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CONCEPTUAL SCHEME OF ENVIRONMENTAL SAFETY OF URBAN AREAS ADJACENT TO THE FACILITIES OF THE CONSTRUCTION INDUSTRY

The existing approaches to assessing the environmental safety of territories located near construction industry enterprises are analyzed: cement plants, factories for the production of concrete and reinforced concrete structures. Threats to the ecological safety of built-up landscape that adjoin them have been identified. A structural and logical scheme of means to ensure the environmental safety of construction industry facilities and adjacent territories has been developed. It includes monitoring the state of the main components of the physical environment (soils, atmosphere and hydrosphere), assessing threats to the safety of urban residential areas and a system of organizational, technical, managerial and engineering solutions. A conceptual scheme for the environmental safety of urban areas adjacent to factories has been developed, based on the interaction of such main components as scientific substantiation of anthropogenic loads, monitoring of the environment, conservation of landscape and biological diversity, greening of economic activities, provision of environmental services and recreational activities in adjacent areas.

Keywords: *conceptual scheme, environmental safety, built-up areas of megalopolises, cement plants, ready-mixed concrete and reinforced concrete structures plants.*

Introduction

The industrial enterprises of the construction industry located in Kharkov are characterized by long-term operation of outdated technological complexes and equipment (often still from Soviet times) with significant material and high obsolescence. The industrial products manufactured by them fully comply with international standards in quality and compete on equal terms with similar products from European and leading world manufacturers, but the technologies used at the enterprises are outdated. And although plants for the production of ready-mixed concrete and reinforced concrete structures, as well as an experimental cement plant (due to its small capacity) are not potentially hazardous facilities (in terms of the occurrence of industrial accidents or man-made disasters), without cardinal modernization their further operation is associated with a certain environmental risk and is dangerous for the surrounding areas and the local population.

Analysis of recent research and problem statement

Today, in the activities of enterprises of the construction industry in Ukraine, a lot of attention is paid to the issue of establishing standards and the place of environmental safety, but most often it is about the prospects for the development of green construction in Ukraine [1].

The issue of environmental safety of urban areas located next to the existing enterprises of the construction industry with their outdated technological processes and equipment (an experimental cement plant, factories of ready-mixed concrete and reinforced concrete structures, which were built during the Soviet time), is very relevant, because today there is a significant the number of these enterprises turned out to be not just within the city, but almost in the center of residential areas. Therefore, it is necessary to balance their profitable activities with a decrease in the impact on the environment and health of the local population. To improve the environmental safety of urban areas, it is necessary to carry out a complete technical re-equipment of enterprises with a mandatory solution to the problem of greening each production process, as well as to develop a system of engineering and organizational and management solutions to reduce the level of environmental hazard of the territories.

The subject of the presented research is the processes of minimizing the environmental hazard of urban areas adjacent to the existing facilities of the construction industry, namely to plants for the production of cement, concrete and reinforced concrete structures.

The purpose of this study is to assess the level of environmental safety of urban residential areas built-up to the existing facilities of the construction industry, namely to plants for the production of cement, concrete and reinforced concrete structures.

To achieve this goal, **the following tasks** were set:

To develop a conceptual scheme for the environmental safety of urban areas adjacent to the existing facilities of the construction industry, namely to plants for the production of cement, concrete and reinforced concrete structures.

Analyze the existing approaches to ensuring the environmental safety of territories.

Carry out the identification of threats to the environmental safety of built-up areas in the adjacent territories.

To develop a system of engineering and organizational and management solutions to reduce the level of environmental hazard of territories.

Presentation of the main material

According to the law of Ukraine "On the basic principles (strategy) of the state economic policy of Ukraine for the period until 2020", the central threat to environmental biodiversity is human activity and the destruction of the natural habitat of flora and fauna [2].

The destruction of the natural environment occurs, among other things, due to uncontrolled industrial production and obsolete equipment of industrial enterprises, which has long worked out its resource. Among the tasks of improving the environmental situation and increasing the level of environmental safety, the following are highlighted:

- Strengthening state environmental control over compliance with legislation during the operation and reconstruction of existing industrial enterprises based on an assessment of their risk to public health.

- Revision of the existing regulatory framework in order to ensure environmental requirements, in particular, in the process of reconstruction and dismantling of industrial facilities. In technically developed countries, national standards are being created that take into account the socio-economic and natural conditions of the country. These standards are a recognition of the need for environmental friendliness of enterprises, including the construction industry. They are aimed at increasing the importance of ecology as an integral part of society for realizing the sustainability of cities and the country as a whole.

- Ensuring informing by business entities of the population about the impact of the work activities of nearby enterprises on the environment, as well as organizing wide discussions by citizens of projects for the reconstruction of existing enterprises.

