

# ЕКОЛОГО-ГІГІЄНИЧНА ОЦІНКА ВПЛИВУ ДІЯЛЬНОСТІ ПІДПРИЄМСТВ З ВИГОТОВЛЕННЯ АСФАЛЬТОБЕТОНУ НА СТАН ДОВКІЛЛЯ З УРАХУВАННЯМ ВИМОГ ВІТЧИЗНЯНОГО ЗАКОНОДАВСТВА ТА ДИРЕКТИВ ЄС

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## ECOHYGIENIC ASSESSMENT OF THE OPERATIONAL IMPACT OF THE ENTERPRISES FOR ASPHALT CONCRETE PRODUCTION ON THE STATE OF THE ENVIRONMENT TAKING INTO ACCOUNT THE REQUIREMENTS OF DOMESTIC LEGISLATION AND EU DIRECTIVES

**T**

he entry of Ukraine into the European transport system, the advantageous geographical position on the path of major transport flows between Europe and Asia, and the strengthening of economic ties between Ukraine and other countries have led to an increase in the intensity of traffic in directions, which in turn requires an improvement of the quality of roads [1].

In Ukraine, the length of the network of highways of general use makes up 169.5 thousands km, of which 49.2 thousands km are the roads of state importance. However, 97% of all roads have high wear and need major or ongoing repairs. In addition, there is an acute problem with the state of more than 9.6 thousands bridges which do not meet the requirements of modern norms and actual load according to technical parameters. Such a state of public roads and bridges does not fully ensure fast, comfortable, economical, and safe transporta-

tion of passengers and goods. The development of transport creates a social tension in society, reduces the competitiveness of domestic economy [2]. A state of roads has a large impact on the number of traffic accidents. Ukraine became one of the ten countries in Europe with the highest mortality rate of traffic accidents (9 deaths per 100,000 population). According to the data of the Ministry of Internal Affairs of Ukraine for the first half of 2018, about 70 thousands accidents were registered on roads, in which almost 13 thousands people were injured.

The use of asphalt concrete pavement technology is still the most widespread in the world and in Ukraine. Thus, in Ukraine, the share of asphalt concrete pavement is about 98% among all other types of covering, in Europe – more than 90%, in the USA – about 94%.

Considering that organic binding agents are one of the main

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**Keywords:** asphalt concrete enterprise, eco-preserving technology, environmental measures, sanitary-and-protective zones, sanitary legislation, EU directives.

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**Мета роботи.** Еколого-гігієнічна оцінка впливу діяльності підприємств з виготовлення асфальтобетону на стан довкілля з урахуванням чинного вітчизняного законодавства та вимог Директив ЄС.

**Матеріали та методи досліджень.** У статті використано такі методи: бібліосемантичні, аналітичні та санітарно-епідеміологічної експертизи проектних матеріалів.

**Результати досліджень.** Проаналізовано проектні матеріали вітчизняних асфальтобетонних заводів з впровадженням сучасної екологозбережної технології виробництва асфальтобетону, пилогазоочисних систем та використання гото-

вих бітумів (продуктів переробки нафти). За результатами санітарно-епідеміологічної експертизи проектних матеріалів встановлено, що застосування ефективної системи пилогазоочистки, використання у виробництві готових привозних бітумів забезпечує дотримання гранично допустимих концентрацій забруднюючих речовин в атмосферному повітрі на межі нормативних та розрахункових санітарно-захисних зон (СЗЗ).

**Висновок.** За результатами аналізу матеріалів проектної документації можна передбачити, що виробництво асфальтобетону з використанням сучасних технологій забезпечить дотримання вітчизняного санітарного законодавства та Директиви 2008/50/ЄС Європейського Парламенту та Ради від 21.05.2008 р. “Про якість атмосферного повітря та чистіше повітря для Європи”.

**Ключові слова:** асфальтобетонні заводи, екологозбережна технологія, природоохоронні заходи, санітарно-захисні зони, санітарне законодавство, Директиви ЄС.

