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Use Of Waste To Obtain Granular Porous Glass-Crystal

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Annotation: *The results of research carried out on the production of granular porous materials based on the processing of ashes from coal from the Angren deposit, waste of stone foundry production of related enterprises of that region are presented. The economic efficiency of the production of cellular and lightweight concrete has been substantiated due to the partial replacement of cement with these aggregates.*

Keywords: Granular porous materials, surfactants, differential thermogram, cellular and lightweight concretes, pyroxenes and plagioclases.

The research institute stromproekt is investigating the possibility of obtaining granular porous glass-crystalline materials based on stone-foundry waste, represented by the granulate of the stone-casting melt, breaking of products and substandard acid-resistant powder, and non-ferrous metallurgy slags from the processing of coal ash from the Angren deposit. The chemical composition of stone-foundry waste is characterized by a high content of iron oxides (up to 15%), the phase composition is mainly represented by a glass phase with small amounts of magnetite and spinel.

Angren slags are X-ray amorphous with a high content of Al_2O_3 (up to 15%) and CaO (up to 20%).

A necessary forming and swelling agent-waste of production of salts of fatty acids (surfactants). In solid form, it is the product of the evaporation of the mother liquor-waste of processing sulphate waters for the extraction of sodium sulfate. Using the technology developed at the Research Institute of Surfactants, high-purity Na_2SO_4 with a basic substance content of 98-99% is obtained, which is widely used, including in glass making. The chemical composition of the surfactant is as follows (%): sodium sulfate-40-45, water-soluble organic acids and their salts-45-50, chlorides-4-7, nitrates-0.5-1, water-up to 1. The surfactant is obtained in the form of brittle soluble in the water of granules of gray and gray-green colors with a size less than 3 mm, with an ignition temperature of at least 500^0C. The mother liquor is a 30% surfactant solution with an ignition temperature of at least 600^0C.

The surfactant thermogram showed that weight loss starts from 80 ° C, and in the range 250-1100 ° C gas removal occurs uniformly and at a low rate (2% per 1000 ° C temperature increase). Up to 1200 ° C, weight loss is 20-25%.

Organic acids that are part of the surfactant when decomposed under the pressure of gases that prevent oxidation from the outside, release carbon, which reacts with sodium sulfate,

$$SO_3+2C=S^{2-}+CO+CO_2..$$

This is the reason for the smoothness of gas formation, which is so important for obtaining a fine-pored structure with closed porosity.

The presence in the surfactant composition of salts of fatty acids with a surface-active effect is important at the stage of the formation of raw granules from non-plastic raw materials. Powders of inorganic wastes are characterized by high lumpiness: for powders with a specific surface of 1700-2000 cm^2 / g, the degree of lumpiness is 0.68-0.85. The strength of raw granules with normal moistening is extremely low. Moistened granulation with a surfactant solution significantly increases their strength; drying at a temperature of 150-200^0C After molding, it allows to obtain raw granules with a strength exceeding the known analogs: they can withstand up to 40 drops from a height of 500mm, crushing resistance reaches 50N and more.

Viscometry data and subsequent laboratory studies made it possible to estimate the swelling integral: for stone-casting waste 1070-1120^0C, for slags 1100C-1150^0C.

Under laboratory conditions (manual molding and on a laboratory screw press, foaming on a substrate and in a heat-resistant steel drum), granules based on Angren slag and stone waste were obtained, respectively, with the following characteristics: bulk density 550-750 and 600-800 kg / kg3, strength when squeezed in the cylinder 3-3.5 and up to 7 MPa, water absorption 16.5-25 b 12-20%, frost resistance up to 60 and up to 100 cycles. Additional heat treatment increases the strength of the granules.

Differential heat treatment at 900 and 1000^0C according to exothermic peaks: for samples from petrurgic melt granules - at 630,840,1060,1130 and 1170^0C; for Angren slags - at 532.932 and 1140^0C. Based on the foaming parameters, prolonged exposure at temperatures above 1000^0C is not feasible.

Additional heat treatment at temperatures of 900 and 1000^0C according to X-ray structural and petrographic analyzes increases the content of the crystalline phase for stone-casting waste up to 60%, for slags - up to 50%. Heat treatment at lower temperatures has practically no effect on the degree of crystallization. In the first case, the main crystalline phase is pyroxene solid solutions (diopside), resistant to the action of acids and alkalis, with a hardness of 5-6 units on the Mohs scale; in the second, plagioclases (anorthite), having a hardness of 6-6.5 units; anorthite decomposes in hydrochloric acid acid.

With a lower content of olivine, which reduces the chemical resistance of the material, for the stone-foundry waste the temperature of additional heat treatment was 1000^0C, for Angren slags - 900^0C. In the first case, the strength of heat-treated granules with a bulk density of 900kg / m^3 andof granules without heat treatment was 58.5 and 41.8 MPa in the piece, respectively (in terms of strength in the cylinder, about 13 and about 9 MPa.

Additional heat treatment insignificantly decreases acid resistance ((from 97.3 to 96.1% in 98% H_2SO_4 solution) and increases alkali resistance (from 93.2 to 94.1% in 35% NaOH solution) /. The filler is resistant to ferrous and silicate decomposition.

The molding moisture was selected on the basis of the analysis of the work of laboratory and factory screw presses, and the concentration of the solution was based on the limitation of the content of sulfur compounds in the aggregate in the case of its use in concretes with prestressed reinforcement (up to 3%), the addition of a swelling intensifier, in this case, sulphite-yeast brews.

As a result of laboratory experiments, the following technological regulations for the production of the material were selected and tested: crushing and grinding to a specific surface area of 1500-20000C cm2 / g (sieve with a mesh size of 0.5 mm); moistening with a surfactant solution (in terms of dry matter for stone-casting waste 8 % by weight of powder, for Angren slag-5%) to molding moisture content of 11-12% (for granulation 14-15%); mixing in a mixer, on runners; forming on a screw press, perforated rollers (pelletizing on a granulator) with dusting with refractory powder; drying in a conveyor (chamber) dryer at a temperature of 150-200^{0}C for 1 hour; roasting in a rotary kiln for 5% surfactant concentration and% 1 SDB (temperature will be 1110^{0}C); additional heat treatment (not carried out on an industrial scale); crushing to the required fraction at the request of the consumer).

As a result of the tests, 1.5 tons of porous granular glass-crystalline material was obtained, which should be used at the facility of the building materials plant for filling frame floors on an epoxy bond (ED resin - with polyethylene polyamine and dibutyl phthalate). The expected economic effect from the implementation is up to USD 11 per 1 m2 of coverage due to the increase in the service life of the floors when replacing natural materials.

The material based on Angren slags, produced under laboratory conditions, was used in NIIstromproekt to obtain several types of lightweight and cellular concrete. In particular, using the increased strength of the aggregate, as well as the low binding capacity of the ground slag, two types of low-cement concretes (6% cement) using Angren ash and slag and cementless autoclaved concrete (density 1500 kg / m3, compressive strength 17MPa). Only by saving cement, the efficiency from the introduction of a new aggregate should be 5 US dollars per 1 m3 of aggregate.

Surfactant as a substance possessing the most rational at enterprises for the production of alumina expanded clay and ash gravel, where significant modernization of technological equipment is not required.

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