Today, the approach to assessing the environmental safety of territories is the need to reduce the aggregate detrimental impact (that is, over the entire life cycle) of industrial facilities and buildings that have an impact on the environment and human health due to their location in the adjacent territories. An important indicator and at the same time a factor in the development of production is the ecological

technological capacity of the territory – a generalized characteristic of the territory corresponding to its maximum technological load; it demonstrates the ability of the region to accumulate the influence of industrial activities without consequences for the ecosystem [3].

A number of reinforced concrete plants are located in Kharkov: RCS-1, 3, 4, 5, 9, 15, reinforced concrete construction plant N 348, plant of reinforced concrete structures and building parts, plant of reinforced concrete structures Kharkivmetrobud, plant of reinforced concrete parts Kharkivoblagrostroy. There is also an experienced small-scale cement plant. All these enterprises were built on the outskirts of the city, but now they are in the middle of residential areas, since they were built in those days when Kharkov was much smaller. All of them are characterized by the same problems: deterioration of equipment and the need to ensure the environmental safety of adjacent territories. These problems are solved by a complete technical re-equipment with a mandatory solution to the problem of greening each production process. This is a complex science-intensive problem that is inextricably linked with the main directions of sustainable development. [4-6]. The activities of these enterprises may negatively affect the population [7-9], which lives in the zones of their influence, as well as lead to a deterioration in the state of the air and water environment, soil and groundwater. A high degree of environmental risk is the emission of pollutants into the air; use of alternative fuels, waste water discharges into water bodies, accumulation of heavy metals in the soil cover and in plants. Hazardous engineering-geological processes and phenomena can develop both at the industrial sites of enterprises due to the increased anthropogenic load, and beyond them. The main influence is the total weight of the plant and the constant intra-plant movement of heavy transport (the plants are operating constantly). Therefore, these objects are constantly changing the environment around them. Such modern large cities as Kharkiv have a complex and multi-layered infrastructure (which is exactly the basis of anthropogenic impact on the biosphere). And large industrial facilities in megalopolises, in large numbers, additionally exert a powerful dynamic and static load on the lithosphere and lead to dangerous engineering and geological processes (such as soil subsidence, karst formation, flooding, capillary rise, erosion, etc.).

In the megalopolises of Ukraine, factories of reinforced concrete structures are the most powerful sources of urban noise, but according to the State Sanitary Rules for Planning and Development of Settlements, they are classified only as IV hazard class with a sanitary protection zone for residential areas equal to 100 m. The current sanitary standards allow their placement in close proximity not only to enterprises of the V hazard class with completely silent

industries (such as pharmaceutical plants and precision instrument-making enterprises), but also from medical, educational and scientific institutions that require strict standardization of acoustic conditions, not to mention already about residential development. As a result, the people working and living in the adjacent territory and the entire city economy suffer significant socio-economic losses. For example, in the zone of noise discomfort of the RCS-5 plant in the city of Kharkov there are more than 5000 people, since the noise level outside the RCS -5 plant reaches 90-95 dBA, and around other plants of reinforced structures it is even higher. The problem of reducing the noise level in the areas adjacent to the factories can be fundamentally solved at high economic costs. This will undoubtedly prevent economic losses to an industrial enterprise from the negative impact of its activities on the environment. But it is possible that the price will be many times higher than the final result of the technological process. However, in a big city, achieving sound comfort is one of the most important environmental problems, although the legislation of Ukraine does not provide for payment for increasing the noise level, as is done in technically developed countries of Europe.

The total noise loads in the territories adjacent to noisy companies in Ukraine are regulated by Building codes-3077-84 and State All-Union standard 12.1.003-83. The maximum permissible noise level in the territories of residential neighborhoods, including those adjacent to "loud" enterprises, is regulated by State building codes B.1.1-31: 2013, and in the territories of industrial enterprises by State sanitary norms 3.3.637-99. Separate technological equipment, first of all – a vibrating platform for compacting concrete, is almost the main source of noise (their noise exceeds sanitary standards by 30 dBA), railway and heavy vehicles, in general, entire reinforced concrete plants are not only the main sources of noise in cities – they always form the noise mode of entire areas. However, today, due to the increasing noise impact of equipment and its physical wear and tear, this is an even bigger problem than ever.

Any state and enterprise must solve the problems of environmental protection, consistently improving all elements of the structure of the system "technological complexes – technical activities – environmental protection". Which element of this system to give preference depends on the type of activity, state of technology and the severity of environmental protection problems in each specific case, for each specific enterprise. But if on a national scale it is possible to solve the problems radically, at once with all the elements of the system, then for one single enterprise such an approach is impossible due to the high costs.

Not a single reinforced concrete plant in Ukraine can afford them today. Therefore, today, instead of a complete replacement of equipment and their shielding (to protect against the noise of the adjacent territories), one has to confine oneself only to construction-acoustic solutions.

