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MODERN PROBLEMS OF THE INFLUENCE OF ENTERPRISES PRODUCING POLYMER PRODUCTS ON HUMAN HEALTH AND THE ENVIRONMENT (Literature review)

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Abstract:
Today, the increasing demand for polymer products not only in our country but also worldwide, as well as developing and improving ways to reduce the impact of harmful chemical substances in their composition on human health and the environment, remains one of the pressing issues facing specialists in the field of preventive medicine.
The article examines the experiences of foreign countries focused on the problems of various factors affecting human health and the environment in the production of polymer products.

Keywords: chemical factor, workplace air quality, health status, risk factors, prevention

During our research, we studied a total of 27 articles related to the field, available in the e-library scientific library, Google Scholar scientific publications search system, and international databases such as Cyberleninka, Web of Science, PubMed, Medline, and Scopus, to examine the current pressing issues of the impact of polymer product manufacturing enterprises on human health and the environment.
Certainly, in accordance with modern demands, the number of enterprises engaged in the production of polymer products used in various sectors of the national economy is increasing daily. This necessitates increasing the effectiveness of preventive measures aimed at reducing the impact of harmful factors on the health of workers employed in these production workshops, as well as on the environment, while also addressing the growing number of manufacturing enterprises and the hazardous factors characterizing their production conditions.
RESEARCH METHODS. Data analysis was conducted using the e-library scientific library of literature, the Google Scolar scientific publication search engine, and international databases such as Cyberleninka, Web of Science, PubMed, Medline, and Scopus.

RESULTS:

The chemical factor is the leading determinant of working conditions in polymer material production. The complex of harmful substances entering the air of the working area includes chemicals used as raw materials for obtaining intermediate and final products. The impact of harmful substances on workers' bodies is combined or intermittent. In several workplaces at polymer production enterprises, the combined influence of high-temperature harmful substances, noise intensity, work difficulty, and other risk factors on workers' health status and functional indicators has been assessed [3, 21].
The principle of obtaining polymers is based on the polycondensation reaction of polyester isocyanates with the formation of urethane bonds in the presence of water, catalyst, foaming agents, emulsifiers, and a whole range of targeted additives (plasticizer, flame retardant, dye, stabilizer, etc.). The initial raw material is presented as a 2-3 component system, with component A being a mixture of polyethers with various targeted additives; component B - isocyanates or their mixture; component C comes separately in the form of a catalyst, which can be mixed with component A under production conditions. A number of large manufacturing enterprises mix the starting materials according to the formulation and prepare it themselves [9]. Component C comes separately in the form of a catalyst, which can be mixed with component A in production conditions. A number of large manufacturing enterprises mix the starting materials according to the recipe and prepare it themselves [9].
The possibility of developing changes in the health status of a particular worker is largely determined by

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the individual sensitivity of their organism to a particular production environment.

The importance of considering issues of adaptability in the bodies of workers engaged in polymer product production as a whole, compensatory-adaptive mechanisms, the emergence of predisposition to the development of production-related or other pathologies, and the connection with the growth of this production, is undoubtedly relevant. Conducting research in this area can be useful in developing predictions of individual risk for occupational disease development and selecting prevention measures and methods [4, 11, 10].

However, most of them are poisonous, easily combustible, and some (for example, epoxy resins) release toxic substances when heated above 60°C. Therefore, work with polymeric materials is carried out in separate production facilities with a relative humidity of no more than 70% and an air temperature of no lower than 15°C. The walls of the room should be smooth and covered with decorative tiles at a height of at least 2 meters from the floor. Such rooms are provided with local suction, inlet-outlet ventilation, providing an amount of air exchange not less than 8...10 times per hour. It is considered necessary to install airtight cabinets here for storing artificial resins, adhesives, etc.

Work with polymer materials is permitted to persons under the age of 18 (except for women), who have passed the entry and primary occupational safety instruction at the workplace and are recognized by the medical commission as suitable for this type of work. Employees are obliged to wear special clothing and other personal protective equipment established for them according to the norm.

It is necessary to cover the working areas where the composition of polymer materials is made with paper, and after the work is completed, it must be burned. In the technological process, the use of dust-like capron with a particle size less than 0.1 mm is prohibited due to its explosive potential. It is forbidden to store polymeric materials in the vicinity of heating devices, drying chambers, and electric motors when they need to be ventilated and stored in a separate room. It has been shown that polymer composites should only be prepared, heated, and evaporated in suction cupboards, the doors of which can be opened 5 minutes after firing [18, 23].

