities, network and modern technologies.

Circle 3: "Big Digital History" – the result of the combination of the first and second circles. It creates a new field of science that needs detailed studying and can be used for processing historical data. Its development will give a good result for the improving of historical science in general and will help preserve a lot of valuable materials.

Human need to take a direct part in this process. Their task is to select information according to the following characteristics: topicality, adequacy and usefulness (the

most important one). Without a human's activity, though insignificant, Big Data in historical science won't be able to develop, and "stagnation" can occur. This approach of Big Data and history will make them more productive. Historian will extract complex knowledge from the smallest crumbs of evidence that history has left behind. Big Data offers a complementary path to knowledge. Hiscorian will start with complicated work but then it would be simpler to work with the material. Big Data will show us more historiograhphy and preserve a lot of value information. That can also help to mend a "split" between them which may get much bigger. But Big Data has some disadvantages. Historians that are not able to use Digital History may be in the danger of getting mired in data.

The main task of the usage of Big Data is a simplification of the work in historical science in order to be able to process large volumes of information. Three main steps enabling a close contact between Big Data and history must be highlighted:

Step 1 – Digitization. Books have to be turned into images.

Step 2 – Transcription. Transformation into text.

Step 3 – Preservation of data. That allows making data more accessible and carrying out more thorough research. This is needed to be made carefully because of a value of the works.

Humans will get access to a great amount of information and will be able to use it for the development of historical science. American historian Roy Rosenzweig made a huge contribution to the development of Digital History in USA. His work in digital history was recognized in 2003 with the Richard W. Lyman Award for "outstanding achievement in the use of information technology to advance teaching in the humanities.". The historian said: "The injunction of traditional historians to look at "everything" cannot survive in a digital era in which "everything" has survived. There is no sense to conceal something that cannot be concealed. Big Data made data more accessible for learning history and analyzing the past. It will help solve an important number of questions". And that is really so. With the development of Big Data, everyone will be able to get necessary information in just a few minutes. Free and open access to the data will be provided. We'll be able to learn about all the most important events in human history and not only about the events belonging to only some short period of it.

We have to realize the necessity of this process which will safe our history and a great amount of historical researches. The aim is to highlight immediately what often requires careful thought. Humans without big data cannot do that, so this modern technology is needed. History has many kinds of materials but now digital material is much better for her.

Also, big data opens up new perspectives for the development and optimization of historiographical research today. For example, The Seeley Historical library, Great Britain, Cambridge, contains 95,000 historiographic works. They create Big Data. Computers can read this amount of information quickly, whereas a human would spend all his life on that. Even though that the sets of data can be very big, the information that consists in them has much less size. Processing of such amount of information requires special methods. One of these is Data Mining (intelligent data analysis). Data Mining is gaining knowledge throug data research, processing of data samples, and clearing and collecting data. It will open us a new way of studying history and searching for information if we use it right. Data mining is an interdisciplinary subfield of computer science, involving the methods at the intersection of artificial intelligence, machine learning.

Conclusion

Modern fundamental changes in the number and quality of historical information particularly actualize a necessity in application of concepts and ideas of Western European and American historiography in domestic researches, extension of scientific tools of Ukrainian historians. The key benefit of Big Data technology usage is that it allows comparing the historical information that was earlier incomparable. That can change our view of historical events and make data accessible. And that will develop the history science and make researches full of earlier unknown information.

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Main tendencies of the Internet development in the future and new Internet professions

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Abstract – The prospects of the emergence of new IT-professions are considered, according to the latest forecasts of the future development of the Internet.

Keywords – the Internet, information activities, the future, IT- professions.

I. Introduction

According to the research of Ukrainian Internet Association, in Ukraine, by the beginning of 2017, 21.6 million Internet users have been charged and internet penetration is 64.8%. [1]. In this context, enormous prospects for the Internet professions will open up. New degree programme Documentation Science and Information Activities in Lviv Polytechnic National University offers a wide range of online trades that already occupy the highest positions in the ratings of employers. But, according to recent forecasts of Internet development, the list of such professions will expand considerably. The purpose of our research is to determine the perspectives of IT-professions, taking into account the latest forecasts of the future development of the Internet.

II. Modern Internet services predicted by science-fiction writers of XIX-XX centuries

Various science-fiction writers imagined a world with some characteristics of the internet, to be sure. Mark Twain in 1898, in one of his least compelling stories, imagined a "telectroscope" that would allow people to use a phonelike object to view locations around the world. He imagined that thanks to the telectroscope, "the daily doings of the globe" would become fodder for worldwide gossip and discussion (read social networks!), but that wasn't different from the old-fashioned telephone party lines.

Later on, writers like William Gibson, in his 1984 novel "Neuromancer", and David Brin, in his 1990 book "Earth", imagined something closer. But by then, the nascent beginning of the internet was already emerging in the scientific community, at least. In any case, by no means did anything like the internet ever become as ubiquitous in science fiction as teleportation in its various guises, antigravity cars, warp drive, hyperdrive, wormholes, or any of the other standbys for getting from one place to another faster than light can travel. On "Star Trek", humans talked to computers – they even used something like floppy disks and memory sticks – but nowhere did crew members get information from ethereal machines whose locations and identities were otherwise unknown. Large-scale central computers that governed whole societies were imagined, but not a diffuse network of machines, including home refrigerators and pocket-size computers, on which users' identities were unknown [2].

This is not to disparage science-fiction writers. Their job is not to predict the future – it's to imagine it based on current trends. That's what's so amazing about the internet: The ubiquitous World Wide Web arose from an unexpected place. Indeed, perhaps the most remarkable thing about the internet is that necessity was the mother of its invention.

III. Main tendencies of Internet development: expert predictions

The Internet has changed our lifestyle: how we communicate, express ourselves, get information and do the shopping at last. But, unfortunately, the Internet is killing the traditional way of getting news – newspapers and magazines. A lot of people create their own media – create blogs, share the information via social networks, for example, Facebook, Twitter, Instagram and others. The Internet greatly changes the way how we do business. At lot of press conferences are conducted through Skype, the mail is sent to e-mail boxes, and a lot of contracts are sighed through the Internet. Nevertheless, with the positive changes of the Internet also come negative ones. Hackers have become more advanced and have created viruses and other threats to attack people's computers through the Internet and steal the information or money. So, we have talked a little bit about Internet in the past and nowadays. Now we want to tell you about some predictions.

The Internet and the World Wide Web are still relatively young. The public web is only 25, and like most twenty-something it still has a lot of growing up to do. While debate continues on net neutrality, privacy and architecture of the Internet, there are some agreements about the future of the Internet over the next 10 years.

As part of a series of reports marking the 25th birthday of the web, Pew Research Center's Internet Project, in partnership with Elon University's Imagining the Internet Project, asked nearly 1,500 Internet experts open ended questions about the future of the web. The majority believes that the Internet will become like electricity during the next decade, less visible but more important and embedded in everyday life. But while the experts agreed on how Internet will continue to grow, they disagreed on the implications.

The predictions the future of the Internet from the Digital Life in 2025:

- Information sharing over the Internet will be so effortlessly interwoven into daily life that it will become invisible, flowing like electricity, often through machine intermediaries.
- The spread of the Internet will enhance global connectivity, fostering more positive relationships among societies.
- The Internet of Things, artificial intelligence and big data will make people more aware of their world and their own behavior.

- Augmented reality and wearable devices will be implemented to monitor and give quick feedback on daily life, especially in regard to personal health.
- Political awareness and action will be facilitated and more peaceful.
- An Internet-enabled revolution in education will spread more opportunities with less money spent on buildings and teachers.
- Dangerous divides between haves and have-nots may expand, resulting in resentment and possible violence.
- Pressured by these changes, governments and corporations will try to assert power – and at times succeed – as they invoke security and cultural norms.
- People will continue – sometimes grudgingly – to make tradeoffs favoring convenience and perceived immediate gains over privacy; and privacy will be something only the upscale will enjoy.
- Humans and their current organizations may not respond quickly enough to challenges presented by complex networks.
- Most people are not yet noticing the profound changes today's communications networks are already bringing about; these networks will be even more disruptive in the future [3].

Some examples of the Internet in the future one can find even in popular films and animated serials. The Simpsons is an American animated sitcom. It is popular because of the prediction about Trump becoming a president of the USA. So, what they say about internet? Ultranet (as they call the future internet) is a system that is a clear descendent of the contemporary internet. It was developed sometime before 2041. The system allows those to "plug in," meaning have a jack inserted on their neck, to enter. The manner of entering the Ultranet may be a parody of the Matrix, where humans had cables inserted in many parts of their bodies. This looks like crazy but who knows what will be in the next century of our civilization.

IV. Internet professions of the future

In the future will be many new Internet professions. "60% of the best jobs in the next ten years haven't been invented yet." – Thomas Frey. In the past, careers were stable, linear and singular. People chose one path and pursued it over the course of their lives from college to retirement. In our modern age of technology driven exponential change – this model no longer works. Careers are now complex, fragmented, specialized, collaborative and ever evolving. More often than not, our work life will be made up of a portfolio of micro-careers.

Here are careers that will likely come of age in the next 10 years. Some of these jobs exist now, but will come into greater demand soon. Others do not exist yet, but we see strong potential in their emergence. For example:

Personal Digital Curator: A specialist that recommends and maintains your unique suite of apps, hardware, software and information sources for your evolving personality and career;
Personal Life Log Archivist: In the age of the completely archived life, there will be a need for AI experts to organize, catalog and make sense of volumes of personal content and to identify potential uses for one's life log; ***Hackschooling Counselor:*** This counselor encourages students to hack the real world and experiment with life rather than only pursuing traditional educational paths;
Privacy Consultant: This consultant reveals vulnerabilities in an individual's personal, physical, and online security points;
Skype Staging: Hired career advisors that prepare and help an individual work through remote interviews or video conferencing, including etiquette, appearance and conversational skills;
Meme Agent: Similar to a celebrity or talent agent, a Meme Agent represents and maximizes the value of the personality or intellectual property used in a meme [4].

Conclusion

There will be many new internet professions in the future that will not only develop informatization in all spheres of our lives, but also solve the moral and cultural problems of the information society. In particular, the list of TOP-20 professions of the future, formed by the well-known research company Sparks & Honey, confirms the increased attention to the culture and personality on the Internet.

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Images of European culture in Ukrainian history textbooks

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Abstract – The paper attempts to describe the image of Europe in textbooks on history that are connected with the problem of the quality of the school textbook. The articles for research were chosen from the Ukrainian textbooks; they cover the question of what historic school courses should be prevailed is relevant. Should we emphasize national history, world history, or history in general, and what criteria should be decisive for formation of the image of Europe culture in Ukrainian textbooks.

Keywords – textbook analysis, heritage, mosaic ambivalence

I. Introduction

The topicality of the study of the peculiarities of the reflection of Europe in Ukrainian textbooks on history is determined by the European choice of Ukraine, the scientific dialogue between Ukraine and Europe. Nowadays Ukraine like many other post-communist countries seeks to become a member of the European community. In practice, it means adopting many changes that will be aimed at harmonizing Ukrainian rules and standards with those that prevail in the West.

The relevant changes are happening at the moment. Obviously, they should continue their development in the education system. Therefore, in our opinion, it is important in school textbooks to present Europe thereby to develop in the younger generation the desire to develop their own state taking into account European aspirations for the correct settlement of conflicts preserving their dignity, tolerance (but at the same time fundamental one) to the conflicting party.

The geographical location and affiliation of parts of modern Ukraine to various state institutions during different historical periods contributed to intercultural interaction. Therefore, of course, many objects of historical and cultural heritage were created through this interaction. It is important not just to present a list of architectural monuments or monuments in the textbooks a list of architectural memorials or monuments, but to explain the historical context of their appearance. Analyzing the historical didactic of the period of independence, Ukrainian historians partly consider the questions of the fact how the development of culture, the creation and functioning of memorial of historical and cultural heritage is highlighted in the textbooks and educational materials[1]. The purpose of our research is to trace how the historical and cultural heritage of Europe is reflected in the Ukrainian school textbooks and how the components of the image of Europe are actualized nowadays.

Therefore, it is necessary to find out what information and images presented in the Ukrainian textbooks on history form an idea and conception of European culture. The main attention of our research will be focused on Ukrainian textbooks on world history, as in contradistinction to the textbooks on Ukrainian history, more information on Europe and the world as a whole is provided there.

Analysis of Ukrainian history textbooks

In the textbook on the history of Ukraine (for the 5th grade), during a narrative on the universities in Ukraine it is stated that one of the oldest universities of Europe and the world is Sorbonne University. There is also a brief information about the history of this institution [2].

Thereby, we see in what manner the cultural values of Europe and the historical past of cultural and educational institutions are transmitted. This takes place in the form of comparison and implication of historical and cultural memory of Ukraine into the European space (inheritance).

Book writing as a cultural phenomenon appears to us in the context of inter-state and interpersonal relations. In the textbook for the 5th grade, it is said that the daughter of the mighty ruler of Kyivan Rus Yu. Wise (1019-1054 AD) Anna brought with her a book of the Bible. It was the book on which the French kings coming to the throne took an oath for centuries. Consequently, according to the text of the textbook, in the 11th century Kyivan Rus was spreading its cultural heritage to other European countries (shared its treasures) [3].

In the textbook for the 5th form in the narrative about the architectural features of Ukraine it is mentioned that in Europe there is a territory whose name is interpreted as "the land of castles". It's about Castile which is famous for its castles in the whole world. Today about 400 of them are preserved, and this is the largest amount than any other structures of antiquity. The proprietors fortified their castles, decorated and given the notable names to them as follows: "The Great Ship of Castile", "Castle of Honor", "Rock of the Falcon", etc. Today, many ancient castles in Castile become museums, schools, and other cultural institutions. Such stories about the peculiarities of European culture illustrate the architecture of European territories different from Ukrainian architecture[2]. After reading this information the pupils have the opportunity to learn more about the architectural styles of the Middle Ages from the Ukrainian textbooks on history. In addition, the wide coverage of the architecture and the art of the Medieval Europe combined with similar texts and drawings about Ukraine gives an opportunity to understand the image of Ukrainian culture in a single space with Europe as a whole.

On belonging of Ukrainian culture to the pan-European one is also described in the textbook for the 5the form: "Slavs are called a large group of modern European nations. These include, in particular, Ukrainians, Belorussians, Russians, Poles, Czechs, Slovenes, Slovaks, Bulgarians, Macedonians, Croats, Montenegrins, Serbs. All of them are united by a common origin, and therefore, the proximity of languages. After all, once the Slavs were the people who lived in the center of Europe in ancient times"[3]. Thus, we can see that the textbook's author endeavors to emphasize the common cultural and linguistic belonging to the European heritage.

While presenting the material about the origin of the primitive art and religious beliefs, the authors of Ukrainian textbooks repeatedly cite the examples of rock paintings located in Europe (6th grade, Pometun) along with the same ones found in Ukraine[4]. This, obviously, should form the perception of Ukraine, Spain and France

as being included in a single space. In the history of Ancient Greece, the textbook's author emphasizes the social factors of existence in connection with the confrontation between the demos and the aristocracy [4].

In textbook on history for 7 an 8 grade we can observe that Ukrainians imported their printed books from other countries (Poland, the Czech Republic) for a long time, because on the territory of Ukraine wasn't their own typography. Consequently, the authors of the textbook, G. Serhiienko and V. Smoliy emphasize the influence of European cultural and educational factors on the development of the situation in Ukraine [5]. However, in the presentation of the material about the object of interest of the old Ukrainian language and art, "Peresopnytskyi Gospel" (1556-1561), there is no information that it was translated and concluded on the basis of the Lutheran New Testament of Seclusitsyan of 1553 [5]. This, in turn, would allow to consider cultural processes in Europe and in the world in connection with historical processes in the territory of Ukraine

In Ukrainian textbooks on history, European culture at the end of the 18th century – 19th century is considered first and foremost in the form of romanticism whose representatives, according to the texts, are R. Shelley, O. Pushkin, M. Lermontov, L. Van Beethoven, G. Heine, F. Schiller, J. Goethe, F. Goya and H. Daumier. In particular, the two latter ones in the textbook published in 2011 the following information is provided: "Goya tagged on his canvases arrogant aristocrats, ministers of the church, and Daumier depicted in his canvases the pompous faces of the bourgeoisie who sought wealth and power." In our opinion, the presentation of European culture in such a light may give the impression that for hundreds of year the European cultural space has been penetrated by socialist slogans and an appeal to fight the "bourgeoisie" [6]. Therefore, it is obvious that in the textbook it is not necessary to use the discussion concepts of this nature and to cover only one discourse.

The narrative on the literary authorities mentioned in the textbook and on their works is put in the context of the modern era for them. Therefore, the reader can comprehend not only the main idea of the works, but also perceive the nature of the historical period. For example, in the light of the information on the German writer Bertold Brecht it is said that he became a reformer of the drama of the interwar period, the "father" of the "epic theater," and his drama "Mother Courage and her children" is filled with anti-war pathos and allegorical meaning, the tragic fate of human virtues in war conditions [7].

The fact can also be added that the work of the representatives of the new (appeared in the 20's) literary direction – the literature of the "lost generation": Eric-Maria Remarque, American-American Ernest Hemingway, Frenchman Henry Barbusse and others has special features. The main theme of their works is the meaninglessness of the war, the physical and moral damages of its participants, the loss of a whole generation whose destiny was lost.

Such a reflection of the nature of works enables to understand more deeply not only the peculiarities of works, but also the social mood in that time.

Conclusions

Modern Ukrainian textbooks are characterized by the transition from a monodocratic look at history to a pluralistic one, a desire for a certain objectivism, a greater weighting of historical characteristics and assessments. The Ukrainian textbooks of the new generation are aimed at avoiding unambiguously ideologized assessments, alternative points of view on the events are oftenpresented. So in this study of Ukrainian textbooks on history, we can observe a "mosaic ambivalence" that observes in the desire to distance itself from the Soviet legacy. At the same time, in the textbooks for pupils of grades 5-11 there are some formulations that were laid down earlier in Soviet times.

Consequently, the historical education experiences an intensive process of development. Among its features – the work on qualitative improvement of school courses in the history of Ukraine, and, consequently, modernization of relevant textbooks.

Those subjects in which the textbooks present the European context and significance of European civilization influences on Ukrainian history, for example, in the 8th form – Renaissance ideas, reform and counterreformational movements in Ukraine, etc.; in the 9th form – the influence of the ideas of Western romanticism on the Ukrainian nation-building of the XIX century, needs to be expanded, precised and systematized.

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National Interests of Ukraine in Implementing the Baltic-Black Sea Union Project

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Abstract – The aim of the paper is to determine national interests of Ukraine as a potential member of the Baltic-Black Sea Union. Also it is important to examine historical retrospective of the development the idea of the Baltic-Black Sea Union. Particular attention is paid to the advantages and disadvantages of new regional organization for Ukrainian national interests. It is hoped this study will inform students, scholars and other interested persons about idea of the Baltic-Black Sea Union, peculiarities of its implementation and prospects for development.

Keywords – Baltic-Black Sea Union, Intermarium, Ukraine, national interests, Russian aggression, Baltic Sea region, Black Sea region.

I. Introduction

At the beginning of XXI century new challenges in Europe have become urgent for each EU state. The problem of refugees and terrorism is closely intertwined with political crisis within the EU, and Russia is trying to exert its influence on international politics. Taking into account such situation, Central and Eastern European Countries started to review an idea of creating an international organization in the Baltic-Black Sea region.

According to the "parents of geopolitics" Ukraine belongs to the countries of the Baltic-Black Sea belt. The stability of Euro-Atlantic system depends on these states. Countries of Central and Eastern Europe will play a significant role in the structure of European security over the next few decades. In this context, the relevance and curiosity of the idea of Baltic-Black Sea cooperation or, in other words, the Baltic-Black Sea Union project is a very interesting initiative, which, in case of its successful implementation will bring lots of benefits to member states, including Ukraine.

II. Development of the Idea of the Baltic-Black Sea Union

There are some differences in interpretation the region, where new organization is going to be established, because almost each state of Central and Eastern Europe has its own name and vision of the future organization. In particular, the Polish name Międzymorze (from między = "between" or "among"; + morze = "sea"), meaning "Between-seas", was rendered into Latin as "Intermarium." Three Seas initiative is a regional "soft" formation initiated by Croatia and Poland: a corridor on a North-to-South axis connecting Scandinavian states with Balkans through Poland. Mitteleuropa in German discourse notifies parts of Europe allocated between its Eastern and Western poles. And Ukrainian term Baltic-Black Sea Union envisages the restoration the geopolitical patterns of the late Kyivan Rus [2]. In this paper the term "Baltic-Black Sea Union" is going to be used as the main.

In the post-Versailles era, Polish leader Józef Piłsudski proposed to the authorities of Lithuania, Belarus and Ukraine forge an interstate union. Piłsudski risked and pushed forward an intellectual speculation on how to strengthen subjectivity and sovereignty of the "young" states in games between major powers. From the perspective of time, this speculation can hardly be defined as a real-life success.

The confederative plan proposed by Juzef Pilsudski, Polish leader, today is considered as multilateral agreement on mutual assistance between the Baltic Sea and the Black Sea countries.

According to Pilsudski project, an organization should include countries of Central and Eastern Europe (Ukraine, Czechoslovakia, Poland, Romania, Hungary, Yugoslavia, Latvia, Lithuania, Estonia, Moldova, Belarus), which will unite in a new alliance in contrast to Germany and Russia.

Exploring Ukrainian historical visions of the Baltic-Black Sea Union also reveals some theorising and intellectual exercising. Among Ukrainians the Baltic-Black Sea Union project was actively supported by Y. Lypa, S. Rudnytskyi and M. Hrushevskyi. Ukrainian military chief and Piłsudki's partner Symon Petlura was the first to introduce an idea of the Black Sea union (Armenia, Azerbaijan, Georgia, Kuban and Ukraine). Being fully functional, the union would allow regional nations to withstand Russian pressure and preserve national independence. Finally, Ukrainian geo-politician Y. Lypa is an author of the so-called Black Sea doctrine, the main idea of which was to unite Poles, Byelorussians, Ukrainians and Lithuanians in the Black Sea-Baltic federation. He believed that Ukraine should unite efforts of the Eastern European nations in order to secure their independence from colonisers. Ukraine had an "undeniable" right to become such a leader due to the largest and most densely populated state with considerable economic potential [1].

Also it is worth to mention that the idea of creating a regional organization in the Baltic-Black Sea region is an important element of modern interstate relations of the countries of Central and Eastern Europe.

For the first time since collapse of the USSR an idea to create such an alliance was proclaimed by then-President of Lithuania A. Brazauskas during the Vilnius summit of 1997. The desire of Brazauskas was also supported by presidents of Ukraine L. Kravchuk and L. Kuchma.

In 2006 during summit of leaders of the Baltic-Black Sea region in Vilnius participants emphasize the importance of regional cooperation for European and Transatlantic integration. The Croatian president made an initiative to establish the Adriatic-Black Sea-Baltic Union in 2015. In fact, in the early 2000s, there was an initiation and certain institutionalization of economic, historical and geopolitical cooperation in the Black Sea-Baltic region.

The aim of the Baltic-Black Sea Union in modern times is strengthening cooperation between member states in order to provide security, economic development, intergovernmental dialogue etc [6, P. 135].

Ukraine, despite the conflict with Russia and financial dependence from foreign partners still has a very powerful economic potential to get a leading position in future organization. In the post-Soviet space Ukraine is the second after Russia place by population. In terms of GDP, Ukraine ranked second in Central and Eastern Europe after Poland. According to the available scientific potential, it has one of the first places in Europe.

In Ukrainian society today there is a problem with interpretation of the Baltic-Black Sea project. Among Ukrainians, there is lack of clear understanding of what this project represents and which benefits Ukraine will get as potential member of the Baltic-Black Sea Union.

III. Advantages and Disadvantages of the Baltic-Black Sea Union for the Realization of National Interests of Ukraine

Taking into account different internal and external factors, membership of Ukraine in the Baltic-Black Sea Union may bring both advantages and disadvantages to our state.

In case of successful implementation of the project, Ukraine would become a driving force of the future geopolitical association. If during next 2-3 years Poland, Belarus, Lithuania and Ukraine will establish body of the organization, then in 10-15 years the Baltic-Black Sea Union will attain the level of Germany, France and Great Britain in terms of military and economic potential. It has been estimated that military alliance of Ukraine and Poland with defence expenditure of 16-20 billion dollars and the total number of armed forces from 400 to 500 thousand troops may become the most powerful military force in Europe which will play a leading role in NATO military policy [4].

Cooperation within the Baltic-Black Sea Union would strengthen the geopolitical role of Ukraine, which can become a decisive factor for Ukraine`s accession to European and Euro-Atlantic structures [3].

The economic component of Ukraine's national interests as a member of the Baltic-Black Sea Union can be expressed in simplifying business operations in common economic market, implementation of joint logistical, infrastructure and energy projects etc.

The idea of creating the Baltic-Black Sea Union is increasingly coming forward in the forefront along with an increase in the problems of EU unity. These problems are due to factors such as huge inflow of refugees to EU countries, sometimes ambiguous Brussels policy in relation to most strategic issues, the discontent of some EU countries regarding the size of tax deductions to the common budget, distribution of quotas on agricultural products and so on. According to Y. Prykhodko, the Baltic-Black Sea Union should become not only a buffer, but catalyst for changes in the old Europe that are already took place. The Baltic-Black Sea Union project will significantly change geopolitical situation in the region in terms of security, military cooperation and relationships between EU and member states of new organization.

However, not everyone expects that creating a new organization will have positive effects in the region. According to Henry Tendi, the negative side of this process is the fact that Europe is not interested in supporting the initiative to create the Baltic-Black Sea Union. In this case, Ukraine risks lose support from EU in protection of territorial integrity, sovereignty and European integration. At the same time, Moscow has never concealed anger about formation of the Baltic-Black Sea Union and beginning of such a process will only worsen the situation in the East of Ukraine.

Y. Prikhodko also suggests that on the one hand the Baltic-Black Sea Union could become a perfect shield for EU from the Kremlin. But on the other hand Brussels will take a leading position in the whole Europe, trying to prevent development and prosperity of the Baltic-Black Sea Union [5, P. 42].

Among the negative aspects of creating a new regional organization most scholars determine the desire of Poland to take over all the power in the Baltic-Black Sea Union in order to promote its own interest. In this case, Ukraine will take a minor role in the organization and will not be able to defend its national interests to the fullest.

Conclusion

In this paper the national interests of Ukraine as a potential member of the Baltic-Black Sea Union were determined. Today for Ukraine it is important to be actively involved in the creation of new security unions, but it is also necessary to make efforts in order to protect its own independence, security and defence.

The Baltic-Black Sea Union may prove to be an effective way to strengthen the European security system, intensify the process of integration of the states of Eastern and Western Europe, stabilize and harmonize relations within the EU, and eliminate any attempts to separate Eastern European countries between the West and the Russian Federation.

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Historical Museums of the 21-st Century: Prospects of the Mission

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Abstract – The main prospects for the mission historical museums may undertake in modern society are analysed. Special attention is paid to the fact that museums must get accustomed to the challanges of globalization process. As a consequence, the mission of museums and the approaches they employ in museum management need reconsideration. The mission of historical museums is emphasized to be closely connected with current political situation in Ukraine.
Key words: museum, history, mission, mass society, visitors.

I. Introduction

Modern Ukrainian society seems to try to blend the responses to the globalization and informatization challenges with the identity attempts pursuant to the established traditions, customs, mental perception etc. Traditional identity indicators – ethnical, religious, social-grouping, are getting eliminated, while the socially marked (prestige) ones are overtaking the identifying and determining function. Such tendencies pose new challenges to historical museums as one of the sources of national memory. Social and cultural changes in modern society compel us to reconsider the role of the museum in cultural space, the ways and forms of its activity as well as its mission, and find the effective tools enabling realization of the latter.

The museum as one of the socio-cultural institutions provides a regulated type of social relations and has a peculiar binding force in preserving the cultural heritage. Museums undertake the responsibility over arrangement of the collections, preserving and demonstration of museum exhibits. They also determine special institutional instructions and behaviour patterns based on respect for the past, social memory and experience [1, p.194].

Through the formulation of its mission, the museum declares what it is and what its goals are. At the same time, from the inside, in particular for the museum's staff, this mission is the basic principle that defines all the types of activities in the museum. Each museum determines the subject of mission individually. There is no one common mission predetermined for all the museums. Such factors as collection, staff, and even location of the museum may outline its mission. The mission, in turn, can be short-term, long-term, or combine several components (sub-missions). Taking into consideration that the museum follows democratic approach of communication, one should not ignore the elements of entertainment that are widely used in leading European museums. [3, p. 220].

In modern science, the mission of museums is interpreted as: a) the purpose (super-task) of the museum is creation of the culture of the present and the future on the basis of preservation and actualization of the most valuable part of all the variety of heritage; b) an element of the strategic planning of the activity of a particular museum (for example, a prospect statement, which declares the main purpose of the museum, its social essence and principles of functioning. Such statement, alongside with the Statute of the museum, specifies the development of the museum's long-term policy and prospects. The policy is from time to time clarified and revised. [2, p. 44].

Historical Museum illustrates the most important milestones of Ukrainian history, applying various museum resources, demonstrates its continuity, highlighting the ethnogenesis, the foundation and formation of the statehood, Ukrainian national development. (4, p. 10). Modern museum serves as a kind of culture modeling system, integrating its cultural and historical codes and representing the characteristic cultural features and values. Therefore, the task of the museum is to shape the attitude of the man to the world, to his past, rather than to present some fundamental knowledge. Historical museum is predetermined to form not the knowledge of history, but a personal attitude towards it. At the same time, we should remember that modern culture is the culture of a dialogue, characterizing by the diversity of personality-oriented thoughts, every of which has the right for existence and becomes relevant only in relation to others. [2, p. 45]. The museum facilitates consolidation of individual freedom through critical reflection of the past. In addition, it should exercise the policy of tolerance as part of museum's mission, demonstrating its maturity and modern way of development (4, p. 10).

Due to current political situation in Ukraine, when some of its territories are occupied by the Russian Federation military forces, of great importance are the following issues: the question of common historical memory formation, overcoming the disagreements in the interpretation of key historical events by different groups of population, and the formation of a powerful national historical narrative. The museum of historical profile should become the instrument ensuring consolidation of Ukrainian society, raising its level of historical consciousness, strengthening its identity and restoring national memory. Then the main mission of the museum will be to generate the culture of the present and future, at the same time preserving and updating all the components of historical heritage. [7] From the point of the discourse of the memory, the role of museums in the conditions of social and cultural transformations is quite significant, since in such periods the society tend to radical reconsideration of the past, to establishment new distances and contrasts, and therefore a collision, or an attempt of imposing the "settled" and the "new", etc. may occurs. All this requires a timely response from museums [1, p. 196].

The museum should realize its mission through implementing systematic changes and taking strategic steps to make the museum accessible to everyone, as well as to become an innovative and organizationally effective

institution. The museum should demonstrate the policy of tolerance, encouraging the study and research of its stock collections, and provide maximum accessibility to its exhibits and collections. It should become the center of scientific research, since its collections are a rich resource for studying the history of Ukraine. Museum should become the site for scientific conferences, lectures, educational events for schoolchildren and students. A special platform for creation the professional environment with modern museum psychology should be established here, and a team in which each team-member exercises his potential to his best. An important component is the visitor-oriented policy of the museum. To realize this, it is necessary to create the conditions for the visitor to feel comfortable in the museum zone: to equip recreation areas, create a children's zone, and make the museum accessible for people with special needs [4, p. 10 – 11].

Museum's stakeholders – individuals and institutions that fall under the influence of the museum or receive some benefits from it – should not be omitted either. Therefore, the professional growth of the museum staff provided through trainings, seminars, etc., and constant cooperation with various organizations, representatives of mass media and sponsors play an important role while realization the mission of the museum. Moreover, working with the public is also highly important [3, p.221-222]. Among the museum audience, there are permanent and temporary visitors, depending on the frequency of visits. The presence of the skeleton of regular visitors is a significant qualitative indicator of the museum's activity, its place in the society, evidence of its social effect for in the local community. Increasing the regular audience is a hard day-to-day job, and the result of a thoroughly worked-out concept. The content of this work is based on what the museum offers to the local community. The most traditional way of updating the reputation of the museum in this respect is to organize exhibitions. Cyclic forms of work are believed to be more effective in increasing the regular audience and establishing a close, constant connection with local population, rather than single, occasional, one-time exhibitions. The former can be based of one type of activities, for example, a sightseeing subscription (a program of excursions devoted to a certain idea is developed), museum clubs or studios [5, p. 103 – 104]. The technical component of increasing the regular audience is a toolkit allowing sharing the information about the museum and its activities and, consequently, attract visitors. And here one cannot do without the Internet [5, p. 105].

Historical science can no longer remain outside the processes that take place in the field of new information technologies. In this connection, there arises the problem of comprehension of opportunities and perspectives of technological innovations of the modern world. Science needs not only historic and cultural retrospections for such phenomena as computer, the Internet, virtual museum, cyber space, etc., but also a thorough study of the methods of their scientific-historical application, in particular, in the museum domain. [6, p. 147]. Museums throughout the world use the Internet as a tool of communication; thus they spread information about museum's collection, expositions, thematic excursions, lectures, work with visitors, etc. [6, p. 155]. General information about the museum, its opening hours, entrance and excursion fees are the necessary issues on the museum's Internet site, as well as contact information. [5, p. 105].

Conclusion

Definition of museum's mission and its realization is the direction the museum chooses not only for its staff, but also for the local community, or even the society in general. In current conditions, the museum is not only the preserver, interpreter, but also a facilitator of active, creative way of learning the cultural heritage providing researching experience for its visitors. Advancement of expositions, raising the professionalism of museum workers, attracting visitors, advertisement and involving the Internet – all these widen the possibilities of successful implementation of the mission of the historic museum as the savior of the national memory in modern society.

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The noble coat of arms on a female portrait of the 17th – early 20th centuries in the collection of the Lviv Historical Museum

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Abstract – The coat of arms on a noble portrait serves as an important tool for the identification of people on the portraits. Taking into account this circumstance in future will allow to give more accurate information about the persons depicted on portraits in the collection of the Lviv Historical Museum, most of which are not yet identified or the identification is mistaken or hypothetical.

Keywords – coat of arms, noble portrait, nobility, Lviv Historical Museum.

I. Introduction

The noble portraits take a significant part in the collection of the art fund of the Lviv Historical Museum. The chronological boundaries of the portraits painting are the 16th-20th centuries, and the authors are mostly artists who lived and worked in Eastern Galicia, in particular in Lviv, as well as artists from some European countries [1, p. 3]. However, the authorship of most works remains unknown.

II. The noble coat of arms on a female portrait

Lviv Historical Museum has a tremendous collection of portrait paintings. In total, the collection contains 43 portraits with the image of coat of arms. 37 of portraits picture gentry men, 6 of them are portraits of women, and 8 are the portraits of Lviv burghers-patricians. In complex these all are the works of the17th and the early 20th centuries. Thus, on the basis of the materials of the Lviv Historical Museum it is possible to study the features of gentry heraldry and herbaceous creation. The subject of this study is the coat of arms of a woman's portrait, since the content and semantic load that it could transmit was often somewhat different from those motifs that were present in the iconography of the coat of arms on portraits of male noblemen. While the coat of arms on a man's portrait unambiguously indicated the belonging of the gentry to the genus of his father, then the coat of arms on the portrait of the noblewoman could reflect the belonging to the family of not only the father but also the husband, or even that could be a combination of both coats of arms. This article is intended to clarify these and the other features of the coat of arms on a female portrait.

The analyzed complex of material allows making some important conclusions. The coat of arms on a noble portrait serves as an important tool for the identification of people on the portraits. Taking into account this circumstance in future will allow to give more accurate information about the persons depicted on portraits in the collection of the Lviv Historical Museum, most of which are not yet identified or the identification is mistaken or hypothetical. Returning to the female portrait, it is worth noting the following features: the artists, as a rule, placed the coat of arms on the right or left upper part of the portrait. Mostly, the armorial shield does not have clearly shape and it is stylized with plant or some other ornament, which is an expression of Baroque art. In general, baroque features early appeared in a gentry's portrait that shows a desire to emphasize the spectacular showiness, paradise, heroization of the person [2, p. 161].