A plant of reinforced concrete structures is a whole complex of noise sources interconnected by main and auxiliary technological processes [10, 11]. They consist of a number of point and spatial noise sources that radiate sound energy into space. When determining the main sources of noise and the entire path of sound movement from the source to the residential area, construction and acoustic noise protection measures should be developed that will reduce the sound levels at the protected objects by up to 20-30 dBA. So the zones of acoustic discomfort in the adjacent territories are reduced several times. Figure 1 shows the main threats (risks and challenges) for the environmental safety of the territories adjacent to plants for the production of cement, concrete and reinforced concrete structures.

For the conditions of Kharkov plants for the production of cement, concrete and reinforced concrete structures, environmental measures were developed to reduce industrial dust emissions into the atmosphere. Analyzed the classification scheme of the system of combating industrial dust and gaseous emissions of cement plants and plants of reinforced concrete structures. It is implemented by five main functional elements. These are binding, retention, trapping, scattering of pollutants and air purification from pollutants. For the conditions of the Kharkov Experimental Cement Plant and the RCS-5 plant, innovative methods of dust suppression were proposed [12-14] using fog-generating and foam-generating units: a hydrodynamic method using irrigation, as well as dust suppression using foam or using fog. The mechanism of interaction between water droplets and dust particles in the air, depending on their size, has been analyzed, recommendations have been developed for improving the process of dedusting the process raw materials of cement and concrete plants with foam. An optimal fogging scheme is proposed to achieve maximum sanitary and hygienic and environmental efficiency. The newest dustproof equipment for specific conditions of raw materials and cement clinker grinding sites has been proposed. A system of engineering solutions has been developed that will reduce the hazard level of these enterprises for the nearby built-up areas.

A structural and logical scheme of the means to ensure the environmental safety of the construction industry facilities and adjacent territories has been developed is shown in Fig. 2.

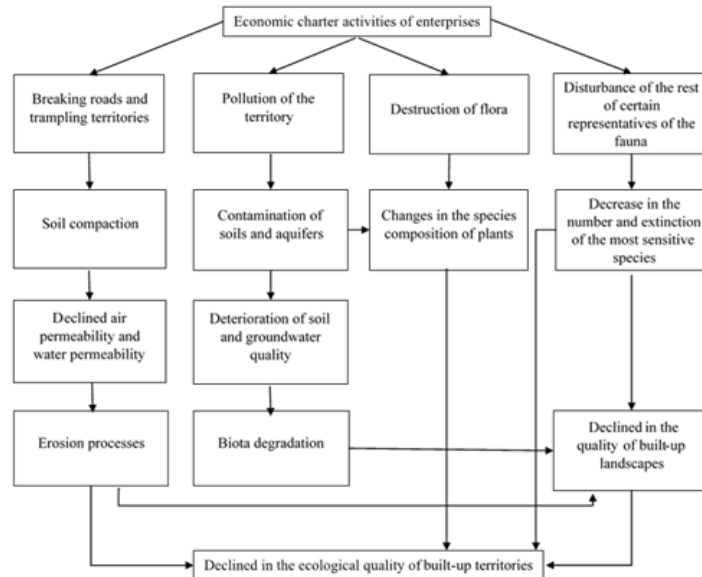


Fig. 1. The main threats to the environmental safety of the territories adjacent to the plants for the production of cement, concrete and reinforced concrete structures

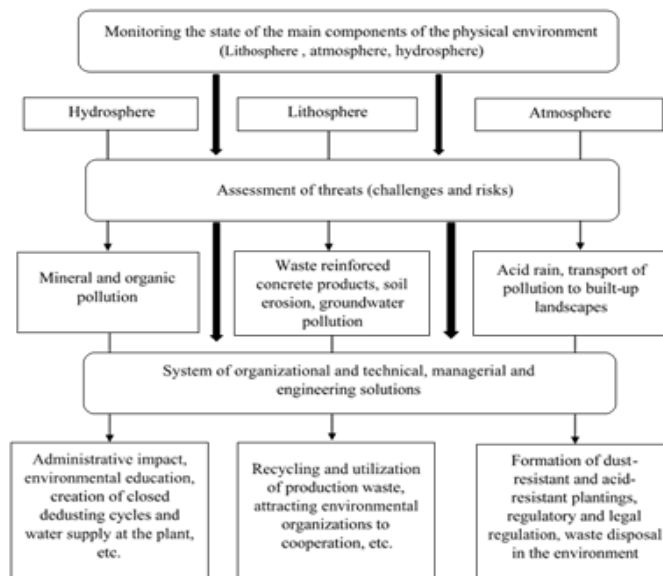


Fig.2. Structural-logical scheme of the means to ensure the environmental safety of construction industry facilities and adjacent territories

A conceptual diagram of the ecological safety of urban areas adjacent to the existing facilities of the construction industry has been developed, shown in Fig. 3. It is based on the interaction of such basic components as the conservation of landscape and biological diversity, the greening of economic activities, the provision of environmental services, the activities of environmental organizations, recreational activities in the adjacent territories, monitoring of the state of the environment and scientific substantiation of anthropogenic loads.

