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INTERNAL ENVIRONMENTAL AUDIT OF THE ENTERPRISE AS A COMPONENT OF ENVIRONMENTAL MANAGEMENT

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Abstract. The research is devoted to measures to increase the level of environmental safety of an industrial enterprise through the implementation of an internal environmental audit. The organization of the environmental management system at the enterprise was studied in terms of resources, operational planning and management, non-compliance, and corrective actions. Documentation regarding the organization of the internal environmental audit conducted at the enterprise, maintenance of environmental documentation, and obtained permits for emissions from stationary sources was considered. Based on the results of the analysis of the information array about the environmental aspects of the enterprise, corrective recommendations for improving the state of the enterprise in the environmental sphere were developed.

Keywords: environmental aspect of production, risk, pollutant emissions, solid waste.

1. Introduction

The basis of environmental management methods includes environmental controlling, environmental accounting, environmental audit and quality management. An environmental audit is considered a voluntary tool for regulating environmental issues since this activity is based on the initiative and high level of environmental awareness of enterprises producing goods and services. Audit results help the management determine the possibility of achieving environmental policy goals.

Internal audit involves inspections carried out by the company's staff to identify weaknesses, technological process flaws, or malfunctions of control equipment, and to gather evidence of the effectiveness of environmental measures. Unlike external environmental audits, internal eco-audits are preventive diagnostic tools conducted almost continuously within the enterprise.

2. Theoretical Part

Two fundamental concepts of audit activity regulation are highlighted. The first concept is applied in continental Europe – in countries such as Germany, France, Austria, and Spain. Here, audit activities are regulated by legislation, tax requirements, and controlled by Government agencies. Conversely, in the UK, USA and Australia, audit activities focus on cooperation between the economic entity and investors and creditors, carried out by professional public audit associations. Thus, in international practice, environmental audits already have their legislative, normative-methodological base, organizational structure, and qualified environmental auditors.

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For Ukrainian audit activities, the series of international standards of the ISO 14000 Environmental Management System, which are voluntary, is used as a foundation.

Violators of environmental legislation are subject to mandatory environmental audit programs. For example, in 2019, the EPA forced corrections at 1900 facilities, directed $4.4 billion in investments for environmental modernization of enterprises, and collected $472 million in fines, initiating 170 criminal cases. The range of fines imposed by the Agency is quite broad: up to $356,000 for air pollution, up to $1.3 million for drinking water pollution, and up to $93,700 for land depletion (Ecobusiness Group, 2021).

Environmental audit is conducted as a separate type of audit during the purchase or transfer of real estate and is performed in almost all real estate transactions (Real Estate Assessment, Property Transfer Audit) (Bondar, 2013). Significant attention to environmental management and audit issues is paid in EU countries. The most popular environmental management systems include the British Standard for Environmental Management Systems BS 7750 (1992), the international standard of the International Organization for Standardization ISO 14001 (1996), and the European Environmental Management and Audit Scheme (EMAS, 1992). For example, now in Germany, about 8000 companies and enterprises are certified according to the ISO 14001 standards, and more than 2100 – in EMAS (Daiankach, 2022).

The difference between the most popular standards lies in their specific requirements.

EMAS, initiated as a mandatory procedure in 1995, requires industrial companies in EU countries to regularly conduct environmental audits and publish their results regarding the company's impact on the environment (Nebyltsova, Ostapenko, 2013). Unlike certification procedures, EMAS requires an Environmental Declaration, which must include the environmental goals achieved by the company, processes and activities affecting the environment, natural resource consumption, and the state of purification equipment (Bondar, 2013). This declaration is made publicly accessible.

However, EMAS has undergone significant changes over time. EMAS II (2001) was based on Regulation 761/2001, focusing on voluntary participation of enterprises in the forestry, agricultural and municipal services in the EMAS EU system (Regulation, 2001).

