

## THE KEY ASPECTS OF ATMOSPHERIC AIR ECOLOGICAL MONITORING CONCEPT FORMATION AT THE URBAN SYSTEMS LEVEL

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**Abstract.** The key aspects of atmospheric air ecological monitoring concept formation on the urban system have been analyzed. The principal scheme of concept construction has been proposed. It has been defined that the concept has to be built on the anthropocentric approach. The samples of atmospheric air ecological monitoring unsolved issues on the urban system of the town of Kremenchuk (Ukraine) have been taken to concretize the integral parts of the concept with defining goals, objectives, statistic results and dynamic indicators of the concept implementation.

**Key words:** concept, ecological monitoring, atmospheric air, urban system, monitoring system.

### Introduction

Nowadays in Ukraine the state system of ecological monitoring is operating, including the monitoring of atmospheric air quality. Since 2014 the State Hydrometeorological Service (State Emergency Service) has carried out the observation of atmospheric air pollution in 53 cities of Ukraine on 162 stationary observation posts, 2 routing observation posts and 2 trans-boundary transfer stations. The sanitary and epidemic service of the Ministry of Health Protection is carrying out the observation of atmospheric air quality in residential and recreational areas [1]. It should be noted that there are 460 cities in Ukraine where by January 1, 2014, 60.5 % of the total country's population lived (excluding settlements subordinated to City Councils). Thus, there is a kind of dissonance between the number of cities where monitoring of atmospheric air quality is carried out – that is only 8 % of the total number. Such situation is not acceptable taking into account the process of power decentralization

and European integration of Ukrainian environmental legislation (including the sphere of atmospheric air quality monitoring). Sanitary and epidemic service has been eliminated de jure [2]. State environmental inspectorate is severely limited in its audit functions and according to the announced “Concept of reforming the system of state supervision (control) in the sphere of environmental protection in Ukraine” [3] must also be eliminated. This way, at the state level, under conditions of European integration atmospheric air quality monitoring is carried out only by State Hydrometeorological Service (Statehydromet). It is common under such conditions, that local municipalities (especially those of technically loaded cities) have to solve these problems themselves.

The drawbacks in the system of State Hydrometeorologic Service (Statehydromet) observations have been highlighted and analyzed in a number of researches [4], where, in particular, the following drawbacks have been specified:

- determination of the observation posts number and places of their location is peremptorily carried out on the basis of the outdated document [5] depending on the population and with a focus on gathering information on the impact of specific sources of environmental contamination with location of stationary posts in the vicinity of the impact sites;

- observation program (full observation at 1 a.m., 7 a.m., 1 p.m. and 7 p.m. by local time, the partial one at 7 a.m., 1 p.m. and 7 p.m. accordingly [6]) is justified by the departmental instructions and the ability of the existing technical base to carry out measurements, leaves a significant amount of time to an industrial facility for intensification of the processes, realization of which may cause significant level of contamination, and can also result in difficulties while analyzing large amounts of data, finding correlations and subsequent forecasting of the air pollution state;

– assessment of the influence of physical factors of environmental danger formation on air pollution is not carried out as a result of the contamination levels dynamics and therefore the inexpediency of these parameters fixing at stationary posts of the observation network;

– cooperation between different institutions at the municipal level is not coordinated.

In other analyses [7] concerning the imperfection of the monitoring system, it has been specified the following: "...the state system of environmental monitoring with its structure, level of organization, capabilities of the environmental state quantitative and qualitative parameters measurements, the way of data transmission and aggregation does not correspond to the assigned tasks and modern requirements".

The authors [8] have analyzed the drawbacks of atmospheric air monitoring system at the level of technically loaded urban system of Kharkiv. In particular, it has been stated that the main drawbacks of the existing monitoring system are the following: the absence of coordination and uniformity of information technologies, the lack of networks maintenance with information exchange means and consequently, lack of efficiency in the provision of information to users; the absence of unified integrated observation network at the regional level, which should include the monitoring entities networks, the automated stations network and the center of collecting and processing information based on the monitoring results; the insufficient level of technical and methodical provision of the observation networks functioning.

The authors [9] have made an analytical review of the issue of public access to monitoring systems information. It has been concluded that this issue in Ukraine has positive examples of solutions to this challenge. However, there is no unified conceptual approach of the state power in this matter.

Consequently, the vast majority of the drawbacks mentioned above have certain organizational and technical nature and it can be eliminated by reforming the legislative framework and the automated informational and analytical systems creation. Meanwhile the theoretical basis of monitoring systems improvement at the level of urban systems (urban areas) is not sufficiently developed and does not have a conceptual approach.

Thus, the goal of the work is to analyze the key aspects of atmospheric air ecological monitoring concept formation at the urban system level specifying the components of the concept.

