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# FEATURES OF PROCESSING OF TECHNOGENIC INDUSTRIAL WASTE IN THE CONSTRUCTION INDUSTRY

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***Abstract:*** *Analytical researches concerning use of industrial waste at manufacture of construction products are carried out in work. As a result of the conducted researches it is established that complex use of industrial waste gives the chance to receive effective building materials.*

**Keywords**: fly ash; phosphogypsum; construction materials.

**Анотація:** *В роботі проведені аналітичні дослідження щодо використання промислових відходів при виробництві будівельних виробів. В результаті проведених досліджень встановлено, що комплексне використання промислових відходів дає можливість отримати доступні, ефективні будівельні матеріали.*

**Ключові слова:** зола-винос; фосфогіпс; будівельні матеріали; металевий шлам.

## Introduction

The largest amount of industrial waste is accumulated by enterprises of mining, metallurgical and heat industries. The colossal accumulation of such waste disrupts the ecological balance in nature, is a source of environmental pollution. The use of waste in the construction industry will solve a number of problems: - environmental (reduce the impact of harmful substances on the environment), economic (the cost of mortars, concrete and recycled products is much cheaper), and social (increase housing and other facilities, cheaper materials) [1-2].

## Research results

In the Vinnytsia region on the territory of the former production association "Khimprom" accumulated about 800 thousand tons of harmful chemical waste - phosphogypsum [3]. The second harmful product of the region's production activities is the accumulation of ash and slag waste at the Ladyzhyn thermal power plant, the current number of which is about 20661 thousand tons [4]. About 300 thousand tons of dispersed metal waste - SHH-15 steel sludge - have been accumulated at the enterprises of metalworking productions of the region [5].

An obstacle to the full-scale use of man-made industrial waste in the field of building materials is the presence of natural radionuclides in their composition. According to the results of analytical studies, it was found that the total specific activity of phosphogypsum is 56.9 Bk / kg, fly ash - 284 Bk / kg, red sludge - 450 Bk / kg [5-6]. Therefore, it can be argued that the use of such waste in the manufacture of construction products is possible without any restrictions.

The search for new binders is mainly due to two reasons: on the one hand, high energy consumption and, as a consequence, the high cost of production of Portland cement; on the other hand, the need for materials with special properties (resistant to high temperatures, aggressive substances, radiation, biological organisms, with high or low density, etc.) [7-8]. The development

of technological processes in the sectors of the national economy, the change in consumer demand for construction products require the development of new building materials and, above all, binders.

Obtaining a complex binder based on waste from the chemical industry will solve the problem of energy and resource conservation relevant to Ukraine by creating new building materials for multifunctional purposes.

Among the large number of known technologies for the production of building materials using man-made waste, there are none that would be widely used in the industry of building materials and products. Because these technologies are usually associated with deep cleaning, heat treatment of industrial by-products, which significantly complicates the technological process and leads to the re-accumulation of hazardous waste [9-10].

In [11-13] the authors proposed a complex metal-ash-phosphate binder, which can be used for the manufacture of heat-resistant concrete. Fine metal sludge is used as the oxide component of the binder. This sludge is practically not processed due to the high dispersion and content of lubricants and coolants. It is formed during the manufacture of bearings from steel SHH-15. The percentage of iron is 86.3 - 87.96 %. The average particle size of the sludge is $2 \times 10^{-5}$ m. The specific surface area of this powder reaches $0.5 - 2 \times 10^3$ $m^2$ / kg [14]. During storage of sludge in open dumps there is a deep oxidation of iron and drying of water components of lubricants and cooling substances. The oxide layer consists of hematite ($Fe_2O_3$), magnetite ($Fe_3O_4$), justice (solution of $Fe_2O_3$ in FeO), lapidocrit (FeO (OH)) [14-15].

The second component of the complex binder is phosphogypsum. Phosphogypsum waste is a by-product of phosphoric acid production by extraction. Depending on the temperature-concentration conditions of decomposition of phosphate raw materials, the solid phase of calcium sulfate can be represented by one of three forms: dihydrate, hemihydrate or anhydrite. Phosphogypsum waste can be attributed to gypsum raw materials, because they consist of 80-95% of calcium sulfate (table 1).

Table 1- Chemical composition of waste of Vinnytsia production association "Khimprom"

| The main components | Content,% by weight | |
|---|---|---|
| | Phosphogypsum – dihydrate | Phosphogypsum – anhydrite |
| $P_2O_3$ (general) | 0,5 - 1,5 | 1,2-2,15 |
| $P_2O_3$ (water soluble) | 0,1-0,7 | 0,5 -1,6 |
| CaO | 22-23 | 31-33 |
| $S0_4$ | 38-39 | 52-56 |
| $R_20_3$.(R=Fe+A1) | 0,1-0,3 | 0,2-0,5 |
| F | 0,1-0,2 | 0,9-1,2 |
| Water is hygroscopic | 21-29 | 18-22 |
| Water is crystal hydrate | 19-21 | 0,7 -1,2 |

Large-scale use of phosphogypsum in the technology of production of construction products is hindered by its specific features: the presence of phosphoric and sulfuric acid and water-soluble harmful compounds of phosphorus and fluorine. Residues of phosphoric and sulfuric acid, soluble

salts - monocalcium phosphate, dicalcium phosphate, slow down hardening and reduce the strength of cement binders [16].

The authors in [17-18] suggest washing phosphogypsum with water using the additive "C-3" or "Relaxol". These additives provide better leaching of acids with less water. As a result, you can get a small amount of acidic effluents with a high concentration of phosphoric and sulfuric acids, which are then used for chemical activation of fly ash.

To destroy the vitreous ash-removal, the authors in [19-20] propose to activate ash-removal by acidic residues from phosphogypsum washing. The destruction of the vitreous ash-removal opens access to reactive components of its components. Its most important property is its ability to react with calcium hydroxide $Ca(OH)_2$, which is released during hydration of cement.

## Conclusions

Analytical studies confirm the possibility of complex processing of phosphogypsum waste, fly ash and metal sludge. The purpose of further research is to develop a technology for the manufacture of heat-resistant concrete using industrial waste.

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