Fig. 1. The noble coat of arms "Mnishek" on portrait of Ursula Vishnevecka

Fig. 2. The noble coat of arms "Yelita" on portrait of Anna Vishnevecka

Fig. 3. The coat of arms on portrait of Kateryna Venino

Fig. 4. The noble coat of arms "Sreniava" on portrait of an unknown woman

The image of the coat of arms on a woman's portrait as nothing else characterizes the change of its functional purpose in comparison with the Middle Ages, where the arm of coats was an attribute of military affairs, the flag, which served for gentry of a particular territorial or tribal community [3, p. 33]. In the Early Modern Age and later, the coat of arms was as a symbol of the person's belonging, regardless the gender, was he a priest or a warrior, to a particular family community. Through the coat of arms the greatness, the authority and the achievements of previous generations of the family became the hereditary social capital of their descendants. It is not a coincidence that the portraits of women depicted the coat of arms of the parents, and not the husband.

On the two out of six portraits, the coat of arms is completed with sets of initial letters. This phenomenon is quite common in the iconography of the gentry' emblem and gives it very individual features. The use of initial letters has a double meaning. First, they identified directly the person who was portrayed. Secondly, the initial letters outlined not only the name and surname of the person on the portrait, but also his/her social status. The second couple of letters, as a rule, symbolizes the position occupied by a depicted person. If we talk about a woman's portrait, as in the case of Kateryna Venino, it demonstrates the social position of her husband, which automatically determines the personal status of a woman in a society.

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Construction of the main building for the Tsisars-Royal Technical Academy in Lviv in 1873-1877 on the pages of «Gazeta Lwowska» newspaper

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Abstract – Described the main milestones in the construction of the main building for the Tsisar-Royal Technical Academy in Lviv in 1873-1877 according to the materials of Polish periodical of that time "Gazeta Lwowska". Emphasized the importance of this process, not only for the educational system of the Austro-Hungarian Empire, but in general for social and cultural life of the region.

Keywords – Technical Academy, constructing, main building, architectural project, newspaper, education, mention.

I. Introduction

Lviv Polytechnic National University is one of the oldest technical higher educational institutions in Europe and the first one in Ukraine. The history of this educational center is very rich in interesting, remarkable dates, inventions of the best European models, involving in its activities a whole galaxy of technical leaders.

Its popularity, success and effectiveness, the Technical Academy was due to the active promotion of the central government of Vienna in the educational sphere, the keen attention of the new monarch to the issues of science. In addition, in the first decades of its existence, there was an urgent need to revise and complete the reorganization of the educational sphere of the empire, shifting priorities from the classical humanitarian to the technical vector. After the beginning of the industrial era (second half of the eighteenth century), the labor market began to formulate a request for specialists of new profiles – engineering type, specialists who could continue to develop experimental science, to implement and apply the nature of new theoretical developments, to modernize technical processes.

Efficiency and progressiveness of the educational process significantly depended on the material and technical base of the educational institution. In 1871 the status of the Technical Academy was raised – the right of a higher educational establishment was granted. In the 1960s, the leadership of the academy in connection with the increase in the number of students, the expansion of research work understood the need for the construction of an additional building that would meet the educational and scientific requirements of technical education. Thus, an educational institution in 1872, by the decree of the Emperor Franz Josef, was allowed to build his own home for the needs of the academic community. Significant funds were earmarked – 1 million 300 thousand of Roman golden Austrian government and ordered the creation of a project for a professor of architecture Julian-Octavian Zakharievich. [1, p.11]

In early 1873, the project was completed and approved. The architect planned to create a non-Renaissance style building. Construction began at the beginning of April 1874 on a plot of land, in the western part of the city at New World Street (later – L. Sapiega street, now S. Bandera street). [2] This is a prestigious suburb of the then Lviv, as it was the main highway connecting the Lviv railway station with the central part of the city. The work was fast.

The construction of a new building for the Technical Academy has become a major event in the public life of the time in Lviv – the press, especially the Polish, actively informed the public about the chronicle of the structure. We have a lot of testimonies in "Gazeta Lwowska" (the official printed matter of the Austrian authorities), which enable us to better recreate the events of those days and to feel the atmosphere better than when studying official documents. In one of May 2, 1874, we find out that "the construction of the Technical Academy is facilitated by the Lviv Construction Bank". [3] The authors of the test genuinely admire the grandiose scale of construction, pointing out: "full of life and movement on the severalmarging segments between the streets: Lipova, Mariii Magdaleny, Novyi Svit, Karpinskogo and St. George's Square, where for a few years will be the premiere building of the academy, near her building for conducting laboratory works, and, finally, a residential building". [3] The construction works of 1873-1877 under the direction of Zakharievich were also realized with the help of the architects Sigmund Kendzersky, Alfred Kamenobrodsky and A. Gauff. Interestingly, the land allocated for the construction of the Technical Academy was considered one of the best in Lviv in terms of its agronomic characteristics. The most important building material was considered a stone designed for the foundation.

One and a half years later, as of September 28, 1875, "the main building of the Technical Academy in Lviv was almost under the roof." [4] An easy delay in the construction process could be explained by the lack of masons who could handle huge stones, designed for columns and pillars under the foundation of the tower. Hoping also, if the weather allowed, to cover the building by the roof of that year, which was done before November 15, 1875 (except for the main facade of The New World street). Also, by the middle of November, the house, intended for the laboratory, was already completely completed. [5]

In 1876 the work continued. In the summer of 1877, construction was already nearing completion – a large proportion of the rooms were already provided for use by professors and academics. "Lviv become decorated with such a building that in its size exceeds all the structures of our city, followed by the house of invalids. In spite of the spatial savings, the interior of the building has many attractions: full of harmony and lightness, with the body looks respectable, suitable for its purpose". The author also draws attention to the beauty of the ionic columns,

the richness of the lobby and the perfectly executed magnificent allegorical figures, symbolizing Engineering, Architecture and Mechanics – three faculties that were located in the building. And some lecture rooms are equipped with the latest technical samples. Emphasized the absolute practicality of the Technical Academy main building. [6]

Fig.1. The main building of the Tsisars-Royal Technical Academy in Lviv

Construction works completed by October 1. [7, p.118] The inauguration and dedication of the newly built corps took place on November 15, 1877. In the morning, at 9.00 a ceremonial divine serviced at the Church of St. Mariia Magdalena (modern House of Organ and Chamber Music in Lviv) with the participation of Archbishop Verkhleisky, Metropolitan Sembratovich and Archbishop of the Armenian ceremony Romashchenko. Among the guests were the Minister of Education Dr. Stremayr, the governor of Galicia A.Pototsky, Commander-in-Chief of the Austro-Hungarian Army General Cavalry E. Neiperg. Other small state officials, professors, representatives of various educational institutions also attended. After the celebrations in the church, the community went to the main building of the academy, where a religious act of consecration was carried out by Archbishop Verkhleisky with the help of the numerous clergy. Subsequently, a number of high-ranking guests came to the audience who emphasized that "the former Academy has become the highest scientific institution that has embraced all technical branches and, finally, can admire its incredibly magnificent main building, its temple of science. [8] The special significance of the opening of this building for the development and well-being of the population of Galicia was noted. At 17 o'clock the same day a banquet was held at the George Hotel on the occasion of such a celebration. [9]

Thus, for four years, Lviv was enriched with another architectural pearl. The availability of new spacious rooms and new special laboratory facilities created additional opportunities for research work in the walls of the Technical Academy. The construction of a new building started the formation of the Lviv architectural school, the training of technical personnel. The project of the building also became the first software product of Y. Zaharievich, which he performed brilliantly. [10, p.81]

It should be noted that three years later, the Technical Assistant of Austria-Hungary, Franz Josef I, who was so impressed with the grandeur of this architectural pearl, visited the Technical Academy that he decided to give a series of paintings to the residents of Lviv which would allegorically reflect the technical progress of mankind. [11] The author of the future collection was the famous Polish artist Y.Mateyko and his students.

Conclusion

So, the construction of the main building for the Tsisars-Royal Technical Academy in Lviv was widely reflected at the time of the periodic part of the Austro-Hungarian Empire, especially in the Polish. «Gazeta Lwowska» newspaper was the main official printing authority of the Austrian authorities, the main information resource of the Polish community (owner – Polish Culture Society of Lviv Land). In fact, the mention of construction in the "Chronicle" section is present on average every two weeks. Sometimes the comments were concise, sometimes quite long texts, emotionally painted by the authors can be found.

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Metallographic examination of 16th century cannon material from the collection of Lviv History Museum

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Abstract – The article presents a detailed description of a16th century cannon from the collection of Lviv History Museum. It briefly looks at metallographic analysis techniques of cannon material. It describes metallographic examination of the 16th century cannon from the collection of Lviv History Museum. It makes a conclusion concerning a micro- and macrostructure of the 16th century cannon material from the collection of Lviv History Museum.

Key words: the 16th century cannon, metallographic examination. iron, micro-, macrostructure, Lviv History Museum

Historical Weapon Study is an interdisciplinary science. It is closely connected with Military and War History, History of Vehicles and Equipment and Art History. Weapon Study also borders on Ballistics and Tactics in issues of artillery research. Modern scientific tendencies take Weapon Study to a whole new level by making Materials Science its constituent. What can better tell us about secrets of a cannon if not its metal?

Nowadays, the collection of Lviv History Museum (further read LHM) comprises iron beaten 16th century cannon [1;2]. The item joined the collection of the museum in 1940 after having left the collection of Taras Shevchenko Scientific Society Museum which was dissolved as a result of museum reform in Lviv. The inventory of Taras Shevchenko Scientific Society Museum mentions that the cannon was given to the museum by a dean Fr. Iliarion Gela in 1934[1].

The cannon gets the registration number № 3-2880 [LHM] in the inventory of LHM. The specifications are as following:

Total length of barrel 675 mm
Length of barrel bore 630 mm
Diameter of barrel bore 27 mm
Diameter of muzzle end 48 mm

The body of the cannon is octagon. The breech end is broken. The inner side of the breech end has got 6 intervals of screw thread for breech screw clamping. As a result of an explosion the screw is lost. Firing tube is of conical shape (getting narrower depth ward) with

diameter of 17 mm and located at the distance of 170 mm from the breech end.

Character of destruction can testify that the cannon was made of three plates of packet iron welded by hammer-welding method. Reasons of barrel explosion can be clarified with help of metallographic examination.

It is worth mentioning that metallographic examination first took place in archeological and historical researches in the first part of the 20th century. Files of archeological excavations "The Trails of Ancient Cultures. Ancient Rus" (1951) contain publication by A. B. Kolchyn "Mastership of Ancient Rus Blacksmiths" in which the author applies metallographic analysis to examine relics of cold steel arms [4]. In the recent years there appeared a number of researches applying cannon metallographic analysis carried out by Polish scientists. An outstanding modern professional in the sphere of archeological metallography is Ann Feuerbach (New York, the USA). This tendency is shown in the works of Denys Toyichkin dedicated to cold steel arms study. Researches in the artillery sphere haven't been presented yet.

This research is the first attempt to make the analysis of the 16th century cannon from Lviv History Museum.

Picture 1. Specimen selection for microstructural analysis:
a – blank for the specimen; b – destructed breeching part of the destructed cannon

The specimen for the microstructure analysis (picture 1a) was cut out with a jab saw to omit overheating of metal from the most ruined part of the cannon. (picture 1b)

The microstructure was examined with metallographic microscope MMT-14C magnifying the sample 100 and 500 times. The microstructure was recorded with an eye lens camera LCMOS14000KPA. Specimens for micro-analysis were fastened to frames with self-curing base rasin «Duracryl ® Plus» (picture 2). The surfice of the specimen was ground with abrasive paper and then polished with diamond pastes. [8].
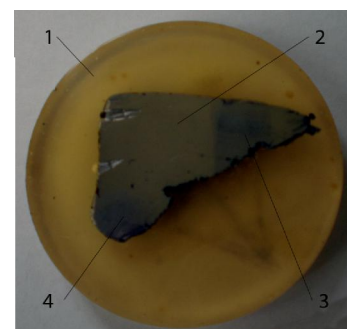
Picture 2. Specimen for microstructure analysis :
1– self-curing base rasin «Duracryl ® Plus»;
2 – microsection; 3 – acid etched surface towards barrel bore; 4 – acid etched surface of the thread

In the course of polishing diamond pastes were changed in the following order:

ACM40/28 → ACM14/10 → ACM7/5 →
→ ACM5/3 → ACM3/2 → ACM2/1

Aiming to detect phase and structural state, the polished surface of the microsection was chemically contrasted with Nital etching reagent (a 4 % solution of nitric acid HNO_3 and ethanol C_2H_5OH) [3;9]

Line arrangement of slag inclusions were detected in the unetched microsection (picture 3a). They go parallel to the barrel long axis. Distance between the lines of slag inclusions is 600 …700 μm and it is almost equal along the whole barrel width. Close to the front edge consistent order of slag inclusions is disturbed (picture 3b) which could relate to metal deformation peculiarities in the course of the item production by open die forging method. Unetched microsections do not show any disruptions of metal integrity in the form of cracks, exfoliation and other defects which could have considerably changed mechanical and exploitation properties of the cannon material.

a   b
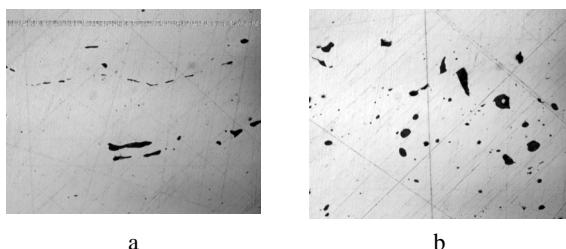
Picture 3. Slag inclusions

After chemical contrasting of microsection surface with Nital etching reagent, it was detected that metal structure of the cannon is peculiar for carbon steel that is it consists of ferrite and perlite (picture 4 a,b)

a   b
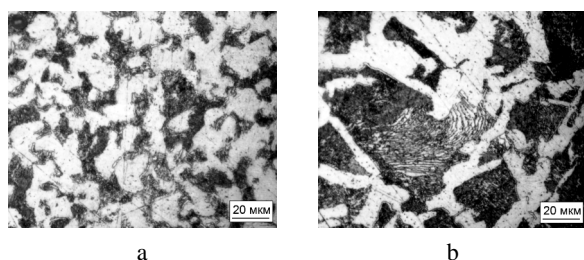
Picture 4. Metal structure

Moreover, slightly deeper from the outer surface (approximately 600 μm) there was detected negligible decarbonization which could have been caused by long-lasting holding of the aready produced item at the temperatures of above 900 °C during the final stage of the production operation. Under the decarbonized layer there is an equiaxed ferrite and perlite structure (picture 4a). Equiaxed grains testify about full completion of recrystallization processes after hot shaping of forging. Perlite of grain structure more often locates on the ferrite

grain junction lines. Correlation between ferrite and perlite in the structure of this section is estimated according to standard state scales ГОСТ 8233–56 and equals to $\frac{35}{65}$ that corresponds to the quantity of carbon approximately 0,28 %.

At the depth of nearly 5.3 mm from the surface, under equilibrium structure there was detected a 3mm layer with defected Widmannstatten structure (picture 4b). This structure results from the disruption of heating and cooling regimes of blanks by hot-forming method (forging). The structure is characterized by abnormal acicular structure of ferrite grains which grow through perlite grains [2;7]. As a result of this structure, mechanical properties catastrophically deteriorate and this concerns impact value in particular.

This defective structure must have substantially slackened hardness of one of the three plates which were used for barrel cannon production by the forging method. This might have ruined the breeching part of the examined cannon.

Conclusion

1. It was detected that the cannon was produced with help of three plates by the hammer-welding method.

2. Microstructural analysis ascertained that structure of the examined plate is characteristic for malleablized (carbonized) packet iron.

3. The microstructure contained considerably thick segments of Widmannstatten structure which significantly slackened hardness and impact value of material and could be the possible reason for cannon ruining.

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System of Detection and Scanning Bar Codes in Panoramic Images on Raspberry PI

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Abstract. This work is focuses on the problem of detecting and scanning bar codes in panoramic images. The block diagram of a system identifying bar codes in panoramic images using Raspberry PI. The program algorithm of the system detection and scanning bar codes in panoramic images for Raspberry PI were proposed. It is established that systems can be used in industry, medicine, and in the control system.

Keywords – Raspberry PI, bar code, structural scheme, algorithm, program, OpenCV.

I. Introduction

Bar code is a sequence of black and white stripes containing certain information in a suitable form for reading by technical equipment. Bar codes were widely used. Baare codes are using as the key index for access to the database. But traditional one-dimensional bar codes allow only one-axis scan for which values only have widths of strokes and intervals. Requirements of introducing bar codes dictated by the extremely high volume of deliveries, territorial dispersion of interdependent organizations and enterprises lack information about product features on the packaging and accompanying documents. Today the most commonly in using are linear barcodes for reading information [1]. Panoramic photography can take pictures from 180^0 and more, so it can capture at this frame a large number of products with bar codes. Then, these images will be scanned and recorded in the database. Then you can run other bar codes in the frame [1,2].

II. Structural scheme of the system

To solve the problem, it is necessary to develop a structural scheme (Fig. 1). In this structural scheme is most appropriate to use Raspberry PI (unicameral computer).
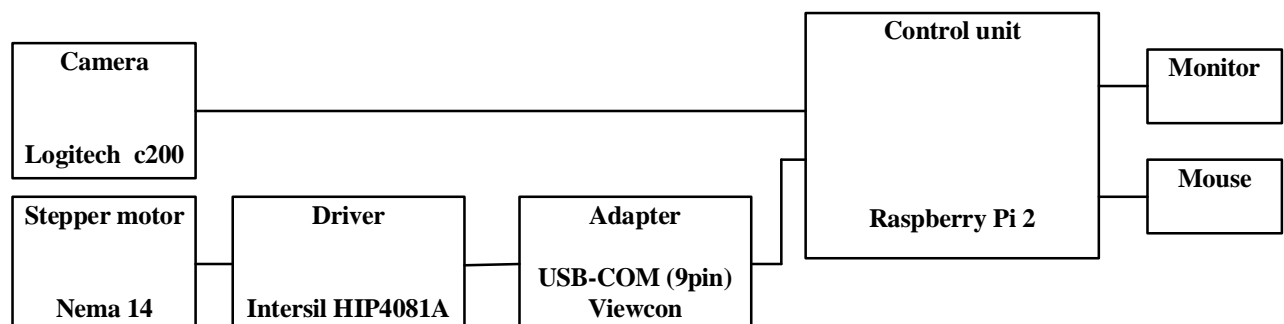
Raspberry PI has the following features: processor ARM Cortex-A7, 900 MHz, number of core 4, RAM 1 GB, number of ports 4, Ethernet port. In addition to Raspberry PI board in the scheme provided the stepper motor Nema 14, driver Intersil HIP 4081 that provide this engine in action. Also adapter uses for communication between the board the Raspberry PI and Driver Intersil HIP 4081. For shooting the panoramic image using a webcam, which is attached to the stepper motor. Also Raspberry PI board connected to the monitor and to the mouse. Raspberry PI is similar to Linux, so you can record a program on the board and this system will successfully perform its functions without a computer. For the successful work of the structural scheme of the system, it is necessary to develop an algorithm for the program. This task is completed and presented on (Fig. 2.). For this purpose used library OpenCV, which used to work with digital photos and video stream. [3] Algorithm includes following steps. First of all, our system required a panoramic image, a panoramic picture is composed of several images. The number of pictures is chosen in a program, then stepping motor rotates the camera and run specified number of shots. The next step is to compare a given number of steps with the already passed, if these numbers are the same, then all the pictures are taken and you can begin to glued them. Snapshots may not stick together unless there is a need for common endpoints. Further, if the image is successfully glued can see a ready-made image. At this stage, the task of panorama shooting ended, the next step is to find and recognize bar codes on an image. First we transform the image to black and white for a successful search bar codes on the image. After the black and white panoramic photos was made bar codes can be recognized and scanned.. Recognition results are displayed and written to the file.[3,2].

III. Results and Disscusion

After creating a search and recognition system bar codes for panoramic images, studies to determine the optimal conditions for proper system work. Studies were conducted using cameras with different resolutions 5, 10, 15 Mpx and at different distances. Then the expirement was conduct. Main aim was to find optimal distance.

Fig.1. The structural scheme of system

Fig.3. Depending on the time of scanning from distance to object.

To identify the optimal parameters used two parameters, namely the distance to the subject and time for the scanning. The results of the study are shown in Fig.3.

The diagram shows that for cameras with different resolutions most optimal distance for scanning is 30 cm. This scanning with camera resolution of 5 Mpx is 6 seconds for the camera 10 Mpx – 3 seconds for the camera 15 Mpx – 2 seconds. Speed depends on the resolution of the camera .

Conclusion

The structural scheme of detection and scanning bar codes in panoramic images for Raspberry PI, and the algorithm of the program is the best option for proper system work, the optimal distance is 30 cm for identification and recognition, speed depends on the resolution of the camera.

Acknovledgement

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Fig.2. Algorithm for system's program.

Making answer algorithm for chat-bot

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Abstract –This paper explores pro and cons of existing chat-bots and investigate methods of their improvement. Particularly, is proposed usage of Rabin-Karp and Knut-Pratt algorithms for making answer to user and is demonstrated their effectivity.

Keywords: chat-bot, hashing, prefix-function.

I. Introduction

A robot or bot, as well as an internet bot, a www-bot, etc., is a special program that performs automatically and / or on a given schedule of any action through the same interfaces as an ordinary user. During the discussion of computer programs, mainly used for internet. Chat-bots take a significant part in our life. Therefore, we started exploring the most used bots and found a disadvantage. The aim of the paper is the recognition of user's gender for making chat-bot's answer more human likeness

The purpose of the work is to develop an algorithm for analyzing and parsing the user's text for automatically generating the response of the chat bot, taking into account the topics of correspondence and morphology of the text. The algorithm's work will be based on prefix function and hash function. Also, a comparison of the developed algorithm with the existing ones will be made.

II. Existing bots

Bots which are using push-button interface to give the answer are the most common. However, the subject of our research is the bots that "understand" the natural language (with the nature language interface). The best online artificial intelligence (AI) online chats- Mitsuku, Rose, Poncho, Right Click, Insomno Bot, Dr. AI та Melody.

1. Mitsuku is one of the best bot in AI. Also is the current Laurel Laureate of Loebner. The Loebner Prize is an annual competition for methods of artificial intelligence, which defines intelligence that is most similar to human. Competition format is a standard Turing test [2]. This bot can talk about something, unlike other ones, done for a specific task.
2. Rose. The ChatBot, which won the Loebner Prize in 2014 and 2015 [3].
3. RightClick. Launches a program that creates websites. He asks general questions during the conversation: "What is the area of your interests?" and
4. "Why do you want to create a website?" Based on the analysis of the replies received, the chat bot creates custom templates. Quite adequately responsive to non-site-related topics [4].
5. Poncho is a meteorological specialist. He sends notifications at least twice a day with the user's consent and is smart enough to answer such questions as "Should I take an umbrella today?" [5].
6. Insomno Bot is designed for "night owls". This applies to all people with sleep problems. This bot has the ability to keep conversation on any topic [6].
7. Dr. AI bot asks for symptoms, body parameters and disease history, then lists the most and least likely causes of the symptoms and sorts them in order of severity [7].
8. Baidu melody. This application collects medical information about people, and then passes it to doctors in a form that facilitates their use for diagnostic purposes [8].

III. Used methods

The prefix function [9, 10] of the string π (S, i) defines the length of the largest prefix of the string S [1..i], which does not matches this line and at the same time is its suffix. It is the length of the longest beginning of a line, which is also its end. For line S it is convenient to represent a prefix function in the form of a vector of length |S|-1. You can consider the prefix-function of the length |S|, putting π (S, 1) = 0. Example of the prefix of the function for the line «abcdabcabcdabcdab»:

•S[i]¤	a¤	b¤	c¤	d¤	a¤	b¤	c¤	a¤	b¤	c¤	d¤	a¤	b¤	c¤	d¤	a¤	b¤
•π(S,i)¤	0¤	0¤	0¤	0¤	1¤	2¤	3¤	1¤	2¤	3¤	4¤	5¤	6¤	7¤	4¤	5¤	6¤

Hashing [11] is converting an array of input data of arbitrary length (an array of rows) into (output) a bit string of fixed length executed by a certain algorithm. A function that implements an algorithm and performs a convertion is called a hash function or a convolution function. Output data is called an input array, key, or message. The result of conversion (output) is called Hashing is used in the following cases:

• for building associative arrays;
• to find duplicates in series of data sets;
• for constructing unique identifiers in data sets;
• to calculate checksums from the data (signal) for further detection of errors (which occurred accidentally or intentionally) that arise during storage and / or transmission of data;
• to store passwords in security systems in the form of a hash (for the password recovery for the hash code you need a function that is inversed to the used hash function);
• for the development of an electronic signature (in practice, not just the message, but its "hash-image") is signed, etc.

IV. Proposed method

The algorithm of the chat bot will consist of searching for the keyword (words) of the conversation and the formation of the person's termination of the verb.

We search for a keyword by means of hashing. To do this, we use the calculation formula:

$$h(S) = S[0] + S[1] * P + S[2] * P\,2 + \; + S[3] * P\,3 + ... + S[N] * P\,N,$$

where P is a simple number. Choose P, which is approximately equal to the number of characters in the input alphabet. For example, if the strings are composed only of small Ukrainian letters, then the good choice will be P = 37. We use the Rabin-Karp algorithm to search the substring in the string for O (N).

Let the text of user is T and line S in it, consisting of small Cyrillic letters, are given. It is necessary to find all occurrences of the line S in the text T for the time O(|S| + |T|). The keyword search algorithm consists of the following steps:

1. Let's count the hash for line S.

2. Let's count the hash value for all prefixes of line T.

3. We will choose all subclasses T of the length |S|. Each of them can be compared with other lines of length |S| in time O(1).

When the keyword has been found, you must define the individual verb ending. So, we try to find the verb as the word located before or after the keyword found. We test the ending using a prefix function: by Knutt-Pratt algorithm., which does not contain explicit line comparisons and is executed for O (n) actions. Here is an algorithm scheme:

1. We will count the value of the prefix function π [i] for i ∈ [1..n-1] (π [0] = 0).

2. To calculate the current value π [i], use the variable j, which indicates the length of the current sample considered. First j = π [i-1].

3. We test a sample of length j, for which we compare the characters s [j] and s [i]. If they are the same, then we consider π [i] = j + 1, i: = i + 1. If the characters are different, then we reduce the length j, assuming it is equal to π [j-1], and repeat this step of the algorithm from the beginning.

4. If we have reached the length of j = 0 and so did not find the same characters, then stop the sampling process and consider π [i] = 0, i: = i + 1.

V. Advantages of proposed method

Due to big complexity of well-known algorithm they are not as effective as we wish. According to this, we propose usage of Rabin-Karp and Knut-Pratt algorithms, due to their effectivity. In consequence of hashing we reduce a quantity of comparison which let the algorithm works faster. To add, we can find special endings with linear complexity. Results of research can be used not only for chat-bots and also for finding keywords in the text.

An aggregated comparison of algorithms is given in Table 1.

As you can see, the developed algorithm does not dominate only KMP-search in the case when we immediately find the required sample.

TABLE 1

COMPARISON OF ALGORITHMS

Algorithm	Complexity
Developed algorithm	$O(|S| + |T|)$
Linear search	$O((T-S + 1) * T)$
KMP-search	from $O(|S| + |T|)$ to $O((T-S + 1) * T)$
LSA	$O(n^2 k^3)$, n=$|S| |T|$
SVM with tf-idf scheme	$O(|Q||S||T|)$

Conclusion

After analyzing existing methods, we see that the complexity of the developed algorithm for finding keywords is less than of well-known algorithm. Using the prefix function to form a bot response allows you to work with Cyrillic texts. The proposed algorithm improves work of chat bots, which determines the gender of the interlocutor. This brings the bot closer to the level of human conversation.

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Approach To Implementation On Fpga Of Data Compression Algorithm C Language Descriptions By The Means Of Vivado Package

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Abstract – The features of devices for monochrome images lossless compression by JPEG-LS method in modern element base are discussed. Capabilities of Vivado package (Xilinx) for JPEG-LS algorithm C- to suitable for implementation in FPGAs VHDL-descriptions transformation were tested and described. C language structures, which can not be processed by specified means and possible circumvention of such structures were defined.

Keywords: lossless compression, FPGA, JPEG-LS, software implementation, hardware implementation.

I. Introduction

The possibilities of the Vivado package (Xilinx ~~file~~) for converting the existing description of the algorithm JPEG-LS in C language into VHDL descriptions suitable for implementation in the FPGA are described in the paper. The C language constructs which can not be processed by the indicated tools are defined. Also possible ways of bypassing such structures are defined. The hardware implementation of image compression using the JPEG-LS method is less flexible than software and requires specifications in the size of the data to be processed. Also, unlike the program, the future FPGA compression unit has to processes the video stream of data, rather than individual images, which adds specification to the implementation method of such a device. Such units are used in security systems, systems for collecting information, satellite, underwater and other systems of photo-video surveillance, as well as in astronomical instruments and telescopes.

II. Development of the hardware implementation of the jpeg-ls method by means of Vivado

There is a well-known software implementation of the algorithm JPEG-LS [3], which allows you to make changes to the algorithm of work, to model its work and to determine the characteristics of the method. Also well-known example [1] of successful hardware implementation of the compression node on the FPGA by the JPEG-LS method exists and the means [2], which allow the conversion of C-descriptions into VHDL descriptions, are suitable for the development of FPGA topology.

The aim of the work is to explore the possibility of using existing and custom-made C-descriptions of compression algorithm and the means of their transmission in VHDL descriptions to create the topology of an FPGA, which satisfies the requirements of customers.

C-descriptions that were not created for implementation to FPGA were used. The main task to be solved for a successful hardware implementation of jpeg-ls v2.2 is to adapt the existing C-code for its use in the Vivado HLS environment.

To do this, a project is created in the Vivado HLS environment, which contains all jpeg-ls v2.2 program files.

When creating a project, you must specify the main function of the project (in this case it is main ()) and choose or create a test-bench file to verify the program's performance.

At this stage of the work there are serious complications, because the code implementation and code that can process and synthesize Vivado HLS, are significantly different.

In particular, during synthesis the C / C ++ constructs that are not synthesized by Vivado HLS should be eliminated or replaced. Such constructions are described below.

III. System calls

System calls can not be synthesized because they are actions that are related to the execution of some queries from the operating system in which the C program runs.

Vivado HLS will automatically ignore frequently used system calls that are used only to display data and have no effect on the execution of the algorithm (for example, printf () and fprintf (STDOUT)), so system calls can not be synthesized and should be removed from code (functions) before synthesis.

Other examples of such calls are getc(), time(), sleep(), etc., which make requests to the operating system.

IV. Dynamic memory usage

Any system calls that control the allocation of memory in the system, such as malloc (), salloc (), and free () use the operating system memory resources which are created and released when the program is running.

For hardware synthesis, such constructions should be modified so that they become completely autonomous, with precisely defined by all necessary resources.

System requests for memory allocation should be removed from the code before the synthesis. However, since the dynamic allocation of memory is used to implement the functional units of a project, it must be transformed into equivalent representations that are to be synthesized.

V. Recursive functions

Recursive functions can not be synthesized. This also applies to functions that can create endless recursion.

There are also certain limitations when using pointers. The pointer definition is not supported in the general case, but is supported for internal types in C.

During the synthesis of the jpeg-ls v2.2 codec, 23 designs were identified, which were discussed above and should be replaced for successful synthesis of the VHDL description.

Errors occur when working with external files, system calls such as clock, putc, and dynamic memory usage functions.

The first step in eliminating these errors is to clearly identify the working file name and avoid entering the initial information (parameters) from the command line.

With hardware implementation, it is not possible to choose a filename because the information will be received continuously and will be compressed only with one scenario.

The code should be modified so that the compression does occur without the input of parameters from the keyboard. Therefore, in the C-description, you must specify a file name and remove the keyboard-name input that is not already necessary. By highlighting the problematic constructions of the code with the __SYNTHESIS_ macro, you can achieve code synthesis, but also loss its functionality.

As the result of the Vivado synthesis, HLS generates three groups of files in different hardware description languages – VHDL, Verilog, and SystemC.

With this approach, the functionally reduced VHDL code is created since the constructs that can not be synthesized by the Vivado HLS package were removed from the source code.

The result of the synthesis allows further research (review of the code itself and the technological scheme that corresponds to it) with the standard tools of designing the topography of the FPGA, that is, allows you to work out the full design technology.

After successful synthesis of the created vhdl-description you can view the RTL and technological scheme of the project.

VI. Further research direction

The results allowed us to determine the areas of C-descriptions that can not be processed by any tools of the Vivado HLS package.

The found parts of the code were removed from the descriptions with the help of macros __SYNTHESIS__, which allowed to completely pass the process of creating the topology of the FPGA from the original existing description in C.

The next step is to replace the source code segments with such descriptions that can be processed by means of the Vivado HLS package, as well as the creation of technological tools that can automatically search for certain problematic areas in the original C-descriptions, followed by their automatic replacement (with the possible participation of a person) to equivalent descriptions that do not violate the algorithm's operation and are processed by tools of the Vivado HLS package.

Conclusions

In this work we tested the implementation of the algorithm with the tools of the Vivado HLS package (Xilinx) with the transformation of existing descriptions of the C algorithm into VHDL descriptions, suitable for implementation in the FPGA. Constructs of the language C, which can not be processed by the indicated means, and provided methods for correcting the initial descriptions language C were defined.

Complications in working out existing C language descriptions arise when data streams and files, dynamically distributed memory, system calls and pointers are in the program.

Due to the isolation of problematic areas, a functionally limited VHDL description is created, which allows to run a complete technological path to create an FPGA topology.

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The model of software execution time remote testing

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Abstract – The work deals with the problems of testing embedded systems in the case when the latter are geographically distributed, which is gradually getting more common. The analysis of the application domain has revealed the lack of information concerning remote testing of the execution time of an embedded system. The authors have investigated into the possibility of evaluating the duration of time-critical functions of a distant embedded system. We've introduced a model and an algorithm for measuring the firmware execution time remotely that sustained approbation with a number of experiments.

Keywords – execution time testing, worst-case execution time, embedded system, Keil uVision, UVSOCK.

I. Introduction

Software engineering in general and quality assurance in particular are constantly evolving, with the latter have been providing sophisticated methods, processes and tools for testing software no matter how complex it might be. Meticulous quality assurance of modern software assumes unit testing, integration testing, and other reputed approaches. Most of these methods are not easy to apply to embedded systems because of the specific nature of such systems, their hardware restrictions and the fact that the firmware execution depends on the performance of all the peripheral devices included into any embedded systems which makes the behavior of the latter less determined due to the fact that the latency of peripheral devices might be arbitrary to some extent. Besides, many functions of embedded systems are not supposed to be tested by software engineers, because typically an embedded system being developed is a part of some larger system that is resided in a distant place and thus is not available during the phases of developing and testing. Hence, in order to check whether the embedded system being developed works properly, they use various simulators.

The fact that the whole embedded system cannot be fully accessed caused evolution of static methods for testing the software execution time. These methods do not assume the actual execution of the software being under evaluation either in hardware or in simulator. The input data for these methods may be presented by the source code and, in addition, by the hardware architecture model. The difficulties of using static methods for analyzing software execution time are as follows: the results might be and typically are too pessimistic, besides, creation and analysis of hardware models are time-consuming. As a result, the system gets excessively backed-up.

These problems are addressed by a number of software execution time testing methods [1-4], the efficiency of which has been proved when testing real embedded systems. However, such methods are not intended for remote testing.

In order to solve the problem of testing a remote embedded system the authors of [5] have proposed the architecture of a tool that gives the possibility to test a system via TCP. The proposed tool allows its users to access all the resources of an embedded system, test the latter automatically and archive the testing results. The developed tool is effective for integration testing but not applicable for software execution time testing. Since embedded systems are typically hard real-time systems, careful evaluation of software execution time is of primary importance.

All the above-mentioned leads to the idea of investigation into the possibility of remote testing software execution time directly in an embedded system being subjected to quality assurance.

