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**ANALYSIS OF THE IMPACT OF HAZARDOUS SUBSTANCES THAT APPEAR  
DURING THE FOUNDRY PROCESS ON WORKING CONDITIONS AND THE  
ENVIRONMENT**

The use of new technical developments, improvement of old technologies in foundry production, and the introduction of modern equipment do not solve all the problems of improving the air in the working area. All casting manufacturing processes are accompanied by the release of dust, aerosols, and gases. This affects the health of workers, their performance and the possibility of occupational diseases.

To reduce the content of harmful substances in the air of the working area and create favorable working conditions, it is necessary to identify sources at all stages of production processes. Determining the composition of harmful substances, researching and measuring concentrations, comparing actual data with standard values according to requirements, creating comfortable and safe workplaces is an important task of labor protection in the foundry industry.

Foundry production has a complex structure and uses a wide variety of technological processes [1], the main of which are: preparing the charge, loading it into melting furnaces, preparing the molding and core mixture, molding, melting the metal and pouring it into molds, knocking out, cleaning. In all departments, harmful factors arise, such as metal vapors, aerosols, dust, gases. When transporting charge materials, dust is released, which includes oxides of iron, manganese ore, ferroalloys, ferrochrome, etc.

When smelting metals and alloys in various melting units, the main component of dust is silica [2]. Carbon monoxide, carbon dioxide and sulfur dioxide, nitrogen, nitric oxide, hydrogen, as well as aerosols saturated with oxides of iron, manganese, vanadium, molybdenum, nickel, lead, etc. are released into the air zone .

Sources that emit the largest amounts of dust and gases include: preparing molding materials, making molds and cores, melting and pouring metal, and knocking out and cleaning castings. In the manufacture of molds and cores, various binders and non-stick coatings

are used [3]. The intensity of the release of harmful substances depends on the performance and design of the equipment, its operating mode, and the technological process. Due to the fact that in recent years the process of introducing new technologies and equipment into foundry production has intensified, it seems appropriate to study the state of labor protection of foundry workers in new conditions.

The casting is produced by filling a vacuum mold with a polystyrene foam model with liquid metal, which is gasified under the influence of the heat of the liquid metal [9]. Models for casting are produced by blowing polystyrene powder into lightweight aluminum molds, followed by foaming the granules by heating them. To mold painted models from polystyrene foam, quartz sand without a binder is used [4]. When pouring metal, thermal destruction of the polystyrene foam occurs. The harmful gases formed in this case enter the thermocatalytic afterburning unit through gas outlet channels.

When casting using gasified models, labor-intensive and environmentally hazardous processes are eliminated: preparing molding and core mixtures, making cores, knocking out and cleaning castings, and the volume of finishing operations is reduced by 70-80%. A detailed analysis of casting using gasified models showed that modern technologies also have sources of harmful emissions. In this case, these are areas for making models, pouring metal into molds, cooling and sand regeneration.

When pouring molds, water vapor, hydrogen and an increased content of carbon monoxide are released into the air of the workshop [6]. The composition of the released gases includes more than 50% H<sub>2</sub>; 30-35% CO and about 10% CO<sub>2</sub>, H<sub>2</sub>S, SO<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>. During the initial stage of casting solidification, 70% CO is released. Carbon monoxide is one of the most harmful gas components released from foundry molds. The actual CO content in such a gas varies from 8 to 35% by volume, i.e. exceeds the maximum permissible concentration (6-10)·10<sup>3</sup> times. The content of phenol, formaldehyde and ammonia is also 10-10<sup>3</sup> times higher than the maximum permissible concentration.

In conventional foundries, when drying molds and cores, carbon monoxide and sulfur dioxide are released, their amount depends on the type of fuel burned. The smallest emissions are observed when burning natural gas, only 0.75 g/kg CO. When knocking castings out of the flasks, a significant amount of dust, gases, and various vapors are released. The dust content of the air above the knockout grille with hanging umbrellas ranges from 2 to 7 kg/m<sup>3</sup>. Also, a large amount of dust is generated when cutting and cleaning castings. The dust concentration reaches from 6 to 8 g/m<sup>3</sup>, and in the immediate vicinity of the castings being processed - 20 mg/m<sup>3</sup>. Cleaning of castings is carried out in stripping drums, stripping machines, shot blasting and shot blasting chambers.