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components in the composition of asphalt concrete mixtures, they include specific pollutants of ambient air a hygienic assessment of the impact of the operation of the enterprises producing asphalt concrete on the environment and public health remains relevant [3].

The aim of this study was to conduct an ecohygienic assessment of the impact of the operation of the enterprises producing asphalt concrete on the state of the environment, to develop new hygienic criteria and to improve the existing ones for the location of asphalt concrete enterprises, taking into account the latest domestic sanitary, environmental, and urban planning legislation and the requirements of the EU Directives.

**Objects and methods.** The enterprises of various capacities, producing asphalt concrete, were the objects of the study. We used the methods of expert assessment and sanitary and epidemiological examination of construction projects.

**Results and discussion.** The sphere of town-planning by its architectural, health preserving, and price policy is an important economic indicator of any country in the world. The requirements of the European Charter of Local Self-Government, ratified by Ukraine, the Law of Ukraine "On the Principles of State Regional Policy", as well as the recommendations of the WHO, the United Nations Economic Commission for Europe (UNECE), the EU and the Council of Europe directives are directed to the creation and support of the favourable living environment and the preservation of public health [4].

According to the Article 3 of the Constitution of Ukraine, human health is one of the highest social values of the state. Article 50 defines the right of every person to a safe environment for life and health. Article 27 of the Law of Ukraine "Fundamentals of the legislation of Ukraine on health care" stipulates that "... sanitary and epidemiological well-being of territories and settlements is ensured by a system of state incentives and regulators aimed at a strict adherence of sanitary-hygienic and sanitary-and-anti-epidemic rules and norms, by a complex of special sanitary-hygienic and sanitary-and-anti-epidemic measures".

The development of new hygienic criteria and improvement

of the existing ones for the location of the industrial enterprises, including asphalt concrete enterprises, taking into account the latest domestic sanitary, environmental, and town-planning legislation and international experience, is one of the main tasks of the Laboratory of Hygiene of Planning and Development of Human Settlements and complies with the process of adaptation of sanitary legislation of Ukraine to the legislation of the European Union, stipulated by Article 51 on the Partnership and Cooperation Agreement between Ukraine and the European Community (European Union) and its Member States [4].

The requirements of Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe establish the air quality standards for the composition of the most harmful air pollutants and the rules for the assessment of the quality of ambient air [5].

Environmental legislation remains an important tool in the solution of the problems of the environmental protection in the EU States, and its strict observance and improvement is one of the priorities in the environmental policy of the European Community. The main efforts of the EU states in the field of environmental protection are aimed at pollution prevention, guarantee of the environmental safety of the construction products, determination of the responsibility for damage to the environment. The European Commission is empowered to apply sanctions up to the responsibility at the level of the European Court in respect of those states that do not fulfill their obligations.

Ecological liability and reimbursement of the ecological damage to the environment are envisaged in the normative European document – Directive 2004/35/EC of the European Parliament and the Council, 21 April 2004 [6].

According to the latest Law of Ukraine "On the Assessment of the Impact on Environment", which entered into force in 2017, the asphalt concrete enterprises are referred to the second category of types of planned activities and objects that may have a significant impact on the environment [7].

In order to improve the material and technical basis of the road economy, the Government of Ukraine approved the Concept of

the State Target Economic Program for 2018-2022 of January 11, 2018, № 34-p. aimed at the intensification of the innovative and scientific-and-technical activities in the road-economy, the effective operation and development of enterprises for the production of asphalt concrete. The introduction of modern efficient energy- and resource-saving materials and technologies will ensure high quality and durability of road and bridge structures. A use of optimum variants of the location of the objects of road-economy is provided by the concept. It will contribute to the protection of the territories and objects of the nature reserve fund and to the prevention of the harmful impact of road construction on the environment and residential territory. The establishment of noise abatement facilities, the preservation of the ways for migration of animals, the regime of protection of the territories and objects of the nature reserve fund, and other environmental protection purposes are among the main measures for the preservation of the environment [2].