To prevent the harmful effects of epoxy waxes, hardeners, and other substances, hands are pre-impregnated with liquid ointment (based on basiline or lanolin) and periodically (every two hours of work) washed with hot soap water for the protective layer as needed. An epoxy-containing substance is applied to the repaired part without touching it using a special tool (spatel or shovel). To remove leaks and excess epoxy wax from the parts, it is removed with paper, moistened with acetone or other solvents used for these purposes, and then with a cloth. When the epoxy enters the wax skin, it is rubbed off with a dry tampon with a soft cloth, then with a tampon moistened with acetone, after which the hands are washed in soapy water.

When hardeners come into contact with skin on the hands, they must be washed off with soap and hot water, and the area should be wiped with a soapy paste. Smoking and eating are prohibited while working with epoxy resin and other polymer compositions. Scientific sources mention the use of solvents (dichloroethane, carbon tetrachloride, etc.) for degreasing newly manufactured and repaired parts before applying polymer coatings [12].

According to several authors, recommending and expanding automation in the production process allows for proper equipment selection, significantly increased labor productivity, ensuring consistent product quality, expanding the product range, and reducing the impact of negative factors affecting worker safety [13, 22].

In their research, American scientists Wallace MA, Kormos TM, and Pleil JD (2016) demonstrated the role of blood-borne biomarkers and bioindicators in the science of preventing environmental impacts on health to coordinate health effects. Environmental hygiene science focuses on identifying sources of environmental pollution with adverse health effects and developing effective intervention strategies to reduce long-term disease risk. Over the past few decades, the World Health Organization has recognized that health risks are linked to interactions between the environment and the human genome. With the sequencing of the human genome, similar efforts are now required to establish this "G × E" (gene-environment) interaction and to unravel human exposomes, which consist of the accumulation of metabolic reactions and environmental influences throughout a person's lifetime. Exposomes comprise endogenous and exogenous chemicals, most of which are measured as biomarkers in blood, breath, and urine. The impact of pollutants is assessed by analyzing the biological fluid for the pollutant itself or its metabolic products. New methods are being developed to use numerous biomarkers, known as bioindicators, to demonstrate biological changes that may have adverse health effects in the future. Typically, environmental biomarkers are assessed using non-invasive (excreted) media, such as breath and urine [9, 19, 30].

Although blood is considered the most suitable biological fluid for analysis and forms a central compartment that interacts with every living cell, it is often not used for biomonitoring in most cases due to practical reasons such as concerns about infectious diseases, waste management, or clinical conditions. The objective of this study is to review the current use of blood samples in environmental health research,

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provide a brief comparison of blood with other biological matrices, and propose additional recommendations for blood analysis in studying its impact on the human body [26, 27].

Today, large-scale expansion of production abroad and in our country leads to an increase in the number of enterprises in the heavy and light industries (mining and metallurgy, chemical industry, oil refining, glass, automotive industry, yarn manufacturing, cotton growing, textile, footwear and polymer products) and a number of measures are being taken to create optimal working conditions for workers working in them and reduce morbidity [1, 2, 14]. At the same time, the occupational exposure to industrial chemicals is a serious potential health problem and can lead to chronic occupational liver disease. Although the disease initially goes without symptoms, occupational liver disease can progress to cirrhosis, liver cancer, and death. Some chemicals in production, such as vinyl chloride and its use, are constantly associated with occupational liver diseases such as hepatic hemangiosarcoma.

Occupational exposure to industrial chemicals can lead to chronic occupational liver diseases, which are potentially a serious health problem [5, 11, 29].