## Theoretical part

The concept is a structured document that combines specific tasks solving of which is required to achieve the objectives aimed at solving actual problems. It determines the direction of the strategy implementation

as a plan for achieving a certain goal. Unlike the strategy, the concept has the variability signs in the process of solving the assigned tasks and it does not indicate the specific terms of achieving the goal set. Besides, it is peculiar for strategies, in contrast to concepts, to determine not only the results but also the indicators that actually have to reflect the process of any problem solving. However, it should be noted that addition of the indicators unit to the concept structure will create conditions for clearer understanding of strategic goals and allow in the process of strategy formation not only to define the terms of implementation, but also set the numerical values of the indicators.

It is necessary to clearly understand the fact that the basic philosophical thought while constructing ecological concepts should be their clear focus on protection of the human rights on clean environment, health protection, the environmental natural components protection from the effects of anthropogenic and, especially, technogenic activities of the society. This fact is especially important for developing the environmental monitoring concepts, as the main objective of monitoring system implementation at the urban systems level should be the environmental and health protection, but not obtaining information in order to support the activities of the state monitoring system.

It also should be taken into account that sociogenic factors of ecological danger forming, such as: environmental awareness, environmental knowledge, environmental culture in most cases are crucial in the process of environmental security management. Thus, the systematic sociological researches for enquiring the level of the mass environmental awareness are the necessary prerequisite for the concept task formulation and the interpretation of the results of their solving.

Taking into account everything mentioned above, the basic structure of the ecological monitoring concept presented in Fig. 1 has been proposed.

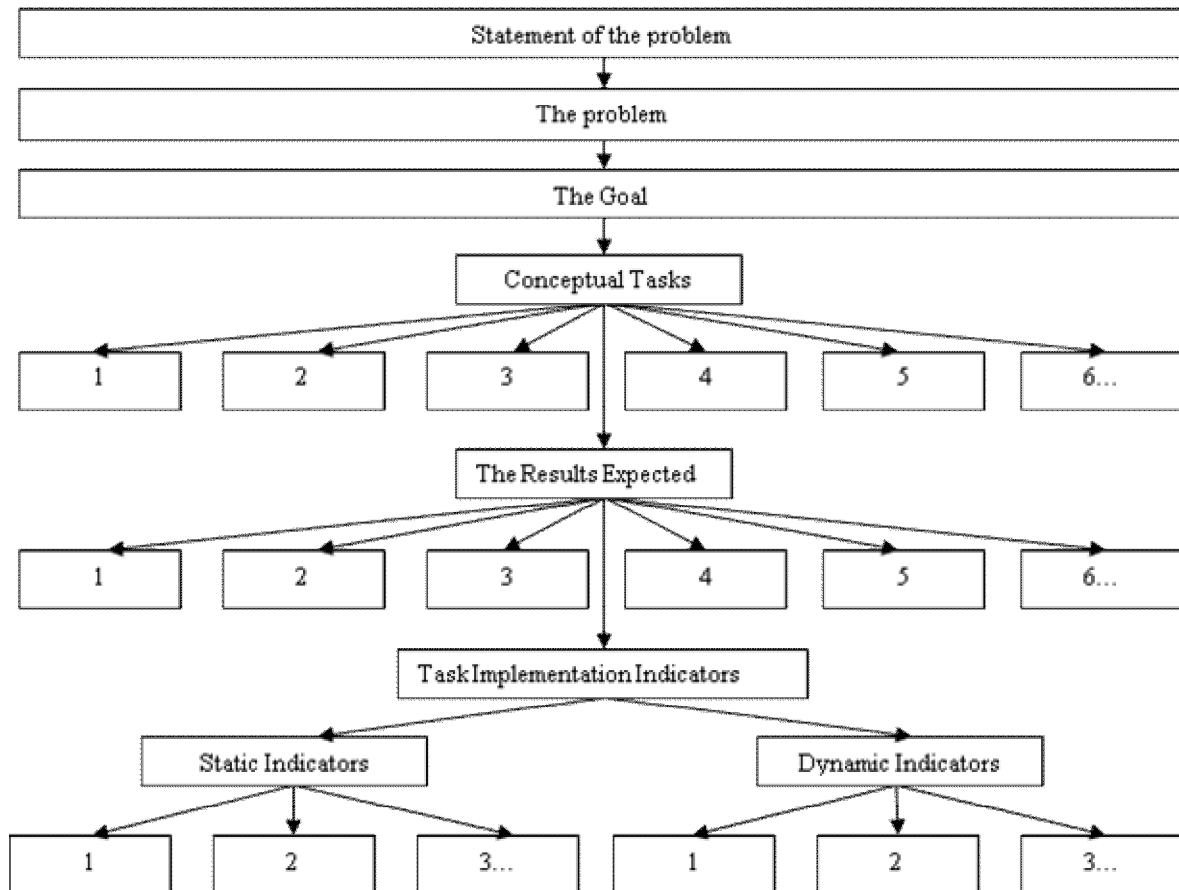
Therefore, the structure of the concept of environmental monitoring at the level of urban system, which should determine not only the objectives of the concept, but also the guidance and indicative outcomes of their solution has been proposed.