According to the current normative document of the sanitary legislation – "State sanitary rules for planning and development of settlements. SSR № 173-96", approved by the Order of the Ministry of Health of Ukraine № 173 of 19.06.96, registered in the Ministry of Justice of Ukraine on July 24, 1996, № 379/1404, and "Sanitary classification of enterprises, manufactures, structures, and sizes of sanitary-protective zones for them" that is presented in this document in the Appendix № 4, the normative sizes of sanitary protection zones (hereinafter – SPZ) are established for existing and planned construction/reconstruction of enterprises depending on their hazard class (p. 5.6). Production of asphalt concrete is classified as hazard class I with 1000 m normative SPZ [8].

These hygienic norms were duplicated in the State Construction Norms of Ukraine "SCN 360-92\*\*". Town-planning. Planning and building of urban and rural settlements". In accordance with the paragraph 10.12\* of this document, "for the enterprises for asphalt concrete manufacture as for the objects, that are the sources of air pollution, the size of sanitary protection zones are established in accordance with

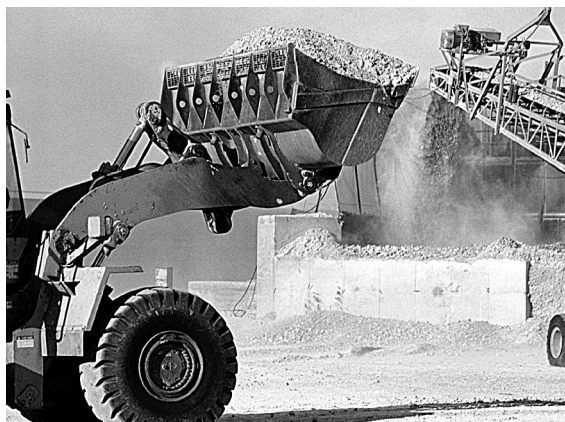
the design sanitary norms for industrial enterprises, and their sufficiency must be confirmed on the basis of the calculation of predicted levels of pollution in accordance with the current guidelines for calculation of the dispersion of harmful substances from the emissions of the enterprises in the atmosphere" [9].

The majority of modern existing asphalt concrete enterprises (hereinafter – ACE) in Ukraine were built during the post-war development in accordance with the requirements of "Sanitary norms for design of the industrial enterprises. SN 245-71" and had the normative SPZ of 300 m.

An increase of the normative SPZ from 300 m to 1000 m was due to the complaints of the bad smells from the population at the territory adjacent to these residential development enterprises because the black binding agents of coke and by-product process (tar, resin, etc.) with the strong unpleasant smell of the pollutants in their composition were used in the manufacture of asphalt concrete. That's why, according to the Order of the Civil Service of Motor Roads of Ukraine of 27.10.2005 № 490, a use of the black binding agents of coke and by-product process on the roads for general use was banned. It decreased the emission of the pollutants at the operation of the enterprises for the manufacture of asphalt bitumen materials for road covering. At modern stage, bituminous-emulsive technology is applied.

For today, domestic asphalt concrete enterprises are characterized by the introduction of modern ecologically safe technology for the production of asphalt concrete, dust-gas treatment systems, and use of finished bitumen (oil refining products), that stipulates less harmful emissions with smaller values of pollutants, including odorous substances, that actualizes the issue of the differentiation of the hygienic standards for asphalt concrete enterprises, taking into account capacity, use of raw basis, technology, and the introduction of nature preserving measures.

In order to ensure sanitary and epidemiological well-being of the population during the implementation of urban planning documentation for the construction of new production facilities in Ukraine, a procedure of the size changes in the SPZ hygienic standards on the basis of the Expert Commission on the establishment



## ГІГІЕНА ПРАЦІ

and change of the size of sanitary protection zones under the Chief State Sanitary Doctor Ukraine (hereinafter – Planning Expert Commission), formed by the order of the Ministry of Public Health of Ukraine, 03.03.2010, № 187 was initiated [4].

