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The Possibilities for Mining Waste Processing

Nowadays, processing of waste is one of the most important issues in mining. Every year mining industry creates a huge amount of waste products. Those waste products are a source of environmental pollution because they lead to combustion (smoldering) due to the content of coal particles. Besides, the toxic smoke and refuse heap smoldering make it intolerable to live in the settlements situated near mines. Furthermore, huge areas are required to store waste while they can be used for agriculture.

Almost nothing is undertaken to recycle mining waste in Ukrainian mines. Goaf stowing of mine rock refuse is the only way to reduce the amount of waste but it is only up to 30-40%. At the same time, mining waste can be successfully used in the industry of building materials. Three ways to recycle mining waste exist:

- to use waste as a raw material or as coal containing admixture for the manufacturing of building ceramics;
- to use waste for manufacturing porous aggregates (agloporite, keramzit);
- to use waste for various concrete mixtures and mortars preparation.

Using mining waste is the most effective way for the first two cases. Burning is used for manufacturing these materials. So, coal content allows to reduce temperature of burning and to improve the fusibility conditions of clay products. Moreover, coal particles burn out during the burning process and a large amount of pores are formed. Heat conductivity and weight are decreased. At same time the strength characteristics of the material do not reduce. The results of our research are given in the tables below.

Table 1

Chemical Analysis of Mining Waste

Kind of material	Weight content of basic oxides, %												
	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	P_2O	MnO	CaO	MgO	K_2O	Na_2O	SO_3	CO_2	п.п.п.
1.Loamy Soil	7	7,01	2,15	0,58	-	-	5,07	1,55	1,85	0,71	0,08	4,9	8,7
2. Mining waste	62,5	20,0	6,6	0,9	0,14	0,14	1,3	1,65	4,0	0,5	-	-	1,08

Table 2

Average Physical and Mechanical Characteristics of Ready-made Products from Two-component Mixtures

Waste products content	Burning temperature, t, ^oC	Average density, ρ, g/cm^3	Compressive strength, MPa	Tensile strength, MPa	Water absorption, W, %
Loamy soil + 30,40,50% waste products					
30%	950	1,65	13,3	4,84	16,7
40%	950	1,66	16,3	5,5	16
50%	950	1,65	12,6	5,02	18,5

Burning temperature of clay items can be reduced by blending clay with fluxes such as felspar, iron bearing ores, etc. Plasticity of moulding mass can be increased by adding surfactants such as sulphite-sodium vinasse or red mud (0.1–0.3%).

According to the chemical analysis mining waste is similar to clays in chemical composition. Chemical analysis of mining waste and loamy soil is shown in table 1. Besides, mining waste contains a large amount of iron oxide which gives red colour while burning, improves impermeability and durability, gives strength and hardness, and lowers the fusion point of the clay.

The possibility to manufacture high-quality ceramic bricks from loamy soil and mining waste has been investigated. Average physical and mechanical characteristics of ready-made ceramic products from two-component mixtures are given in table 2.

From the results obtained we can conclude: 1) using of mining waste allows to increase porosity and to reduce heat conductivity and weight of clay products; 2) burning temperature is decreased to 950^{o}C; 3) according to the table 2, it is possible to get high-quality clay product from these materials.

The third way to recycle mining waste includes spayed concrete and filling mortars preparation directly in the mine. These materials are used for filling cracks and fixing space in mines. This way enables us to unload the transport system of a mine. This will reduce the cost of ground support construction, carry in some changes in the cycle of works, and greatly simplify the task of processing mining waste.

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