## Results

The approximate structure of the concept based on the analysis of the environmental monitoring system problems of technically loaded urban system of the town of Kremenchuk [10] has been developed. The need to develop the environmental monitoring concept for the town of Kremenchug, like for the most industrially loaded cities in Ukraine, is caused by the failure of the current monitoring system to reasonably determine the contribution of different sources of environmental

hazards to the general level of atmospheric air pollution of the urban system. So, for Kremenchuk, the decisive is the fact of determining the results of the work of stationary monitoring stations network, mobile sources of transport emissions as the main pollutants of

atmospheric air while 100 % of the complaints of the town inhabitants come to the municipal crisis line from the town areas that are located within industrial junctions. Besides, it occurs mainly at nighttime when the observations are not carried out.



**Fig. 1.** The basic structure of the ecological monitoring concept

*The basic problem* is the lack of systematic and operational observing system to develop actionable recommendations and making effective management decisions to prevent, ban and minimize the effects of air pollutants on environmental components and human health.

*The purpose of the concept* is considerate modernization of the observing system and formation of informational and analytical system of town atmospheric air quality estimation to ensure the rights of each resident for clean air and access to quality environmental information.

*Conceptual tasks are the following:*

- 1) improvement of standard (systematic) monitoring system;
- 2) development of an effective operational (crisis) monitoring system;
- 3) creation of photo and video monitoring;
- 4) improvement of the warning system on the occurrence of climatic conditions conducive to air pollution;

5) introduction of expert analysis practice of the primary information of the operational monitoring systems and the secondary information of the standard monitoring systems;

6) anthropocentric reorientation of sociological monitoring (by the problem that is considered);

7) modernization of the informational system displaying the results of the monitoring system work.

*The expected results:*

1. Optimization of atmospheric air pollution monitoring system at the level of urban system with the provision of obtaining high quality operational and statistical information methods of stationary and routing observations and predictive modeling.

2. Establishment of the informational and analytical system of atmospheric air monitoring at the local level ensuring broad Web oriented hierarchical and differential access to environmental information.

3. Organization of the expert and analytical system work for the development and making management

decisions to provide the reduction of the environmental risk level.

4. Creation of a systematic public survey sociological system dealing with the environmental problems in order to ensure the enhancement of environmental awareness and culture.

*The indicators of conceptual objectives implementation.*

1. Modernization of the location system of stationary observation posts over the air pollution in order to perform the tasks of the European integrated state monitoring system.

2. Support of information – analytical system with round the clock observation network operational information.

3. Photo and video fixation of the results of ecological danger sources operation to prove the excessive impact on the air quality.

4. Provision of effective operation of short-term system for forecasting the adverse weather conditions occurrence, which can contribute to air pollution.

5. Analytical processing of the observation system data in the crisis (emergency) situations through the independent public expert evaluation.

6. Completeness and representativeness of the analytical data obtained from the sociological research results.

7. Web-based visualization of the monitoring system components work with the differentiation of the information and access to it.

*The concept performance indicators.*

Technical *static* indicators:

– averaged values of pollutant concentrations, standard and complex index values of atmospheric air pollution obtained from the observations results on the urban “background” observation post in comparison with the other urban network posts;

– actual values of the pollutants concentrations fixing the exceeding sanitary and hygienic standards and meteorological conditions under which these exceedances have been recorded;

– photo and video materials to accompany the excessive pollutants concentrations facts fixed in town atmospheric air;

– relevant experts’ conclusions with clear definition of the exposure objects contribution to the general level of air pollution.

Technical *dynamic* indicators:

– decrease in fixed cases of atmospheric air regulatory purity criteria values exceedances in adverse weather conditions;

– increase in the number of expert opinions taken into account on the cases of legislation violation in the sphere of atmospheric air protection.

Social *dynamic* indicators:

– decrease in the percentage of sociological surveys system respondents, which determine the “lack of

information” indicator as a local environmental problem;

– increase in the percentage of respondents satisfied with the level of information on air pollution in the town;

– increase in the number of the local citizens’ appeals to the Web resource of informational and analytical system;

– decrease in the number of citizens’ appeals on air pollution issues to the crisis and information lines of municipal authorities.

## Conclusions

The basic scheme for the development of atmospheric air ecological monitoring concept at the level of urban systems has been proposed. The need to display static and dynamic results of the concept implementation in the form of indicators that will clearly respond to the problematic conceptual issues with a focus on the prevention of the techno sphere objects negative effects on the environment and human health, the generated environmental hazards reduction, the environmental security improvement at the local level through the social factors management has been specified.

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