The casting process under study is characterized by the release of the following harmful substances - SO<sub>2</sub>, MnO, SiO<sub>2</sub>, CO<sub>2</sub>, MgO, CO, phenol, formaldehyde, methyl alcohol, benzene, furfol, zinc oxide, the maximum permissible concentration of which is from 0.3 to 20 mg/m<sup>3</sup>. Their harmful effects manifest themselves in irritation of the mucous membrane of the respiratory tract, affect the circulatory system, blood vessels, skin, nervous system, and if a person remains in the explosive zone for a long time, it can cause occupational diseases. For timely detection of high concentrations of harmful substances, constant monitoring of their content in the air of the working area is necessary. Methods for controlling harmful substances are divided into three groups [5]. Analytical and laboratory methods are used in research work. These include sampling and analysis in laboratory conditions. Laboratory methods include photochemical, luminescent, chromatographic, spectrophotometric and other methods.

An analysis of the main stages of the technological process of manufacturing castings using gasified models showed that all of them are accompanied by significant pollution of the air of the production area with harmful substances, and this indicates the advisability of performing such research when introducing new technologies and equipment in foundry production.

### Література

1. Пономаренко О. І., Євтушенко Н. С. Системна оптимізація процесів у ливарному виробництві. /Перспективні технології, матеріали й обладнання в ливарному виробництві : матеріали VIII міжнародної науково-технічної конференції, 21–24 вересня 2021 р. – Краматорськ : ДДМА, 2021. – 96-97 с.

2. Євтушенко С. Д., О. І. Пономаренко, Н. С. Євтушенко. Методика вибору технології виготовлення виливків / С. Д. Євтушенко, О. І. Пономаренко, Н. С. Євтушенко // Перспективні технології, матеріали й обладнання в ливарному виробництві : матеріали 9-ї міжнар. наук.-техн. конф., 25-27 вересня 2023 р. / ред. В. А. Корсун. – Краматорськ : ДДМА, 2023. – С. 49-51.

3. Н. С. Євтушенко, І. О. Мезенцева, О. І. Пономаренко, С. М. Мезенцев. Формування та профілактика професійних захворювань обрубувачів ливарних цехів. // Матеріали XIX Міжнародної науково-практичної конференції (10-12 жовтня 2023 р., м. Харків-м. Київ). – Харків, НТУ «ХПІ». – с.92-95.

4. Н.С. Євтушенко, О.І. Пономаренко, Н.Є. Твердохлебова, І.О. Мезенцева, Є.О. Семенов, С.Д. Євтушенко. Забезпечення безпечних умов праці для профілактики професійних захворювань працівників металургійного і ливарного виробництва //Метал та лиття України = Metal and Casting of Ukraine. –2022. – Т.30, № 3 (330). – С. 117-125 .<https://doi.org/10.15407/steelcast2022.03.116>

5. Мезенцев С. М. Запорука майбутнього життя - безпека праці / С. М. Мезенцев, Н. С. Євтушенко, І. О. Мезенцева // Future Healthcare: Innovations, Advances and Progress : proc. of the 2nd Intern. Sci. and Practical Internet Conf., June 15-16. – Dnipro : FOP Marenichenko V. V., 2023. – P. 105-107.

УДК 331.45

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### **PROPERTIES OF STARTING MATERIALS FOR THE MANUFACTURE OF RODS WITH RESIN BINDERS**

Improving the quality of molding sands is one of the urgent tasks of foundry production. However, according to existing data, 40-60% of casting defects are due to unsatisfactory quality of molding sands. Therefore, one of the main ways to improve the quality of castings is to increase the requirements for the quality of source materials.

Molding sands are the main component of molding and core sands: in molding sands they make up up to 95% of the total mass of the mixture, and in core sands – 95–97% [1].

Currently, quartz molding sands are most widely used. The most stringent requirements are imposed on sands for the preparation of molding and core mixtures of cold and hot curing, especially when used as a resin binder.

The greatest influence on the properties of mixtures is exerted by the size of the clay component and grain composition. It is advisable to use enriched sands. The use of unenriched sands with a clay content of more than 0.7...0.8%, especially fine-grained ones, leads to a significant drop in strength at all stages of hardening. To compensate for the loss of strength, the resin consumption is forced to increase by 1.2...1.5 times, at the same time the