The EMAS III (2009) update included new elements like revised audit cycles and the introduction of EMAS Global for global applicability. The new edition of EMAS II:2001 was adopted with the aim of unifying this scheme with the ISO 14000 series standards. EMAS III:2009 includes new elements (Regulation, 2009; Hutsalenko, Fabiianska, 2019):

- Revised audit cycles for further improvement of application (this is for companies with fewer than 250 employees and a turnover of less than 50 million UAH and for micro-enterprises).
- Key environmental indicators for adequate documentation of environmental performance.
- Implementation of EMAS Global to ensure the availability of EMAS for organizations and sites worldwide (and not just for EU countries).

To ensure better compatibility with the ISO 14001:2015 environmental management standard, the provisions of EMAS were also revised. The new Regulation (EU) 2017/1505 came into force on September 18, 2017, and includes updates to Annex I (Environmental Assessment), Annex II (Environmental Management System Requirements), and Annex III (Environmental Audit). Since January 9, 2019, Annex IV to the EMAS III regulation has been developed (Commission Regulation, 2018). This amendment includes updates to the key EMAS indicators and the formulation of the Environmental Declaration.

Despite its comprehensive approach, EMAS's popularity is relatively low due to its narrow geographic spread and the widespread adoption of ISO 14001. As of October 2021, there were 3887 organizations registered in EMAS, with the highest numbers in Germany (1115 organizations), Italy (1034 organizations), Spain (966 organizations), and Austria (268 organizations) (Boiko, 2023).

ISO 14001, on the other hand, requires the audit information to be conveyed only to the client and is often implemented simultaneously with ISO 9001 procedures, making it less effort-intensive.

Also, the implementation of an environmental management system according to ISO 14001 requires less effort and time, as the procedure at the enterprise often takes place simultaneously with the improvement of the ISO 9001 procedure. However, a number of environmental lawyers from the USA and the UK tend to consider the principles of EMAS more progressive and effective than certification under the requirements of ISO 14000.

All standards are periodically reviewed by ISO to ensure they still meet market requirements. The

editions of ISO 14001 have already taken place in 2000 (to ensure compatibility of regulations with the ISO 9001 quality management standard) and in 2015 with ISO 14001:2015-11, "Environmental management systems – Requirements with guidance for use". The purpose of the changes was to implement a procedure for the reliability of optimized environmental indicators (monitoring, measurement, and evaluation; corrective actions, and continuous improvement). In 2021, a scheduled review of the Standard was completed, and its validity was confirmed until 2027. The new version of ISO 14001 focuses on improving environmental performance rather than enhancing the management system itself.

In Ukraine, ISO 14000 standards have been adopted as national standards since 1997. The legal basis for environmental audits is governed by the Ukrainian laws "On Environmental Protection" (1991) and "On Environmental Audit" (2004). The current methodological base for implementing environmental audits includes various national regulations and standards (DSTU ISO 14001:2015; DSTU ISO 14004:2016; DSTU ISO 14015:2005; DSTU ISO 14031:2016; DSTU ISO 14050:2016; DSTU EN ISO/IEC 17021-2:2020; ISO/IEC 17021-1:2015; Metodychni rekomendatsii, 2006). From 1996 to December 29, 2017, the national environmental certification system UkrSEPRO was in operation, which included 149 certification bodies for products (works, services) and 811 testing laboratories (centers) (UkrSEPRO, 1996). The National Accreditation Agency (NAAU, 2002), a member of the International Accreditation Forum (IAF) and the European Accreditation (EA), ensures that certificates issued in Ukraine are recognized across Europe and beyond. Audits are conducted if stipulated by environmental criteria or as necessary, determined by an expert commission.

The audit of production facilities is carried out if it is provided for by environmental criteria (depending on the product category) or if necessary, as determined by an expert commission. When assessing services, organizations ("green office", "green class"), and real estate objects, an on-site audit is mandatory (service delivery site, organization office). Identified non-conformities, based on the assessment results, are provided to the applicant for elimination within the timeframes specified by the conformity assessment body (ISO 14024:2018).

Environmental audits at industrial enterprises can focus on production environmental audits, financial environmental audits and compliance environmental audits. During the audit, the processes are evaluated to determine if they already meet the environmental requirements. Successful certification of the management system results in an EMS certificate valid for three years, with annual surveillance audits required to maintain compliance with ISO 14001 standards.