Conclusion

An assessment of the level of environmental safety of urban areas adjacent to the existing facilities of the

construction industry has been carried out. A conceptual scheme of the environmental safety of urban areas adjacent to the existing facilities of the construction industry, namely to plants for the production of cement, concrete and reinforced concrete structures, has been developed. The analysis of existing approaches to ensuring the environmental safety of territories is carried out. The identification of threats to the ecological safety of residential areas in the built-up territories was carried out. A system of engineering and organizational-but-management solutions has been developed to reduce the level of environmental hazard of territories.

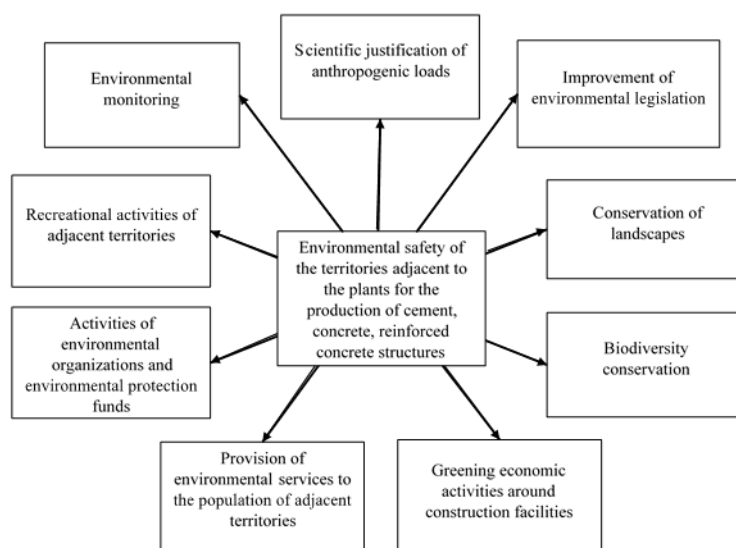


Fig.3. Conceptual scheme of environmental safety of urban areas adjacent to the existing facilities of the construction industry

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КОНЦЕПТУАЛЬНА СХЕМА ЕКОЛОГІЧНОЇ БЕЗПЕКИ МІСЬКИХ ТЕРИТОРІЙ, ПРИЛЕГЛИХ ДО ОБ'ЄКТІВ БУДІВЕЛЬНОЇ ІНДУСТРІЇ

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Встановлено місце екологічної безпеки міських селітебних територій великих міст, що розташовані поруч з потужними промисловими підприємствами будівельної індустрії – з заводами з виробництва цементу, бетону та залізобетонних конструкцій. Проаналізовано існуючий підхід до оцінки екологічної безпеки територій, який полягає в необхідності скорочення сукупної згубної дії (тобто за весь життєвий цикл) промислових об'єктів і будівель, які мають вплив на навколишнє середовище і здоров'я людей через розташування на прилеглих територіях. Визначено, що важливим показником і одночасно фактором розвитку виробництва є екологічна техногенність території – узагальнена характеристика території, що відповідає її максимальному техногенному навантаженню; вона демонструє можливість регіону акумулювати вплив промислової діяльності без наслідків для екосистеми. Проведено ідентифікацію загроз для екологічної безпеки селітебних зон від діючих цементних заводів і заводів з випуску товарного бетону і залізобетонних конструкцій, розташованих на прилеглих територіях. Розроблена структурно-логічна схема засобів по забезпеченню екологічної безпеки об'єктів будівельної індустрії і прилеглих до них територій. Вона включає моніторинг стану основних компонентів фізичного середовища (ґрунтів, атмосфери і гідросфери); оцінку загроз безпеці міських селітебних територій і систему організаційно-технічних, управлінських і інженерних рішень. Розроблено концептуальну схему екологічної безпеки міських територій, прилеглих до діючих об'єктів будівельної індустрії з їх застарілим обладнанням, яка базується на взаємодії таких основних компонентів як збереження ландшафтного та біологічного різноманіття, екологізації господарської діяльності, надання екологічних послуг, діяльність екологічних організацій, рекреаційні заходи на прилеглих територіях, моніторинг стану довкілля і наукове обґрунтування антропогенних навантажень.

Ключові слова: концептуальна схема, екологічна безпека, селітебні зони мегаполісів, цементні заводи, заводи товарного бетону і залізобетонних конструкцій.