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RADIATION CONTROL OF SECONDARY TECHNOGENIC RAW MATERIALS

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Summary. *Radiation safety is one of the most important hygienic criteria for environmental safety of a material. Great influence on man and his ecological safety are building materials, which contain substances with a certain content of natural radionuclides. Knowledge of the regularity of the distribution of natural radionuclides in the structure of man-made raw materials, as well as their behavior in the process of technological processing into building materials are very valuable. After all, even at the design stage, you can assess their content in the finished products and make timely adjustments to prevent recycling of building materials and protect human health. The authors assessed the radiation hazard of secondary man-made raw materials according to international standards and showed that slag samples are radiation-safe and can be used as a building material without any significant radiological threat to the population.*

Keywords: *radionuclides, radiation safety, radiation control, man-made raw materials, industrialslag, radiation properties, gamma spectrometric analysis, γ-irradiation, radiation-safe building materials*

The main dose of radiation from natural sources (natural radionuclides and their decay products) a person receives in a closed unventilated room, and about 10 % of cases of lung cancer are provoked by radon [1]. This is not fully taken into account in the development, manufacture and application of building materials.

Concentrating in the process of technological processing, natural nuclides and heavy metals introduced by natural and man-made components form compounds that during operation can pass from the structure of building materials into the environment, thereby creating dangerous concentrations in the air. The solution to the problem of obtaining environmentally friendly building materials using natural and man-made raw materials can be achieved through a systematic approach, which

involves the implementation of a set of measures including chemical binding of natural radionuclides and heavy metals into stable low-soluble compounds or blocking them in the building material structure [2].

Knowing the patterns of distribution of natural radionuclides and heavy metals in the structure of natural and man-made raw materials and behavior in the process of technological processing into building materials, you can at the design stage to assess their content in finished products and make timely adjustments to prevent reprocessing of building materials and protect human health. Both natural and man-made raw materials include radionuclides (radium-226, thorium-232, potassium-40, etc.), which are sources of radiation [3, 4]. During the decay of radium-226, radioactive gas is released, which enters the environment. According to experts, it contributes up to 80% of the total radiation dose to humans. One of the mandatory components of monitoring should be the control of radiation characteristics of waste, as blast furnace slag concentrates natural radionuclides: 226Ra and 232Th (α, γ – emitters) and 40K (β, γ – emitters), which does not belong to the radioactive series [5]. The radioactivity of the material can be associated with its deposit or obtained in addition with the use of raw materials from quarries, quarries, etc., located near areas of man-made radiation pollution of the lithosphere. Thus, radiation contamination of building materials may be due not only to its origin, but also to the introduction of radioactive contaminants from the environment. In any case, this negative property can be diagnosed by the chemical composition of the material. For example, the use of building materials containing heavy metals, etc. should be avoided. Therefore already at designing it is necessary to know characteristics of radiation danger of material and at a choice of building materials to try to avoid use of building materials with high indicators of radiation activity, first of all for inhabited and public buildings [6]. One of the current problems of radiation monitoring is the provision of devices that can work effectively in search mode: to have the shortest measurement time and to present the measurement results in the most acceptable way. It is well known that information in analog form is perceived and analyzed by a human operator more efficiently than in digital form. That is why dosimetric devices with such a representation of information can not only, but should be used when performing radiation monitoring in search mode. However, devices that would fully meet the requirements of radiation monitoring of some facilities (environmental facilities, vehicles, scrap metal) are not produced in Ukraine [7]. At the same time, in Ukraine there is a rather large park of dosimetric devices of the SRP-68-01 type with the analog (non-digital) indicator by means of which gamma surveys of territories were carried out. Territorial bodies of the Ministry of Environment have recently used similar devices Ludlum M19 (USA). Devices like SRP-68-01 are characterized by high reliability, ability to work in a wide range of temperatures, atmospheric pressure and humidity.

Enterprises and organizations engaged in the production, supply of construction materials and raw materials, as well as enterprises whose waste is used for the manufacture of construction materials or as construction materials must provide radiation control according to Section 8 "Radiation Safety Standards of Ukraine" [8], basic sanitary rules for ensuring radiation safety of Ukraine [9], system of norms and rules for reducing the level of ionizing radiation of natural

radionuclides in construction [10].

In accordance with building codes, depending on the concentration of radionuclides, building materials are divided into three classes [8]:

1st grade. The total specific activity of radionuclides does not exceed 370 Bq / kg. These materials are used for all types of construction without restrictions.

2nd grade. The total specific activity of radionuclides is in the range from 370 to 740 Bq / kg. These materials can be used for road and industrial construction within the territory of settlements and the zone of perspective building.

3rd grade. The total specific activity of radionuclides does not exceed 700, but below 1350 Bq / kg. These materials can be used in road construction outside the settlements - for the foundations of roads, dams, etc. Within the settlements they can be used for the construction of underground structures, covered with a layer of soil thicker than 0.5 m, where long stays are excluded.

Radiation control is performed by public and private control services: laboratories, departments, laboratory centers within public and private organizations and enterprises, as well as individual laboratories, laboratory centers (complexes) that have the status of public or private enterprise and are accredited by Gosstandart or the Ministry of Health of Ukraine. They determine the exposure dose rate of gamma radiation of the rocks of the field, take samples to determine the content of radioactive elements in the rocks of the field, determine the total specific activity of radionuclides and the results of the work make a report on radiation and hygiene assessment. Experimental studies have proven the environmental safety of blast furnace slag domains of metallurgical enterprises: the amount of natural radionuclides in them does not exceed the permissible norm and for radiation safety belong to class 1 (effective specific activity of natural radionuclides ≤ 370 Bq $\cdot$ kg^{-1}). An assessment of the radiation hazard of building materials according to international standards showed that slag samples are radiation-safe and can be used as a building material without any significant radiological threat to the population. Timely radiation control and elimination or reduction to the normative level of ionizing radiation will preserve not only health but also high efficiency, as staying for a long time in rooms with high radiation background or radon levels in the air can have a negative impact on health.

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