The purpose of this study is to measure the concentration of gaseous and solid pollutants arising from additive production operations and after processes in production conditions when plastics are used as starting materials. The secondary goal is to propose means to reduce the impact of pollutants released during additive production processes and to assess the concentration level based on target indicators and proposed limits of action. The volatile organic compounds were analyzed using a thermodesorption gas chromatographic-mass spectrometric instrument obtained using the Tenax TA adsorption device. Carbonyl compounds were obtained using DNPH-Silica cartridges, analyzed using a highly efficient liquid chromatography device, particles were measured using the P-Trak instrument, and samples were taken using the IAQ-Calc instrument to determine air quality in the room. The concentration of dust mass was simultaneously measured using DustTrak DRX and IOM-sampling devices. At the stage of preparing the plastics for heat treatment, the dust concentration was the highest (2070-81890 m/cm3). Conversely, the total concentration of volatile organic compounds is low (113-317 µg/m) in dust photopolymerization and preparation by such methods. However, the total concentration of volatile organic compounds was higher in the casting materials, possibly due to the sputtering of the material and the binding agent (1114-2496 µg/m), where part of the spray may be aerosol. Formaldehyde is a filler for a number of other carbonyl compounds, and it was found in low concentrations (3-40 µg/m3) in all methods, with the exception of the material processing method. A significant dust concentration (1.4-9.1 mg/m3) was detected only after multi-current synthesis and processing of objects made from a powdered layer. It has been proven that adverse health outcomes associated with additive production can occur among affected workers, depending on the levels of pollution measurements [6; 20, 29].

From a practical standpoint, the association of certain chemicals with occupational liver diseases is so strong that programs for limiting their impact and medical monitoring are sanctioned by the International Labour Organization (ILO) Office for Occupational Hygiene and Safety. According to him, he established the standard for vinyl chloride (ILO). It is recommended to determine the chemical substances of the liver (bilirubin, alkaline phosphatase, aspartate aminotransferase or AST, alanine aminotransferase or ALT and gamma-glutamyltransferase) in workers of a plant producing vinyl chloride or polyvinyl chloride exposed for more than 10 years for six months. Unfortunately, these liver tests are often the norm, even in cases of chronic occupational liver disease. Therefore, the probability of professional hepatotoxicity was insufficiently recognized even among workers included in the medical observation program, specifically for liver diseases [16, 24].

According to the authors, workers are exposed to chemicals, which are chemicals that affect the breast carcinogens and endocrine system, and the working environment is heavily polluted with dust and steam. It follows from this that there is a high load on the body of workers working at polymer enterprises, which is significantly higher than the load that can be found in the public. The description of such effects in the polymer industry places women at a disproportionate risk, emphasizing their gender. Measures are being discussed to address these impacts and the need to make regulatory decisions [15, 28, 31].

The results of the study allowed us to determine that professional risk in representatives of the main professions of large-scale production (operators and processors) belongs to class 3.2 of working conditions, belongs to the average risk category, and indicates the need for further improvement of the system of preventive measures. Working conditions in small-scale production are characterized by the presence of most manual labor operations and correspond to the intolerable class 3.3, occupational hazard category. To reduce the risk to the health of workers in this type of production, it is possible to develop regulatory legal documents and increase the employer's responsibility for ensuring the safety of working conditions [1, 14, 25].

Therefore, working conditions in the modern polymer industry are characterized by the influence of a number of harmful occupational factors on the workers' bodies. The impact of harmful working conditions serves as the basis for increasing the risk of developing and increasing the harmfulness of endocrine, respiratory, nervous, and musculoskeletal diseases in workers in the PPU industry. A number of studies have shown that the number of pathologies reliably increases with an increase in the work experience of workers, with the presence of an etiological contribution of professional factors [15, 17].

Discussion. During the study of scientific data from open international scientific sources, the leading factor in the impact of chemical substances in the form of gas-vapor on the health of workers at enterprises producing polymer products is the high association of chemical substances with the origin of occupational liver diseases, it is recommended to determine the effect of formaldehyde, vinyl chloride or polyvinyl chloride chemical substances on liver enzymes (bilirubin, alkaline phosphatase, aspartate aminotransferase or AST, alanine aminotransferase and gamma-glutamyltransferase or

It has been established that the development of the polymer production industry plays a significant role in optimizing working conditions at enterprises, modernizing workplaces, and reducing chemical hazard factors in the form of dust and gases in the environment, as well as protecting workers' health.

CONCLUSION. An analysis of existing scientific sources shows that today, not only in our country, but also in developed countries around the world, the development of the polymer industry requires the development of technical, technological, and sanitary-hygienic measures aimed at optimizing working conditions at enterprises, modernizing workplaces, reducing risk factors, effectively using personal protective equipment, and preventing occupational diseases.

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