II. The model of remote testing process

The model of remote testing process assumes that a client-server architecture, shown in Fig. 1, should be used.
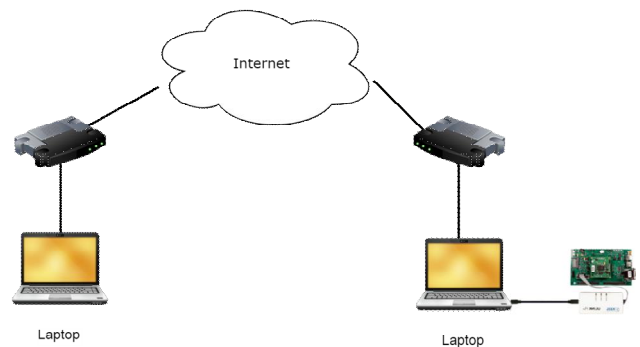

Fig.1 The model of software execution time remote testing process

A server might be a personal computer which is connected with an embedded system being tested via a programmer. A TCP server created by Keil uVision, allows the QA engineers to use standard integrated development environment's features including variables watch and control, breakpoints, controlling the code execution in a debug mode, etc. A client is a personal computer, which executes the testing algorithm, sends test data and instructions to the server, and measures the software execution time. Keil uVision's tools are accessed via API uVision Socket Interface [6].

III. Testing algorithm

The developed algorithm assumes that the software execution time is to be measured using two breakpoints, one at the beginning, another at the end of the code fragment being tested. The time elapsed between two breakpoints should be measured. The remote testing algorithm is shown in Fig. 2
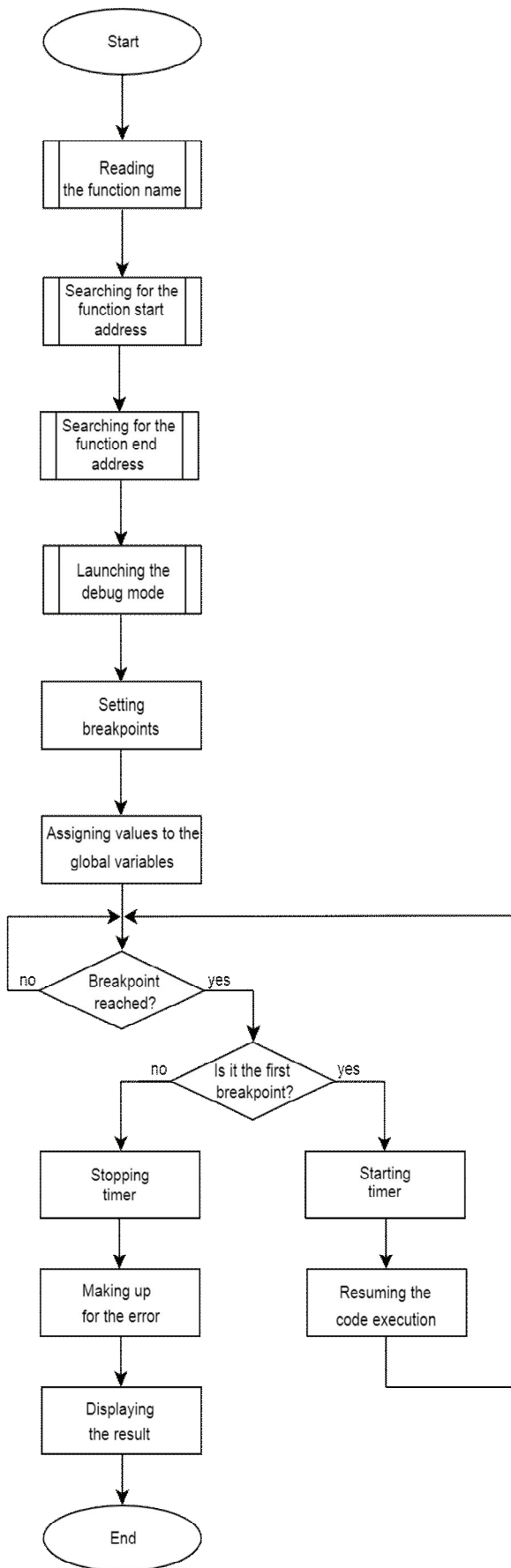
Fig.2 The block diagram of the algorithm of software execution time remote testing

Step 1. Reading the name of the function the execution time of which is to be tested.

Step 2. Seeking for the address where the assembler-like code of the function is placed in the embedded system's program memory. At this step we perform syntax analysis of the map-file auto-generated by the IDE during compilation along with other auxiliary files. Any map-file contains the names of all the functions included into the assembly, and the names of all the global variables along with the addresses indicating where these variables reside in RAM. In the case if no traces of the function have been detected in the map-file, the algorithm sends a corresponding message to the user interface.

Step 3. Seeking for the end of the function. This step requires syntax analysis of the listing file, another file generated during compilation. The file contains a C-language code and its assembler-like "translation".

Step 4. Setting up Keil uVision in the debug mode and starting the firmware execution in a real embedded system.

Step 5. Setting up breakpoints at the function's beginning and ending addresses. When entering into a breakpoint the integrated development environment Keil uVision which serves in this case as a TCP sever generates an event. The event causes the corresponding callback-function to be invoked on the client side. The callback function is the most significant part of the proposed algorithm since it's the very function responsible for measuring the execution time of the function being tested.

Step 6. Assigning such values to the corresponding global variables that would cause control flow to the function to be tested.

Step 7. When entering into the callback-function indicating that some preset breakpoint has just been reached, we start the timer in order to measure the code execution time.

Step 8. Sending an instruction prescribing that the program should resume its execution.

Step 9. When the callback-function is triggered again (because the breakpoint corresponding to the end of function has been reached), we stop the timer, define the error of program execution time measurement, make up for it and show the result. The nature of the error and the ways of compensation for it are described in the next section.

IV. Measurement inaccuracy

The error of program execution time measurement is a sum of methodological error and the random error. The methodological error is caused by the measurement algorithm and can be defined by (1).

$$t_A = t_{Start} + t_{CHO} + t_{Stop} \qquad (1)$$

where t_{Start} is the execution time of the function that resumes firmware in the embedded system;

t_{CHO} is the duration of the procedure that checks the number of the breakpoint which caused invocation of the callback-function.

t_{Stop} the execution time of the function stopping the timer used for measurements.

In order to define the methodological error we evaluate the computational complexity of each algorithm's working stage that affects the total duration:

$$O_A = O_{Start}(2) + O_{CHO}(1) + O_{Stop}(2) \qquad (2)$$

where $O_{Start}(2)$ is the computational complexity of the function that resumes the firmware in the embedded system.

$O_{CHO}(1)$ is the computational complexity of the procedure that checks the number of the breakpoint which caused the invocation of the callback-function.

$O_{Stop}(2)$ is the computational complexity of the function that stops the timer.

In accordance with the performed calculations of the computational complexity we determine the methodological measurement error using the formula $t_A = O_A(5)/N$, where N is the amount of instructions per second (for a personal computer).

The random error is caused by the delay of transmitting data via the Internet:

$$t_N = t_{StartN} + t_{BP} \qquad (3)$$

where t_{StartN} is the duration of sending the instruction, prescribing that the remote embedded system should resume executing its firmware, via the Internet;

t_{CHO} is the duration of sending the instruction, telling the remote embedded system that it should invoke the callback function, via the Internet;

The duration of transmitting any instruction via the Internet is a random value that is comprised of the delay of signal transmitting, the delay of processing it in network nodes, and the delay in the receiving buffers [7, 8].

In order to find out the delay of sending packages between personal computers via the Internet, we use Ping utility.

The software execution time is calculated as:

$$t_{EX} = t_M - t_A - t_N \qquad (4)$$

where t_M is the measured software execution time.

VII. Experiments

In order to investigate into the proposed remote testing algorithm experimentally we've implemented the latter in the form of a separate software unit written in C#.

Experiments were conducted using two personal computers Lenovo W520 including processors with the clock frequency of 2.2HHz and RAM 8 GByte and a real-time embedded system running under control of STM32F407 microcontroller with the clock frequency 8 MHz.

The function chosen for testing was the implementation of the bubble sort algorithm (Fig. 3).

```
void bubblesort(int *a, int n)
{
 for(j = 0; j < n - 1; j++)
 {
  for(i = 0; i < n - 1; i++)
  {
   if (arr[i] > arr[i + 1])
   {
    tmp = arr[i];
    arr[i] = arr[i + 1];
    arr[i + 1] = tmp;
   }
  }
 }
}
```

Fig.3 The function implementing the bubble sort algorithm

The choice of an algorithm, implementation of which was to be tested, can be attributed to the following facts: the algorithm is well-known and fully researched, it has relatively low computational complexity (N^2) and the time of its execution depends solely on the amount of instructions per second for the specific microcontroller.

We've tested the bubble sort algorithm on an array of 100, 200, 500, 1000, 2000, 5000 and 10000 items.

The results of testing the execution time of the function that implements the chosen sort algorithm performed on different amounts of input data are summarized in Table 1.

TABLE 1

THE TESTING RESULTS

№ of items	Calculated execution time, s	Measured execution time, s	Average Ping, s
100	0,00125	0,00349	0,035
200	0,005	0,0063	0,041
500	0,03125	0,034275	0,52
1000	0,125	0,127	0,045
2000	0,500	0,504	0,045
5000	3,125	3,144	0,055
10000	12,500	12,514	0,054

The dependence of the relative measurement inaccuracy on the execution time of the function implementing the sort algorithm is depicted in Fig. 4.
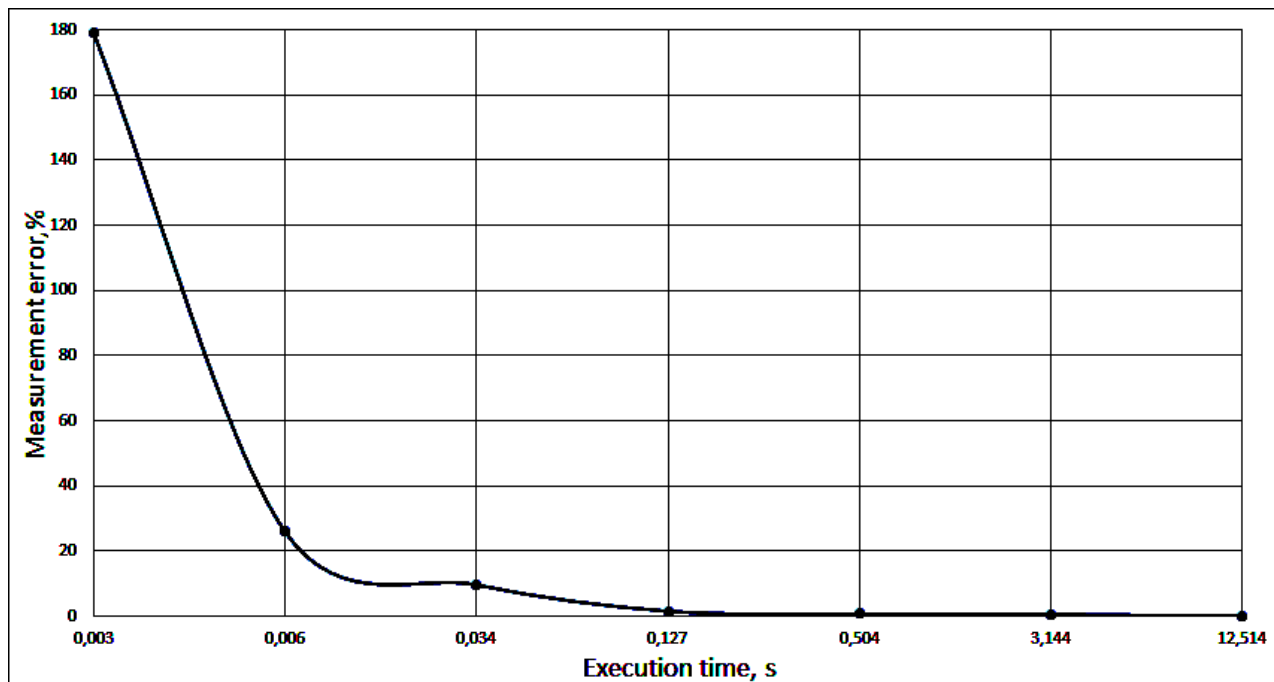
Fig. 4 The dependence of the relative measurement error on the function's execution time

Conclusion

Upon the proposed model and algorithm of software execution time remote testing we've investigated into the possibility to test embedded systems remotely in practice.

Having performed a number of experiments we researched the influence of delays in sending data via the Internet on the obtained results. It has been detected that measurement of delays in sending five packages and averaging the results cannot provide a sufficient accuracy for compensating for the measurement error. This fact can be attributed to the delays' being of arbitrary nature and their dependence of the network route selected for packages being sent and of the readiness of network nodes to process packages.

The performed investigation into the relative measurement error has proved that the error increases when the execution time of the function being tested reduces. This means that the developed algorithm is reasonable to use when testing time-consuming threads and functions.

In order to reduce the relative measurement error it's reasonable to use auxiliary algorithms that force the choice of the route for sending packages to the remote embedded system via the Internet, for network technologies allow us to select a fixed route. This would narrow down the amount of factors contributing into the random part of the measurement inaccuracy and make the averaged delay of sending a package more relevant.

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The Heat Treatment Influence on the Main Quality Indicators of Ag/n-n$^+$GaAs Heterojunctions

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Abstract − The effect of heat treatment on the parameters and characteristics of Ag/n-n$^+$GaAs heterojunctions is studied. Various methods for the Schottky barrier height and the nonideality factor determining have been examined and tested. The most accurate method for determining the heterojunction parameters using the current-voltage characteristic was found.

Keywords − heterojunction, current-voltage characteristic, barrier height, nonideality factor, silver.

I. Introduction

The study of silver-gallium arsenide heterojunctions is carried out in the direction of the technological regimes development which can improve the qualitative characteristics of microwave devices with Schottky barriers [1, 2]. Comparing to gold, silver has a higher thermal and electrical conductivity, a relatively small diffusion coefficient in gallium arsenide, which allows to reduce the transition layer thickness.This should improve the products technical characteristics. Therefore, the technological regimes development to manufacture improved silver based GaAs heterojunctions is relevant from a scientific and practical poinst of view.

The aim of current work is to determine the heat treatment influence on the real current-voltage characteristics, the Schottky barrier height φ_b and the nonideality factor η of the Ag/n-n$^+$GaAs heterojunction.

II. Matherials And Methods

For the study, n-n$^+$GaAs (111) B epitaxial monocrystalline was used, the epitaxial layer thickness was 2 μm, the donor concentration was $N_D=2\cdot10^{16}$ cm^{-3}. The GaAs substrate was degreased in a mixture of toluene and methyl alcohol (1:2), treated in H_2SO_4:H_2O_2:H_2O:3:1:1 sulfuric acid etchant, followed by exposure to dioxisuccinic acid during $1.2\cdot10^3$ seconds.

According to the results of previous studies [1-2], high-purity silver is chosen as the barrier material. With GaAs it forms compounds that do not change in the operating temperature range. The contacts were made by vacuum evaporation. To measure the metal-semiconductor barrier transition current-voltage characteristics (CVC) a four-probe method has been used [3].

The thin-film structures with a Ag/n-n$^+$GaAs Schottky barrier current-voltage characteristics analysis assumed, that in the initial structures the charge carrier transfer mechanism at the free carriers concentration $N_D=2\cdot10^{16}$ cm^{-3} in GaAs is determined by thermionic emission.

Despite the fact that the basic physical processes in the Schottky barriers have been studied in [4] and [5], there are still some disagreements about the the current-voltage characteristics deviation reasons from the ideal ones. It is assumed [5] that the real metal-semiconductor barrier transitions CVC depend on the their fabrication method. One of the main qualitative indicators of such contacts are barrier height φ_b and nonideality factor η [4] and [5], however the accuracy of these parameters depends not only on the accuracy of current and voltage measurement, but also on their determination method.

The comparative analysis of the Schottky barrier height (φ_{bn}) is made of the determining methods accuracy using the CVC, based on the experimental data obtained for Ag/n-n$^+$GaAs barriers.

There are several methods for the potential barrier height φ_b determining [4,5,6]. the φ_b determining method from the CVC direct branches is one of them [4,5].

In [5] authors described the current-voltage characteristic, taking into account the limitation of the describing the steady-state CVC to four parameters (Schottky barrier height, φ, nonideality factor η, successive R_s and shunt R_p resistances) as Eq. 1:

$$I = I_0 exp\left(\frac{qV_{pn}}{\eta kT}\right)\left[1 - exp\left(\frac{-qV}{kT}\right)\right]+\frac{V_{pn}}{R_p} \qquad (1)$$

where $I_0 = A^{**}T^2 Sexp$ (-qφ_b/kT) is the saturation current, $V_{pn}=V-IR_s$ is the voltage at the metal-semiconductir transition, R_p – shunting resistor; Ohm; R_s – flow resistance, Ohm; A** – the effective Richardson constant, A·cm^{-2}·K^{-2} and S is the area of contact, cm^2.

From the Eq. 1, the conditions [5,7] were determined. There the contribution of R_s and R_p is very small (less than 1%) and they can be neglected:

The calculation of the CVC by the method proposed by Rhoderick E.H. in [5] is the simplest in the implementation. The current through the Schottky barrier is described there by the Eq. 2:

$$I = I_0 exp\left(\frac{qV}{\eta kT}\right)\left[1 - exp\left(\frac{-qV}{kT}\right)\right] \qquad (2)$$

Here V is the applied voltage, V; η – non-ideal factor; T – the environment temperature, K; q – the electron charge, Kl; k is a constant. In [7-10], the direct approximation method for the entire CVC length is proposed and described by the Eq. (1). The disadvantage of this method is the complex calculations.

III. Experiment

The current-votage characteristics of Ag/n-n$^+$GaAs heterojunctions, which were made in vacuum by the thermal evaporation method at annealing temperatures of 703...853 K and an annealing time of 6 10^2 seconds were investigated, Fig. 1.

The main parameters calculation of the produced at different temperature regimes Ag/n-n$^+$GaAs heterojunctions (Table 1) was made using the IVbarrierCalc2 program [7].

It is established that an annealing temperature increase up to 803 K gives the highest barrier height φ_b for the Ag/n-n$^+$GaAs heterojunction.
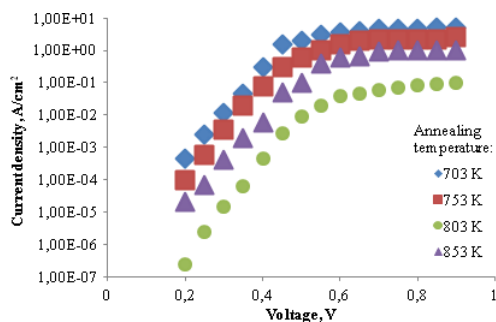
Fig.1 Direct Ag/n-n$^+$GaAs contacts current-voltage
characteristics

TABLE 1

THE Ag/n-n$^+$GaAs HETEROJUNCTIONS PARAMETERS

t_{ann}, K	The calculation method	η	φ_b, V	R_s, Ohm	e
703	direct approx.	1,254	0,773	0,21	0,28
	Rhoderick	1,20	0,783	-	0,09
753	direct approx.	1,24	0,804	0,75	0,31
	Rhoderick	1,30	0,800	-	0,44
803	direct approx.	1,08	0,983	3,70	0,07
	Rhoderick	1,10	0,979	-	0,07
853	direct approx.	1,32	0,85	1,02	0,3
	Rhoderick	1,34	0,85		0,29

IV. Discussion

A comparative analysis of the obtained nonideality factor η values (Table 1), calculated by two different methods, showed that for barrier silver to GaAs based transitions with $N_D=10^{16}$ cm^{-3}, produced by the recommended heat treatment method (the annealing temperature is 803 K, the annealing time is 6 10^2 seconds, φ_b=0.98 V), the smallest nonideality factor value of η=1,104 is obtained using the direct approximation calculation method. The [4] and [5] explain that the nonideality factor η at a low doping level ($N_D=10^{15}$ cm^{-3}) and 300 K is close to 1, but with the doping level increase ($N_D=10^{16}$ cm^{-3}), the difference of η from 1 becomes significant.

Studies show that in order to determine the height of the potential barrier for a short extension of the exponential CVC part, the direct approximation method is the most accurate, since it takes into account the series resistance and the C-V characteristic for V <kT/q.

The nonlinear φ_b nature dependence of the applied voltage appears in the displacements bounded in region between 0.44...074 V (Fig. 1), which leads respectively to a nonideality factor η change.

Conclusion

It has been established that the annealing temperature increase to 803 K gives the highest value of the barrier height φ_b for the Ag/n-n$^+$GaAs heterojunction. Using this recommended thermal processing regime forf the Ag/n-n$^+$GaAs barrier transitions (annealing temperature of 803 K during 6 10^2 seconds), the least nonideality factor value η = 1,087 was obtained by the direct approximation calculating method. The nonlinear nature of the dependence of the barrier height φ_b on the applied voltage appears in the displacement region bounded between 0.44 ... 074 V, which respectively leads to a change in the non-ideal factor η. With a short extension of the exponential region of the CVC to determine the height of the potential barrier, the most accurate direct approximation method used, since it takes into account the serial resistance and the CVC region at V <kT/q.

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Formation of identifying parameters reference values of information and psychological impact

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Abstract –The paper defines and describes the identifying parameters of information and psychological impact. There are formed reference values that are necessary for revealing the information and psychologic influence.

Informational and psychological influence, information war, benchmarks, identifying parameters, fuzzy logic .

I. Information and psychological influence identifying parameters determination

Identification of information and psychological influence allows to implement countermeasures effectively and win during the information confrontation. Therefore, arises the question about its implementation. During the research, the following basic characteristics of the IPI were identified:

- «duration of implementation of IPI» – LT,
- «stage of manifestation» – DM,
- «economic losses level» – EL;
- «percentage of the population that watches foreign TV» – PP;
- «percentage of the population that reads the foreign press» – PN;
- «level of trust in government» – CG;
- «the level of protest attitudes of the population» – PM;
- «information infrastructure development degree» – II;
- «external factors influence degree» – IF.

So, we present the set of identifying parameters for the number of investigated situations as follows:

$$IPF = \left\{ \bigcup_{I=1}^{9} IPF_I \right\} = \{IPF_1, IPF_2, IPF_3, IPF_4, IPF_5, IPF_6, IPF_7, IPF_8\} = $$
$$= \{LT, DM, EL, PP, PN, CG, PM, II, IF\}$$

II. Formation of reference values for identifying parameters

Reference values are formed according to [1] and [2].

The parameter LT is characterized by the following linguistic assessments: {short (К), medium (С), long (Д)}. Intervals for reference values determination = {[0-25], [26-50], [51-75]} days. Creating assessments summary table and basic frequencies matrix that are presented in table 1.

TABLE 1

	0-25	26-50	51-75
К	24	9	5
С	14	29	21
Д	12	19	30

Defining $v = |\ 50;\ 57;\ 56\ |$ i Max = 57

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 27,36; 9; 5,09 \\ 15,96; 29; 21,38 \\ 13,68; 19; 30,54 \end{vmatrix}$$

and maximums vector = $\|27,36\ \ 29\ \ 30,54\|$

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1; 0,3; 0,1 \\ 0,6; 1; 0,7 \\ 0,5; 0,7; 1 \end{vmatrix}$$

Supports: $T_{log11} = T_{log21} = T_{log31} = 25\ /\ 100 = 0,25$, $T_{log12} = T_{log22} = T_{log32} = 50\ /\ 100 = 0,5$, $T_{log13} = T_{log23} = T_{log33} = 75\ /\ 100 = 0,75$. After making the transformation, obtain a set of parameter reference values LT = T_{log} = {short (К), medium (С), long (Д)} and the terms of the linguistic variables for this parameter:

К = {0/0,25; 1/0,25, 0,3/0,5; 0,1/0,75; 0/0,75},
С = {0/0,25; 0,6/0,25; 1/0,5; 0,7/0,75; 0/0,75},
Д= {0/0,25; 0,5/0,25; 0,7/0,5; 1/0,75; 0/0,75}.

Graph of the membership function of the terms of the linguistic variable "The aims of IPI implementation" is shown in fig. 1:
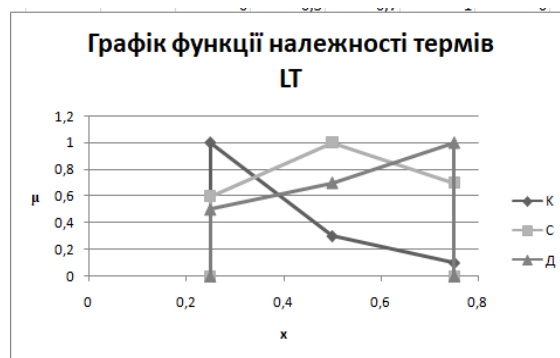

Fig. 1. Graph of terms affiliation «The aim of IPI implementation»

The parameter DM is characterized by the following linguistic assessment: {primary (П), deployed (Р), final (З)}. Intervals for reference values determination = {[0-10], [11-20], [21-30]} IPI events per year. Creating assessments summary table and basic frequencies matrix that are presented in table 2.

TABLE 2   TABLE 3

	0-10	11-20	21-30
П	14	9	4
Р	12	15	10
З	7	14	17

	0-20	21-50	51-80
М	16	8	1
С	7	12	3
В	1	5	8

Define ν= | 33; 38; 31 | and Max = 38

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 16,12;9;4,9 \\ 13,82;15;12,26 \\ 8,06;14;20,84 \end{vmatrix}$$

and maximums vector = ‖16,12 15 20,84 ‖

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1;0,6;0,24 \\ 0,86;1;0,59 \\ 0,5;0,93;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=10/30=0,33$, $T_{log12}=T_{log22}=T_{log32}=20/30=0,67$, $T_{log13}=T_{log23}=T_{log33}=30/30=1$. After making the transformation, obtain a set of parameter reference values DM=T_{log} = { primary (П), deployed (Р), final (З)} and the terms of the linguistic variables for this parameter:

П = {0/0,33; 1/0,33, 0,6/0,67; 0,24/1; 0/1},
Р = {0/0,33; 0,86/0,33; 1/0,67; 0,59/1; 0/1},
З = {0/0,33; 0,5/0,33; 0,93/0,67; 1/1; 0/1}.

Graph of the membership function of the terms of the linguistic variable Stage of manifestation shown in fig. 2:
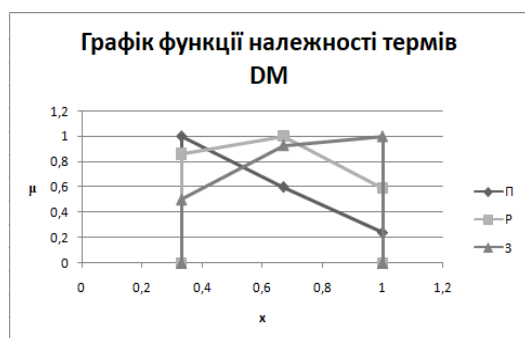

Fig. 2. Graph of terms affiliation «Stage of manifestation»

The parameter EL is characterized by the following linguistic assessment: {small (M), middle (C), high (B)}. Intervals for reference values determination = {[0-20], [21-50], [51-80]} thousands of dollars per year. Creating assessments summary table and basic frequencies matrix that are presented in table 3.

Define ν= | 24; 25; 12 | i Max = 25

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 16,67;8;2,08 \\ 7,29;12;6,25 \\ 1,04;5;16,77 \end{vmatrix}$$

and maximums vector = ‖16,67 12 16,67‖

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1;0,67;0,13 \\ 0,44;1;0,38 \\ 0,06;0,42;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=20/80=0,25$, $T_{log12}=T_{log22}=T_{log32}=50/80=0,63$, $T_{log13}=T_{log23}=T_{log33}=80/80=1$. After making the transformation, obtain a set of parameter reference values EL=T_{log} = {small (M), middle (C), high (B)} and the terms of the linguistic variables for this parameter:

M = {0/0,25; 1/0,25; 0,67/0,63, 0,13/1,0/1},
C = {0/0,25; 0,44/0,25; 1/0,63; 0,38/1; 0/1},
B = {0/0,25; 0,06/0,25; 0,42/0,63; 0,1/1; 0/1}.

Graph of the membership function of the terms of the linguistic variable "Economic losses level" shown in fig. 3:
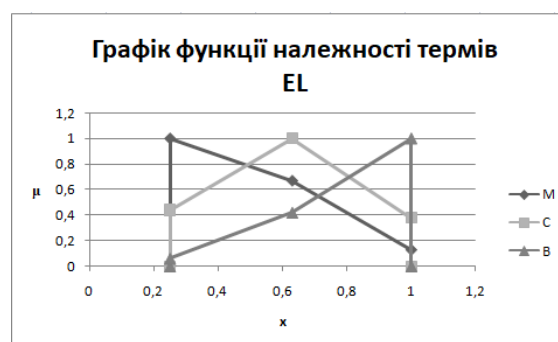

Fig. 3. Graph of terms affiliation «Economic losses level»

The parameter PP is characterized by the following linguistic assessment: {small (M), medium (C), high (B)}. Intervals for reference values determination = {[0-33], [34-66], [67-100]} percent. Creating assessments summary table and basic frequencies matrix that are presented in table 4.

TABLE 4   TABLE 5

	0-33	34-66	67-100
M	20	14	6
C	7	13	1
B	2	7	15

	0-33	34-66	67-100
M	18	11	4
C	8	12	0
B	0	7	9

Define $v = |\;29;\;32;\;22\;|$ i Max = 32

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 24,83;16;9,82 \\ 8,69;13;1,64 \\ 2,48;7;24,55 \end{vmatrix}$$

and maximums vector = $\|24,83\;\;16\;\;24,55\|$

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1;0,92;0,4 \\ 0,4;1;0,07 \\ 0,1;0,54;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=33/100=0,33, T_{log12}=T_{log22}==T_{log32}=66/100=0,66, T_{log13}=T_{log23}=T_{log33}=100/100=1$. After making the transformation, obtain a set of parameter reference values PP=T_{log} = {small (M), medium (C), high (B)} and the terms of the linguistic variables for this parameter:

M = {0/0,33; 1/0,33; 0,92/1; 0,4/1; 0/1},
C = {0/0,33; 0,4/0,33; 0,8/0,67; 0,07/1; 0/1},
B = {0/0,33; 0,1/0,33; 0,44/0,66; 1/1; 0/1}.

Graph of the membership function of the terms of the linguistic variable "Percentage of the population that watches foreign TV" shown in fig. 4:
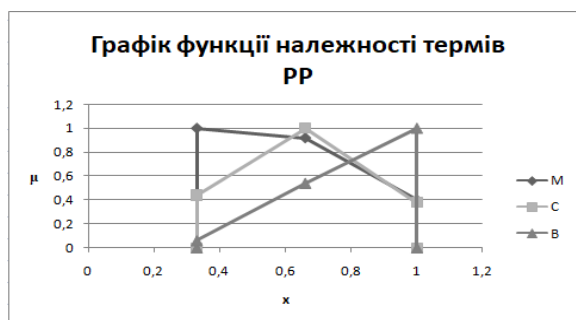
Define $v = |\;26;\;30;\;13\;|$ i Max = 30

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 22,85;14;10,15 \\ 10,15;12;0 \\ 0;7;22,85 \end{vmatrix}$$

and maximums vector = $\|22,85\;\;14\;\;22,85\|$

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1;0,92;0,44 \\ 0,4;1;0 \\ 0;0,58;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=33/100=0,33, T_{log12}=T_{log22}==T_{log32}=66/100=0,66, T_{log13}=T_{log23}=T_{log33}=100/100=1$. After making the transformation, obtain a set of parameter reference values PN=T_{log} = {small (M), medium (C), high (B)} and the terms of the linguistic variables for this parameter:

M = {0/0,33; 1/0,33; 0,92/0,66; 0,44/1; 0/1},
C = {0/0,33; 0,4/0,33; 1/0,67; 0/1},
B = {0/0,33; 0,58/0,67; 1/1; 0/1}.

Graph of the membership function of the terms of the linguistic variable "Percentage of the population that reads the foreign press" shown in fig. 5:
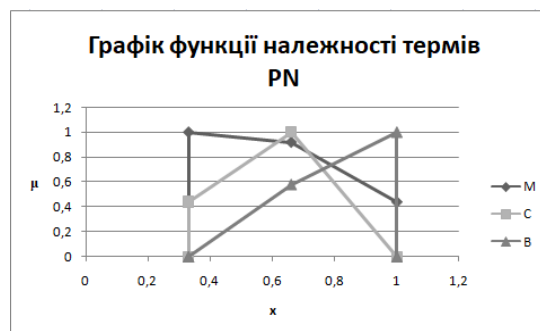

Fig. 4. Graph of terms affiliation «Percentage of the population that sees foreign TV»

Fig. 5. Graph of terms affiliation «Percentage of the population that reads the foreign press»

The parameter PN is characterized by the following linguistic assessment: {small (M), medium (C), high (B)}. Intervals for reference values determination = {[0-33], [34-66], [67-100]} percent. Creating assessments summary table and basic frequencies matrix that are presented in table 5.

The parameter CG characterized by the following linguistic assessment: {distrust (Н), partial trust (Ч), full confidence (П)}. Intervals for reference values determination = {[0-33], [34-66], [67-100]} percent. Creating assessments summary table and basic frequencies matrix that are presented in table 6.

TABLE 6   TABLE 7

	0-33	34-66	67-100
Н	29	15	6
Ч	20	25	18
П	0	5	22

	0-33	34-66	67-100
Н	24	12	8
С	10	20	7
В	3	8	18

Define $v = \begin{vmatrix} 49; 45; 46 \end{vmatrix}$ i Max = 49

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 29;16,33;6,39 \\ 20;27,22;19,17 \\ 0;9,5,44;23,43 \end{vmatrix}$$

and maximums vector $= \|29\ 27,22\ 23,43\|$

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1;0,6;0,27 \\ 0,69;1;0,82 \\ 0;0,2;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=33/100=0,33$, $T_{log12}=T_{log22}=T_{log32}=66/100=0,66$, $T_{log13}=T_{log23}=T_{log33}=100/100=1$. After making the transformation, obtain a set of parameter reference values $CG=T_{log}=\{$ distrust (Н), partial trust (Ч), full confidence (П)$\}$ and the terms of the linguistic variables for this parameter:

Н = {0/0,33; 1/0,33; 0,6/0,66; 0,27/1; 0/1},
Ч = {0/0,33; 0,69/0,33; 1/0,66; 0,82/1; 0/1},
П = {0/0,33; 0,2/0,66; 1/1, 0/1}.

Graph of the membership function of the terms of the linguistic variable "The level of trust in government" shown in fig. 6:
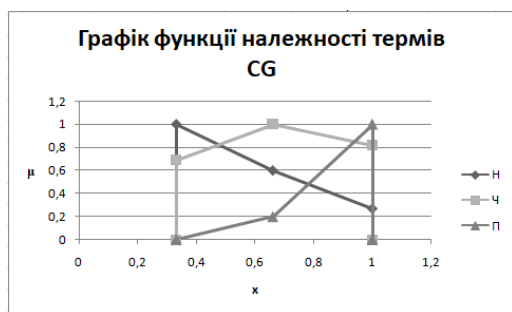

Fig. 6. Graph of terms affiliation «The level of trust in government shown»

The parameter PM characterized by the following linguistic assessment: {low (Н), middle (С), high (В)}. Intervals for reference values determination = {[0-33], [34-66], [67-100]} percent. Creating assessments summary table and basic frequencies matrix that are presented in table 7.

Define $v = \begin{vmatrix} 37; 40; 33 \end{vmatrix}$ i Max = 40

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 25,95;12;9,7 \\ 10,81;20;8,5 \\ 3,24;8;21,82 \end{vmatrix}$$

and maximums vector $= \|25,95\ 20\ 21,82\|$

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1;0,6;0,44 \\ 0,42;1;0,39 \\ 0,13;0,4;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=33/100=0,33$, $T_{log12}=T_{log22}=T_{log32}=66/100=0,66$, $T_{log13}=T_{log23}=T_{log33}=100/100=1$. After making the transformation, obtain a set of parameter reference values $PM=T_{log}=\{$low (Н), middle (С), high (В)$\}$ and the terms of the linguistic variables for this parameter:

Н = {0/0,33; 1/0,33, 0,6/0,66; 0,44/1; 0/1},
С = {0/0,33; 0,42/0,33; 1/0,66; 0,39/1; 0/1},
В = {0/0,33; 0,13/0,33; 0,4/0,67; 1/1, 0/1}.

Graph of the membership function of the terms of the linguistic variable "The level of protest attitudes of the population" shown in fig. 7:
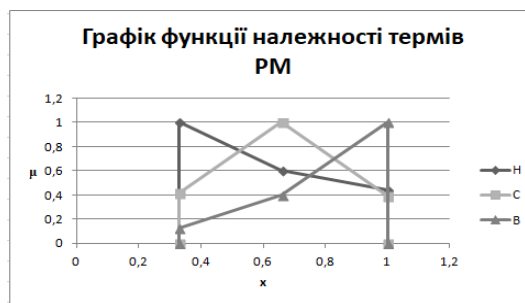

Fig. 7. Graph of terms affiliation «The level of protest attitudes of the population»

The parameter II characterized by the following linguistic assessment: {undeveloped (Н), moderately developed (С), developed (П)}. Intervals for reference values determination = {[0-5], [6-10], [11-15]} score. Creating assessments summary table and basic frequencies matrix that are presented in table 8.