The functioning of the Planning Expert Commission for the review of the issues on the evaluation of planning and building of human settlements from the point of view of the ecological consequences for the environment and consequences for the health of people and the safety of their living conditions at the determination of the sizes of the SPZ for industrial and agricultural facilities of the I-III classes of danger complies with the item 239 of the plan for the implementation of the Association Agreement between Ukraine and the European Union (Chapter 22 Public Health) and WHO recommendations (resolution EUR/RCC/R2 to the "European Action Plan for Strengthening of Potential and Public Health Services").

The projects for the establishment of SPZ for 768 objects, including 43 asphalt concrete enterprises, were considered by the Planning Expert Commission in 2009-2017 [4].

According to the results of the scientific sanitary-and-epidemiological examination of the four construction/reconstruction projects of the enterprises for the production of asphalt concrete mixtures investigated in 2017, the following was established.

At the investigated ACE, modern asphalt concrete sets were installed for the production of the asphalt concrete mixtures of such brands as "Teltomat T-1", DS-168, DS-158, DS 117-2E, DS-158Z, DS-228. By the capacity, the studied ACEs were distributed as follows: two ACE of low capacity (3.2 thousands tons/year and 5 thousands tons/year), one ACE of medium capacity (18 thousands tons/year) and one ACE of high

capacity (100 thousands t/year). Three ACE (75%) were equipped with one asphalt mixing set (AMS), a high capacity ACE – with three medium capacity AMS ("Teltomat T-1" – 45 t/year, DC-168 and DC-158-50 t/year). Characteristics of the enterprises for the production of asphalt concrete mixtures are given in the table.

Two ACE began to work in 1974 and in 1979 at the time of the current normative document – "Sanitary norms for design of industrial enterprises. SN № 245-71" (with a hygienic standard size of 300 m). Now objects are equipped with modern three-stage air-purifying sets with a total purification efficiency of 97.67%. At the high capacity enterprise, a three-stage system for dust-gas purification consists of direct-flow cyclone with a purification efficiency of 33.5% (I degree); battery cyclone and bag filters with a cleaning efficiency of 86.5% (II degree); damp cleaning with a clearing efficiency of 74.0% (III degree). At the ACE of medium capacity, the air purification system is represented by a battery cyclone SCN-40 and a wet dust collector "Rotaklon". Implementation of nature preventive measures ensured the reduction of gross emissions of the pollutants to the level of 30.4 tons/year for ACE of high capacity, up to 7.92 tons/year – for medium capacity enterprise, and up to 3.95 tons/year and 3.39 tons/year for ACE of low capacity.

The investigated ACEs of low capacity (3.2 thousands tons/year and 5 thousands tons/year) were put into operation after 1996 at the moment of new regulatory act of sanitary legislation – "State sanitary rules for planning and development of settlements. SSR №173-96" (where the normative SPZ made up 1000 m).

The ACE of low capacity is equipped with a three-stage cleaning system which includes a cyclone, a bag filter, and a screw-

driver "Venturi" with a dust and gas flow rate of 99.7-99.85%. The application of an effective system of dust-gas purification provided a compliance with the maximum allowable concentrations on the verge of normative and calculated SPZ from the sources of emissions of enterprises to existing adjoining residential development which was formed historically. Thus, according to the calculations of the scattering of the specific pollutants in the ambient air (carbon monoxide, nitrogen dioxide, sulfur dioxide, saturated hydrocarbons, benzene, xylene, phenol, toluene, formaldehyde, benz/a/pyrene, inorganic dust with SiO<sub>2</sub> content of 70-20%, soot) at distances of 414-680 m, the absence of the excess of the maximum allowable concentrations was confirmed. It is a basis for the establishment of new sizes