According to available sources of information, a typical environmental management system at an enterprise consists of the following components: environmental service of the enterprise, staff awareness, taking into account the background indicators of the geographical environment of the enterprise, determining the level of technologies and cleaning technologies of the enterprise, indicators of resource consumption, assessment of the level of environmental safety and standards for each source environmental hazards, planning measures to respond to environmental accidents, constant control over the operation of the environmental safety system, application of measures to improve the operation of the management system.

A critical analysis of the methodological methods of conducting internal environmental audit in Ukraine and recommendations for their improvement are presented in the works of the authors (Nebyltsova, Ostapenko, 2013; Khomyk, 2016; Lebedevych, Novak, 2011; Mashkov et al., 2020).

Article Goal: To analyze the documentation and conduct an internal environmental audit at an industrial enterprise, identifying priority environmental aspects that may negatively impact the natural environment.

3. Material and Methods

The organization and conduct of internal audits at the enterprise are carried out according to the documentation "Planning and Conducting Internal Audits". Control of documented information is carried out according to "Documented Information". Documentation, creation, updating, and management of documented information are conducted according to MD 7.5 "Documented Information" (MD 7.1.4., 2021).

An internal environmental audit at the industrial enterprise is organized annually. Each action of the internal auditors is meticulously recorded in special protocols. The audit program, information package, and data obtained during instrumental and special studies, documented according to accepted procedures, constitute the set of environmental audit documentation.

The document reflecting the results of the environmental audit is the Audit Conclusion, which

consists of several standard sections, detailing the legal and organizational aspects of the audit, characteristics and information on environmentally significant activities of the enterprise, a detailed description of the practical and theoretical works carried out, a report on financial expenses, various guarantees, and confirmation of the conclusion's quality.

4. Experimental Part

The enterprise carries out technological operations with bulk materials – milling, fractioning, transportation, transferring, drying, mixing, and grinding. Fig. 1 schematically presents the technological line for dolomite preparation.