TABLE 8   TABLE 9

	0-5	6-10	11-15
H	7	4	2
C	8	10	6
P	4	17	12

	0-33	34-66	67-100
H	28	15	10
C	19	32	12
B	9	12	20

Define $v= \begin{vmatrix} 19; 31; 20 \end{vmatrix}$ i Max = 31

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 11,42;4;3,1 \\ 13,05;10;9,3 \\ 6,53;17;18,6 \end{vmatrix}$$

and maximums vector = $\|13,05 \quad 17 \quad 18,6\|$

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 0,88;0,24;0,17 \\ 1;0,59;0,5 \\ 0,5;1;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=5/15=0,33$, $T_{log12} =T_{log22} =T_{log32} =10/15=0,67$, $T_{log13}=T_{log23}=T_{log33}=15/15 =1$. After making the transformation, obtain a set of parameter reference values $II=T_{log}$ = {undeveloped (H), moderately developed (C), developed (P)} and the terms of the linguistic variables for this parameter:

H = {0/0,33; 0,88/0,33, 0,24/0,67; 0,17/1; 0/1},
C = {0/0,33; 1/0,33; 0,59/0,67, 0,5/1; 0/1},
P = {0/0,33; 0,5/0,33; 1/0,67; 1/1; 0/1}.

Graph of the membership function of the terms of the linguistic variable "Information infrastructure development degree" shown in fig. 8:
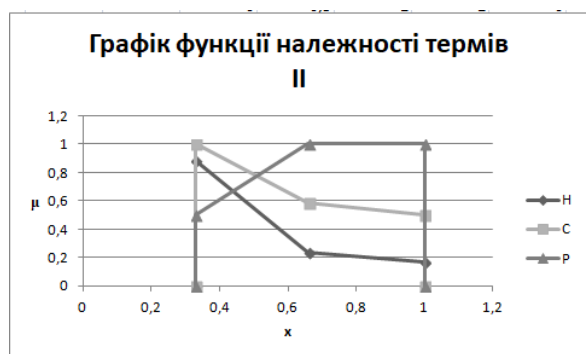

Fig. 8. Graph of terms affiliation «Information infrastructure development degree»

The parameter IF characterized by the following linguistic assessment: {low (H), middle (C), high (B)}. Intervals for reference values determination = {[0-33], [34-66], [67-100]} score. Creating assessments summary table and basic frequencies matrix that are presented in table 9.

Define $v= \begin{vmatrix} 56; 59; 42 \end{vmatrix}$ i Max = 59

Calculating the derivative frequency matrix:

$$\begin{vmatrix} 29,5;15;14,05 \\ 20,02;32;16,86 \\ 9,48;12;28,10 \end{vmatrix}$$

and maximums vector = $\|29,5 \quad 32 \quad 28,10 \|$

Calculating the matrix of supplies and reference guards for the parameter

$$\begin{vmatrix} 1;0,47;0,5 \\ 0,68;1;0,6 \\ 0,32;0,38;1 \end{vmatrix}$$

Supports: $T_{log11}=T_{log21}=T_{log31}=33/100=0,33$, $T_{log12} =T_{log22} =T_{log32} =66/100=0,66$, $T_{log13}=T_{log23}=T_{log33}=100/100 =1$. After making the transformation, obtain a set of parameter reference values $IF=T_{log}$ = {low (H), middle (C), high (B)} and the terms of the linguistic variables for this parameter:

H = {0/0,33; 1/0,33, 0,47/0,66; 0,5/1; 0/1},
C = {0/0,33; 0,68/0,33; 1/0,66; 0,6/1; 0/1},
B = {0/0,33; 0,32/0,33; 0,38/0,66; 1/1, 0/1}.

Graph of the membership function of the terms of the linguistic variable "External factors influence degree" shown in fig. 9:
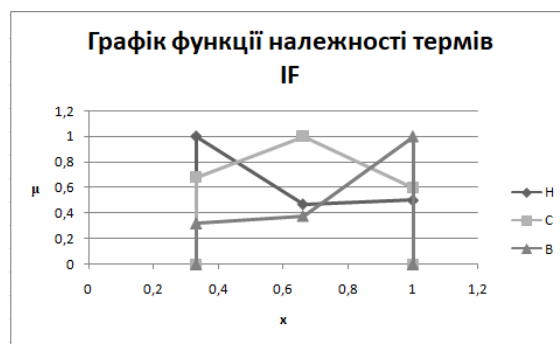
Fig. 9. Graph of terms affiliation «External factors influence degree»

Conclusions

Therefore, in order to predict the possibility of realizing information-psychological influence or to define and identify it is necessary to develop a system that will monitor the basic characteristics and, basing on heuristic rules, to reveal information and psychological influence, comparing the current values of the proposed parameters with the reference values given in this assemblage.

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Methods of solving the problem of calculation the optimal path on a given relief

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Abstract – The article substantiates the relevance and formulated the tasks that need to be solved in order to develop the mathematical background and software of the automated system of choosing a path on a given relief. An analysis of literary sources on the research issues was performed and a method for solving the problem of calculating the optimal route for a given vehicle on an cross country terrain was proposed. Directions of further work for solving the defined task are outlined.

Keywords – path choice, route, optimization methods, algorithm, cross country terrain.

I. Introduction

The greatest value in the world is human life. And any developments that make it possible to preserve and save human life are necessary and relevant.

Unfortunately, human civilization devotes a huge part of its resources to the development of devices that are designed to take away human life. Even the ancient Romans said «Si vis pacem, para bellum» ("If you want peace, prepare for war").

One of the promising directions for the development of modern weapons is the use of computerized automatic systems that are capable of solving various tactical tasks. Unmanned aerial vehicles have been widely used lately. With the help of remote control, they can solve both combat and reconnaissance tasks. Ground robots are equally important solutions. They can deal with demining, exploration, evacuation of wounded and directly combat tasks. However, the remote control in modern radio-electronic war can not solve the whole range of problems faced by combat robots. The relevant task is to develop software systems for autonomous path selection on a given relief in the absence of remote contact with the operator. However, this task has not been solved to date. Mathematical models, methods and algorithms for choosing a route are not sufficiently studied such as a multi-criteria optimization problem in the case of time deficit.

The above considerations substantiate the relevance of the chosen research topic.

II. Problem Formulation

The goal of the study is to develop mathematical background and software for system of automated choice of the path on a given relief.

To accomplish the research goal, it is necessary to solve such problems:

- to analyse the subject area;
- to investigate existing analogues of the developed system;
- to analyze existing models and algorithms for solving the problem of choosing a route and laying the route;
- to formalize the task of choosing a path on a given relief, build a mathematical model and develop algorithms for solving the problem;
- to choose the development tools and implement the developed algorithms in the form of software automated system of choosing a path on a given relief.

The object of the study is the processes of choosing a path on a given relief.

The subject of the study is the means of formal specification and methods of program realization of the task of choosing a path on a given relief.

III. Literature Overview

To date, a sufficiently large number of methods have been developed to solve the problem of laying routes: methods for solving the salesman problem [1], traffic management in telecommunication networks [1]. However, these methods are single-criteria optimization methods that must be solved in fractions of seconds [2]. In [3] was proposed a method for finding an optimal path, the program implementation of which requires several hours of work [4], which of course can not be acceptable for real-time systems.

The method of solving the problem of laying routes using a cellular automaton is substantiated in [4]. A formal description of a cellular automation and the rules for its functioning in solving the problem of finding the route of the air object movement were proposed. The solution of this problem with the use of the proposed cellular automaton is possible with the presence of obstacles in the way of movement. The conducted studies [4] showed that for this type of celluar automation it is necessary to enter indicators of control of cyclic repetitions, in particular when the machine runs all the time in the same way, for example, near the obstacle. The use of this cellular automaton allows it to be used as a basis for the development of tools for automation of decision making processes to find optimal routes in different conditions of the environment.

In [5] proposed a method that drives various types of vehicles on the road network of the different permeability in different parts of the road. The proposed method is implemented in the device that select the optimal route of maneuver. The device provides an automated selection of the optimal route for vehicles. The criterion for optimizing the route is chosen to minimize fuel and lubricants. The disadvantage of the proposed method is the lack of the possibility of laying the route in any area outside the highways.

Algorithms for the construction of optimal and quasi-optimal routes for the movement of mobile objects on rough terrain and transport networks are investigated in [6]. The algorithms for combined motion variants are

considered. It is concluded that the efficiency of the proposed algorithms is not worse than the basic Ford-Bellman algorithm and depends on the complexity of the transport graph. To construct quasi-optimal solutions, a wave algorithm with computational efficiency proportional to the number of nodes of the transport graph was proposed. The disadvantage of the proposed method is that the proposed algorithm for constructing an optimal route for mobile objects in cross country terrain requires significant computing resources, which leads to an increase in the time for processing information.

IV. Solution Methods and Future Research

To solve the problem of choosing a road on a given relief, the following method is proposed:
– to download an electronic map of the area;
– to define the start and end points of the route;
– to define the tactical and technical characteristics of the vehicle;
– to analyse the permeability of the relief with taking into account the matrix of heights, to calculate the coefficients of permeability on the basis of the tactical and technical characteristics of the given vehicle, to define the impassable zones;
– to calculate a cell size and to build a two-dimensional grid based on the vehicle's tactical and technical characteristics;
– to calculate a weight coefficients for each cell of the grid based on the coefficients of patency and the criterion of optimality;
– to exclude of impassable zones from a two-dimensional grid;
– construction of a weighted graph;
– calculating the optimal route for a given vehicle.

In further research, it is necessary to construct a mathematical model and algorithm for solving the problem of calculating the optimal route for a given vehicle on an cross country topography, to select software and to do a program implementation of the algorithm.

Conclusion

The article substantiates the relevance of the task of choosing a road on a given relief, formulates the purpose of the research, outlines the tasks that need to be solved to achieve the goal. Based on the analysis of literary sources, a method of solving the problem of calculating the optimal route for a given vehicle on a cross country terrain is proposed. Directions of further work for solving the set task are outlined.

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The Means of Building Digital Libraries

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Abstract − The information technologies of building electronic libraries are considered. The emphasis is on the application of cloud platforms for the further development of service-oriented library systems.

Keywords − electronic library, full-text document, cloud services, service-oriented library system.

I. Introduction

The formation of high-quality digital libraries is associated with the development of and use of distributed databases. An electronic library should be perceived as a type of information systems that are intended to accumulate, structure and organize large amounts of digital information with further access to it.

The electronic library, in addition to storing documents, should ensure the selection and search of the necessary information; for this purpose, global and local directories are created, the exchange of electronic documents is occured.

The purpose of this article is to explore the platforms for building electronic libraries of full-text documents.

II. Background

The problems of software and technology ensuring for the creation of electronic libraries were considered by F. Voroycky [1], A. Zvysliy [2,3], Yu. Khokhlov [4].

The basis of the electronic library is the electronic collection of electronic documents containing library materials and documents in electronic format:
• bibliographic and abstract databases and indexes;
• editions on CDs;
• e-books, electronic journals, conference materials,
• other on-line databases and Internet resources.

The term "electronic library" means a relatively new type of library and information systems designed for the accumulation, structuring and storage of an array of electronic documents with an appropriate access system [5].

The electronic library is a collection of electronic resources, organized on the basis of known rules and techniques of library science, that is, performs such processes as the acquisition, processing, systematization, subject indexing tools, storage and other, as well as the creation of the catalog and reference and search system in electronic form.

Since the electronic library is, first of all, a library, then when creating and organizing its resources, you need to use the available apparatus, software and rules of library technology, and also take into account the specifics of electronic media and the trends of modern information technologies.

The electronic library as a component of higher educational institution is an independent information and communication system, the main purpose of which is to provide scientific communications at a high-quality new level.

The electronic library is one of the important elements in the system of scientific communications, which promotes timely informing of users, expansion of the communicative environment of scientists, dissemination of scientific knowledge, their popularization.

Various electronic materials can be stored in numerous collections of the electronic library. These are files with instructional literature, program packs, reference books, illustrations, educational and research work of the institution's employees, information and documents from various sources.

For their efficient search, metadata and hyperlinks are created to their storage location. The purpose of the development of the electronic library is to facilitate the transformation of printed materials into digital form, their processing, which provides improvement of maintenance processes for local and remote users.

In addition, the well-organized operation of the electronic library greatly enhances the speed of providing users with the necessary full-text documents.

Moreover, most modern users, particularly in the context of inclusive education, prefer to obtain the necessary documents in electronic form.

The information infrastructure of a typical e-library consists of:
• automated technological complex,
• information resources,
• tools for supporting the functioning of the electronic library.

Today, the most common means of creating electronic libraries are:

1. **DSpace platform as an open source software.**

DSpace is a universal repository designed to hold intellectual products of scientific organizations, electronic full-text materials of various types and formats, the model of publication involves self-archiving.

With the dynamic introduction and formation of collections of institutional repositories on DSpace platform and the increase in the number of bibliographic descriptions in electronic catalogs of libraries, the tendency for them to acquire new qualities and forms of co-operation has been formed.

This form is the process of joining full-text versions of publications stored in the electronic scientific archive of the Scientific library of Lviv polytechnic National University with bibliographic references of the database "Proceedings of Lviv Polytechnic Scientists", which collects bibliographic references of publications of University scientists for all years of their activities at the University. This database is created in the automated library system UFH / Library.

The question of correlation the bibliographic references of the university staff database of the papers with the full text content of the electronic archive was considered by T. Patrusheva [6], O. Kovyazina [7], A. Rzheusky [8], who provide information about the possibility of a user switching from the metadata of the electronic catalog to full-text materials stored in other databases.

2. Cloud-based technology.

M. Goldner [9] expressed his view on cloud services and their benefits to libraries in three main areas: technology, data, and community.

Diane Murley [10] presented a list of resources and services that may be associated with cloud services in legal libraries.

P. Sasikala [11] insisted on the concept of cloud services from the perspective of a variety of technologies, services and affordable cloud models in government, enterprises, higher education institutions, and library institutions.

The implementation of cloud services for the development of its own catalog of the new generation through its ease of use, effective workflows, user servicing and rapid training was carried out at the St. Thomas University Law School [12].

The libraries can host their own websites in the clouds. The Columbia County Public Library uses the Amazon EC2 (Elastic Computing Cloud) service to host its website.

The libraries can create a digital library, a content management system, an institutional repository, an interlibrary loan, an integrated library system from a local form of management – to the delivery of its own virtual environment through cloud services. Features, comparative analysis and definition of the most suitable cloud services for implementation in libraries, is presented in the article [13].

3. DuraCloud platform.

DuraCloud is a distribution of DuraSpace company that supports open technology projects that provide long-term storage and secure access to electronic assets.

DuraSpace was founded as a result of the merger of two of the largest providers for managing access to digital content: DSpace Foundation and Fedora Commons. It also includes electronic library management systems such as DSpaceDirect, Fedora, and VIVO.

DuraCloud – is a service for archiving, exchanging and managing content in the cloud. To save documents, 400 TB content is provided. DuraCloud is the next step in the development of service-oriented library systems. This platform is payable, but you can try a test mode.

Conclusion

Thus, we considered information technologies and basic platforms for building electronic libraries containing full-text versions of documents.

Subsequently, the cataloging of electronic resources depends on the development of a model for processing their types, the formation of files with the identification of new cataloging documents and the introduction of technology for processing the input document flow for efficient cataloging of electronic resources.

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Modification of the initialization and crossing methods of ant and genetic algorithms for solving the transport problem in the tourism

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Abstract – The article proposes to analyze the behavior of ant colonies, namely the search for the shortest route by means of the allocation of pheromones and the function of crossing the two solutions of the genetic algorithm, to develop a method and algorithm for the following operations: search of the optimal route, calculation of resource costs, search of the distance, route time, routes.

Keywords – ant algorithm, genetic algorithm, an initialization method, crossing method, transport problem, transport task, ant colony, hiking trails.

I. Introduction

In recent years, algorithms of computational intelligence have been increasingly used to solve combinatorial optimization problems. Such algorithms have some advantages: practical application, flexibility in configuration and allow you to get beneficial results that help to find the best solution for a short period. Among these algorithms are ants and genetic algorithms.

So far, to fulfill the reference transport task, an ant algorithm was used. Such an algorithm relates to a class of routing algorithms. The article suggests using an ant algorithm to solve transport problems because, for the sake of finding the shortest path, ants distinguish pheromone traces in the search for a source of food. As a result of such actions on the path with the highest concentration of pheromones, more and more ants will move, considering this path to be the shortest. This approach allows you to find the optimal solution for most transport tasks.

However, having set the task to accomplish the transport task, taking into account the use of resources, the calculation of their costs, one ant algorithm will not be enough. There was a need to use the genetic algorithm, namely its functions of crossing two solutions. The genetic algorithm allows to pass a few solutions of the ant algorithm by creating a descendant that contains a single solution with specified properties such as fuel consumption, time consumption, distance traveled, etc.

In practice, such transport solutions, taking into account the cost of resources, are already being used. Combining two or more algorithms for creating a hybrid algorithm will allow accomplishing the objectives set. However, the application of such a solution requires a technical basis, following current trends in the world[3].

Every day technology development is increasing. New roads create, new tourist resorts creates, communication channels of tourist centers creates, that is, the transport network, as a rule, is growing. As a result, optimizing new routes is a topical issue. Therefore, intensive study of this sphere and development of new solutions is a promising direction.

II. Analysis of literary sources and formulation of the problem

In the process of developing a new algorithm, it was necessary to understand the work of the ant algorithm, namely, as colonies of the ants in providing themselves with food, looking for the shortest path between the nest and the source of food without visible, active coordination mechanisms. Studies have revealed the chaotic activity of ants, but as soon as the source of food found, more and more ants were moving along the shortest path. Most varieties of ants use an indirect form of contact, through pheromone traces. To increase the efficiency of the algorithm, namely the process of finding the shortest route between local points, we used pheromone traces. The desirable result is remembering the best routes and a quick calculation of paths with a higher concentration of pheromones [1].

Another algorithm in the study and design of a modified algorithm was the selection of a genetic algorithm that contained adaptive search methods, which today are often used to solve transport tasks of functional optimization. They base on the genetic processes of biological organisms.

In the work of the genetic algorithm, the agent interbreeding function use. This approach makes it possible to serve tourists more efficiently and automates this process in a way that each agent contains all the previous results of the performed routes, and this will allow not to look for a new solution again, but to use the solution already found.

The research methods use: Ant Colony Optimization (ACO) method, crossbreeding solutions genetic algorithm (CSGA), modifications of operators (modification operators, MO) and other methods. These methods are already efficiently used to solve various tasks: ACO is used to solve shortcut route search tasks, CSGA is used to solve transport tasks, MO used for clustering data and objects. Together, the above methods are used to create a hybrid algorithm[4].

The research objective is to create a hybrid algorithm that will significantly improve the efficiency of transport tasks in the field of tourism.

Based on the system analysis of the subject area and the modern technologies used to solve transport problems, as well as algorithms and methods for the realization of such tasks, the purpose of the article form.

The purpose of the article is to increase the efficiency of transportation between cities and manage the accommodation of tourist points in a rational manner, such as fuel consumption, choice of transport type, number of seats and standing in transport, time spent on transportation [2,5].

To achieve the purpose of the article, the following tasks were set:

1. To analyze modern technologies used for solving transport problems;

2. To formulate the necessary statement of the task for transportation of tourists between settlements taking into account rational use of resources;

3. To develop algorithms for solving the search of the optimal route between cities, the arrangement of tourist destination points and the traffic volume of tourists about the number of seats in transport;

4. To investigate the effectiveness of the algorithm in the form of a numerical experiment.

III. Development and modification of initialization and crossing of genetic and ant algorithms for solution of transport problem

The primary task of the modified operator of initialization is to generate routes in such a way that they are correct while retaining the functions of minimizing the path to be transported.

To find the optimal solution for the transportation of tourists from the m points of the route $A_1, A_2, \mathbf{K}, A_m$ to the n points of the final stops on route $B_1, B_2, \mathbf{K} B_n$ minimize the cost of resources for the transportation of tourists.

We define through $c_{i,j}$ – the cost of resources for transportation from i point of the route to j point of the final stop, through a_i – the number of tourists at i point of the beginning of traffic. Also, though b_j we will define the needs of tourists in the transport at j point of the final stop, through x_{ij} – the number of tourists that need to transport from point i from the start of the route to j point of the final stop.

The mathematical model for solving a search using the interrupt and initialization operators will look like this:

$$F(x) = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij} \qquad (1)$$

under the following three conditions:

$$\sum_{j=1}^{n} x_{ij} = a_i, i = \overline{1,m} \qquad (2)$$

$$\sum_{i=1}^{m} x_{ij} = b_j, j = \overline{1,n} \qquad (3)$$

$$x_{ij} \geq 0, i = \overline{1,m}; \quad j = \overline{1,n} \qquad (4)$$

A modified operator of initialization has a memory, that is, a database of saved routes, local points, and calculations, which allows the system not to spend resources to search for a new path.

The operator of crossing ant and genetic algorithms work in such a way as to receive not only new routes but reduce their number, which allows reducing the number of vehicles.

Conclusion

In the article an analysis of modern methods of optimization of routes used for solving transport problems with which the solution for the transportation of tourists between settlements is designed taking into account the rational use of resources. These methods include genetic and ant roid algorithms, which search for the optimal route and the allocation of collection points.

From the created modifications of the operators of initialization and crossing, a system develops that solves the transport problem in the field of tourism, taking into account the location of the collection points. The article analyzes modern methods of route optimization, which are used to solve transport problems, with the help, which they have planned the solution for the transportation of tourists between settlements taking into account the rational use of resources. These methods include genetic and ant algorithms, which search for the optimal route and the allocation of collection points.

By the established modifications of the operators of initialization and crossing, develops a system that solves the transport problem in the field of tourism, taking into account the collection point points, as well as tourists in transport.

When investigating the effectiveness of the algorithm in the form of a numerical experiment and checking the effectiveness of the mobile application by the "first test" method, it discovers that the system builds a route from one settlement to another with the least error and distance.

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User Interface Constructed on the Contextual Knowledge that Describing Ontology

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Abstract – The paper describes some approaches to UI design automation based on the contextual knowledge that describes ontology domain. Tools interface development based on ontologies software, based on the principle of separation of designing and implementing the user interface and business applications and their subsequent binding and automatic code generation interface for its model. To develop the proposed ontology, in terms of which UI developers form the corresponding components of his model; generation interface is more programming languages on different platforms; supports both local and network interaction with business applications; Model interface is divided into components according to groups of professionals engaged in its development (subject area experts, programmers, designers) and contains all the information necessary for its development and automatic generation according to the model.

Keywords – design, implementation, ontological modeling, models, approaches and methods of design automation interface, intelligent information systems.

I. Introduction

Currently, the actual problem is conceptual formation "transparent" representations for weakly structured domains. Today the leading paradigm structuring information flows are ontologies or hierarchical conceptual structures that formed the analyst on the study and structuring of information flows, documents, protocols learned contextual knowledge and other sources.

Ontological engineering (OE) develops the main provisions of engineering knowledge – science models and methods of collecting, structuring and formalizing knowledge.

Ontological engineering is taking its first steps, so each analyst goes through trial and error, creating complex ontological structures that reflect the maze of professional knowledge in various application areas.

However, knowledge engineering – an area of artificial intelligence, while the OE covers a wide range of applications – from knowledge management systems to distance learning.

Today artificial intelligence – a broad area of research and development of intelligent systems intended for use in areas of human activity, it is difficult formalized. Currently, decided to allocate several areas of artificial intelligence. One of the areas associated with the development of intelligent systems based on knowledge. In this direction are developing models of knowledge, creation of knowledge bases.

One of the promising applications of the methods of this area is the development of intelligent systems instructive. IIS intended for automation and individualization of learning.

Traditionally, there are four models of knowledge used in the construction of knowledge bases of knowledge-based:
1. Logical model;
2. Production model;
3. Framed model;
4. Semantic networks.

But, currently of particular interest to researchers in artificial intelligence cause ontology. Ontologies can be used to represent knowledge about the subject area concepts and alleged relations between them, describe the content of web pages. In addition ontology can be used in the construction of knowledge bases ITS not only, but also any other programs.

Ontology is central to the systems using knowledge. Ontology is a formal model of the conceptualization of the domain [1]. This model contains a definition of the domain entities and relationships between them. Building software systems based on ontologies avoid re-conceptualization of the domain, which allows to reduce the use of resources at the analysis stage and system design.

II. Organization of the formation and renewal of contextual knowledge learning intellectual system

Ontology development in a particular subject area knowledge is a very complex and lengthy process, when for several years a group of developers creates a set of concepts of the domain ontology. Therefore, the system of formation of ontological knowledge base contains integrated tools combining ontologies that let you create and complement the main domain ontology learning environment through the use of subject knowledge (knowledge of software), presented the Semantic Web. Such ontologies will be called ontologies that complement or to simplify – components.

The source component ontology search system is multi-ontological information domains. Searches this system formed on the basis of tasks and thesaurus software expert local knowledge base. Found ontologies relevant components from external repositories and other educational resources are loaded semantic Web search engine to Business database integrated credit union ontologies [2].

It is necessary to consider some approaches to UI design automation based on the knowledge that describes ontology domain. Tools interface development based on ontologies software, based on the principle of separation of designing and implementing the user interface and business applications and their subsequent binding and automatic code generation interface for its model. To develop the proposed ontology, in terms of which UI developers form the corresponding components of his model; generation interface is more programming languages on different platforms; supports both local and network interaction with business applications; Model interface is divided into components according to groups of professionals engaged in its development (subject area experts, programmers, designers) and contains all the information necessary for its development and automatic generation according to the model.

III. Design and implementation of ontology learning system

Approaches and methods for automated user interface design based on ontology software designed to address the following issues:

- Providing support for the development of sophisticated and complex interfaces (based on high-volume models the concepts of dialogue and manual tasks);
- Automation interface development to meet the requirements of users and their experience level of the computer; environment using a software system; taking into account the principles of "usability" (convenience and simplicity), different standards and guidelines for the development of style;
- Providing scalability for application of new knowledge about design, new guides users through style and standards development.

Design and implementation of ontology is carried out on the following principles:

- *clarity* – ontology must efficiently transfer sense imposed deadlines;
- *consistency* – the definition should be consistent; extensibility – ontology should be designed so as to ensure the intended use for the separation dictionaries and terms that allow the possibility of expansion monotonous and / or specialization without the need for revision of existing concepts;
- *minimum impact coding* – conceptualization, the underlying ontology created must be specified at presentation, not the character encoding; minimum ontological commitments – ontology must contain only the most important assumptions about the world that is modeled to leave the possibility for expansion and specialization.

The process of creating an ontology includes three procedures:

Project management: planning, monitoring and quality assurance. Planning to determine which tasks should be performed, how they are organized, how much time and what resources are required for their implementation. Control ensures that scheduled tasks performed exactly as expected. Quality assurance need to be sure that components and products in general are at a given level.

Own development: specification, conceptualization, formalization and implementation. The specification defines the goal of an ontology, its intended use and potential users. Conceptualization provides structuring subject knowledge in a meaningful explicit model. The formalization of the conceptual model transforms the formal or "computer". In implementation of appropriate computer model programmed knowledge representation language.

On the wave of interest in ontology created tools and mechanisms specifically targeted the wide use of ontologies in problems of intelligent search, classification, identifying inconsistencies in the data model the behavior of intelligent agents.

The main provisions of the UI design automation is [3]:

1. Increased general model user interface: the interface to the model adding new components – user models and model environment (in this case -o PO) using the program (to describe the various contexts of use).

2. Separation of knowledge needed for design automation at the groups that need iterative sequence for further automation.

3. Development of ontology software for each group MPO knowledge, in terms of which will be modified (change) knowledge of automation for each stage according to the requirements of a particular development or development of the subject area as a whole. 4. Development of a method of design automation interfaces based on the use of ontologies in the system software knowledge to the exclusion of modification of the method for changing knowledge.

Conclusion

On the wave of interest in ontology created tools and mechanisms specifically targeted the wide use of ontologies in problems of intelligent search, classification, identifying inconsistencies in the data model the behavior of intelligent agents. But even having a good tool environment does not eliminate the problems associated with the difficulties of designing and building the most ontologies, and ontology extraction process automation as a whole, job acquisition of knowledge, and the present have their effective solution. Especially valuable are already developed ontologies and experience to use them for a wide range of tasks.

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Logical inference mechanism in situational awareness systems

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Abstract − In the article are described problems related to creation and maintenance of situational awareness systems. An approach based on situational knowledge representation with ontological models is selected for attaining situational awareness in complex intelligent enterprise systems, where objects can be in several situations in the same time and some situations are defined imprecisely. Granular computing approach is used for reduction of situational knowledge management complexity.

Keywords – situation assessment, situational awareness, ontology, logical inference, granular computing.

I. Introduction

The main task of modern intellectual decision support systems is to release from intervention human-operator in systems operation, that is, fully automated integration of sensor data without practicing direct interaction with the user. Such systems should interact and exchange information with the external environment. Today, this area of research is very promising, as various applications (smart building, systems for public transport, etc.) are being developed to improve the everyday life of a person.

The development and maintenance of situational awareness is a necessary condition for such systems [1].

Situational awareness (SAW) as an understanding of system's environment state is a mandatory part of any decision-making system. The process of situational awareness formation and maintenance is a complex one, including the stages of gathering data from sensors, interpreting those data and updating knowledge about the current situation in order to make the correct decisions.

For operation of the system that performs the functions of SAW, is necessary to be based on a specific domain model. One way of building this model is the using of ontologies. Before using ontology models were built for each domain separately. It was inconvenient to modify the system and re-use knowledge of the situation. This caused the feasibility of using ontologies [2].

II. The main results of the research

Situation awareness is based on representation and analysis of situations. It is impossible to achieve situational awareness without the preliminary analysis of the situation [3].

Sometimes situational awareness is defined as a situational assessment and certain sources frame it as a same unit. However, it must be understood that these concepts have some differences. While situation assessment is focused on system interaction, the notion of situational awareness (SAW) is centered on the interaction of system with the users (in this case, "awareness" refers to the awareness of the final user of the current system state for forecasting and prediction its next states) [4].

Using knowledge of the subject area presented in the form of ontology and ontology-based models to identify situations has important advantages in comparison with using decision tables, trees or rule sets [5]. In particular, it allows storing and using knowledge of the subject area and the possible situations in it in a coherent form, taking into account dependencies between objects and situations presented in the form of relations. Moreover, the use of ontologies to identify situations provide additional possibilities for situation definition and processing using structural features of ontology and logical inference mechanisms.

Ontology defines a common vocabulary for researchers who need to share information in the subject area. It includes machine-interpreted the wording of the basic concepts of the domain and the relationships between them [6].

Formally, situational knowledge within the ontology is encoded as descendants of a separate class *Situation*. The description of the situation (attribute *DefinedFor*) contains a reference to the class for which this situation is determined. It simplifies finding situations in the process of solving practical problems, when there is a need to find a situation for a particular object of certain class.

If $\bar{S} = \{S_1, S_2, ..., S_n\}$ – is set of situations. We define function, which maps the set of classes in the ontology to the set of situations:

$$F_{TS} : T \rightarrow \bar{S} \ . \tag{1}$$

This function allows to divide the set of situations into subsets corresponding to ontology classes:

$$\bar{S} = \mathbf{U}_{i=1}^{nt} S_{Ti} \ . \tag{2}$$

Sets S_{Ti} can overlap, because the object of a certain class can be in several situations simultaneously.

A promising approach to simplification of situational knowledge management is using the paradigm of granular computing [7], creating default situation definitions for large groups of objects.

A promising approach to simplification of situational knowledge management is using the paradigm of granular computing [7], creating default situation definitions for large groups of objects.

Granular computing is an umbrella term to cover any theories, methodologies, techniques, and tools that make use of granules in problem solving. Basic ingredients of granular computing are granules such as subsets, classes, and clusters of a universe [8, 9].

The use of granules generally leads to simplification of practical problems resolution. In case of ontological modeling, when classes form a hierarchy and attributes of classes are inherited by subclasses, using an approach of granular computing can be translated to situation definition, when possible, for classes of higher levels of the hierarchy.

The definition of situation S_j contains an attribute *SDefinition* – At_{def}, which stores Boolean expression CS_j (signature), which takes a value "true" for objects of given class that reside in certain situation. That is, object $t_{ij} \in T_i$ reside in S_{Ti} if $Cs_{STi}(t_{ij}) = True$.

In the simplest case, when the situation is defined by the state of an object of a given class T_i, the signature CS_j contains only attributes of this class:

$$CS_j = BooleanExpression(a_1, a_2, ..., a_n) , \qquad (3)$$

where: $\forall i : a_i \in At_i \in T_i$, $BooleanExpression(a_1, a_2, ..., a_n)$ – is Boolean expression with arguments $(a_1, a_2, ..., a_n)$.

In the basis of logical inference mechanisms in ontological modeling is the description logic. It uses a set theory to form axioms and to construct new classes of ontology based on existing classes.

Ontology modelling presents a good base to definition of *situationally-oriented concepts.* These concepts and the corresponding classes of ontology are determined by situation definitions. Therefore, they are subclasses of ontology classes for which such situation applies. Examples of situationally-oriented concepts are the concepts of "meeting attendee" or "traffic rules violator". The definition of ontology concepts through the situations allows not only to justify their creation, but also to find all necessary attributes and relations used by these concepts.

A set of all objects (population) of situational class T_s, specified for class T_i by situation S_{Ti} is a subset of objects of class T_i for which axiom CS_{STi} in situation S_{Ti} is a class constructor.

$$\forall t_S : Cs_{STs}(t_S) = True, T_S \subseteq T_i \qquad (4)$$

In addition to the attributes and relations inherited from the higher levels of hierarchy, such situationally-oriented ontology classes have their own attributes and relationship identified in the situation model. Using situational concepts allows us to enrich the ontological model of subject area and use logical inference to obtain and use new knowledge about the situation.

On the other hand, using the mechanisms of logical inference based on description logic allows us to build complex situational concepts with basic operations of set theory and therefore consider and find objects which, for example, simultaneously reside in several different situations.

Conclusion

Development and implementation of systems with situational awareness is a relatively new and popular area of research due to the growing interest in autonomous intellectual systems. The decision-making process in such systems is based on information about current domain state and general knowledge about domain dependencies and rules. There are many different methods for knowledge representation and processing in situational awareness systems each having their flaws and use cases.

Thus, there is a need to build a unifying framework allowing using different reasoning and decision-making methods for a single set of input data and knowledge about domain.

The usage of logical reasoning is an important part of any knowledge-based system because it helps to maintain the logical consistency of domain model and the correctness of data.

An approach based on situational knowledge representation with ontological models is selected for attaining situational awareness in complex intelligent enterprise systems, where objects can be in several situations in the same time and some situations are defined imprecisely. Granular computing approach is used for reduction of situational knowledge management complexity.

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Hardware complexity of multipliers of extended Galois field in FPGA

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Abstract − In this paper, the implamantation of matrix multiplier of the Galois fields with basics 2, 3, 7, 13 and the analysis of the implementation of multipliers with a higher basis on the FPGA Xilinx Virtex-7 is considered. It is shown that the smallest hardware costs will be in multiplier of Galois fields with a base 3, 29% less than in binary fields. For the implementation of the Guild cells with a large foundation, the core generator of the modified Guild cells was implemented..

Keywords: Galois fields GF(d^m), multiplier, modified Guild cell, LUT, nucleus generator.

I. Introduction

At present, cryptographic methods for protecting information based on the use of FPGA and cryptographic protocols built on multiplication operations in Galois fields GF(n^m) have become acute. Matrix multipliers of Galois fields GF(n^m) are characterized by high hardware costs, and therefore it is expedient to find the best method for their implementation. The paper compares the hardware costs of multiplier fields of Galois GF(n^m) based on their practical implementation in FPGA.