for the SPZ. Taking into account the proximity of the investigated asphalt concrete enterprises to the residential development, the following measures were proposed: adherence to asphalt concrete production technology and control of the effectiveness of the implemented environmental protection measures; annual monitoring of ambient air at the boundary of the established SPZ, and noise measurements at the boundary of the nearest residential development in order to confirm the adequacy of the established SPZ for each concrete object; presentation of the copies of the Laboratory tests to the SI "IPH, NAMSU" to generalize the information, development of new norms of the SPZ for ACE, and making of the appropriate amendments to the "Sanitary classification of enterprises, industries,

structures, and sizes of sanitary protection zones for them" SSR № 173-96.

**Conclusions.** On the basis of the ecological and hygienic assessment of the impact of the asphalt concrete enterprises' operation on the state of the environment and sanitary-and-hygienic conditions of the inhabitants of adjoining residential development, we can state:

1. The majority of modern asphalt-concrete enterprises in Ukraine are working on finished bitumen to fulfill the order of the State Service of Motor Roads of Ukraine on the prohibition of the use of black binding agents of coke-refining process (tar, resin etc.), 27.10.05 № 490, which complies with the requirements of the Directive 2004/35/EC of the European Parliament and Council "On the ecological responsibility

Table

### Characteristics of the enterprises of various capacities for the production of asphalt concrete mixtures and implemented environmental protection measures

List of objects, capacity in tons/year	Technical equipment, kind of fuel	Gross Emissions, tons/year	SPZ dimensions for SH 245-71/SSR 173-96	Environmental measures
ACE with the power of 100 thousands tons/year	ACS: "TeltomatT-1" (45 t/year), DS-168 (50 t/year) and DS-158 (50 t/year) operating on natural gas	<b>30.4 tons/year</b> , including: nitrogen dioxide – 4.025, carbon monoxide – 7.978, phenol – 0.0102, inorganic dust containing SiO <sub>2</sub> 70-20 percent – 16.77, benz/a/pyrene – 0.00017, iron and its compounds – 0.0057, manganese and its compounds – 0.0006, metallic mercury – 3.3E-6, benzene – 0.0195, xylene – 0.102, toluene – 0.0582, formaldehyde – 1.5655, saturated hydrocarbons – 0.06.	Compliance with the standard size of 300 m by the SN 245-71 (the enterprise was put into operation in 1974).	Three-stage system of dust-cleaning: I – cyclone direct-axial; II – battery cyclones and bag filters, and III – wet cleaning. Total efficiency of the gas cleaning is 97.67%.
ACE capacity 18 thousands tons/year	ACS : DS 117-2E operating on natural gas	<b>7.92 tons/year</b> , including: nitrogen dioxide – 0.8989, sulfur dioxide – 0.3837, carbon monoxide – 1.3447, phenol – 0.0266, substances in the form of suspended solid particles undifferentiated by composition – 1.1036, benz/a/pyrene – 2.1E-7, iron and its compounds – 0.0035, manganese and its compounds – 0.0003, xylene – 0.5063, phenol – 0.0266, saturated hydrocarbons – 0.2074, etc.	Compliance with the regulatory size of the SPZ in 300 m by the SN 245-71 (the enterprise was put into operation in 1979).	The system of dust cleaning: the battery cyclone STS-40 and the wet dust collector "Rotokolon". The total efficiency of gas cleaning is 98.7%.
ACE capacity of 5 thousands tons/year	Upgraded ACS: DC-1583 operating on natural gas	<b>3.95 tons/year</b> , including: nitrogen dioxide – 0.166, sulfur dioxide – 0.021, carbon monoxide – 0.474, phenol – 0.009, dust inorganic with SiO <sub>2</sub> content 70-20 percent – 2.979, benz/a/pyrene – 0.001, benzene – 0.009, xylene – 0.166, toluene – 0.100, formaldehyde – 0.015, saturated hydrocarbons – 0.014, etc.	Reduction and establishment of the regulatory size of the SPZ: 414 m in the west, 657 m in the northwest and 1000 m in other directions by the SSR 173-96.	Three-stage system of dust cleaning: a cyclone, a bag filter and a screwdriver "Venturi" with a coefficient of purification of a dust-gas flow of 99.7-99.85%
ACE with a capacity of 3.2 thousands tons/year	Upgraded ACS ДС-228 operating on natural gas	<b>3.393 tons/year</b> , including: nitrogen dioxide – 0.39, carbon monoxide – 0.47, phenol – 0.41, inorganic dust containing SiO <sub>2</sub> 70-20% – 0.381, benz/a/pyrene – 0.49, iron and its compounds – 0.001, manganese and its compounds – 0.001, benzene – 0.4005, xylene 0.001, toluene – 0.404, formaldehyde – 0.402, saturated hydrocarbons – 0.4009, etc.	Reduction and establishment of the standard SPZ: 680 m in the southwest and 1000 m in all other areas by the SSR 173-96.	Relay-contact system for dust removal from cyclones, bag filter and dust collector. with a coefficient of purification of dust and gas flow of 96.4%