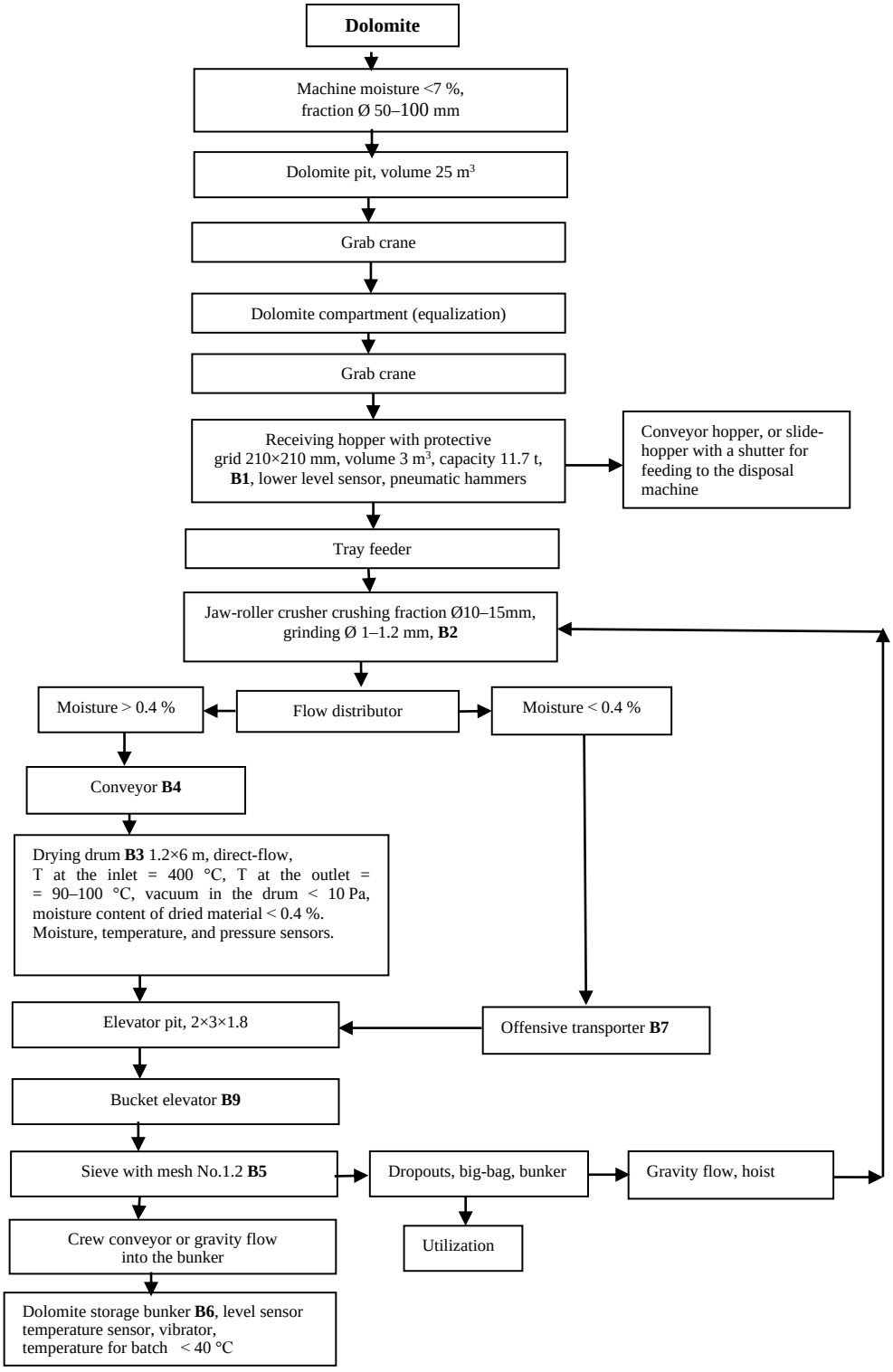

Fig. 1. Technological line for dolomite preparation

With the "batch : cullet = 90 : 10" ratio, the required amount of raw materials per ton of batch is presented in Table 1. One shift requires 50 tons of batch.

Table 1

Required amount of raw materials per ton of batch

Material Name	Processing Losses (%)	Daily Consumption (kg)		Annual Consumption (tons)
		without loss	with losses	
Sand, PK-100-U	7.8	28917.80	32708.74	11938.69
Dolomite, Dk 19-0.1	3.8	7072.06	7367.50	2689.14
Soda grade A	0.7	6691.59	6764.65	2469.10
Chalk, KM-2	1.3	1543.66	1567.81	572.25
Sodium sulfate, technical	0.5	487.00	489.99	178.85
Potash, technical (hygroscopic)	1	1922.19	2351.30	858.225
Feldspar, Matrix 350	0.8	3365.70	3396.95	1239.89
Total		50000.0	54646.97	19946.145

The allowed volumes of pollutant emissions, related to the main emission sources, in the Permit for emissions of pollutants into the air from stationary sources – are not set. Emissions from specific equipment types were within the permitted volumes (see Table 2).

Table 2

Allowed volumes of pollutant emissions from other emission sources

Emission Source	Pollutant Name	Approved MAC (mg/m^3)	Measurement Methods
Storage of bulk materials, batch preparation areas, drying drums	Substances in the form of suspended solid particles, undifferentiated by composition	150	MVV No. 081/12-0161-05 Industrial gas-dust emissions. Methodology for measuring the mass concentration of substances in the form of suspended solid particles in organized emissions from stationary sources by gravimetric method
Lacquering section	Phenol	20	MVV No. 081/12-0745-11 Methodology for measuring the mass concentration of phenols
Workshop	Manganese and its compounds in terms of manganese dioxide	5 – total concentration of manganese and its compounds in terms of manganese dioxide, chromium and its compounds in terms of chromium trioxide, easily soluble fluorides (eg NaF) and their compounds in terms of fluorine	MVV No. 081/12-0402-06 Industrial gas-dust emissions. Methodology for measuring the mass concentration of manganese in organized emissions from stationary sources by photocolorimetric method
	Chromium and its compounds in terms of chromium trioxide		MVV No. 081/12-0570-08 Industrial gas-dust emissions. Methodology for measuring the mass concentration of chromium (III) compounds in organized emissions from stationary sources by titrimetric method MVV № 081/12-0407-07 Industrial gas-dust emissions. Methodology for measuring the mass concentration of chromium (VI) compounds in organized emissions from stationary sources by photocolorimetric method
	Fluorides, easily soluble (e.g., NaF) and their compounds in terms of fluorine		MVV No. 081/12-0170-05 Industrial gas-dust emissions. Methodology for measuring the mass concentration of fluorine and its vaporous and gaseous compounds in organized emissions from stationary sources by photocolorimetric method
General ventilation	Substances in the form of suspended solid particles, undifferentiated by composition	150	MVV No. 081/12-0161-05 Industrial gas-dust emissions. Methodology for measuring the mass concentration of substances in the form of suspended solid particles in organized emissions from stationary sources by gravimetric method