II. Analysis of the literature

In [4], in order to reduce the hardware complexity of the multiplier of the Galois field elements, the main element of which is the multiplicative matrix, an approach is proposed, which is to replace the multiplication matrix with the size mxm on the mixer and the ordered modified smaller multiplier matrix. Due to this, the reduction of structural and hardware complexity will increase the time complexity of multiplication [5]. To determine the possibility of implementing a multiplier on FPGA, the problem of a more accurate evaluation of it, taking into account the features of the FPGA topology, appears. The aim of the work is to estimate the hardware cost of creating a multiplier matrix [6] of the multiplier of the Galois field elements in a polynomial basis in order to select the field in which the hardware costs will be the smallest. During the execution of this work, on the basis of the proposed multiplier model in [1] and [2], its implementation was carried out and the theoretically verified the values of the hardware complexity obtained in [1] and [2].

III. Implementation on FPGA

To perform a multiplication operation in Galois fields, you can apply a matrix multiplier. It has a number of advantages and disadvantages. Among the disadvantages is a large hardware and structural complexity, among the advantages – high performance hardware implementation multiplier.

Matrix multipliers perform a multiplication operation in a non-traditional way through successive shifts and additions, but in parallel. The scheme of the operation of multiplication corresponds to the usual "multiplication by column". In the matrix of the elements of the multiplier, there is a bitwise multiplication of discharges and the summation of intermediate results. For the multiplication and summing up of intermediate results, Modified Guld cells (MGC) are used.

Modified GC for Galois GF(d^m) fields have 3p inputs and p outputs, each bit. Modified KG can be considered in 2 variants:

1) to consider Guild cell as a "black box" – a completely integral element in which the internal structure is insignificant, and only the number of inputs and outputs is taken into account;

2) with clarification of the internal structure (Guld cell consists of a multiplier and adder);

In the first variant, the number of LUT, used to implement a single modified GC − $k_{gd} = (2^{p-5} - 1) * k$, where $p = 3 * \lceil \log_2 d \rceil$, and k $= \lceil \log_2 d \rceil$. Hence it follows. So:

$$k_g = (2^{3*\lceil \log_2 d \rceil - 5} - 1) * \lceil \log_2 d \rceil \qquad (1)$$

To implement a multiplier in the Galois fields with the base d GF(d^m) you need − $k_{kd} = 2m^2 - 2m + 1$ modified GC and additionally $(m-1) * (2^{3*\lceil \log_2 d \rceil - 5} - 1) * \lceil \log_2 d \rceil$ LUT to find the coefficient, which must be multiplied by an irreducible polynomial. These hardware costs for the implementation of the element f, which forms this coefficient, can be neglected in this case, since they are small in comparison with the utilities for the implementation of the Guild cells himself.

Hardware costs, when sold, modified by the GC for the second option, ie as a set of multipliers and adder are calculated by the formula:

$$k_{gd} = (2^{2*\lceil \log_2 d \rceil - 5} - 1) * \lceil \log_2 d \rceil * 2 . \text{ So:}$$

$$k_g = (2^{2*\lceil \log_2 d \rceil - 5} - 1) * \lceil \log_2 d \rceil * 2 \qquad (2)$$

In the Galois fields GF(d^m) multiplier implementation requires − $2m^2 - 2m + 1$ GC. The costs for the implementation of the element f are neglected, because they are small, in comparison with the expenses for the implementation of the multiplier itself.

In fig. 1 shows the internal structure of modified GC in the implementation as a) "black box" and b) with refinement of the internal structure of the multiplier GF (3^4).

Fig. 1. Implementation of modified GC for Galois fields GF (3^4): a) "black box"; b) with clarification of the internal structure

In the first version, one function is formed which depends on 6 variables, which performs multiplication by module 3 and addition by module 3, in the second one – 2 functions that depend on 4 variables, the first of which performs multiplication by module 3, and the second is the addition for module 3.
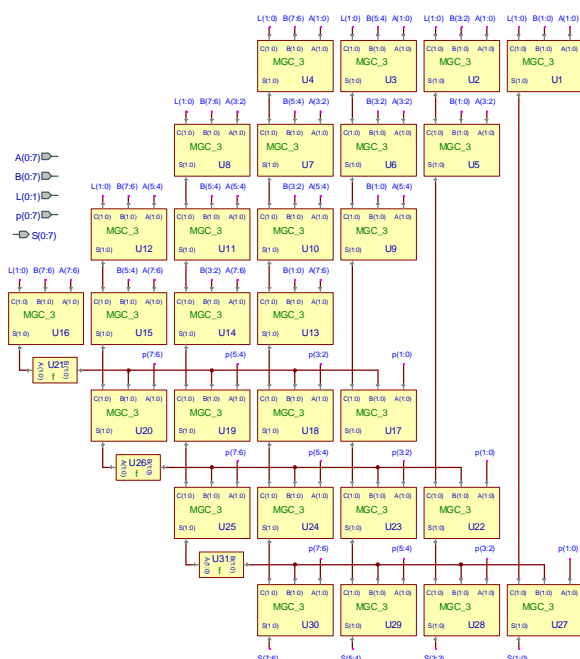
Fig. 2. Scheme of Galois multiplier GF (3^4)

The value of hardware costs for the implementation of memory modulators GF (2^{15}), GF (3^9), GF (7^5), GF (13^4), all having schemes similar to Fig. 2, is shown in the graph of Fig. 3 and table 1.

From graphic fig. 3 shows that the smallest hardware cost has a multiplier for the elements of the GF field (3^9).

Fig. 3. Graph of hardware costs of multipliers of fields of Galois GF (2^{15}), GF (3^9), GF (7^5), GF (13^4): a) with refinement of the internal structure; b) "black box"

The field for which the multiplier is constructed	The number of modified Guild cells	Number of elements in the box compared to GF (13^4)	The amount of used LUT in the multiplier when presenting the modified Guild cells as a "black box"	The amount of SLICE used in the multiplier when presenting the modified Guild cells as a "black box"	The amount of used LUT in the multiplier when the modified Guild cells is represented as a multiplier and adder	The amount of SLICE spent in the multiplier when a modified Guild cell is presented as a multiplier and adder
GF (2^{15})	435	101,3 %	207	144	195	131
GF (3^9)	153	96,5 %	148	75	381	144
GF (7^5)	45	95,4 %	6192	2423	276	135
GF (13^4)	28	100 %	8250	3758	2508	1128

From the table, we see that the smallest hardware costs will be in fields with a base of 3 GF (3^9).

Conclusion

A comparison of the hardware costs of multipliers of Galois fields with bases 2, 3, 7, 13 on the FPGA Xilinx Virtex-7. As a result of the comparison of the results of implementation of the multipliers, it can be seen that the smallest hardware costs will be in the Galois multipliers with the base 3, 29% less than the binary fields that coincide (does not match) with the previously obtained theoretical results.

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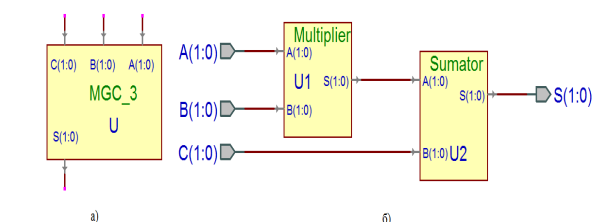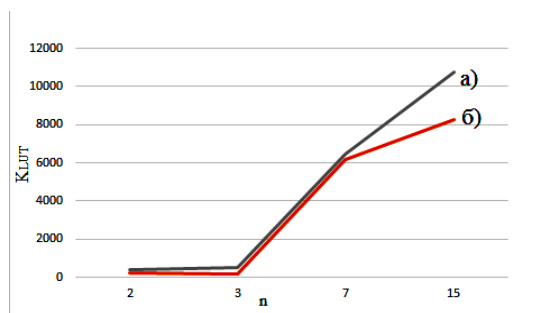
A Fitted Numerical Method for Singularly Perturbed Integro Differential Equations with Delay

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Abstract − This study deals with the singularly perturbed initial value problems for a quasilinear first-order integro-differential equations with delay. A numerical method is generated on a grid that is constructed adaptively from a knowledge of the exact solution, which involves appropriate piecewise-uniform mesh on each time subinterval. An error analysis shows that the discrete solutions are uniformly convergent with respect to the perturbation parameter. The parameter uniform convergence is confirmed by numerical computations.

Keywords − Singularly perturbed problems, integro-differential equation, difference schemes,uniformly convergent.

I. Introduction

Consider an initial value problem for the linear second order singularly perturbed integro-differential equation with delay

$$eu'(t) + f(t, u(t), u(t-r)) + \\ + \int_0^t K(t,s)u(s-r)ds = 0 \quad t \in I, \quad (1)$$

$$u(t) = j(t), \ t \in I_0, \quad (2)$$

where $I = (0,T], I_0 = (-r,0]$. $0 < e \le 1$ is the perturbation parameter, $a(t) \ge a > 0$, $f(t)$ and $j(t)$ are given sufficiently smooth functions satisfying certain regularity conditions to be specified and r is a constant delay.

Volterra delay-integro-differential equations (VDIDEs) arise widely in scientific fields such as biology, ecology, medicine and physics This class of equations plays an important role in modelling diverse problems of engineering and natural science, and hence has led researchers to develop a theory and numerical analysis for VDIDEs.

Delay differential equations play an important role in themathematical modelling of various practical phenomena in thebiosciences and control theory. Any system involving a feedback control will almost always involve time delays. These arise because a finite time is required to sense information and then react to it. A singularly perturbed delay differential equation is an ordinary differential equation in which the highest derivative is multiplied by a small parameter and involving at least one delay term [1-4]. Such problems arise frequently in the mathematical modelling of various practical phenomena, for example, in the modelling of several physical and biological phenomena like the optically bistable devices [5], description of the human pupil-light reflex [6], a variety of models for physiological processes or diseases and variational problems in control theory where they provide the best and in many cases the only realistic simulation of the observed phenomena[7].An overview of numerical treatment for first and second order singularly perturbed delay differential equations, may be obtained in [8-15](see,also references therein).

The numerical analysis of singular perturbation cases has always been far from trivial because of the boundary layer behavior of the solution. Such problems undergo rapid changes within very thin layers near the boundary or inside the problem domain. It is well known that standard numerical methods for solving singular perturbation problems do not give satisfactory result when the perturbation parameter is sufficiently small. Therefore, it is important to develop suitable numerical methods for these problems, whose accuracy does not depend on the perturbation parameter, i.e. methods that are uniformly convergent with respect to the perturbation parameter [16-19].

In a singularly perturbed delay differential equation, one encounters with two difficulties, one is because of occurrence of the delay term and another one is due to presence of perturbation

parameter. To overcome the first difficulty, we employed the numerical method of steps [2] for the delay argument which converted the problem to a initial value problem for a singularly perturbed differential equation. Then we constructed a numerical scheme based on finite difference method on non uniform Shishkin mesh for the numerical solution.

In the present study we discretize the problem(1)-(2) using a numerical method, which is composed of a fitted difference scheme on piecewise uniform Shishkin mesh on each time-subinterval.

II. Discretization and Mesh

In this section,we construct a numerical scheme for solving the initial value problem(1)-(2).

We propose the following difference scheme for approximation (1)-(2)

$$L_N y_i = e\frac{y_i - y_{i-1}}{h} + f(t_i, y_i, y_{i-N}) \\ + \sum_{j=0}^{i-1} h_{j+1} K(t_i, t_j) y_{j-1} = 0, \quad i = 1, 2, ..., N_0, \quad (3)$$

$$y_i = j_i, \ -N \le i \le 0, \quad (4)$$

The difference scheme (3)-(4), in order to be $e-$ uniform convergent, we will use the Shishkin mesh. For the even number N, the piecewise uniform mesh $W_{N,p}$ divides each of the interval $[r_{p-1}, s_p]$ and $[s_p, r_p]$ into N/2 equidistant subintervals, where the transition point s_p, which separates the fine and coarse portions of the mesh is obtained by $s_p = r_{p-1} + \min\{r/2, a^{-1}e \ln N\}$.

III. Convergence Analysis

We now estimate the approximate error $z_i = y_i - u_i$, which satisfies the discrete problem

$$L_N y_i = R_i, \quad i = 0, 1, 2, ..., N_0, \tag{5}$$

$$z_i = 0, -N \leq i \leq 0, \tag{6}$$

where R_i is the truncation errors.

Theorem. The continuously differentiable function f(t,u,v) satisfies the regularity

conditions and the derivative $f(t, u, v)$ is bounded for

$\dfrac{\partial}{\partial t} f(t, u, v)$ is bounded for given interval. Then the following estimate holds

$$|y_i - u_i| \leq CN^{-1} \ln N, \quad 0 \leq i \leq N_0,$$

where u_i is exact solution of the problem (1)-(2) and u_i is the solution of the problem (3)-(4).

IV. Numerical Results

In this section, a simple numerical example is devised to verify the validity for the proposed method.

Consider the test problem

$$eu'(t) + u(t) + u(t-1) + \int_0^t u(s-1)ds = 0, t \in (0, 2],$$

$$u(t) = 1, \quad -1 \leq t \leq 0.$$

The exact solution given by

$$u(t) = \begin{cases} e^{-t}, t \in [0,1] \\ \dfrac{1}{e^2} e^{-t/e}[ee^{2/e} - ee^{(t+1)/e} - e^{t/e}(t-e)e^2 \\ +e^{1/e}(-1+t+e-et+2e^2-e^3)], t \in [1,2] \end{cases}$$

We define the exact errors $e^{N,p}$ as follows

$$e^{N,p} = \|y - u\|_{w_{N,p}}, \quad p = 1, 2$$

where y is the numerical approximation of u for values of N and e.

Maximum errors and rates of convergence.

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We define the exact errors $e^{N,p}$ as follows

$$e^{N,p} = \|y - u\|_{w_{N,p}}, \quad p = 1, 2$$

where y is the numerical approximation of u for values of N and e.

Maximum errors and rates of convergence.

e	N=64	N=128	N=256
2^{-2}	0,01328142	0,0640103	0,0322010
2^{-8}	0,01361427	0,0692344	0,0330323
2^{-16}	0,01482356	0,0713864	0,0342657

Conclusion

In this study we have presented a numerical approach to solve a quasilinear singularly perturbed first-order integro-differential equation with delay. We proposed a fitted difference scheme on piecewise-uniform Shishkin mesh on each time subinterval. We have shown that the method displays uniform convergence with respect to the perturbation parameter for numerical approximation of the solution.

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Numerical Solution of Singularly Perturbed Convection-Diffusion Equations

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Abstract − In this paper, a new method is given for solving singularly perturbed convection-diffusion problems. The present method is based on combining the asymptotic expansion method and the variational iteration method (VIM) with an auxiliary parameter. Numerical results show that the present method can provide very accurate numerical solutions not only in the boundary layer, but also away from the layer..

Keywords − Convection-diffusion problems, boundary layer, variational iteration method, asymptotic expansion, auxiliary parameter..

I. Introduction

In this paper, we consider the following singularly perturbed convection-diffusion problems [1],

$$Lu(x) = \varepsilon u''(x) + a(x)u'(x) + b(x)u(x) = f(x,u),$$
$$0 \le x \le 1 \qquad (1)$$

with the boundary conditions

$$u(0) = A, \, u(1) = B \qquad (2)$$

where $0 < e \ll 1$, $a(x)$, $b(x)$ and $f(x,u)$ are assumed to be sufficiently smooth, and such that (1)-(2) has a unique solution. Further, it is assumed that the function $a(x) \ge a > 0$, a is a constant. Under the above assumption, singularly perturbed convection-diffusion problem (1)-(2) possesses a unique smooth solution with boundary layer on the left side of the domain $[0,1]$.

Singularly perturbed problems depend on small positive parameter which multiplying with highest derivative term. This parameter cause to the solution changes quickly in some region and changes slowly in some other regions. The existence of perturbation parameter lead to complication, so classical numerical techniques not useful to solve such problems. Because of this, different techniques are needed to overcome this complication. In the recent times, a wide range of particular methods have been improved by a lot of authors for approximate solution of singularly perturbed problems [2-5].

II. The solution of singularly perturbed convection-diffusion problem Eqs.(1)-(2)

In this section the asymptotic expansion approximation to the solution of singularly perturbed convection-diffusion problem (1)-(2) is constructed.

Theorem 2.1. (Maximum Principle) Suppose v is a smooth function satisfying $v(0) \ge 0$, $v(1) \ge 0$ and $Lv(x) \le 0$ for all $0 \le x \le 1$. Then $v(x) \ge 0$ for all $0 \le x \le 1$.

It follows directly that problem (1)-(2) has a unique solution. Let $u(x)$ and $u_0(x)$ be the solutions of (1)-(2) and its reduced problem, respectively

$$a(x)u_0'(x) + b(x)u_0(x) = f(x,u_0) \qquad (3)$$
$$u(1) = B, \qquad (4)$$

Then, the zeroth order asymptotic expansion approximation,

$$u_{as} = u_0(x) + v_0(x), \qquad (5)$$

where $v_0(x)$ is the solution of the below equations (6)-(7).

$$v_0''(x) + a(0)v_0'(x) = 0, \, x \in (0,\infty) \qquad (6)$$
$$v_0(0) = A - u_0(0), \, v_0(\infty) = 0 \qquad (7)$$

We see directly $v_0(x)$ is given by

$$v_0(x) = (u(0) - u_0(0))e^{\frac{-a(0)x}{e}}. \qquad (8)$$

We note that Eqs. (1)-(2) also has a unique solution but that the solution will not in general satisfy the boundary condition at $x = 0$.

Theorem 2.2. For sufficiently smooth $a(x)$, $b(x)$ and $f(x,u)$, the zeroth order asymptotic expansion approximation $u_{as}(x)$ satisfies the inequality,

$$|u_{as} - u(x)| < e, \qquad (9)$$

where $u(x)$ is the solution of (1)-(2). The proof of theorem 2.1. and theorem 2.2. can be found [6]. In order to obtain zeroth order asymptotic expansion approximation $u_{as}(x)$, it remains only obtain the solution $u_0(x)$ of terminal value problem (3)-(4).

III. The solution of terminal value problem (3)-(4)

The solution of terminal value problem of (3)-(4) will be obtained by using the variational iteration method with an auxiliary parameter. Terminal value problem (3)-(4) can be converted into the following equivalent form

$$w'(x) = \frac{f(x,w)}{a(x)} - \frac{b(x)}{a(x)}w(x) = F(x,w), \qquad (10)$$
$$0 \le x \le 1$$
$$w(x) = B \qquad (11)$$

for (10), according to the VIM, we can obtain the following iteration formula:

$$w_{n+1}(s) = w_0(s) + \int_1^x F(s, w_n(s))ds, \qquad (12)$$

where $w_0 = B$.

IV. Variational iteration method with an auxiliary parameter

In this section, the basic ideas of the variational iteration method [7] are introduced. We consider the following differential equations:

$$Tu = Lu + Ru + Nu - g(x) = 0 \qquad (13)$$

where L is the highest order derivative that is assumed to be easily invertible, R is a linear differential operator of order less than L, Nu represents the nonlinear terms and $g(x)$ is a inhomogeneous term. According to variational iteration method, we can write down a correction functional as follows :

$$u_{n+1}(x) = u_n(x) + \int_0^x l(x,t)Tu_n(t)dt, \qquad (14)$$

An unknown auxiliary parameter $\mathbf{h}$ can be inserted into the variational iteration algorithm (14),

$$u_1(x,\mathbf{h}) = u_0(x) + \mathbf{h}\int_0^x l(x,t)Tu_n(t)dt, \qquad (15)$$

$$u_{n+1}(x,\mathbf{h}) = u_n(x,\mathbf{h}) + \mathbf{h}\int_0^x l(x,t)Tu_n(t)dt, \ n \geq 1 \qquad (16)$$

where $l(x,t)$ is a general lagrange multiplier which can be optimally identified via variational theory [8]. The approximate solutions $u_n(x,h)$, $n \geq 1$ contains the auxiliary parameter $\mathbf{h}$. By means of the so-called $\mathbf{h}$-curve, it is straightforward to choose a proper value of $\mathbf{h}$ which ensures that the approximate solutions are convergent [9].

Finally, we approximate the solution $u(x) = \lim_{n \to \infty} u_n(x,\mathbf{h})$ by the n th term $u_n(x,\mathbf{h})$. The above series solutions generally converge very rapidly. For the convergence of the variational iteration method, we will give the following theorem.

As given by [10], at the n th-order of approximation, one can define the exact square residual error

$$\Delta_n = \int_\Omega [Tu_n(x)]^2 dx \qquad (17)$$

However, it is proven by [10] that the exact residual error Δ_n defined by equation (17) needs too much CPU time to calculate even if the order of approximation is not very high. Thus, to greatly decrease the CPU time, we use here the so-called averaged square residual error $\sqrt{E_n}$ defined by

$$\sqrt{E_n} = \left(\frac{1}{m+1} \sum_{j=0}^m \left(T\left[u_n\left(\frac{j}{m}, \mathbf{h} \right) \right] \right)^2 \right)^{1/2} \qquad (18)$$

Theorem 3.1. (Banach's Fixed Point Theorem). Assume that BS is a Banach space and

$$A : BS \to BS$$

is a nonlinear mapping, and suppose that

$$\|A[u] - A[v]\| \leq a\|u - v\|, \ u, v \in BS$$

for some constants $a < 1$. Then A has a unique fixed point. Furthermore, the sequence

$$u_{n+1} = A[u_n],$$

with an arbitrary choice of $u_0 \in BS$, converges to the fixed point of A.

According to Theorem 3.1. for the nonlinear mapping

$$A[u(x)] = u(x) + \mathbf{h}\int_0^x l(x,t)\begin{Bmatrix} Lu(t) + Ru(t) \\ + Nu(t) - g(t) \end{Bmatrix}dt,$$

a sufficient condition for convergence of the variational iteration method with an auxiliary parameter is strictly a contraction of A. Furthermore, the sequence (19) converges to the fixed point of A which is also the solution of problem (10).

V. Numerical Example

In this section, we apply the variational iteration method which presented in previous sections to singularly perturbed convection-diffusion problems.

Example 5.1. We consider the following singularly perturbed linear convection-diffusion problems [2]:

$$eu''(x) + u'(x) = 1 + 2x, \ 0 < x < 1, \qquad (20)$$

$$u(0) = 0, \ u(1) = 1. \qquad (21)$$

It is easy to see that its exact solution is:

$$u(x) = x(x+1-2e) + \frac{(2e-1)\left(1 - e^{-\frac{x}{e}}\right)}{1 - e^{-\frac{1}{e}}} \qquad (22)$$

The exact solutions and numerical results for different e values are given in Table 1-2. Optimal $\mathbf{h}$ parameter values are given in Table 3 with $n = 3, m = 100$.

TABLE 1

EXACT SOLUTIONS FOR EXAMPLE 5.1 WITH $n = 3$

x	$e = 10^{-3}$	$e = 10^{-4}$	$e = 10^{-5}$
0.0001	-0.0948724468	-0.6318941447	-0.9998345930
0.0005	-0.3921831516	-0.9925632506	-0.9994797600
0.001	-0.6298573177	-0.9987538092	-0.9989790200
0.005	-0.9862605289	-0.9947760000	-0.9949551000
0.1	-0.8882000000	-0.8898200000	-0.8899820000
0.3	-0.6086000000	-0.6098600000	-0.6099860000
0.5	-0.2490000000	-0.2499000000	-0.2499900000
0.7	0.1906000000	0.1900600000	0.1900060000
0.9	0.7102000000	0.7100200000	0.7100020000

TABLE 2

NUMERICAL RESULTS FOR EXAMPLE 5.1 WITH $n = 3$

x	$e = 10^{-3}$	$e = 10^{-4}$	$e = 10^{-5}$
0.0001	-0.09488739680	-0.6319040435	-0.9998361492
0.0005	-0.39224487210	-0.9925787679	-0.9994813120
0.001	-0.62995626190	-0.9987693775	-0.9989805666
0.005	-0.98641232330	-0.9947911399	-0.9949566037
0.1	-0.88825953030	-0.8898258146	-0.8899825717
0.3	-0.60851737770	-0.6098516198	-0.6099851537
0.5	-0.24884889560	-0.2498847980	-0.2499884734
0.7	0.19074591560	0.1900746508	0.1900074692
0.9	0.71026705620	0.7100267268	0.7100026740

TABLE 3

OPTIMAL **h** VALUES FOR DIFFERENT e WITH $n = 3$

	$e = 10^{-3}$	$e = 10^{-4}$	$e = 10^{-5}$
h	0.90271	0.95483	0.97903

Conclusion

In this paper, we have demonstrated the suitability of asymptotic expansion and the variational iteration method with an auxiliary parameter for solving singularly perturbed convection-diffusion problems. The hybrid method can decrease a number of computation. Numerical results show that the hybrid method is suitable and very effective.

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Electrical Properties of Single- and Multi-Walled Carbon Nanotubes Composites at Low Temperatures

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Abstract – Electrical properties of single- and multi-walled carbon nanotubes composites (PEDOT:PSS/CNTs) were investigated in the range of 50 to 200 K. It is established that composite films with multi-walled nanotubes loading show lower resistances as compared to their single-walled counterpart.

Keywords – nanotube, electrical properties, low temperature, composite, polymer.

I. Introduction

Carbon nanotubes, or CNT, are cylindrical objects with a high aspect ratio that results from wrapping a graphene layer onto itself. In case there is a single graphene layer, the structures obtained are referenced to as single-walled carbon nanotubes (SWNTs). If a few layers of graphene are wrapped, the resulting formations are called multi-walled carbon nanotubes (MWNTs). Since their discovery back in 1991 [1], enormous research efforts have been put into the investigations of CNTs properties which are in many ways unique. Composites that have a good homogeneity and dispersion of nanofiller are of considerable interest for a vast variety of applications – from simple electromagnetic interference shielding to sophisticated optical devices [2-4]. Speaking of polymer-based nanocomposites, increased attention is recently paid to poly(3,4-ethylenedioxythiophene) (PEDOT) host matrices doped by poly(styrensulfonate) (PSS) [5] and reinforced with carbon nanotubes.

A number of reports focus on the interaction of external fields with PEDOT:PSS/CNT structures [6,7] and the behaviour of electrical properties of such nanocomposites as a function of frequency was also extensively studied recently [8,9]. Not so much, however, is known about the variation of conductivity/dielectric properties of these composites with temperature, especially in the low-temperature region. On the other hand, the knowledge about the influence of nanofiller on such parameters of the composite as loss tangent or dielectric permittivity is crucial when material engineering for functional applications is considered.

Here we present an attempt of a systematic study of electrical properties of PEDOT-PSS polymer composites reinforced with single-walled and multi-walled carbon nanotubes, specifically focusing on the temperature range of 50-200 K.

II. Experimental

Hybrid composite films were prepared starting from 1% water suspension of poly-3,4,-ethyldioxitiophen from Sigma Aldrich (USA) stabilized with surface active anion substance (polystyrene sulfonic acid). Two types of nanofiller were used: purified (90 wt%) single-walled carbon nanotubes (SWCNTs) with average diameter of 1 nm and lengths within the range of 5 to 30 μm and purified multiwalled carbon nanotubes (95 wt%) with average outside diameter of 65 nm, average inside diameter of 10 nm and lengths within 10-20 μm (MWCNTs). In order to unbundle nanotubes agglomerates efficiently, 30 minutes ultrasonication at 42 kHz frequency was applied. Then, deionized water cleaning process took place, upon completion of which water suspension containing 0.5 mg of nanotubes per 1ml of water was obtained. This suspension was mixed with PEDOT:PSS polymer solution and ultrasonically processed again during 4 hours. After 48 hours of proper drying at room temperature, composite films of PEDOT:PSS/nanotubes were formed on the glass. By varying the ratio between PEDOT:PSS solution and suspension of nanotubes films with different concentration of nanotubes (12 wt% and 16 wt%) were fabricated.

Electrical contacts were deposited on the film surface with conductive paint at the opposite side of the sample (coplanar, or lateral geometry), the distance between the contacts being set to 3 mm.

III. Results and Discussion

Prepared samples of PEDOT:PSS/CNTs composite films were subjected to low-temperature impedance measurements. Fig. 1 shows temperature dependencies of the measured sheet resistance of the SWCNT and MWCNT reinforced composite films measured at 100 kHz frequency in the range of 50 to 200 K. Reasons for selecting such temperature range limits were i) relatively small variation of resistance from 200 K up room temperature (total resistance at higher temperatures is determined by random network of nanotubes with tunneling barriers between individual tubes [10]) and ii) rapid increase of resistance for SCWNT composites below 50 K, so that the values of R were beyond the range of measurements for RLC meter.

Generally, lateral resistance of PEDOT:PSS/CNTs composite films increase non-linearly upon cooling. The dependencies in Fig. 1 are split in two sub-ranges, since, as shown below, there are possibly different mechanisms involved below and above 90 K. As far as different loadings of nanofiller are conidered, sheet resistances decrease with nanotube concentration.
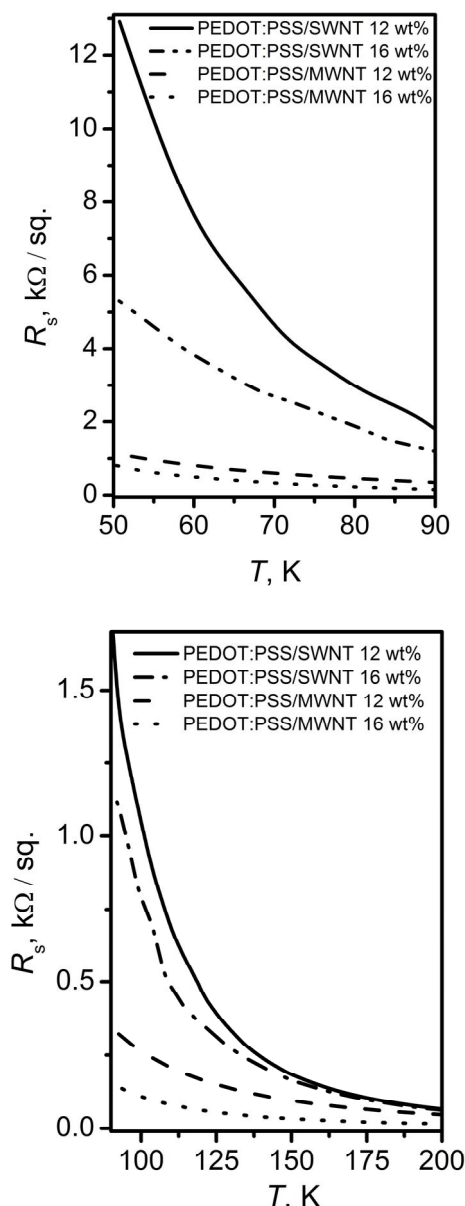
Fig. 1. Sheet resistances of CNT PEDOT:PSS composite films
vs. temperature (measured in cooling regime)

Assuming that low-temperature conduction mechanisms follow activation-type relation, sheet resistance can be expressed as

$$R_s \approx T \cdot \exp\left(\frac{eE_a}{kT}\right), \qquad (1)$$

where e is an elementary charge and k denotes Boltzmann constant. Plotting $\ln(R_s/T)$ as a function of reciprocal temperature and applying least squares fitting procedure one can estimate activation energy for conductivity.

Conclusion

Resistance of PEDOT:PSS composite films with the addition of single- and multi-walled NTs was studied by conductivity measurements in the lateral direction with respect to the substrate surface. Composites with multi-walled NT loading show lower resistances at same T as compared to their single-walled counterpart.

Acknowledgements

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Positron Annihilation Lifetime Spectroscopy in Application to Nanostructured Glasses and Ceramics

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Abstract – Modified nanostructured Ge-Ga-Se chalcogenide glasses and oxide MgO-Al₂O₃ ceramics were investigated using positron annihilation lifetime spectroscopy. It was shown that crystallization process in $80GeSe_2$-$20Ga_2Se_3$ glasses annealed at 380°C for 25 and 50 h indicates specific free-volume transformation. It is established that water vapor modifies defects located near grain boundaries in MgO-Al₂O₃ ceramics sintered at 1300 °C, the process being accompanied by void fragmentation at water adsorption with further void agglomeration at water desorption after drying.

Keywords – ceramics, glass, positron annihilation, modification, free volume, nanovoids.

I. Introduction

Positron annihilation lifetime (PAL) spectroscopy is well-known experimental technique to study extended defects and nanovoids in solids [1]. The method is grounded on physical phenomena of positron-electron interaction in a matter. It is frequently used to identify spatial heterogeneities in crystals (dislocations, vacancies, vacancy-like clusters and agglomerates), free volume evolution in organic polymers (size and number of open-volume holes, inner pores), light metallic alloys (cracks, bubbles), zeolites, gels, etc. But this method has been rarely applied to nanostructured glasses and ceramics because of significant complications in correct interpretation of the obtained data.

The aim of this work is the investigation of inner free-volume structure in the modified Ge-Ga-Se glasses and MgO-Al₂O₃ ceramics.

II. Experimental

The PAL spectra were recorded with conventional fast-fast coincidence system (ORTEC) of 230 ps resolution (full width at half maximum FWHM of a single Gaussian, determined by ^{60}Co isotope measuring) at the temperature $T = 22$ °C and relative humidity $RH = 35$ %, provided by special climatic installation. Contribution intensity of source is 15 %. Two identical ChG samples were used to build a character sandwich arrangement needed for PAL measurements. Isotope ^{22}Na of slow activity (~50 kBq) sandwiched between two identical tested samples was used as a source of positrons [2].

A series of a few independent experiments were assembled with samples of the same thermal prehistory to exclude data scatter because of differences between actual status of samples and uncontrolled instabilities in the experimental setting of PAL spectrometer. The obtained results agreed well with each other within an experimental error-bar, being no more than ±0.005 ns in lifetimes and ±0.01 in component intensities.

The measured PAL spectra were processed with standard LT 9.0 computer program [3], the obtained curve being fitted by two components with t_1, t_2 lifetimes and I_1, I_2 intensities for glasses and four components for ceramics. Therefore, the positron trapping modes, e.g. average positron lifetimes t_{av}, positron lifetime in defect-free bulk t_b, positron trapping rate in defects k_d and fraction of trapped positrons h were calculated using a formalism of two-states trapping model [4]. For present analysis, we have developed special algorithm based on appropriate error analysis of PAL measurements geometry and background removal. In addition, the $(t_2 - t_b)$ difference was accepted as a size measure for extended free-volume defects where positrons are trapped (in terms of equivalent number of monovacancies), as well as the t_2/t_b ratio was taken in a direct correlation to the nature of these defects [2,4].

III. Results and Discussion

Typical spectrum for glasses and ceramics obtained by PAL technique is shown in Fig. 1 and Fig. 2, respectively. They are characterized by a narrow peak and region of long fluent decaying of coincidence counts in a time. The mathematical decay of such curve can be represented by a sum of decreasing exponents with different values of power-like indexes inversed to positron lifetimes [5]. According to the mathematical decomposition proposed in [5], tangent to the sites of PAL spectrum correspond to lifetimes and the area under each of these curves is proportional to the intensities.
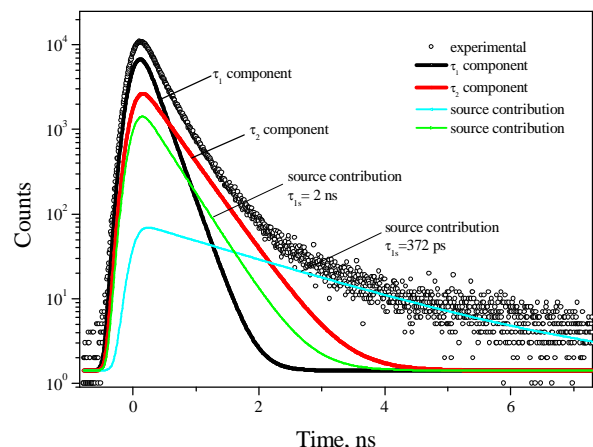

Fig. 1. Typical PAL spectrum decomposed into two components for $80GeSe_2$-$20Ga_2Se_3$ base glass

In the case of Ge-Ga-Se glasses with extending the annealing duration to 25 h, the lifetime t_2 increases and I_2 intensity decreases due to void agglomeration. This trend reduces the positron trapping rate k_d without significant changes in $t_{av.}$ and t_b lifetimes. With further extension of

annealing duration to 50 h, the I_2 intensity increases, while lifetime t_2 decreases from 0.426 to 0.424 ns. These changes result in increased positron trapping rate k_d. The fraction of trapped positrons h decreases in the initial stage of treatment to 25 h and increases at further annealing to 50 h.