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**Objective.** We performed the ecohygienic assessment of the impact of the activity of the enterprises for the production of asphalt concrete on the state of the environment with regard to the latest domestic legislation and the requirements of the EU Directives.

**Materials and methods.** We used bibliosemantic, analytical methods and method of sanitary-and-epidemiological examination of design materials in the study.

**Results.** The design materials of domestic asphalt concrete enterprises with the introduction of mod-

ern eco-preserving technology for the production of asphalt concrete, dust-cleaning systems and use of finished bitumen (products of oil refining) have been analyzed in this article.

According to the results of the sanitary-and-epidemiological examination of design materials, it was established that the use of the effective system of dust-gas purification, the use of finished imported bitumen in the production ensured an observance of the maximum allowable concentrations of the pollutants in the ambient air at the boundary of the normative and designed sanitary-and-protective zones (SPZ). Conclusion. By the results of the analysis of design forms and records, it can be predicted that the asphalt concrete production with the use of modern technologies will ensure a compliance with the domestic sanitary legislation and Directive 2008/50/EU of the European Parliament and the Council "On the ambient air quality and the cleaner air for Europe", May 21, 2008.

**Keywords:** asphalt concrete enterprise, eco-preserving technology, environmental measures, sanitary-and-protective zones, sanitary legislation, EU directives.

for the prevention and elimination of the consequences of the environmental damage", April 21, 2004.

2. Environmental measures with the use of high effective dust-and-gas purification systems were implemented at all investigated enterprises that greatly reduced the gross emissions of the pollutants into the ambient air and decreased the impact on the environment and adjacent residential areas, that met the requirements of domestic sanitary legislation and Directive 2008/50/EC European Parliament and Council "On the quality of ambient air and cleaner air for Europe", 21.05.2008.

3. Implementation of the environmental protection measures with the use of high effective dust-and-gas purification systems at the existing ACE ensured an absence of the excess of the MAC of the specific pollutants at the ACE designed before the establishment of the SPZ that were 1.5-2.4-fold smaller than the normative ones, and it was a cause for the establishment of the new hygiene norms according to the procedure in force in Ukraine for the establishment and change of the sizes of the enterprises' SPZ.

The above shows a necessity of the introduction of differentiated approach to the determination of the standard sizes of SPZ for the enterprises of asphalt concrete production, taking into account capacity, use of raw material (finished bitumen), ecological technologies, and environmental protection measures.