Emissions include substances like:

– suspended solid particles, nitrogen dioxide, carbon monoxide from technological processes such as batch preparation and manufacturing of insulation parts;

– iron and manganese compounds emissions from gas welding works;

– acid vapors (sulfuric, hydrochloric) from chemical analysis of glass and raw materials.

Audit procedures are conducted annually, including:

- Acts verifying the conformity of the gas cleaning installation's actual operating parameters with design parameters (efficiency of the gas cleaning equipment) at the emission source;
- Acts checking the technical condition of the gas cleaning installation at the emission source.

The occupational safety service annually documents:

- POD-3 journals accounting for the operation of gas cleaning and dust collection installations (emission accounting);
- Statistical reporting form 2-TP air;
- Statistical reporting form No. 1-waste;
- Waste accounting journal – as waste is generated and transferred for recycling;
- Reporting 2 TP-water resources.

5. Test Results

Environmental aspects potentially negatively impacting the natural environment are identified. These include air pollutant emissions and industrial waste. The likely negative impact on air quality at the boundary of the sanitary protection zone and the nearest residential area is considered.

Table 3

Environmental aspects and regulatory measures

Environmental Aspect	Risks	Regulation
Air pollutant emissions	Exceeding air quality limits under adverse weather conditions	Periodic (annual) control of the enterprise's dust-gas cleaning equipment efficiency (dust cleaning chambers, paired cyclones CN-15, and battery cyclones type r133/1x20)
	Complaints from residents of the nearest residential development	Continuous monitoring system for major pollutants at observation posts and public disclosure of data
Industrial waste	New legislative requirements in waste management	Recycling own solid waste (cullet) as a batch additive

Compliance Assessment. Non-conformities are determined by: A. Laboratory-instrumental research results; B. Information received from heads of structural divisions.

A. The economic entity controls compliance with established technological emission standards for pollutants in gases discharged from specific equipment types at their exit point (or gas cleaning installation) and at the boundary of the sanitary protection zone and the nearest residential area – quarterly instrumental measurements are carried out by an accredited laboratory from all emission sources. Sampling points are organized according to (KND.211.2.3.063-98).

B. The efficiency of dust-gas cleaning installations and their technical condition is controlled annually by a commission consisting of the chief energy engineer, the head of the batch preparation shop, and the occupational safety engineer. The analysis base includes inventory data of all organized and unorganized emission sources indicating pollutant content. Verification results are documented in an act of conformity of the gas cleaning installation's actual operating parameters with design parameters. In case of deficiencies in the dust-gas cleaning installations, the head of the structural division develops corrective or preventive actions to eliminate them.

6. Conclusions

To improve the enterprise's environmental condition, general recommendations are provided:

1. Reducing the negative impact on the environment by: decreasing emissions of suspended solid particles, undifferentiated by composition, into the atmosphere; reducing industrial waste generation and ensuring safe handling, and implementing waste recycling measures.

2. Main directions for solving technological problems: technological re-equipment and gradual decommissioning of obsolete gas cleaning equipment; implementing measures to improve fuel efficiency; developing a program for the development and use of renewable energy sources.

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