During the crystallization process at annealing for 50 h, the glass structure relaxes towards more thermodynamically favorable state. It means that free-volume nanovoids can be essentially transformed in this process. In the case of the studied ChG the fragmentation of larger free-volume entities into smaller ones occurs. Such process is accompanied by a decrease in t_2 lifetime and a corresponding increase in I_2 intensity.
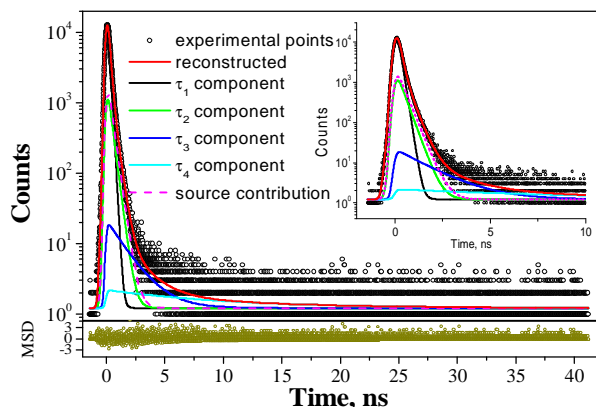
Fig. 2. PAL spectra of MgO-Al$_2$O$_3$ ceramics sintered at 1300 $^{\circ}$C, reconstructed from four-term fitting at the general background of source contribution

Decreasing of the lifetime t_2 in water-vapored MgO-Al$_2$O$_3$ ceramics and increasing of their intensity I_2 shows intensification of positron trapping in defects near grain boundaries filled with water [2]. After drying, the intensities I_2 almost completely return to the initial values (characteristic for initially dry samples). Thus, the water-adsorption processes in MgO-Al$_2$O$_3$ ceramics are accompanied by fragmentation of positron trapping sites near grain boundaries, and respectively, the water-desorption processes are accompanied by agglomeration of free-volume voids [2].

Water-vapor sorption processes in the studied MgO-Al$_2$O$_3$ ceramics result in essential evolution of third and fourth o-Ps-related components. The intensity I_3 increases in initially dry samples after water-vapor exposure, thus confirming o-Ps annihilation in water-filled nanopores through a "bubble" mechanism (with corresponding o-Ps lifetime close to 1.8 ns). After drying, the intensities of the third and fourth components return to the initial value, confirming high efficiency of water adsorption-desorption processes. The intensity I_4 decreases in water-vapor exposed ceramics samples. After drying of the ceramic samples previously exposed to water vapor, the initial pore size tends to be restored.

Additionally, the radii R_3 and R_4 of spherical nanopores were calculated using of o-Ps-related t_3 and t_4 lifetimes in known Tao-Eldrup model [2]. The decreased t_4 value for ceramics dried after water-vapor exposure can be connected with formation of thin layers of water molecules covering the walls of pores with radii of 1.8 nm, which are not completely removed after vacuum annealing at 120 $^{\circ}$C for 4 h.

Conclusion

Positron annihilation lifetime spectroscopy was used to investigation of free volumes in the modified nanostructured Ge-Ga-Se chalcogenide glasses and oxide MgO-Al$_2$O$_3$ ceramics. It is established that in the case of 80GeSe$_2$-20Ga$_2$Se$_3$ glasses it was shown that crystallization process during annealing at 380°C for 25 and 50 h indicates specific fragmentation of larger free-volume nanovoids into a greater number of smaller ones. In modified MgO-Al$_2$O$_3$ ceramics sintered at 1300 $^{\circ}$C it is shown that drying of ceramics in vacuum at 120 $^{\circ}$C previously exposed to water vapor does not restore initial pore size, confirming sensitivity of PAL method to amount of water molecules adsorbed in nanopores. The water vapor modifies defects in ceramics located near grain boundaries and this process is accompanied by void fragmentation at water adsorption with further void agglomeration at water desorption after drying. Using lifetimes of the third and fourth components of PAL spectra the radii of nanopores were calculated using Tao-Eldrup model.

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The research of multiplication in the ternary Galois fields

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Abstract – The research of multiplication in the ternary Galois fields Calculation and finding irreducible polynomials for Galois field **GF(p^m).** *Consider the proposed method of construction serial ternary multiplier element Galois field GF (3^m).*

Keywords – Galois field $GF(2^m)$, Mathematical package Maple, Galois field $GF(3^m)$.

I. Introduction

To protect electronic documents from a possible modification, forgery, copying, use digital signature, to guarantee authenticity

The use of electronic documents offers new opportunities to exchange information, through a global network and peripherals. But there is a problem regarding the protection of electronic documents from a possible modification, copying, forgery and manipulation. To solve it requires a variety of means and methods of information security. One of these methods of information protection is a digital signature (CPU), which with the help of special software guarantees the authenticity of the document, its details and the signing specific person.

II. Modified Guild cell

To construct the ternary field GF (3^m), used modified Guild cells that are different from the binary field increased number of input and output data. Guild cell has a 6-bit input and 2-bit output. The modification is that the construction does not use cell transfer.
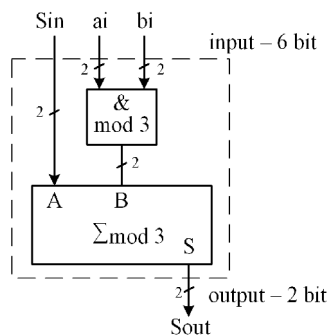

Fig. 1. Modified Guild cell for GF (3^m).

Matrix multiplier for direct and reverse field GF (2^3), shown in Fig. 2.
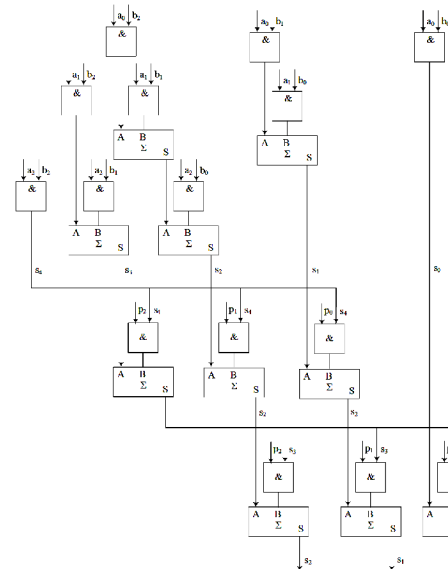

Fig.2. Matrix Multiplier for direct and reverse fields $GF(2^3)$.
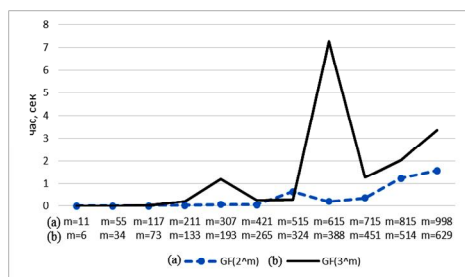
III. Irreducible polynomials

To perform multiplication elements Galois fields important finding irreducible polynomials that form field. This operation requires considerable time-consuming, especially for fields with a large order. Using mathematical package Maple can find such polynomials for the selected field and assess the time of their location, allowing you to indirectly evaluate the complexity of processing elements chosen field. It uses command and Nextprime time.

Table 1 shows a comparison time of polynomials that form field for Galois fields with bases 2, 3, 5, 7, 11, 13 and various orders. The value of the order m in each column of the elected terms of approximate equality in number elemetiv field GF (pm).

TABLE 1

CALCULATING IRREDUCIBLE POLYNOMIALS FOR GALOIS FIELDS GF(p^M)

| p	m						time
2	998	815	715	615	421	307	211
	1,578	1,234	0,359	0,203	0,046	0,062	0,031
3	629	514	451	388	265	193	133
	3,343	2,046	1,281	7,234	0,25	1,203	0,203
5	429	351	307	264	181	132	90
	3,656	2,109	1,765	2,515	0,203	0,078	0,062
7	355	290	254	219	149	109	75
	2,203	1,656	0,234	0,234	1,734	0,984	0,312
11	289	235	206	177	121	88	60
	7,062	4,234	4,14	0,296	0,656	0,171	0,031
13	269	220	193	166	113	82	57
	3,39	0,39	8,171	0,093	1,671	0,031	0,046

Table 1 shows that there are fields of high and low time complexity calculation irreducible polynomials, which indirectly points to the possible complications of processing elements separate fields.

a) GF(2^m) and GF(3^m)
Fig. 3. Calculating irreducible polynomials for Galois fields
$GF(p^m)$.

Figure 3 shows the time of the irreducible polynomial for the Galois field GF (2m) and GF (3m) with equal powers m (Table 2).
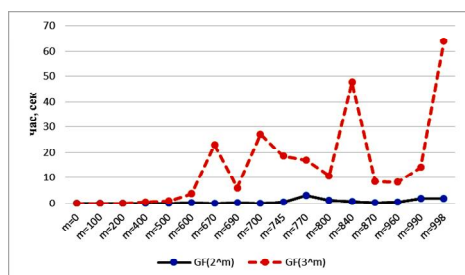
a) GF(2^m) ma GF(3^m)

Fig. 4. Comparison times return irreducible polynomials with the same degrees of Galois fields.

Table 2

Irreducible polynomial

GF	m=100	m=200	m=400	m=600	m=700	m=998	m=2000
GF(2^m)	0	0,015	0,078	0,281	0,031	1,89	36,312
GF(3^m)	0,062	0,078	0,562	3,843	27,218	64	452,328
GF(5^m)	0,015	1,218	1,093	2,703	45,515	223,156	302,796
GF(7^m)	0,156	0,296	23,328	45,015	6,75	155	1133,906
GF(11^m)	1,031	7,546	24	7,234	15,14	185,937	504,359
GF(13^m)	0,109	2,343	26,203	79,078	122,67	171,562	1505,906

Conclusion

The possibility of verification of binary operations on elements of Galois fields using mathematical package Maple.

Considered the construction of a parallel multiplier based on modified cells Hild. Proved its advantages over similar items multiplier binary Galois field GF (2^m).

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Mobile LAN based on BLE-configurable wireless Wi-Fi modules

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Abstract − Cyber-physical systems should be able to integrate into a local, wireless network, which can work in the absence of a global Internet, to solve and redistribute common tasks and exchange information among themselves. The presented network is implemented in two versions (compatible with each other as they work in a similar way using the same data packages) on ESP8266 and ESP32 modules.

The second one is more functional, flexible to use and configurable with built-in Bluetooth 4.2. The network supports up to 16 simultaneously connected devices (clients). Each WI-FI module contains both client and server programs and has an automatic deployment mode.

The user interface is an Android mobile application that performs the search for access points, connections, network configuration via BLE, and TCP/IP connections to manage devices connected to network modules, and to monitor information in a convenient way. At the same time, the network is easy to integrate into any system for UART, it is low-power consuming and it also has a low cost of components.

Keywords − Mobile LAN, WI-FI modules, TCP/IP, Bluetooth Low Energy, GATT, multi-agent system.

I. Mobile LAN based on ESP8266 wireless Wi-Fi modules

First of all, in comparison with traditional cable networks, it has a number of serious advantages, the main of which, of course, is the ease of deployment. Thus, a wireless network does not require cable laying; it is also difficult to deny the benefits of a wireless network, such as user mobility in the area of its operation and the ease of connecting new users to it.

There are two modes of Infrastructure – the basic mode BSS (Basic Service Set) and advanced mode ESS (Extended Service Set).

In BSS mode, all network nodes communicate only through one access point, which can also act as a bridge to an external network. In the extended ESS mode, there is the infrastructure of several BSS networks, with the access points themselves interacting with each other, which allows the transmission of traffic from one BSS to another. Among themselves, the access points are connected using segments of the cable network, or radios.

In our case, the network is built on the Infrastructure (BSS) principle. The access point is also a server for redirecting messages from client to client. Working on the firmware NodeMCU, it allows you to programme the module in the language Lua. The network topology is shown in Fig. 1

Providing a device with a regular Wi-Fi module does not solve the problem of sharing information with many devices, since it is possible to connect to just one Wi-Fi access point at a time. That is, if remote monitoring, data management or monitoring is required, it will be possible to access only one device (multi-agent system), to manage others it is necessary to reconnect to another access point.
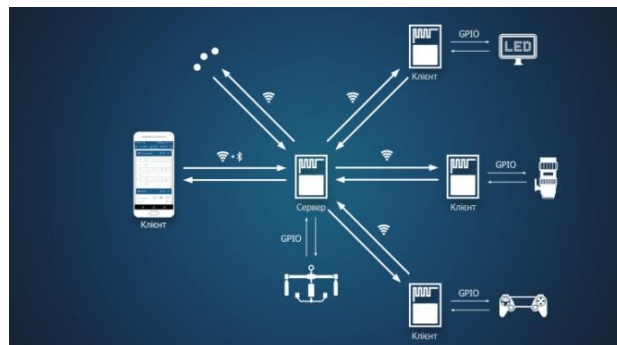

Fig. 1. The topology of a mobile LAN on Wi-Fi modules

The mobile Wi-Fi network is built in such a way that one of the devices acts as an access point with the server, while others are client stations, including mobile devices (smartphones, etc.) from which the control, configuration and monitoring are carried out.

Each WI-FI module contains both client and server applications. An automatic determination of the mode of the Wi-Fi module is enabled when the Wi-Fi access point and TCP / IP server is deployed on the first of the enabled devices, connecting others as a client. The server stores the connection table (shown in Figure 2) with the names and types of connected devices, IP and MAC addresses, sockets, etc. The server also commutes the connection between clients by redirecting messages from one client to another.

The possibility to send a message by identifier or to a group of clients of the same type is implemented. At the same time, the network is easy to connect to any system, it is low power consuming and it also has a low cost of components.

Fig. 2. Connection table (on server)

II. Mobile LAN based on wireless Wi-Fi modules ESP32 WROOM

This mobile local area network, which is based on the principle of operation and data transmission is similar to the given above. The difference lies in the use of a more productive Wi-Fi module based on the dual-core 32-bit microprocessor Xtensa. The module has more internal memory both RAM and ROM. The availability of low-power wireless Bluetooth 4.2 technology has increased reception and transmission speeds as well as improved privacy and security.

The listed characteristics offer the opportunity to increase the speed of data reception between the network clients, simplify the configuration of the network with Bluetooth, as well as increase the number of clients (up to 16 per access point), which are simultaneously connected and able to transmit data.

The difference in the program is in not using the firmware and shells that were the interpreters of other programming languages. The software is written in C using APIs provided by the manufacturer, and with a multitasking real-time operating system for parallelization of tasks in embedded systems – FreeRTOS. Its nucleus is represented by only 3 files. These solutions allow you to increase the speed of network response and reduce the amount of memory usage.

The program code is written in such a way that the memory is allocated dynamically and it is reserved not at the stage of compilation, but at the stage of execution of the program. This allows us to allocate memory more efficiently, there is no need to specify the size of an array, etc. Moreover, it is not always known how much memory will be required (for example, when receiving packages of different types or messages of different lengths).

The functions for splitting packaged packages during forwarding and all-round checks on the integrity of the package and the correctness of the formation are implemented. Packages that do not pass integrity checks or are incorrect are not taken into account, that is, they will not affect the work and network stability.

III. Types of data packages and their purpose

The following packages are used to send data over the network, the form and purpose of which are listed below.

The package is a string in the JSON format – a set of pairs of keys: the value that is generated by the client-sender is sent to the client-recipient through the server, after receiving it is unpacked and the message is extracted. JSON makes it easy to create a row from a data set, and it's just as easy to retrieve data. The package begins with the character "{", and ends with "}", which allows you to check the package for integrity before unpacking.

Packages and purposes:
• The Customer Identification Package (int) is required in order for the server to complete the client data in the connection table. The client sends the package after connecting to the server through the TCP protocol.

{ind = "int", type = "[device type]", name = "[device name (s)]", mac = "[MAC device address]"}
• Customer Message Package (mfc) – sending a message to one customer by device identifier.

{ind = "mfc", client = "[device identifier]", msg = "[message]"}
• Message Group Package (mfg) – Send a message to a group of clients of the same type.

{ind = "mfg", type = "[device type]", msg = "[message]"}
• Customer Configuration Package (sfc) – Sending a message with client config file settings by device ID.

{ind = "sfc", client = "[device identifier]", settings = "[conf config file]"}

IV. Network configuration using BLE (Bluetooth Low Energy)

Both sides use the GATT profile to send data. The profile (GATT) sets the rules for sharing profile and user data through a BLE connection. Unlike the GAP, which defines low-level interactions with devices,the GATT only deals with actual procedures and data transmission formats.

The GATT defines a hierarchical view of the data stored by the server. The GATT built on top of the Attestation Protocol (ATT) is a specific (and mandatory) implementation of Bluetooth Low Energy. Its role within the server is to determine the data structure (including the format) that the client can use to access the required data.

The GATT consists of the following:
• *Profile:* defines a specific case of use and consists of a service group that satisfies the use case.
• *Service:* collecting data and associated with them behaviour patterns to perform a specific function or functions.
• *Characteristics:* contains one value and value information.

So all the network settings are grouped – in the form of services that contain characteristics with values. These data in the form of a table are stored in the non-volatile module memory. When connected via Bluetooth, the mobile device will act as a client and contact the module (server) asking for data reading and recording changes.

As a result, we get more flexibility and convenience in configuring and reconfiguring the basic network settings.

V. The programme (application) – a mobile network client for Android devices

The software (application) is a client implementation for devices running on Android. This application allows you to connect, configure, and manage devices that are connected to networks based on ESP8266 and ESP32 wireless modules.

The application can be functionally divided into two parts:
1) Networking (network search, connection to the access point and server through TCP / IP, network configuration);
2) Work directly with the device connected to the network (settings, management, etc).

The first part is unchanged for any devices that use network data. The second part is the management interface, which is individual for each device, because they differ in purpose, capabilities and functionality.

The interface of the software application for the operating system Android is shown in Fig. 3, 4.

Main features of the 1st part:
• Configuring the network using BLE.
• Enabling / disabling the WI-FI wireless interface on the device from the application.
• Searching and displaying the list of access points within the radius of operation of WI-FI (additional network status information)
• Connecting to an access point selected from the list.
• Storing passwords from access points with which the connection was made.
• Making TCP connection with network server possible
• When the data are entered correctly, the network connection is made and the program list with the connection list to the network of devices is started, the parallel thread that is responsible for the connection is

started, and it allows you not to interrupt it even when the application is completely closed. If you restart it, you can continue to work without installing the connection again.

• After selecting one of the devices on the list, you will be taken to the control and configuration window.
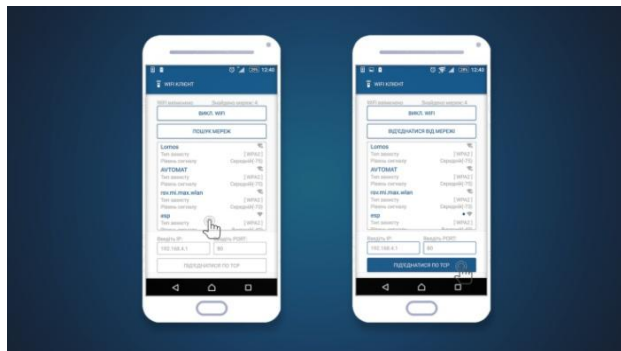

Fig. 3. Interface software application for the operating system Android (functional part of working with networks)
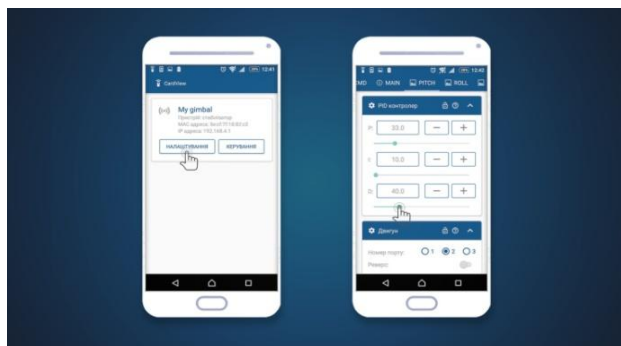

Fig. 4. Interface software application for the operating system Android (functional part of working directly with the device)

Conclusion

The results of the research into the problem of combining devices into a multi-agent system make it possible to achieve high efficiency in the implementation of structural solutions of autonomous nodes of the mobile LAN of the KFS and algorithms for their operation.

In particular, the problem of switching network clients among themselves is researched. There have been proposed formats of data packages for forwarding information from customer to customer by identifier, from client to client group of one type, client identification – for complete information about the device, client settings – for sending configuration file settings to the customer by identifier.

The obtained scientific results can be used for the construction and deployment of autonomous mobile local area networks that are not bound to the terrain, which are portable and easily deployed in an automatic mode. The first of the enabled devices becomes a Wi-Fi access point with a TCP server that commutes and redirects messages between client recipients that also automatically connect to this access point.

The developed network makes it easy to organize a control system with the help of software for Android devices without having to reconnect to each device separately. Also, the application allows you to configure the basic network settings using BLE.

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Computing Square Roots and Solve Equations of ECC over Galois Fields

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Abstract – Computing square roots in finite fields are important computational problems with significant applications to cryptography. Therefore, in this paper, we introduced some methods for finding square roots. Our proposed method calculates the Square root using multiplier over. The proposed method is competitive compared with other existing methods. It is introduced development to decrease of complexity of arithmetic units.

In addition, we approach a novel technique for Computation square roots presented using Half_even_odd unit mixed with multiplier and adder. One approach of Square Root presented using the same multiplier for arithmetic units of ECC. Thus, we goes to gets on reduced complexity for arithmetic units.

Key words: Galois Fields, Elliptical curve cryptography (ECC), square roots, Computation the trace, Computation square roots.

I. Introduction

Computing square roots over finite fields has found many applications in computer Engineering. Our own interest comes from elliptic curve cryptography; there, square root computations into Computation point equation of ECC. In addition, many applications requires several operations of square root and multipliers. This paper presents for used efficient square root based on the multiplier and the adder. The Multiplier Architecture based on the Interleaved MSB-first multiplication. Thus, we have compared multiplication operation with square root.

Moreover, the organization of this paper is as follows: Previous Work, Methods of computing square roots and quadratic equation over, Implementation square roots in Active-VHDL with the simulation and synthesis results followed by conclusion and references.

II. Previous Work

"Irreducibility and r-th root finding over finite fields" that had discuss a conjecture significantly weaker than the Generalized Riemann hypothesis to get a deterministic poly-time algorithm for r-th root finding [1]. "Computing p-th roots in extended finite fields of prime characteristic $p \geq 2$ "that is Very efficient, direct p-th root computation in extended finite fields of characteristic $p \geq 2$ working even for random irreducible reduction polynomial and for any finite field extension was proposed [2]. "Polynomial Representations for n-th Roots in Finite Fields" that generalize the results by considering n-th roots over finite fields for arbitrary $n > 2$ and polynomial representation is one of computational problems for find polynomial functions [3]. "Square root computation over even extension fields" that presents a comprehensive study of the computation of square roots over finite extension fields and propose two novel algorithms for computing square roots over even field extensions [4]. "An Efficient Method for Finding Square Root" that look into some methods for finding square roots that need more than one exponentiation in finite field [5]. In addition to the discussed above, there exist other literature in [6], [7].

Here, we will describe some methods that compute the square root and quadratic equation that enable us on the solution of ECC equation, are as follows:

III. Computation the trace

Let, with $c_i \in \{0,1\}$, represented as the $c = (c_{n-1},...,c_0)$, a primitive method for computing $Tr(c)$ uses the definition of trace, requiring *m-1* field squaring's and *m-1* field additions. A much more efficient method makes use of the property that the trace is linear [8], [9]: $Tr(c) = Tr(\sum_{i=0}^{n-1} c_i z^i) = \sum_{i=0}^{n-1} c_i(Tr(z)^i)$.

Trace operator has the important properties that $Tr(y^2) = Tr(y)$ and $Tr(x+y) = Tr(x) + Tr(y)$ for all $x, y \in GF(2^n)$.

The values $Tr(z)^i$ may be precomputed, allowing the trace of an element to be found efficiently, especially if $Tr(z)^i = 0$ for most *i*. Next are examples of computing traces of elements in $GF(2^{163})$ with reduction polynomial $f(z) = z^{163} + z^7 + z^6 + z^3 + 1$. A routine calculation shows that $Tr(z)^i = 1$ if and only if (iff) $i \in \{0,157\}$. As examples, $Tr(z^{160} + z^{46}) = 0$, $Tr(z^{157} + z^{46}) = 1$ and $Tr(z^{157} + z^{46} + 1) = 0$.

IV. Computation square roots

The basic method over $GF(2^n)$ is based on the little theorem as following [8]:

$c^{2^n} = c$. Then $\sqrt{c} = c^{2^{n-1}}$ over $GF(2^m)$, it can be computed with *m*−1 squarings.

A more efficient method is obtained from the observation that $\sqrt{c}$ can be expressed in terms of the square root of the element *z*.

Let $GF(2^n)$, $c_i \in \{0,1\}$. Since squaring is a linear operation in $GF(2^n)$, the square root of *c* can be written as

$$\sqrt{c} = \left(\sum_{i=0}^{m-1} c_i z^i\right)^{2^{m-1}} = \sum_{i=0}^{m-1} c_i(z^{2^{m-1}})^i.$$

Splitting c into even and odd powers, we have

$$\sqrt{c} = \sum_{i=0}^{\frac{m-1}{2}} c_{2i}(z^{2^{m-1}})^{2i} + \sum_{i=0}^{\frac{m-3}{2}} c_{2i+1}(z^{2^{m-1}})^{2i+1} =$$

$$= \sum_{i=0}^{\frac{m-1}{2}} c_{2i} z^i + \sum_{i=0}^{\frac{m-3}{2}} c_{2i+1} z^{2^{m-1}} z^i =$$

$$= \sum_{i_{even}} c_i z^{\frac{i}{2}} + \sqrt{z} \sum_{i_{odd}} c_i z^{\frac{i-1}{2}} .$$

This reveals an efficient method for $\sqrt{c}$ computing: extract the two half-length vectors $c_{even} = (c_{n-1},...,c_4,c_2,c_0)$ and $c_{odd} = (c_{n-2},...,c_5,c_3,c_1)$ from c (assuming m is odd), perform a field multiplication of c_{odd} of length $\left\lfloor \frac{m}{2} \right\rfloor$ with the precomputed value $\sqrt{z}$, and finally add these results together (Fig.1). There is example of square root calculation for $GF(2^4)$, $z=2$, $\sqrt{z} = 5 = 0101$, $f(z) = z + 1$, $c=1110$, $\sqrt{c} = 1101$.

In the case that the reduction polynomial f is a trinomial, the computation of $\sqrt{c}$ can be further accelerated by the observation that an efficient formula for $\sqrt{z}$ can be derived directly from f. Let $f(z) = z^m + z^k + 1$ be an irreducible trinomial of degree m, where $m>2$ is prime. Consider the case that k is odd. Note that $1 \equiv z^m + z^k (mod\ f(z))$. Then multiplying by z and taking the square root, we get

$$\sqrt{z} \equiv z^{\frac{m+1}{2}} + z^{\frac{k+1}{2}} (mod\ f(z)).$$

Thus, the product $\sqrt{z} \cdot c_{odd}$ requires two shift-left operations and one modular reduction. Now suppose k is even. Observe that $z^m \equiv z^k + 1 (mod\ f(z))$. Then dividing by z^{m-1} and taking the square root, we get

$$\sqrt{z} \equiv z^{\frac{-(m-1)}{2}} (z^{\frac{k}{2}} + 1)(mod\ f(z)).$$

In order to compute z^{-s} modulo, where $s = \frac{m-1}{2}$, one can use the congruence's $z^{-t} \equiv z^{k-t} + z^{m-t} (mod\ f(z))$ for $1 \le t \le k$ for writing z^{-s} as a sum of few positive powers of z. Hence, the product $\sqrt{z} \cdot c_{odd}$ can be performed with few shift-left operations and one modular reduction. For example:

Square roots in $GF(2^{409})$**:** The reduction polynomial for the NIST recommended is the trinomial $f(z) = z^{409} + z^{87} + 1$. Then, the new formula for computing the square root of $c \in GF(2^{409})$ is

$$\sqrt{c} = (c_{evem} + z^{205} \cdot c_{odd} + z^{44} \cdot c_{odd}) mod\ f(z).$$

Square roots in $GF(2^{233})$**:** The reduction polynomial for the NIST recommended is the trinomial $f(z) = z^{233} + z^{74} + 1$. Since $k=74$ is even, we have $\sqrt{z} = z^{-116} \cdot (z^{37} + 1) mod\ f(z)$. Note that $z^{-74} \equiv (z^{159} + 1) mod\ f(z)$ and $z^{-42} \equiv (z^{32} + z^{191}) mod\ f(z)$. Then one gets that $z^{-116} \equiv (z^{32} + z^{117} + z^{191}) mod\ f(z)$. Hence, the new method for computing the square root of $c \in GF(2^{233})$ is $\sqrt{c} = (c_{evem} + (z^{32} + z^{117} + z^{191})(z^{37} + 1) \cdot c_{odd}) mod\ f(z)$. In addition to above, the computation of quadratic equation is solve with repeated or without repeated roots, with repeated roots, a quadratic equation of the type $y^2 + c = 0$, where $c \in GF(2^n)$ and $c \in GF(2^n)$, we must extract the square root of c. Since in any field of characteristic two we have the identity $(x + y)^2 = x^2 + y^2$ and similarly, $(x + y)^{1/2} = x^{1/2} + y^{1/2}$ the square root is a linear operation [7].

In terms of a fixed basis of $GF(2^n)$, namely $u_1,u_2,...,u_n$ we may write $c = \sum_{i=1}^n c_i u_i$, where $c \in GF(2)$. Because of the linearity of the square root, we then have $\sqrt{c} = \sum_{i=1}^n c_i u_i^{1/2}$. Of course, $u_i^{1/2}$ can also be represented in terms of same basis, as $u_i^{1/2} = \sum_{i=1}^n R_{i,j} u_j$, with $R_{i,j} \in GF(2)$. We then have $\sqrt{c} = \sum_{i=1}^n \sum_{j=1}^n c_i R_{i,j} u_j$,

$$\sqrt{c} = \sum_{j=1}^n (\sum_{i=1}^n c_i R_{i,j}) u_j .$$

V. Computation quadratic equation without repeated roots

In general, we can transformation equation of ECC over binary field to the quadratic equation that be written as $y^2 + by + c = 0$ where $b = x$ and $c = x^3 + x^2 + 1$. We have just seen that if $b = 0$, this equation has a unique solution in $GF(2^n)$, and that this solution may be found by multiplying the vector representing c by the matrix R, which extracts square roots.

If $b \neq 0$ we first transform the equation by introducing the new variable $t = \frac{y}{b} \to y = tb$. This new variable satisfies the equation $b^2 t^2 + b^2 t + c = 0$, or $t^2 + t = d$ where $t = \frac{c}{b^2}$.

We now notice that if $t_i^2 + t_i = v_i$ and $t_j^2 + t_j = v_j$, then $(t_i + t_j)^2 + (t_i + t_j) = v_i + v_j$. Hence, a solution of the equation $t^2 + t = d = \sum d_i v_i$; $d_i \in GF(2)$, is given by $t = \sum d_i t_i$, where t_i is a solution of the equation $t_i^2 + t_i = v_i$.

This shows that the set of v for which the equation $t^2 + t = v$ has a solution in $GF(2^n)$ forms a linear subspace of the vector space $GF(2^n)$, and since each value of v corresponds to two values of t, the dimensionality of the subspace is evidently n-1.

Consequently, the solutions of the equation $t^2 + t + d = 0$ may be represented in terms of solutions to the equations $t_i^2 + t_i + v_i = 0$, for $i = 1, 2, , \ldots, n$-1, where the v_i span the space of v's for which $t^2 + t + v = 0$ has solutions in $GF(2^n)$.

If d is not expressible as a sum of such v's, the equation $t^2 + t + d = 0$ has no solutions in $GF(2^n)$. If $d = \sum d_i v_i$, then $t = \sum d_i t_i$ is a solution of $t^2 + t + v = 0$. The other solution is found by adding to the first type solution a solution of $t^2 + t = 0$, namely, $t = 1$.

If $t_i^2 + t_i = v_i$, then we may square both sides to obtain $(t_i^2)^2 + t_i^2 = v_i^2$. By repeatedly squaring, we find that $t_i^{2j+1} + t_i^{2j} = v_i^{2j}$. Summing on j gives

$$\sum_{j=0}^{n-1} (t_i^{2j+1} + t_i^{2j}) = \sum_{j=0}^{n-1} v_i^{2j}.$$

The left-hand side of this equation is equal to $t_i^{2^n} + t_i$, which is 0 for all $t_i \in GF(2^n)$. Therefore, if the quadratic equation $t^2 + t = v$ has solutions in $GF(2^n)$, then $Tr(v) = 0$, where $Tr(v)$ is defined as $\sum_{j=0}^{n-1} v^{2j}$.

However, all elements in $GF(2^n)$ are roots of the equation $y^{2^n} + y = 0$. From the factorization

$y^{2^n} + y = (y + y^2 + y^{2^2} + \ldots + y^{2^{n-1}})$,

$(1 + y + y^2 + y^{2^2} + \ldots + y^{2^{n-1}}) = Tr(y)(Tr(y) + 1)$, we see that exactly half of the elements in $GF(2^n)$ have $Tr(y) = 0$ and exactly half have $Tr(y) = 1$. Since the space of v's for which $y^2 + y = d$ has solutions in

$GF(2^n)$ has dimension n-1, we have the following theorem: If $d \in GF(2^n)$ the quadratic equation $y^2 + y = d$ has solutions in $GF(2^n)$ iff $Tr(d) = 0$.

Further uses of the trace operator it have seen that the quadratic equation $y^2 + xy = x^3 + x^2 + 1$ over $GF(2^n)$ has solutions in $GF(2^n)$ iff $Tr(\frac{x^3 + x^2 + 1}{x^2}) = 0$.

On the other hand there is next theorem: The cubic equation $x^3 + x = h$, $h \in GF(2^n)$, $h \neq 0$ has a unique solution $x \in GF(2^n)$ iff $Tr(h^{-1}) \neq Tr(1)$.

VI. Implementation square roots calculation in Active-VHDL

This section introduces engineering aspects of implementing of square roots over $GF(2^n)$ calculation that uses computation equations of elliptic curves and cryptographic solutions efficiently and securely in specific environments.

The proposed method of ECC enhance arithmetic unit with implementation of square root operation into control unit level. It uses first level arithmetic units such as Adder and Multiplier. It is also uses ROM and Half_even_odd unit. Half_even_odd divides Galois field elements into Even and Odd groups. Its VHDL-description is below. The proposed design of square root unit (SRU) and its block diagram are presented in Fig. 1 and Fig. 2. Its work is based on the solution of quadratic equation (with or without repeated roots) over $GF(2^n)$.
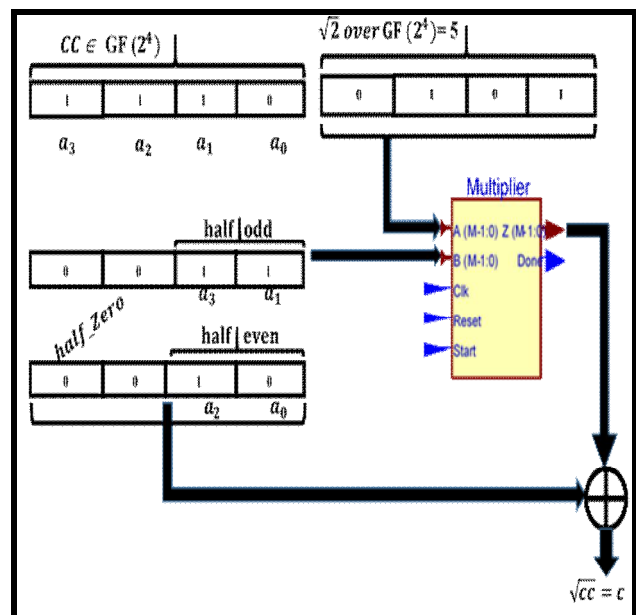

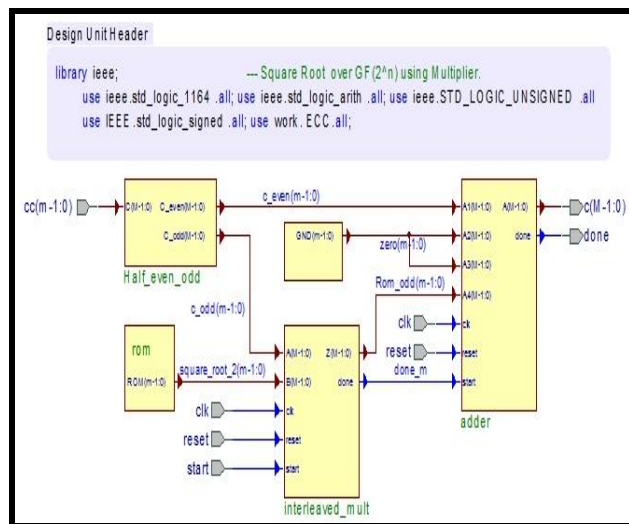Fig. 1. The proposed design of square root unit with Multiplier.