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## ECOLOGICAL AND HYGIENIC ESTIMATION OF THE CONSTRUCTION MATERIALS FILLED WITH CRUSHED POLYMER WASTE WITH SURFACTANTS DEPOSITED ON THE SURFACE IN AGGRESSIVE ENVIRONMENTS

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### ЕКОЛОГО-ГІГІЄНІЧНА ОЦІНКА ВПЛИВУ НА ДОВКІЛЛЯ БУДІВЕЛЬНИХ МАТЕРІАЛІВ, НАПОВНЕНИХ ПОДРІБНЕНИМИ ПОЛІМЕРНИМИ ВІДХОДАМИ, З НАНЕСЕНОЮ НА ПОВЕРХНЮ ПАВ

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**Ключові слова:** гігієнічна оцінка, комунальна гігієна, ПАВ, переробка полімерів, цементно-піщана суміш.

і зростанням обсягів накопичення твердих побутових відходів особливої гостроти набуває проблема їх переробки та утилізації як найбільш об'ємної складової. Відомо, що в Україні щорічно утворюється понад 1 млн. тонн полімерних відходів, і лише близько 18% з них переробляється, а інша частина потрапляє на полігони для захоронення. Для законодавчого вирішення проблеми поводження з твердими побутовими відходами на розгляді перебуває проект Закону України "Про управління відхо-

**ЭКОЛОГО-ГИГИЕНИЧЕСКАЯ ОЦЕНКА ВЛИЯНИЯ НА ОКРУЖАЮЩУЮ СРЕДУ СТРОИТЕЛЬНЫХ МАТЕРИАЛОВ, НАПОЛНЕННЫХ ИЗМЕЛЬЧЕННЫМИ ПОЛИМЕРНЫМИ ОТХОДАМИ, С НАНЕСЕННЫМИ НА ИХ ПОВЕРХНОСТЬ ПАВ**

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**Цель** — эколого-гигиеническая оценка строительных материалов, изготовленных из цементно-песчаных композиций, наполненных измельченными полимерными отходами, с нанесенными на поверхность отходов ПАВ в агрессивных средах.

**Материалы и методы исследования.** Исследования проводились с использованием бытовых и промышленных отходов: полиэтилен-тетрафталата (ПЭТФ), поливинилхлорида (ПВХ) и смеси полиэтилена и полипропилена (ПЭ + ПП); шлако-портландцемента (ШПЦ) М-400 производства ЧасАО "Ивано-Франковскцемент"; песка мытого речного фракции 0,5-1,0 мм.

**Результаты и их обсуждение.** Установлено, что наименьшее количество продуктов деструкции выделяется из образцов, наполненных: ПЭТФ от 2% до 10% от общей массы наполнителя, когда происходит резкое уменьшение потери массы образцов за счет вымывания СаО в условиях углекислотной и расширительной коррозии, а также в дождевой и дистиллированной водах. Ускорение разрушения характерно магниезиальной среде; ПВХ от 2% до 11% происходит резкое уменьшение потери массы образцов в условиях всех модельных коррозионных сред, а также в дождевой и дистиллированной водах; смесью ПЭ + ПП от 0,25% до 2,25% в условиях всех модельных агрессивных сред, в дождевой и дистиллированной водах. Ни в одном из исследованных образцов не обнаружено превышения концентрации ПАВ выше ПДК для воды питьевого водоснабжения.

**Выводы.** Гигиеническими исследованиями установлено, что продуктом деструкции образцов цементно-песчаных композиций, наполненных полимерами, является смесь неорганического аморфного осадка, основную массу которого составляют СаО, Са(ОН)<sub>2</sub>, Са(НСО<sub>3</sub>)<sub>2</sub> от 97,83% до 98,46% от общей массы осадка, другое – Mg(ОН)<sub>2</sub>, Al<sub>2</sub>(ОН)<sub>3</sub>. Продукты деструкции являются нетоксичными, нерастворимыми или малорастворимыми простыми неорганическими соединениями, не оказывают негативного влияния на объекты окружающей среды и человека.

**Ключевые слова:** гигиеническая оценка, коммунальная гигиена, ПАВ, переработка полимеров, цементно-песчаная смесь.

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