Fig. 2. Block Diagram of Proposed Square root Unit

```
-------------------------------------------------
--- VHDL-description  = Half_even_odd of c(x)
-------------------------------------------------
library ieee;
use ieee.std_logic_1164.all;
use ieee.std_logic_arith.all;
use ieee.std_logic_unsigned.all;
use work.ECC.all;
ENTITY Half_even_odd IS

PORT(
 C: IN STD_LOGIC_VECTOR(M-1 DOWNTO 0);
 C_even,C_odd,square_root_2: OUT
STD_LOGIC_VECTOR(M-1 DOWNTO 0));
END Half_even_odd;

ARCHITECTURE Half_even_odd OF

Half_even_odd IS

SIGNAL h_even: STD_LOGIC_VECTOR (((M-((m mod
2)*1))/2)-(1-(m mod 2)) DOWNTO 0);
SIGNAL h_odd : STD_LOGIC_VECTOR (((M-((m mod
2)*3))/2)-(1-(m mod 2)) DOWNTO 0);
SIGNAL even_0: STD_LOGIC_VECTOR (((M-((m mod
2)*3))/2)-(1-(m mod 2)) DOWNTO 0):=(others => '0');
SIGNAL odd_0 : STD_LOGIC_VECTOR (((M-((m mod
2)*1))/2)-(1-(m mod 2)) DOWNTO 0):=(others => '0');
signal mult_done: STD_LOGIC;

begin

half_even:FOR i IN 0 TO ((M-((m mod 2)*1))/2)-(1-(m
mod 2))
        GENERATE h_even(i)<=c(2*i);
        end GENERATE;

half_odd : FOR i IN 0 TO ((M-((m mod 2)*3))/2)-(1-(m
mod 2))
        GENERATE h_odd(i)<=c(2*i+1);
        end GENERATE;
```

```
    c_odd  <= odd_0 & h_odd;
    c_even <= even_0 & h_even;

END Half_even_odd;
```

Conclusion

In this paper new method of Square Root Calculation in arithmetic units which are used in elliptic curve cryptography (ECC) is presented. The method uses traces of Galois Field elements and also can be used to solve quadratic equations in $GF(2^n)$.

The method is based on usage of existing ECC multipliers. The new approach reduces ECC arithmetic units complexity.

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The Dogmata of Secrecy:
Are we Realistic about the Facts and Impact of Massive Leaks of Classified Information?

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Abstract – In recent years, massive leaks of classified information enabled by the Internet have been at the core of political and media attention. Wikileaks and the Snowden files are well known examples. Public and political opinions show a particular black-and-white division. On the one hand there is alarm about the abuse of powers by intelligence services and on the other hand about the possible risks to national security. If we look at the fact finding side of the latter position there appears to be a vacuum. Opinion and not factual or logical proof is dominating the debate at this side. The dogmata of secrecy seem to prohibit such proofs. How can we elevate this debate by obtaining some facts and dependable conclusions in spite of their formal secrecy? In this paper we describe some methods available to perform the research necessary to answer this question and we will start making an inventory of press, political and scientific sources about the Snowden files to be able to estimate the actual as opposed to the alleged security impact of this case of massive leaking of classified information.

Keywords – Snowden, NSA, Leaks, Intelligence, Classified, Secrecy, Security, Transparency, Methodology.

I. The Dogmata of Secrecy

In all worlds in which propositions p and q are true the proposition p strictly implies q is contingent. So in our world where nuclear arms are evidently present since August 6, 1945 and a world war is absent since August 15, 1945 the proposition that nuclear arms strictly imply the absence of a world war is just contingent. To resolve the contingency in this case the hypothesis of deterrence should be falsified or its strength statistically tested. This hypothesis has fortunately neither been falsified nor has its strength ever been tested statistically. In the case of the alleged implication of certain consequences of massive leaks of classified information the position of its proposers is even worse. In the case of nuclear arms there is no doubt about their existence and – if used – their technical consequences nor about the absence of a world war. In the case of massive leaks of classified information there appears to be no oversight of the leaked information and there are no dependable sources for the alleged security consequences. Therefore, the many political and journalistic hypotheses about the alleged security consequences of these leaks are not only not falsified and not tested but at this moment – by lack of data – unfalsifiable and untestable.

This can legally and psychologically be explained by what we identified as the 'five dogmata of secrecy'[1]:

Dogma 1: It is self-evident that we need a secret service;

Dogma 2: It is also self-evident that the secret service is effective;

Dogma 3: We do not need independent research nor data or statistics to support dogma 2 (threats to (national) security suffice);

Dogma 4: The supervision of the secret services can be based on trust;

Dogma 5: We can proceed in the traditional way regardless of technical developments. Secret services (co)operate in a globalized information society but it is sufficient that they are only locally accountable.

The research described in this paper is inspired by the initial observation that there is a strong unbalance between the different public positions taken in the discussion about the implications of the Snowden files. On the one hand the position that intelligence services stretch their powers within and even beyond legal limits is well documented. On the other hand, the position that national security is threatened appears to be undocumented.[2] Since these positions require opposite political and legal arrangements – more oversight of secret services vs more powers for secret services – the answer to the following research questions is important. What methods could be used to document the confirmation or the negation of the latter position? What are the results of their application? What are the requirements for effective further research and what further research is necessary?

II. Methodology

What method can be used to circumvent the problems the dogmata of secrecy pose for research into the security consequences of the leaking of classified information?

To corroborate claims that the disclosure of classified information has certain consequences some conditions have to be met:

(1) The classified information must be available;

(2) The alleged consequences must have actually occurred;

(3) The relation between information and consequences must be theoretically possible, i.e. a coherent explanation has to be present or presented;

(4) To be convincing, this relation must be logically necessary, theoretically necessary – have no (serious) competition of theoretically possible alternatives) – or, if enough data are available, the relation must be probable or at least conventionally plausible, i.e. uncontested.

Interestingly enough the research described in §3. of this paper strongly suggests that just one of these. The conditions has been met in the case of the alleged security

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[1] cf. de Vey Mestdagh, 2015 [30].

[2] Fenster (2012) reaches a similar conclusion in the Wikileaks case [21].

consequences of the Snowden files.[3] The classified information appears to be only partially and selectively available. Many of the claims are based on information that is not available or not explicitly extracted from the available sources. Most of the consequences for security are still in the phase of allegation and not of proven occurrence. The claimed relations are not logically or theoretically necessary. In the absence of data, the probability of the relations cannot be estimated and even the supposed relations are highly contested.

The current debate about the security implications of the Snowden files is therefore based on the theoretical possibility of a relation between partially unknown or undisclosed information and unproven consequences.

This research has been set up to try to change this inexpedient situation. The first step was to make an inventory of possible sources of data. The second step was to define ways of exploring these data. And the final step was – if accessible – to actually search them.

Possible sources of data:
(1) The Snowden files;
(2) Public media (political and journalistic publications);
(3) Publicly available documents of governments and specifically secret services;
(4) Scientific publications;
(5) Technological information.

Ways of exploring these data:
(1) Find data in the Snowden files that inevitably (by logic or by lack of competition) lead to certain consequences;
(2) Make an overview of political and journalistic statements (pro and con);
(3) Find evidence in the publicly available accounts of governments and specifically secret services that harm has been done;
(4) Make documents of governments available, if necessary by exerting rights based on administrative transparency acts;
(5) Use the scientific work of others to reach conclusions;

Infer that certain facts are technically impossible, e.g. by timeline, or implausible by competition.[4]

We will find out if this methodology can help us to circumvent the problem the dogmata of secrecy pose, by applying it. The aims of this research are ambitious and can only be attained over a longer period of time and

through cooperation with journalists and other research groups. We made a start with a thorough inventory of the available Snowden files (§3.1.), the public media (§3.2.), literature (§3.3.) and public accounts of secret services in the Unites States of America (USA), the United Kingdom (UK) and the Netherlands (§3.4.).

III, Sources

First we did a search of the Snowden files to find facts that could entail security consequences ([1]..[7]). Next, we searched the public media to define the dominant opinions and to find analyses of facts and actual consequences and proposals for the reliable assessment of their interrelationship ([8]..[14]). Opinions are abundant, but analyses are missing. Therefore, the next step was searching for these missing analyses and proposals in literature ([15]..[29]). We found many historical descriptions and some theoretical analyses of the developments in the Snowden case but no factual substantiation of opinions or proposals for reliable research. We therefore conducted a systematic search for facts in the intelligence and security archives of the USA ([31]..[38]), the UK ([39]..[45]) and the Netherlands ([46]..[54]) over the period of the first publication of the Snowden files to August 2016. Our research in the archives of the services and the supervisory commissions did not produce facts, not even 'concrete' abstractions of facts. Finally, we did an incidental preliminary research to establish the viability of logical and technical methods to enhance the quality of the debate. We did a technology check on the position that the Snowden files were a condition sine qua non for the Paris terrorist attacks. Our conclusion is that the argument fails on the basis of the ample availability of the technology used before the publication of these files. This therefore seems a viable method for systematic further research.

3.1. The Snowden Files

A fundamental problem for our research is the incomplete and inadequate, often indirect, access to the fundamental facts.

Incomplete simply means that according to the available sources Snowden took between 58.000 and more than 1.5 million files.[5] According to Cryptome (2013, [4]) only 7,302 pages of the Guardian's first reported 58,000 files have been published, while according to the Canadian Journalists for Free Expression (2016, [2]) no more than 1182 documents have been made available.

Inadequate, because journalists with access to the Snowden files have made a small opiniated selection of the files concerned with. For example, the cooperation of Verizon and other American telephone and IT companies with the NSA, the Prism programme, the NSA spying on foreign countries and world leaders and the interception by the NSA of text messages and phone calls, have been selected. However, we are not interested in the deduction of behaviours of our secret services, but in the

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[3] Off course in other cases the facts and consequences are proven, i.e. the facts that hurt the reputation of the NSA and other secret services, the effects this had on the attitudes of oversight organizations and public opinion and some political ([20]), legal, and economic [19], [18] effects.

[4] An example of a technical impossibility is that something happened before it occurred (the terrorists used a technique before 2013 that was only revealed by the Snowden files in 2013). An example of an implausibility is the assertion that a phenomenon has an exceptional cause instead of a commonly acknowledged cause (the terrorists used a technique that was widely known and very common before 2013 only because of the publication of the Snowden files in 2013). See §3.2.

[5] House of Representatives, USA. [32].

corroboration of their propositions about the security consequences of these revelations. The Snowden files cannot provide that, being the alleged cause of these consequences. What they could provide is proof of the existence of the alleged causing facts.

What do we know? We know that the Snowden files are mainly NSA documents. We hardly have access to the original files. We do not even have a systematic inventory of their contents. Estimates of their number range from tens of thousands to more than a million. Actual access is limited to a small number of these documents and in most cases not the most revealing ones. For example, SIDtoday, the internal newsletter for the NSA's Signals Intelligence Directorate, which is partly published by Intercept (2016, [7]). The exception to this could be the revelation of the actual unknown trade of the secret services. However, the fact that secret services are tapping communications is not a revelation, but a confirmation of what secret services lawfully or unlawfully do. The former deputy head of MI6, Nigel Inkster, stated for example: '*I sense that those most interested in the activities of the NSA and GCHQ have not been told much they didn't already know or could have inferred*'.[6] In the case of cryptography there are even arguments to dismiss the relation between publication of the Snowden files and security consequences (see §3.2.).

The reason for the scarcity of available Snowden files is not the unavailability of the files themselves but the selection which is made by the journalists involved. Glenn Greenwald writes: '*From the time we began reporting* […] *we sought to fulfill his* [Snowden's] *two principal requests* […]: *that they* [the files] *be released in conjunction with careful reporting that puts the documents in context and makes them digestible to the public,*[…] *and that the welfare and reputations of innocent people be safeguarded.*'[7] If it is true that certain individuals are more able to fulfil these requests than others, one should expect that these individuals share this burden with more of these able others in order to speed up the process of responsible publication.

3.2. Public Media

Our fact finding mission continued with a search through public media to be able to make an inventory of the dominant opinions about the consequences of the publication of the Snowden files and to analyse their foundations. We decided to include the Guardian [10], the Washington Post [13] and Der Spiegel [9] because of their involvement in the original publication of stories based on the Snowden files and to get international spread. We added the Intercept [11] because of their role as a platform for further publications about the Snowden files and for opening up an archive containing a small selection of the Snowden files. To extend our spread we added two large middle market newspapers USA Today [14], one of the widest circulated newspapers in the USA

and the Telegraaf [8], the largest Dutch daily morning newspaper. We did a search in the archives of all of these media from the time of the first publications until August 2016. To complete this part of our research we scanned the available publications in one large down-market British newspaper, the Sun [12]. The conclusion of this search is that two political opinions are very dominant: amongst – former – government officials (1) *the massive information leaks are a serious threat to intelligence and security*; and amongst journalists (2) *governments massively abuse their powers through their Intelligence and Security Services*. Most of the journalistic comments follow this simple black and white scheme. Criticism is mainly directed at the lack of factual and theoretical underpinning of the opposite political opinions. Systematic analyses of data sources and criticism on – the lack of – methodology used or proposals for a reliable methodology are hard to find.

We shortly followed an interesting side track, because of its importance for further research. In a CNN interview about the Paris attacks with the former head of the CIA James Woolsey, the interviewer stated: '[…] *and they believe they knew to use encrypted communications because of the Edward Snowden revelations.*' Woolsey reacted: '[…] *I think the blood of a lot of these French young people is on his* hands [interviewer: '*because of what he revealed*'] *because of what he turned loose.*'[8] It can easily be shown from public sources that cryptography was available years before the Paris attacks and also propagated and used by terrorist networks.[9] Arguments that try to substantiate the relation between the Snowden files and the use of cryptography by terrorists all suffer from the Post hoc ergo propter hoc fallacy (cf. Shafer, 2014 [27], Adrian Cully in Verkaik, 2015 [29] and Recorded Future, 2014 [25]). This is an example of the kind of further research into technological facts and the methodical use of inferred impossibilities and implausibilities which can help to circumvent the effects of the dogmata of secrecy.

3.3. Literature

We searched SmartCat, Google Scholar and PiCarta to make an inventory of literature about the Snowden files.

We also searched the internet libraries of the oversight organizations mentioned in the next paragraph for literature references. We were not able to access the National Security Archive because our institution has not signed up yet. We did however use the links in the article of Richelson (2013, [26]) to get access to a number of relevant files in this archive. This search has mainly been limited to the post Snowden years 2013- 2016. We read

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[6] Harding, 2014 [24]. See also Berghel, 2014 [16].

[7] Greenwald, G. (2016, May 16). The Intercept is Broadening Access to the Snowden Archive. Here's why. *The Intercept.* [11].

[8] www.cnn.com/videos/us/2015/11/19/ex-cia-director-james-woolsey-edward-snowden-intvw-nr.cnn.

[9] Cf. United Nations Office on Drugs and Crime, 2012 [28]; Al-Qaeda in the Arabian Peninsula. *Inspire Magazine.* Summer 2010 and Fall 2010 issues [15]; Flashpoint Global partners, 2014 [22]; Hussain, M. (2014, September 16). No, Snowden's Leaks Didn't Help The Terrorists. *The Intercept.* Retrieved from theintercept.com/2014/09/16/snowdens-leaks-didnt-help-terrorists/, [11].

more than two hundred possibly relevant publications, including a few additional media publications and documents from the parliamentary archives of the USA, the UK and the Netherlands. We skipped all publications that were irrelevant to our research, for example publications about the behaviours of the NSA and other security services, the wilful cooperation of ICT companies, the events surrounding the leaking of the Snowden files, Edward Snowden as a person and the legal accountability of Edward Snowden. Finally, we concentrated on the thus selected publications about the contents of the Snowden files and its alleged consequences for national security. Apart from some of the sources referred to in §3.2., we did not find any serious, let alone scientific, research into actual or potential facts underpinning the alleged security risks. In most of the publications, the maximum of relevance can be summarized as follows: there is an alleged security risk and I know for a fact, or I think, or it is theoretically possible, or I believe that there is/there is no security risk without being specific about the antecedents or with nonfactual antecedents (see amongst others documents 65,[10] 71, 88, 92 and 112 included in Richelson, 2013 [26]). Facts – the content of specific Snowden documents hypothetically related to documented implications for security – are absent. We included a selection of the literature searched in our list of references ([15]..[29]) to give the reader an impression of common sources and we invite everyone to try to find the facts we are missing.

3.4. Intelligence Archives

The main focus of our current research has been a systematic and full search of the public archives of the oversight organizations concerned with intelligence activities in the USA, the UK and the Netherlands. We searched for factual evidence for the statements made about the consequences of Snowden's revelations. The position that these facts are classified and therefore probably cannot be found is justified, but does not generalize to the position that an abstraction of facts to a certain level, such as a class of facts, is also classified. It suffices to report that there are hard facts about a class of the alleged damages done to security and that the relation between these facts and the actual contents of certain published Snowden files can be established by following a particular explicit line of theoretical argument which has no serious competition. The actual classified facts can even confidentially be reported by the intelligence services to the assigned national supervisory commissions, who can translate them to the aforementioned level of abstraction in their reports to national parliaments. This would for example justify the demands for an increase of funding of intelligence agencies and of their investigative powers. Therefore, abstract statements that explicitly refer to undisclosed facts were included in the search. We did

research in the archives from the time of the first publications of the Snowden files until August 2016. In none of the selected countries one can get direct access to documents of the secret services, with the exception of some noncommittal annual reports. So what we call intelligence archives are the publicly available proceedings of the supervisory national organizations to which the national secret services give account.

3.4.1. United States of America

The actual number of government organizations involved in intelligence activities in the USA is unknown.[11] The United States Intelligence Community (IC) is a federation of sixteen or seventeen – including the Office of the Director of National Intelligence – separate United States government agencies that work separately and together to conduct intelligence activities.[12] Executive oversight of these organizations is given to the President's Foreign Intelligence Advisory Board (PFIAB), the Joint Intelligence Community Council, the Office of the Inspector General (OIG; and the Office of Management and Budget, Congressional oversight of the IC is assigned to the United States House Permanent Select Committee on Intelligence, and the United States Senate Select Committee on Intelligence. There are no public archives of the executive oversight available. We searched the archives of the Congressional Select Committees on Intelligence, the House Committee on Armed Services, the House Committee on Homeland Security, the House Committee on the Judiciary, the Senate Committee on Homeland Security and Governmental Affairs and the Senate Committee on Foreign Relations ([31]..[38]). The pattern that emerges is that these committees are very concerned about the security consequences. This concern appears to be fully based on the opinions of IC officials and not on explicit or abstracted facts. We illustrate this pattern below by a selection of representative quotes from the committee's archives.

House Permanent Select Committee on Intelligence
The position of the HPSCI becomes clear in their Annual Report of 29 December 2014 (H.Rep. 113-717, p.3, [31]). The bulk metadata program that was revealed by the Snowden files was *highly classified*, is *legal* and the NSA protected the constitutional rights of *U.S. persons*. The disclosure has caused damage to national security *that cannot be calculated and which may not become apparent for years.* Although perfectly *effective and legal*, public concern suffices to *end the bulk collection of telephone metadata, while preserving as much of the operational effectiveness and flexibility of the* [bulk metadata] *program.*

The HPSCI suggests that facts and consequences are known. '*This year, massive unauthorized disclosures of classified information caused immense damage to our*

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national security' [32, p. 9]. However, this statement is not accompanied by even abstract classifications of the information and the damage or by any theoretical argument for a relation between these undisclosed information and damages.

On 15 September 2016, the House of Representatives published the HPSCI Executive Summary of Review of the Unauthorized Disclosures of Former National Security Agency Contractor Edward Snowden [32]. According to this report, *'Snowden caused tremendous damage to national security'*. *'Some of Snowden's disclosures exacerbated and accelerated existing trends that diminished the IC's capabilities to collect against legitimate foreign intelligence targets, while others resulted in the loss of intelligence streams that had saved American lives.'* We thought to get some concrete abstractions at last but then the argument deteriorates: *'The full scope of the damage inflicted by Snowden remains unknown. […] The Committee is concerned that the IC does not plan to assess the damage of the vast majority of documents Snowden removed.'* Our question is: If all of the reviewed operations have been compromised and its details are handed over to terrorists and nation states why should the oversight organizations be kept uninformed and ultimately the people be kept ignorant? One of the principal sources of the Review is the IC. The IC should not advise the House of Representatives or the HPSCI but be supervised by it. The IC is marking its own paper. Quis custodiet ipsos custodes?[13]

United States Senate Select Committee

Saxby Chambliss of the SSCI is well aware of at least a part of the limitations of the oversight method applied: *'We cannot do the oversight the American people expect of us if every request for information becomes a protracted battle.'* [35, p. 4].

A different tone is chosen after the first leaks of the Snowden files: *'The Committee is dismayed by leaks that have appeared in the media […] The public disclosure of these programs […] has done grievous harm to the effectiveness of the programs involved and, hence, the nation's security. […] Up until these programs were leaked, their implementation by NSA was an example of how our democratic system of checks and balances is intended to, and does, work'* [37, p. 3]. So the system works fine. This change of tone would be understandable if the IC changed its ways and was providing adequate information.

The following quote suggests that adequate information is provided by the IC: *'The unauthorized disclosures concerning these lawful programs have provided al Qa'ida and others with a roadmap of how to better evade U.S. intelligence collection. […], the programs at issue become substantially less effective.'* [37, p. 4].

However, the SSCI applies the same method as the HPSCI. The IC is marking its own paper without providing any facts. *'As Director Olsen recently acknowledged, these disclosures have caused terrorist groups to change their communication methods and in*

other cases drop out of our collection altogether.' p.3, [35, p. 3]. The source of this conviction is Director Olsen of the National Counterterrorism Center (NCTC). James R. Clapper, Director of National Intelligence (DNI): *'But what I do want to speak to […] is the profound damage that his disclosures have caused and continue to cause. As a consequence, the nation is less safe and its people less secure. […] As a result, we've lost critical foreign intelligence collection sources, including some shared with us by valued partners.[14] Terrorists and other adversaries of this country are going to school on U.S. intelligence sources' methods and trade craft and the insights that they are gaining are making our job much, much harder. And this includes putting the lives of members or assets of the Intelligence Community at risk, as well as our armed forces, diplomats, and our citizens. We're beginning to see changes in the communications behavior of adversaries,[15]'* [35. p. 5].

Next, the cogency of the convictions of the members of the IC is undermined further:

Director Clapper, DNI: *'It's clear as well that our collection capabilities are not as robust, perhaps, as they were because the terrorists—and **this is not specifically because of the Snowden revelations**—but generally have gotten smarter about how we go about our business and how we use trade-craft to detect them and to thwart them.'* [35, p. 41].

Director Olsen, NCTC: *'It certainly puts us at **risk of missing something** that **we are trying to see**, which could lead to putting us at **risk of an attack**, yes.'* Senator Collins: *'And just to quote you back to yourself, you said, 'This is not an exaggeration; **this is a fact**.' And you stand by that.'* Director Olsen: *'I absolutely do, yes.'* [35, p. 50]. In this quote it becomes obvious that the distinction between hypothetical and fact is not clear. The *risk* of missing *something* we are *trying* to see, which *could* lead to putting us at risk … is a hypothetical and not a fact.

Senator Rubio: *'Are there men and women in uniform who are potentially in harm's way because of what this individual has done?'* Lt. General Flynn, director Defense Intelligence Agency (DIA): *'Senator, I believe there are.'* [35, p. 61]. So facts become hypotheticals and hypotheticals become beliefs.[16]

3.4.2. United Kingdom

There are currently ten agencies formally involved in intelligence in the UK.[17] We searched the public archives

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[13] Juvenal, Satires (6, 347), Bochel, H., Defty, A., & Kirkpatrick, J. (2014) [17].

[14] One of these foreign intelligence collection sources is probably the Dutch GISS who unlawfully exchanged telephone metadata with the NSA. See §3.4.3. below.

[15] See §3.2. for an example of the fallacies that come with this kind of argument.

[16] It is of course possible that a belief creates a stronger conviction than actual perception or logical implication. Our preliminary interpretation is that Flynn is just honest.

[17] Security Service/MI5; National Domestic Extremism and Disorder Intelligence Unit (NDEDIU; National Crime Agency (NCA); National Ballistics Intelligence Service (NABIS); National Fraud Intelligence Service; Secret Intelligence Service (SIS)/MI6; Defence Intelligence (DI); Government Communications Headquarters (GCHQ); Joint Intelligence

of five UK oversight organizations ([39]..[45]). The Intelligence and Security Committee of Parliament (ISC); the Investigatory Powers Tribunal (IPT); Interception of Communications Commissioner's Office (IOCCO); The Intelligence Services Commissioner's Office and the Office of Surveillance Commissioner's (OSC). The studied archives of the ISC do not refer to any security consequences of the Snowden files. The archives of the IPT mention the increase of workload caused by the Snowden incidents, the opinion that the UK legislation has failed to keep abreast of the consequences of technology advances and the conclusion that '*the Snowden revelations in particular have led to the impression voiced in some quarters that the law in some way permits the Intelligence Services carte blanche to do what they will. We* [the IPT] *are satisfied that this is not the case*' [43, p. 26]. The archives of the IOCCO [42] do not mention any security consequences of the Snowden files. However, they contain an interesting reference to the dogmata of secrecy: '*They* [the secrecy regulations] *mean that I am not able to confirm or reject publicly parts of the detail said to derive from Snowden allegations. A reader should not draw any inference one way or the other in this respect from what I do say. However, as will I trust appear, I am able to address matters of concern in a way which I hope will be helpful*' [42, p. 40]. The archives of the Intelligence Services Commissioner's Office and of the OSC also do not mention any security consequences. It is apparent that the main concern of all of these oversight organizations is the alleged abuse of powers by intelligence agencies and not the alleged security consequences of the Snowden files. This is in sharp contrast with the public position taken by the government.

3.4.3. The Netherlands

The Dutch General Intelligence and Security Service (GISS)[18] and Defence Intelligence and Security Service (DISS)[19] are supervised by The Commission on the Intelligence and Security Services ('CIVD'), a committee of the Dutch House of Representatives and by The Commission for Supervision of Intelligence and Security Services ('CTIVD'), a government committee composed of independent intelligence experts. We included the available Annual Reports of the GISS [48] and the DISS [47], all of the communications of the House of Representatives and Senate mentioning Snowden and the Annual Reports, press releases and Supervisory Reports of the CTVID ([52]..[54]) and the Annual Reports[20] of the CVID [46] in our research. The National Coordinator for Counterterrorism and Security ('NCTV') is a government official and office that coordinates all intelligence. The public communications of this office were also included

in our research ([49]..[51]). None of these sources assert that a relation exists between the Snowden files and diminishing security, let alone that facts are presented that corroborate such a relation.[21]

Conclusions and Further Research

It is tempting to conclude that the publication of the Snowden files has clear consequences. A number of documented media publications, for example about Prism and the concerted public statements of governments about negative consequences for security, suggest this clarity. We must, however, realize that publications of documented examples of the (mis)behaviours of secret services do not generalize to the reliability of allegations of threats to security. The successful and founded media publications based on the Snowden files can influence public opinion in a twisted way. Sensitive information has obviously been leaked and has hurt sensitive interests, i.e. our confidence in our secret services, therefore the general proposition that this information hurts other sensitive interests, like security interests, gets more credibility. This generalization could be justified. However, the available facts do not justify it at this moment.

Our preliminary research as described above suggests that there are insufficient facts to draw any founded conclusions about the possible consequences of the Snowden files for security. The Snowden files are hardly available. What is available has been selected to corroborate the media publications mentioned. Data about actual security consequences are not available. Our search of the intelligence archives of the USA, the UK and the Netherlands suggests that these data are not only unavailable, but absent. The dogmata of secrecy prescribe that classified information is not published and that we trust in our governmental and parliamentary oversight organizations and their public accounts. However, if these organizations even fail to report in an abstract or generalized way that actually leaked facts have caused actual consequences that are harmful to security, then one should have doubts about their existence. What we found in the intelligence archives are repeated warnings and restatements of the theoretical consequences: 'if classified information is leaked, harm to security will be done' and 'leaking classified information does harm to security', which can be interpreted both as hypothetical and as factual statements. We are puzzled by this consequent choice for ambivalence in de formulations, but we demonstrate in this research that the methodology we chose can be effective. Further research is necessary. First, the obstacle of the unavailability of the Snowden files must be removed. It is understandable that journalists

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Organisation (JIO) and National Counter Terrorism Security Office (NaCTSO).

[18] english.aivd.nl.

[19] www.defensie.nl/organisatie/bestuursstaf/inhoud/eenheden/mivd.

[20] The Annual reports of 2015 and 2016 are not yet available to date.

[21] The other side of the revelation of the Snowden files is confirmed explicitly. The 'CTIVD' concluded that the GISS unlawfully exchanged 1.8 million satellite phone metadata with the NSA. A fact that was revealed by the Snowden files. (CTVID Supervisory Report 38, 2014, February 5, [54]). The required permission of the Secretary of Justice was missing, i.e. there was no executive or congressional oversight.

want to monopolize access to protect their sources, themselves or their scoops. However, the argument that publication should be done carefully and in context and that certain journalists are best equipped to do this leads to an elitist form of historicism and excludes other approaches to the material. There should be no problem in giving science access to all the Snowden files which are currently available to journalists under the condition that journalists hold on to all the concrete scoops and science concentrates on eliciting general knowledge. Science is for example not interested in publishing about Prism as such but it is interested in publishing about the failing oversight system and about the quality of the ratio for new legislation and the introduction of new executive powers. Secondly, oversight organizations, in particular those who serve representatives of the people, should be more careful to report clear abstracted accounts of classified information to provide the rationale for the new legislation and powers which are necessary to adapt to the changed reality of transparency. Finally, government officials and former government officials should be more careful about their statements regarding the consequences of the leaks of classified information. The best illustration of this is the alleged relation between the Snowden files and the use of cryptography by the terrorists involved in the Paris attacks. A first look at the underlying facts seems not to be supportive of this opinion.

So we will try to establish scientific cooperation and cooperation with journalists. We will try to inform oversight organizations and we will do further research testing the technical backgrounds of political allegations. As long as the dogmata of secrecy prevail, the blind will be leading the sheep.

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Violations of the law about advertising in Ukrainian media

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Abstract – In the article there are analised different kinds of advertising in Ukrainian mediasphere. It is investigated the quality of the publicity texts after the criteria of legality, literacy, originality and journalistic ethics. Advertising which violates Ukraianian law about advertising s found out and it is grounded negative influence such kinds of ad on the readers audience and on the society on the whole.

Keywords – advertising, law, violation, media.

I. Introduction

Nowadays advertising became part of our life. It surroubds us everywhere – at home, on the street, in the metro, supermarket etc.

Magazines, television programs, movies and advertising are very well known forms of media and are used constantly in our society to influence on our lives. We confront so many ads every day that we overlook them and they become invisible. From the researches, the typical U.S. citizen will spend more than one year of his or her life just watching television commercials. In any daily routine life, people do tend to keep themselves busy all the time by reading newspaper, watching television, listening to the radio and reading other print media production. That's why the most amount of advertising is placed in mass-media. Nevertheless, advertising should be legal and comply with the laws of Ukraine.

II. Analysis of the problem

The most amount of advertising is placed on television (23,9%), in the newspapers (22,8%) and in the online media (22,1%) [1]. As online media in Ukraine has no special legislative norms, so in our article we examine advertising on the television and in the newspapers. Its pity, but Ukrainian ad market is not high-developed, that's why the advertising in printed mass-media is not of high quality. So we studied the phenomenon of poor quality advertising in Ukrainian press. Advertising can be defined as paid communication that is intended or designed to alter the perception and behavior of people and to cite H. G. Wells [2], advertising is 'legalized lying'. Advertising in printed mass-media can influence on the reader by its original text or by illustration. In our country there is also such kind of ad like hidden advertising, which influences on subconsciousness of the people and which is unrealized. As far as we know, the analysis of the problem of quality or unquality advertising is nowhere to be found in the literature. So we tried to define these terms and for better understanding the phenomenon of unquality advertising we proposed to divide it into two groups:

1. advertising which violates actual Ukraianian legislative norms
2. advertising which violates the norms of the journalistic ethics.

To analyze the advertising of the first group we learned the rules of foreign specialists on advertising such as David Ogilvy [3], Leo Burnett [4], Dominic Hettings [5] and others. They recommend to write creative, original and laconic advertising, using common words and phrases. They also advise to pay attention to the headlines of the advertising. It should consist of no more than 5 words and should be informative, ironical or witty.

Analyzing the Ukrainian press, we have noticed some types of the advertising which is forbidden by the Law about advertising.In particular it is hidden and unconsciousness advertising. When we analyzed the typical advertising in Ukrainian press(we chosed regional newspapers "Vysokyj zamok", "Express" and "Lvivska gazeta" and allukrainian "24", "Gazeta po-ukrainsky" and "Ukraina moloda"), we saw that our ad messages are usually very long and dull, so that it's hard to read the whole text to the end. In fact the ad is made without creativeness or original thoughts; there is no pointing about the advantages of the product, so that the reader is not interested in buying this commodity.

The group of ad which we analyzed was unconscientious and hidden advertising. These kinds of advertising are forbidden by Law "About advertising" [6] but unfortunately such ad messages are popular in Ukrainian newspapers. Among unconscientious advertising the most often is printed ad of alcohol and tobacco. This ad messages are written without the warning about the damage to the health however such notice is compulsory. Another kind of unconscientious ad is advertising of medical preparations, which is printed without direction about the number and date of the special license. In Ukrainian newspapers are also popular ad texts about the services of different sorcerers and witch-doctors, though such advertising is forbidden by law. Unconscientious advertising can bring readers into the trickery and as a result it can be harmful for their health.

Hidden advertising is also printed in our newspapers. Hidden advertising is the text which has hidden purpose – to advertise a product, service or a politician and which is not printed under the headline "Advertising". So hidden advertising we should divide into the commercial and political hidden advertising.

Among hidden commercial advertising the most popular are ad texts about banks and about the services of mobile operators. And this is not strange because as we have already said these companies are the most widen advertisers in Ukrainian press. Hidden advertising is usually written by a journalist like a simple informative text, but when you read this publication, you will understand the hidden purpose of this text – to advertise some product or service. Hidden advertising in Ukrainian press is written in different journalistic genres – short story, analytic article or even essay. And no matter where is printed hidden advertising – in regional or in alukrainian newspapers – it always effects on the readers, and what is the worse – that this influence is unrealized.

But when we get caught into the hidden commercial advertising – we may buy unquality product and what is the result of being caught into the hidden political advertising? Then the result is worse.

Talking about television, we should say that situation with this media is not better. Hidden advertising on the TV is situated usually as product placing – when the advertising is in the content of the Tv program, film or serial.

In the news profram on the channel "Ukraine" there is a big amount of the hidden advertising. In particular it is hidden advertising in the news program about the owner of this channel – Rennat Achmetov and about his companies. Information about him is broadcasted in each news release.

Another Ukrainian channel 1+1 also broadcastes hidden advertising about the bank of his owner – but more rare.

Hidden political advertising is usually widened during the elections, but in fact it is printed in our press more often. Last summer, during the pre-election campaign hidden advertising was printed almost in each number of regional newspapers such as "Vysokyj zamok", "Express" and "Lvivska gazeta". Each of this newspapers supported different politicians.

Texts with hidden advertising were written like informative stories about the one of the members of political parties, and in general this advertising created a positive image to the political subject. Such texts should be printed under the notice "Political advertising", but they were situated under the heading "News" or "Official" so these messages are in fact a hidden advertising. It's good that the political hidden advertising is widening only in regional newspapers. In general Ukrainian press there is no such phenomenon. In such newspapers as "Ukraina moloda", "Gazeta po-ukrainsky" and "24" during the pre-election campaign there were articles about each political party, so we can't say that any of these newspapers supported some politicians.

It is interesting the phenomenon of printing hidden advertising in the newspaper "Ukraina moloda". Near the advertisng there is no mark as "Advertising" or "On the rules of the advertising". Insteas, there is a small letter R in the circle, printed in the corner of the publication. Such kind of printing of the advertising is not provided by the Ukrainian laws and in fact is illegal. Besides it is unhonesty for the older readers, which just can`t notice such symbol.

Sreaking about the unquality political advertisig, we should remember that mass media forms the political consciouness and political culture of the residents, and when people make the wrong choice – it is often the fault of the media. So the journalists should comply with law, with the journalistic ethics and with the own conscious.

The most amount of the political advertising is situated on the TV before the elections. Such advertising is often hidden and unconsciousness. It is manifested in the ordered materials and in the number of the references of the subject of the electional process in the ether of the channels broadcastings.

Conclusion

So, in the conclusion we can say that in the Ukrainian media there are a lot of the advertising, which violates the Law about advertising. The quality of the advertising we can determine by the originality and the method of its presentation and by the legality of the ad. From my researching follows that the ad texts can be unquality as from the one of this positions, thus in both. Its pity that the texts of forbidden advertising are usually written in very original and creative form, and vice versa. And the presence of quality advertising from both this positions is a rare occurrence.

The most often violence of the legislation is the existence of the hidden and unconsciousness advertising. We should also point out that from the one hand the advertising in regional newspapers such as "Vysokyj zamok", "Express" and "Lvivska gazeta" is more interesting and vivid, than in allukrainian press. But from the other hand, in the Ukrainian newspapers such as "Ukraina moloda", "Gazeta po-ukrainsky" and "24" there are less forbidden unquality advertising, than in the regional. So as we see there are more unquality, than quality advertising in Ukrainian press.

On the Ukrainian television the most amount of the forbidden advertising is hidden ad on the channel "Ukraine". And there are few reasons of this phenomenon. Unquality advertising touches to advertisers, advertise-makers, copywriters, journalists and the owners of the media.

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State policy to protect children from violence

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Abstract – The article analyses the main directions of the state policy on prevention of domestic violence as defined by the Law of Ukraine «On Prevention of Domestic Violence,» adopted in 2001. State policy on domestic violence prevention is considered as a set of measures aimed at improving the social protection of families, especially those with children; creating optimal socio-economic conditions for the establishment, development, self-contained and full functioning of the family, children education in the family; forming family relations culture, increasing the responsibility of parents for the family and parenting.

Key words**:** state policy, domestic violence, children, minors, agencies and services for children.

I. Introduction

Violence is one of the problems that attract the attention of scholars and practitioners. In today's world, the boundaries of the object of violence have expanded, covering a variety of population groups, including families with children. Violent actions violate the right to personal integrity guaranteed by the Constitution of Ukraine. Violence against children is especially dangerous and intolerable, since children are unable to defend themselves.

The issue of domestic violence is a serious problem, and the joint efforts of authorities, public and international organisations, researchers and practitioners are required to solve it.

That is why the purpose of this article is to clarify the notion and current situation of the state policy on prevention of domestic violence and investigate the problems of legal regulation of protecting children from violence.

II. Page Setup

The problem of state policy is not yet fully elucidated in the domestic scientific literature, but some questions regarding this issue are covered in the works of a number of Ukrainian scholars. Thus, state policy is a political activity of the state and its institutions, aimed at maintaining the order in society, coordination and subordination of various social interests, achieving social harmony and organisation of social development management. Scholars Rebkalo V. A. and Tertychka V. V. note that state policy is a relatively stable, organised and purposeful activity (or inactivity) of state institutions, performed by them directly or indirectly on certain issues or set of issues that affect life of the society [1, p.6]. State policy is a relatively stable, organised and purposeful activity of the government regarding an issue or subject, which is performed directly or indirectly through authorised agents and affects the society.

The following definition is considered to be generalised: state policy is a conscious activity of authorities and government institutions of various levels, aimed at regulating social relations, ensuring their stability and development in accordance with the defined objectives; a method of social governance which includes the development and implementation of political programmes on economic, social, cultural and political development.

In the context of our study, we should consider the correlation between the state and public policy. In the conditions of democracy, when the level of civil society is rather high, the government forwards a part of its powers to self-government bodies. In this case, it is really reasonable to talk about «public power» as a combination of state and public self-governance. In this context, public policy is a broader notion, as it includes not only governmental policy, but also the policy implemented by non-governmental organisations, associations of state and public bodies, or even private structures and agencies.

Let us note that we still cannot talk about developed civil society in the post-communist countries, where, actually, public policy is equalled to the state policy. However, regardless of differences in terminology, the aim of this policy should be to satisfy the interests of society as a whole, certain social groups and individuals, solving urgent and long-term problems, ensuring the development of the social activity components (economy, politics, social services, etc.), and the nation in general.

«Public Policy Analysis» is a rather developed Western science which deals with the patterns of formation and implementation of public policy. Public policy can be described as a program of activities aimed at solving a particular problem or set of problems, achieving the goals, etc. Leslie A. Pal defines public policy as a course of action or inaction chosen by public authorities to address a given problem or set of problems [2, p.22]. Other well-known authors, Carl Patton and David Sawicky, consider public policy in conjunction with the planning and creation of complex programmes of solving socially important problems [3, p.5].

The main directions of the state policy on prevention of domestic violence are defined by the Law of Ukraine «On Prevention of Domestic Violence», adopted in 2001. This law was the first special legislative act in the sphere of domestic violence prevention in Central and Eastern Europe and the CIS. It defines legal and organisational basis for preventing domestic violence, as well as agencies and institutions that are entrusted with the implementation of such measures.

It should be noted that the implementation of measures to prevent domestic violence relies on:

– central executive body that ensures the formation of state policy on prevention of domestic violence;

– central executive body that implements the state policy on prevention of domestic violence;

– authorised units of the National Police;

– bodies of guardianship and custody;

– specialised institutions for perpetrators of domestic violence and victims of such violence: crisis centres for family members, where domestic violence was committed or a real threat of such violence exists; centres for medical and social rehabilitation of victims of domestic violence.

The executive authorities, local self-governments bodies, enterprises, institutions and organisations regardless of ownership, citizen associations, and individuals can assist in the implementation of measures to prevent domestic violence.

However, it should be noted that among agencies and institutions entrusted with the implementation of measures to prevent domestic violence defined by Art. 3 of the Law of Ukraine «On Prevention of Domestic Violence», there are no:

– services for children as the main body that provides social and legal protection of children, including protection against violence and abuse;

– social services centres for families, children and youth as the only structure at the national level that provides assistance to families and individuals who find themselves in difficult circumstances (including those caused by domestic violence);

– prosecutor's office that monitors the compliance with legislation;

– courts entrusted with bringing to justice persons who are guilty of domestic violence.

– local state administrations;

– other units of the Interior Affairs, apart from those specified in the Law;

– educational institutions;

– healthcare authorities and institutions;

– institutions for victims of violence, apart from crisis centres and centres of medical and social rehabilitation.

Therefore, it is necessary to include the above mentioned subjects into the list of agencies and institutions entrusted with the implementation of measures to prevent domestic violence.

An important direction of improving state policy on domestic violence prevention is the ratification of the Council of Europe Convention on Preventing and Combatting Violence against Women and Domestic Violence as of May 11, 2011. The Ministry Social Policy of Ukraine has so far prepared a draft law on ratification of the Council of Europe Convention on Preventing and Combatting Violence against Women and Domestic Violence.

It should be noted that Istanbul Convention requires the development and implementation of a comprehensive and coordinated policy that provides a holistic approach to combatting all forms of violence against women, including domestic violence, sexual violence, forced marriage, female genital mutilation, persecution, forced sterilisation, forced abortion or sexual harassment.

Besides, Istanbul Convention requires that the member state appoint or establish one or several official bodies responsible for the coordination, implementation, monitoring and evaluation of the policy and measures for preventing and combatting all forms of violence covered by the Convention. The tasks assigned to the coordinating body are to ensure that the actions of all agencies and authorities performing various activities to implement the Convention are coordinated and concerted. First of all, this body should ensure that such measures are carried out smoothly and with the joint efforts of all institutions and sectors of state administration at national, regional and (or) the local levels [4].

Conclusion

Overall, the state policy on domestic violence prevention meets international standards and is aimed at overcoming the stereotypes in this sphere. The national legislation of Ukraine on these issues includes a lot of legal acts that often contradict each other. First of all, it concerns the powers of authorities and institutions that are a part of the system of preventing domestic violence and child abuse, procedures for their reporting, sequence of measures for preventing domestic violence and violence against the child, as well as measures of legal responsibility, etc.

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Guarantees of rights and freedoms of minors

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Abstract – Guarantees of rights and freedoms of minors are fundamental, essential tools that provide constitutional rights and civil liberties in a legal state. The article considers such guarantees as: political, socio-economic and legal. It is accentuated that the effectiveness and completeness of the realization of fundamental rights and freedoms is directly proportional to whether the domestic law complies with generally recognized principles and norms of international law.

Keywords – guarantees, rights, minors, state, legal status.

I. The concept of guarantees

The concept of "guarantee" covers the whole set of objective and subjective factors, aimed at the practical realization of rights and freedoms, to eliminate the possible obstacles to their full or proper implementation [1, p.555]. The imbalance of the mechanism of the implementation of the rights and freedoms of minors leads to their ineffectiveness, so the set of guarantees is especially important to ensure the "basis" of the legal status of minors. The proclamation of the rights of minors necessitates their functionality, which is provided by the guarantees, as a significant component of the legal status.

The guarantees of the rights of a minor are determined primarily by the guarantees of human rights and freedoms. Most scientists recognize that the guarantees are socio-political and legal phenomenon that is characterized by: 1) cognition, because it allows to reveal theoretical knowledge about the object of their (guarantees) influence, to obtain practical knowledge about the social and legal policy of the state; 2) ideology, because it is used by political authorities as a means of popularization of democratic ideas inside and outside the country; 3) practicality, because it is recognized as a tool of jurisprudence, a prerequisite for satisfying the social benefits of a person. Based on this, the authors define guarantees as a system of socio-economic, political, legal organizational preconditions, conditions, means and methods that create opportunities for the personality to fulfill his/her rights, freedoms and interests [2, p.275].

II. Political and socio-economic guarantees of minors' rights.

To political guarantees, we will include the features of the construction and functioning of the entire political system of society, its principles, subjects and the peculiarities of their interaction, since the whole set of political factors of social and public life directly affects the guarantee of the rights of the minor.

In general, political guarantees are summarized with the participation of citizens in the exercise of state authority through such direct forms as elections, referendums, meetings, and other public forms of collective action (hikes, rallies, pickets, petitions) and individual voluntary representations of citizens; it also includes an effective mechanism for the distribution of state authority, multi-party system, citizen participation in governance, and the absence of usurpation of power. P. Rabinovich therefore proposes to include to political guarantees: the democratic structure of society; a pluralist, open political system; the presence of an extensive network of public associations, in particular, the various branches of society; democratic electoral system, etc. [3, p.8].

Socio-economic guarantees of the rights and freedoms of minors cover a set of economic factors that promote full and unhindered realization of rights and provide social protection of the specified demographic group.

Economic guarantees are intended to create a proper material wealth, thus ensuring the economic independence of individuals in society. The minor may own property, is provided with the opportunity to exercise the right to work, the right to freely dispose of his own income, to engage in entrepreneurial activity, that is, state guarantees are aimed at providing a person who has not reached the age of majority, yet to gain economic independence. On the one hand, the state refers to the obligation of parents to support children under adulthood, at the same time does not limit the possibility of economic self-formation, clearly defining the legal limits of the protection of these rights through the establishment of special conditions of work of minors, a number of labor guarantees that make it impossible the excessive exploitation of minors in the labor sphere. Also, the state protects the property of a minor, since all legal actions committed with respect to property should not violate the legitimate interests of a minor, therefore a minor may be deprived of an independent right to carry out legal actions without the permission of parents or authorities of guardianship. We emphasize that the institution of emancipation clearly demonstrates the principles of the legal policy of the modern state in the sphere of minors.

The international standard of social purpose of the state is formulated in Art. 25 of the Universal Declaration of Human Rights, which stipulates that everyone has the right to such a standard of living, including food, clothing, housing, medical examination and social services that are necessary to maintain the health and well-being of him/herself and his/her family, as well as the right to maintenance in case of unemployment, illness, disability, widowhood, old age or other loss of livelihood, for reasons independent of him/her. Social guarantees of the state reveal its social security and orientation. State social guarantees are intended to ensure the minimum living conditions for all members of society. Minors are included in the category of people who need social protection, especially for those who are deprived of the opportunity to receive material support from their parents. First of all, this considers orphans and children deprived of parental care. In Ukraine, on January 1, 2016, 73 182 people were officially enrolled as such children.

Social guarantees are also a priority for minors with disabilities. State social guarantees should create fair

opportunities not only for biological existence, but also for the development of minors. Establishment of rehabilitation and treatment centers, proper level of social benefits, benefits and guarantees and new types of assistance with the definition of the real sources of their funding for provision of medical services, the possibility of obtaining an appropriate level of education, in particular inclusive, adaptation of persons with disabilities in society are important tasks of the state.

Social guarantees in the field of minors' rights:

– protection of motherhood, parenthood, family by the state;

– ensuring the proper level of existence and development of minors;

– availability of social guarantees for minors who require special state support, namely: minor orphans and children deprived of care, persons with disabilities and minors living in low income families;

– functioning of the institutional mechanism of state authorities, implementing the social policy of the state.

From information provided at the parliamentary hearings in 2015-2016 within the framework of the social sector reform program, social programs for supporting children in Ukraine have been reduced. The funding of social work specialists who worked on preventing social orphanhood in communities due to state subsidies from local budgets was stopped. Also, the financing of sanatorium and spa treatment, health improvement and rest for children, children's and youth sports schools at the expense of the Social Insurance Fund for temporary disability; large families, family-type orphanages are exempted from paying housing and communal services, orphans, children deprived of parental care, lost the right to enter outside the competition to higher educational institutions; cancelled the free meals for pupils of 1-4 grades of secondary schools [4].

III. Legal Guarantees

Legal guarantees are those that have their own legal objectives. G. Jellinek highlights social, political and legal guarantees of subjective public rights, noting that "... legal guarantees differ from their social and political by their actions, which can be properly foreseen" [5, 745-747]. They represent a complex system of interacting elements that allow organizing a comprehensive assurance covering various stages of the implementation of rights and obligations, protection from encroachment, the restoration of violated legal rights. Legal guarantees of the rights of minors are means of material, legal and procedural (organizational) nature, which are intended for the implementation and protection of the rights of minors enshrined in the constitution and legislation.

The complex of general legal guarantees for ensuring the legal status of minors will be considered as normative-legal guarantees, on the one hand, and organizational-legal (or institutional-legal) guarantees – on the other. Some scholars [6] believe that the system of legal guarantees is based on a two-level scheme – the international level and guarantees of the domestic level, where international legal guarantees are in the complex of global and regional international conventions (recommendations) and are provided by the activities of interstate associations and their bodies.

Therefore, a set of legal rights of minors includes normative-legal (international and national) and organizational-legal guarantees.

Conclusions

Guarantees of the rights and freedoms of minors are special guarantees of their rights, a system of norms, principles, means and conditions that collectively ensure the exercise of the rights, freedoms and legal interests of a juvenile person.

The value of the guarantees of the rights of minors is that they provide their rights and freedoms not through the methodology of formal priority, but through the achievement of the maximum completeness of rights and freedoms. The rights of minors without guarantees are in a static state, guarantees give them an activity characteristic, that is, provide a functioning dynamic.

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Ensuring privacy right when using social networks

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Abstract – The article analyzes ensuring the right to privacy on the example of modern information technologies such as Social networks.

Keywords – guarantees, rights, minors, state, legal status.

I. Introduction

Discussion about privacy right enforcement started with the publication of Samuel Warren and Louis Brandeis's article in the journal Harvard Law Review in 1890 under the title «The right to privacy» [1]. The researchers stated that due to the importunate journalists' activity there is a «right to be alone» based on the principle of «personal immunity». Later there appeared the statements about the right of certain persons to determine the degree to which the other persons have the access to their information and requirement about the right of the society to know the information on the person.

We believe that modern achievements in the sphere of information technologies threaten the human privacy and cause the negative consequences in the issue of access to the personal data. It should be considered on specific examples more in detail Social networks.

II. Social networks

Social network is the Internet-service designed for the simultaneous communication of users and for their information posting and sharing.

As of January 2017, according to Alexa & SimilarWeb [7] the most popular social networks are as follows: Facebook, Twitter, Linkedin, Instagram, Vkontakte, Odnoklassniki та QZone.

The users and resource owners are mostly interested in the personal data protection in the social networks. Some want to keep their life private and others want to get as many user as possible. Despite the confidentiality policy in the social networks, these are the users who are responsible for the content filling with the personal information. On the social networks servers the central storages are created of the personal data, the amounts of which grow each day depending on its filling by the users.

The analysis of [2] Facebook "Data use policy" testifies to the fact that, depending upon the services used by the person, the present social network received different types of information from the person or about the person, as follows: Sex, date of birth, place of resident (location), telephone number, credit cards numbers, IP-address, related accounts, name change data, political and religious views, list of deleted friends, language of communication, searching requests, etc.

On February 2011 Austrian media-tourist Maks Shrems suspected that Facebook stored all information on USA users and uses it without following the EU norms. After many requests to the directorate of the social network, Shrems received CD-disc from Facebook with all information on him (information was on 1200 pages) stored at the corporation. When reviewing the data he found the messages deleted and closed against public view, stored in the company databases. Based on these violations the lawyer addressed the court twice in Dublin (Ireland) as to the personal data protection. According to the first claim consideration results, the court obliged the social network to be more responsible with regard to the personal data. The second claim was rejected.

In 2013 Shrems addressed the Court of the European Union (Equity court). In October 2015 this court passed a decision about cancellation of the transatlantic agreement about personal data use ("Safe Harbour" Agreement), which allowed American companies transfer the data on their European users in USA. The Agreement was acknowledged illegal as it did not allow the European regulators protect the EU citizens, whose rights to the personal data protection were violated.

In 2015-2016 the governments of some European Union states blamed the Facebook Corporation for not following the confidentiality principles with regard to these users. Thus, in February 2016 the National Committee for data processing and civil liberties of France which conducts the surveillance over following the personal data protection law, stated that Facebook should stop tracking the site visitors who are not its registered users [3]. According to the results of analysis conducted by the French regulator, the Facebook directorate decided that any site visitor accepted the social network using conditions on default, even if they were not authorized on the site. The commission states that social network, automatically transfers the cookie file into the browser of all site visitors and uses it for collecting the data necessary for the advertising. Apart from this the Committee blamed Facebook that the social network stores the data about religious beliefs, political views and sexual orientation of the users. The representatives of the regulator stated that this approach "violates basic rights and interests of the people, including the right to privacy".

In response, the Facebook stated that the statistics kept by the social network does not allow identifying anyone separately and that Facebook plagins are not installed through cookie by the user who has not had them before, i.e. they should have accepted the user agreement before that [4].

To ensure personal data protection on 14 April 2016 European Parliament ratified "General Data Protection Regulations (GDPR) [5], which come into effect on 04 May 2018.

This act presupposes the following:

- Right to forgetting or the right to delete the information (a person may demand the destruction of his/her personal data);
- right to claim (a person will be able to oppose the processing of his/her personal data, including the "profiling" [6]);
- right to the data transfer (people will be able to apply for sending personal data by one their owner to the other);

– fines for the data confidentiality violation (liability is established for the personal data confidentiality infringement, and, depending upon the type of violation, the companies may be brought to the administrative liability in the form of fine amounting to more than 20 million EUR or 4% from the annual world turnover).

Providers outside EU offering the goods and services for the EU citizens shall follow the norms of the said provision regardless of whether they hold the personal data or not. The companies outside EU conducting the monitoring of the EU citizens behavior (for instance, use of cookies on their web-sites which often contain the information on the users to track their behavior) will also be obliged to fulfill the requirements of the new law. Personal data may "quit" the European Economic Area (EU countries + Norway, Iceland, Liechtenstein) only on condition the EU laws on the personal data protection are valid outside the EU territory.

The reform is conditioned by the unification of the rules and necessity of creating the unified, reliable and efficient personal data protection mechanism for EU citizens, including in the Facebook social network. However, this is the user who is to be the personal data protector. You should always pay thorough attention to what you publish in the Network.

Conclusions

In the epoch of the steep development of information technologies, traditional legal methods and instruments are not enough for solving the privacy problems. However, the new technologies shall not be rejected, it is only important to solve the issue of regulation, accumulation, storage, application and protection the information on the person. This will allow realizing the potential and advantages of the information technologies for the consumers and at the same time minimizing the risks of losing the security and confidentiality.

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Using Blockchain to strengthen the rights granted through the GDPR

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Abstract – In this article we delineate two ways in which Blockchain technology could be utilised to store personal data in compliance with the requirements of the General Data Protection Regulation 2016/679, and what their up- and downsides are.
Keywords – Blockchain, transparent Blockchain, opaque Blockchain, GDPR, 2016/079, compliance.

I. Introduction

Lately Blockchain seems to be the quintessential buzzword in "governance land", and it is as if all more or less traditional governance parties want to have a stake in it. Blockchain is a term widely used, which represents an entire new suite of technologies. There is, however, substantial confusion around its definition seeing as the technology is relatively new, and can be implemented in many ways depending on the objective.

There is, however, a general consensus in the IT(-law) community that the use Blockchain-technology can, and will, change our society profoundly. It could – amongst other – have a significant effect on the position of-, and need for, trusted third parties such as public notaries, governments, banks and the cadastre, which might explain the interest of such traditional governance parties in claiming their respective stake in Blockchain.

In this article a short overview of the technological underpinnings of Blockchain will be provided to afterwards elaborate on how Blockchain technology could be used for the processing of personal data compliant with the General Data Protection Regulation[1] (hereafter referred to as 'GDRP').

I. Blockchain-technology

A Blockchain is in essence nothing more than a digital ledger containing lines of data or information.[2][3]

Such a ledger can contain different types of data, varying from transaction records, transactional attributes, credentials, or any other piece of data or information. As a matter of principle only lines of data can be *added* to this digital ledger, and none can be removed or altered.

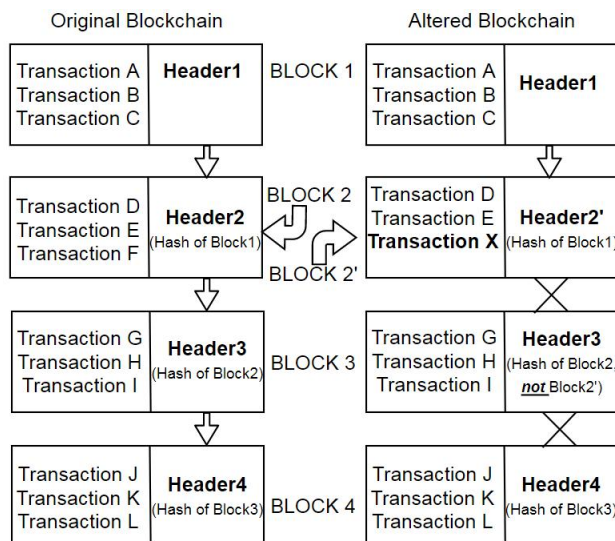Such a digital ledger is spread over a large number of users, computers, or 'nodes' within a Blockchain network, whereby not one single copy of this digital ledger is authoritative. There is not one authoritative copy for all copies synchronise with one another and are thus each of equal evidentiary value. As such if in one copy of the digital ledger a line of data or information is added, this line will be added to all other copies of the ledger.[4] Next to that a Blockchain does not require the participant to have a high-level of trust – or any trust for that matter – in the individual nodes which make up the Blockchain network. Whereas in a traditional network the user has to trust the reliability of each nodes of the network, be it the app used for Internet banking, the connection to the central server, or the database used by the bank.

The fact that a Blockchain does not require the participant to have any trust in the individual nodes of the network is what allows the exchange of data across the globe without resorting to traditional governing entities such as banks, insurance companies, or governments. For the power of Blockchain-technology – or, in general, distributed ledger technology (DLT) – is that if one of the nodes alters pre-existing data this change will be rejected by the other nodes, and the ledger itself is most often secured by applying one or more layers of cryptography and applying game theory.

It is therefore not possible to alter pre-existing data in a Blockchain as long as there are not 50% plus one nodes within the network which reflect this alteration. Because in practice the individual lines of data cannot be altered, Blockchain is a very secure technology, and the data or information stored within it is to such a large extent trustworthy. Next to that Blockchain greatly increases transparency amongst its participants. Seeing as any participant to the Blockchain, be it one running a node or one merely storing data in the Blockchain, can access all contents of the Blockchain, the exchange of data or information is fully transparent.

In itself Blockchain is only one example of distributed ledger technology, what distinguishes Blockchain from other forms of DLT is, however, its use of Blocks. Each set of alterations[5] of the digital ledger is bundled into one Block and to this block a header is added consisting of a hash[6] of the preceding Block. By affixing different Blocks to each other a chain is formed, hence the name Blockchain.

Seeing as the hash is made of the preceding block, the contents of that (preceding) block cannot be altered unnoticed[7]. This principle is illustrated in image 1 – depicting a highly simplified representation of a Blockchain consisting of four Blocks – in which each consecutive Block consists of three transactions. Each of the Blocks contains a header containing a hash of the Block preceding it. As shown, if the contents of Block2 are altered, resulting in Block2', the hash in the header of Block3 no longer corresponds with that of the contents of Block2, and that change will be rejected. If this change *were* accepted the hash in the header of Block4 no longer corresponds with that of the contents of Block3, and *that* change would be rejected.

Original Blockchain / Altered Blockchain

Transaction A, Transaction B, Transaction C	Header1	BLOCK 1	Transaction A, Transaction B, Transaction C	Header1
Transaction D, Transaction E, Transaction F	Header2 (Hash of Block1)	BLOCK 2 / BLOCK 2'	Transaction D, Transaction E, **Transaction X**	Header2' (Hash of Block1)
Transaction G, Transaction H, Transaction I	Header3 (Hash of Block2)	BLOCK 3	Transaction G, Transaction H, Transaction I	Header3 (Hash of Block2, *not* Block2')
Transaction J, Transaction K, Transaction L	Header4 (Hash of Block3)	BLOCK 4	Transaction J, Transaction K, Transaction L	Header4 (Hash of Block3)

Transparent- and opaque Blockchains

The most well-known Blockchain is the one upon which the original crypto-currency, the Bitcoin, is based. The Blockchain which formed the basis for the Bitcoin is an example of a transparent Blockchain. Anyone can open an account, become a node, and afterwards check each transaction[8] within the network. And because Bitcoin uses a transparent Blockchain all participants / nodes have equal rights, as there is no governing body. A public Blockchain like that of Bitcoin should be distinguished from a (more) opaque Blockchain. A Blockchain can be more opaque by limiting;

- who can be a node;
- which parties get access c.q. can access the Blockchain; or
- by limiting which information the different parties can see within the Blockchain.

A more opaque Blockchain does require dependency on some sort of a trusted third party but according to Heukelom et.al.[9] a (more) opaque Blockchain[10] makes it possible to reliably and securely process personal data in compliance with the GDPR.

III. GDPR compliant processing of personal data using Blockchain technology

As stated before, the underlying principle of Blockchain technology is that stored data cannot be altered without as a consequence invalidating all subsequent blocks. As will be shown, this would à priori disqualify Blockchain as a method for the processing of personal data. Hereafter first the GDPR will be elaborated on to afterwards explain how it *is* possible to process personal data in a Blockchain in compliance with the GDPR.

A. The General Data Protection Regulation

The GDPR is (almost) always applicable when personal data is processed. There are a number of terms which are of crucial importance in the GDPR, each of which will be addressed in short hereafter.

Based on article 4 section 1 GDPR 'personal data' means;

[A]ny information relating to an identified or identifiable natural person ('data subject')

an 'identifiable natural person' is defined as;

[O]ne who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

and based on article 4 section 2 GDPR the 'processing' of personal data is defined as;

[A]ny operation or set of operations which is performed on personal data or on sets of personal data, whether or not by automated means, such as collection, recording, organisation, structuring, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, restriction, erasure or destruction

As such if any identifier such as name, address, telephone number, or social security number is stored (i.e. 'recorded' in the sense of art. 4 section 2 GDPR) in a Blockchain, this constitutes 'processing' of personal data and is thus subject to the GDPR. If personal data are, however, irreversibly anonymised[11] and are not relatable to an identified or identifiable natural person there is no personal data and the GDPR is not applicable.

There are two very important rights granted to the data subject in GDPR. The first of these is that the GDPR grants the data subject a right[12] to ask for rectification or completion of his or her personal data, based on art. 16 GDPR. This right, in short, entails that if stored personal data regarding a data subject is (initially) incorrect or incomplete, or has become incorrect or incomplete – because of outside changes – the data subject can ask to have these personal data altered. The second right[12] the GDPR grants a data subject is, based on art. 17 GDPR, the right to ask for erasure of his or her personal data. In short this right entails that a data subject can ask for the erasure of his or her personal data if the personal data are no longer necessary for the objective the data were provided or he or she withdraws consent for the processing.

Two further terms which are of importance in light of this research is the distinction made between the 'controller' and the 'processor' in the GDPR. A 'controller' is defined in on article 4 section 7 GDPR as;

the natural or legal person, public authority, agency or other body which, alone or jointly with others, determines the purposes and means of the processing of personal data; where the purposes and means of such processing are determined by Union or Member State law, the controller or the specific criteria for its nomination may be provided for by Union or Member State law;

and 'processor' is defined in article 4 section 8 GDPR as;

a natural or legal person, public authority, agency or other body which processes personal data on behalf of the controller.

Whereby in principle the 'processor' is *mainly indirectly*, through a processing agreement, and the

'controller' is *directly* obligated to comply with all obligations flowing forth from the GDPR. If personal data are stored within a Blockchain these personal data will be processed by the various participants within that Blockchain. In itself this is no more than an innovative way of exchanging personal data between the various participants within one Blockchain. As there is no hierarchical relationship – unless other agreements have been made – every participant in the Blockchain is equal, and therefore every participant is equally entitled to do what they want with the information in the Blockchain. It is therefore not really possible to speak of *one* processor when storing personal data in a Blockchain, but rather *all* participants in the Blockchain are controller. This raises a series of serious questions such as;

• how should the responsible parties take care of Blockchain security? And

• how can data subjects enforce their personal data rights against the controllers? And

• what happens in case of a data breach?

Are, for instance, all participants in that Blockchain then – based on art. 33 section 1 GDPR – obliged to report this data breach to the (national) supervisory authority?

B. Processing personal data GDPR compliant in a transparent Blockchain

The starting point is that all participants in a Blockchain in which personal data are stored are responsible for this storage and further processing under the GDPR. The parties who run nodes within a Blockchain network are most likely processors, seeing as the primary task of these parties is to make certain the Blockchain functions for all (responsible) participants and they do not determine the purpose(s) nor the means of the processing. If the parties that run nodes are indeed processors the (responsible) participants are based on art. 28 GDPR obliged to conclude processor agreements with the parties who run nodes. This is not very practical (as it would most likely require a significant amount of processor agreements), but in theory it is certainly not unfeasible.

As stated before, one of the strong points of Blockchain technology is that one can trust the validity of information because of its inalterability. As pointed out in the previous section though, this conflicts with the GDPR which grants a right to the data subject that as soon as personal data are no longer needed these should be erased, and the data subject has the right to ask for erasure. And similarly data subjects have the right to alter incorrect or outdated personal data. Regarding the former – the erasure of personal data – this could be achieved by, instead of erasing the data, encrypting the personal data and deleting the key used afterwards. That way the (original) data would not be removed, but an (extra) block would be added detailing the encryption (and subsequent deletion of the key).

Regarding the latter – the problem of needing to be able to alter personal data once the data subject requests this – this could be achieved by adding a block with updated information. Another (potentially better) alternative would be the 'erasure of the 'old' personal data by

encrypting it and deleting the key and the addition of a block with the 'new' personal data. Either alternative would result in the inalterability character of data stored in a Blockchain not being violated.

IV. Processing personal data GDPR compliant in a more opaque Blockchain

Processing of personal data in a more opaque Blockchain poses the same problems as it does in a transparent Blockchain. Within an opaque Blockchain – where either a party has control over 50% + 1 of all nodes, or another way of (trusted) third party governance is present – it is, however, relatively easy to conceive solutions for the aforementioned problems. It would for instance be possible to appoint one party amongst all of the responsible parties who is in charge of complying with statutory tasks (such as reporting data breaches). This is specifically the way joint controllers could organize themselves. Based on art. 26 GDPR they should determine their respective responsibilities for compliance to the GDPR in a transparent manner by means of an arrangement. This arrangement may designate a single point of contact for data subjects, a data subject may, however, exercise his or her rights against any of the controllers.

Similarly, if the parties that run nodes are deemed processors in light of the GDPR, instead of concluding numerous processor agreements based on art. 28 GDPR with the parties who run nodes, this issue can be easily solved by making joint agreements between all participants and parties that run the nodes.

Regarding the third problem, the erasure of personal data, this can easily be resolved, for the removal of personal data requires a majority of all nodes (based on the majority polling result). This means that in an opaque Blockchain whereby one party has the power over 50%+1 of all nodes, the erasure of (personal) data from the Blockchain is very feasible. In such a scenario the majority of nodes would erase the data and all other nodes would subsequently erase the data as well.

As such the obligation to erase personal data stemming from the GDPR does not prevent the storage of personal data in a Blockchain. Regarding the fourth problem, the alteration of personal data, this could quite easily be resolved in the same way as the erasure of data, by changing the stored data for a majority of all nodes. As a consequence of the majority polling result all nodes will alter the data.

Conclusion

In this article we have delineated two ways in which Blockchain technology could be utilised to store personal data in compliance with the requirements of the GDPR, either by using a transparent- or opaque Blockchain.

The former, a transparent Blockchain, has the upside that the original intention of Blockchain technology – the non-reliance on trusted third parties – is upheld and the security-, and trustworthiness of the data remains intact. On the other hand it would require (most likely) a

significant amount of individual processor agreements, and raises a number of questions regarding the compliance to (national) statutory tasks.

The latter, an opaque Blockchain, has amongst others the upside that it requires significantly less processor agreements, there is no need to question the compliance to (national) statutory tasks, and it is possible to factually erase or alter personal data. On the other hand it would require a returning to the reliance on a trusted third party, and the security-, and trustworthiness of the data would be as high as that of the trusted third party.

References

[1] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation.

[2] For the difference in meaning between data and information see e.g. R.L. Ackoff, 'From Data to Wisdom' in *Journal of Applies Systems Analysis*, Volume 16, 1989 p 3-9.

[3] Seeing the use of, and distinction between, the terms data and information in the GDPR is confusing at best, even though there is a significant difference between them, hereafter the terms data and information will be used as they are in the GDPR.

[4] In cases where there is a discrepancy between the different ledgers – for instance because 10 changes were made simultaneously – the network resolves this by polling all nodes and the majority rules.

[5] If a new block were to be added for each alteration this would create a security-risk of cryptanalysis. See E. Biham & A. Shamir, 'Differential Crypt analysis of DES-like Cryptosystems' in, *Lecture Notes in Computer Science*, Springer-Verlag, Berlin, 1990, p. 2-22. Freely accessible at https://link.springer.com/content/pdf/10.1007/3-540-38424-3.pdf

[6] A hash-function is a function in information sciences which converts a very large dataset into (most often) a much smaller dataset.

[7] For the reliability of hashing see e.g. C. Malinowsky & R. Noble, 'Hashing and data integrity: Reliability of hashing and granularity size reduction' in *Digital Investigation*, Volume 4 issue 2, 2007, p. 98-104.

[8] In this case the term 'transaction' means *any alteration i.e. addition to the chain* and not necessarily any financial transaction.

[9] van Heukelom et.al., *Whitepaper Juridische aspecten van Blockchain*, p. 7-11.Freely accessible at <www.pelsrijcken.nl/actueel/publicaties/whitepaper-juridische-aspecten-van-blockchain/> (Dutch only).

[10] Instead of the terms transparent- and opaque Blockchain they refer to them as open- and closed Blockchains.

[11] Consideration 26 GDPR (only) states that *the principles of data protection should not apply to [...] personal data rendered anonymous in such a manner that the data subject is not or no longer identifiable,* as such the anonymisation would not need to be irreversible. The different (national) supervisory authorities have, however, ruled that a reversible anonymised personal data are also personal data in the sense of Directive 95/46/EC, the predecessor of the GDPR.

[12] And conversely it creates an obligation for the processor to alter or erase the stored personal data if requested to do so by the data subject.

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