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TECHNOGENIC PRODUCTS OF CHEMICAL WATER TREATMENT OF HEAT ELECTROCENTRALS AS AN ADDITION TO CLINKER CERAMIC MATERIALS

ТЕХНОГЕННЫЕ ПРОДУКТЫ ХИМИЧЕСКОЙ ВОДОПОДГОТОВКИ ТЕПЛОЭЛЕКТРОЦЕНТРАЛЕЙ КАК ДОБАВКА К КЛИНКЕРНЫМ КЕРАМИЧЕСКИМ МАТЕРИАЛАМ

[1]Kauchur A., [1]Hrachanikau A., [2] Manak P.

[1]Vitebsk State Technological University, Republic of Belarus

[2] JSC «Obolsky Ceramic Plant», Republic of Belarus

[1] Ковчур А.С., [1]Гречаников А.В., [2]Манак П.И.

[1]Витебский государственный технологический университет, Республика Беларусь

[2]ОАО «Обольский керамический завод», Республика Беларусь

ABSTRACT

CERAMIC TILES, MAN-MADE PRODUCTS, CHP CHEMICAL WATER TREATMENT

The article presents the results of research on the possibility of using technogenic raw materials in the production of clinker ceramic construction materials. As a result of the studies carried out, the possibility of using various man-made products of CHP chemical processing in the production of clinker ceramic materials has been established, which is an important reserve for resource saving in construction.

АННОТАЦИЯ

КЕРАМИЧЕСКАЯ ПЛИТКА, ТЕХНОГЕННЫЕ ПРОДУКТЫ, ХИМИЧЕСКАЯ ВОДОПОДГОТОВКА ТЭЦ

В статье приведены результаты исследований по возможности использования техногенного сырья при производстве клинкерных керамических строительных материалов. В результате проведённых исследований установлена возможность использования различных техногенных продуктов химводообработки ТЭЦ в производстве клинкерных керамических материалов, что является важным резервом ресурсосбережения в строительстве.

Technogenic products are accumulations of mineral substances on the surface of the earth or in mine workings, which are waste from mining, processing, metallurgical and other industries and are suitable in quantity and quality for industrial use, which becomes possible

as the technology of its processing and changes in economic conditions [1].

Of the branches of material production capable of consuming industrial (technogenic) waste, the building materials industry is the most capacious. At present, the JSC «Obolsky Ceramic Plant» plans to expand its product range through the production of ceramic clinker products using man-made chemical water treatment products of combined heat and power plants.

The purpose of the present work is to study the possibility of using technogenic products of chemical water treatment of cogeneration plants as an additive in the manufacture of ceramic clinker materials.

Clays and kaolins are the main raw materials for the production of clinker ceramic materials. Along with this, their mixtures with various additives are widely used, for example, fluxes, thinning, pore-forming, plasticizing. So, for example, thinning additives are introduced into the composition of the ceramic mass to reduce ductility and reduce air and fire shrinkage of clays. Such additives include chamotte, dehydrated clay, sand, granulated blast furnace slag, waste from cogeneration plants and deferrization stations (precipitation of chemical water treatment).

Analysis of literature and patent information has shown that various man-made products are used to modify the ceramic mass to make clinker ceramic materials:

– argyllite ground to size less than 1.0 mm at content of fraction 0-0.5 mm not less than 80 %, and additionally apatite concentrate;

– tails of cobalt concentrate extraction in the amount of 20-40 % bulk mass 920 kg/m^3, density 2720 kg/m^3, refractory 1200 ^oC;

– ground basalt of 0.063 mm fraction as fluxing additive;

– granite sifts of 0.1-3.0 mm fraction as a shearing additive and additional granite sifts of less than 0.1 mm fraction as a melt;

– glass waste.

Technogenic products formed during chemical water treatment at the CHPP are a wet mass of dark brown color. Depending on the time of year and the place of formation, the waste contains from 5 to 35 % moisture [4]. The phase composition of technogenic chemical water treatment products, established using x-ray phase analysis, depending on the sampling time, was: silica SiO_2 and calcite $CaCO_3$ in a quantitative ratio of 16 wt. % and 84 wt. %, respectively (a sample of technogenic products taken in the summer); silica SiO_2 – 2 wt. %; FeO (OH) – 16 wt. %; Ca (CO_3) - 82 wt. % (a sample of technogenic products taken in the winter). [3].

The oxide composition of technogenic chemical water treatment products was determined at the testing center of the State Enterprise "Institute NIISM". The oxide content was determined according to GOST 2642-97, GOST 21216-2014. Table 1 shows the oxide composition of technogenic products of chemical water treatment of cogeneration plants.

Table 1 – Oxide composition of technogenic products of chemical water treatment of combined heat and power plants

Component	SiO_2	Al_2O_3	Fe_2O_3	FeO	TiO_2	P_2O_5	CaO	MgO	**П.п.п.**	SO_3	Na_2O	K_2O
Wt, %	0.24	0.64	1.77	2.85	0.03	n/a	47.66	2.26	44.15	n/a	0.20	0.08

The analysis of the particle size distribution of the sample was carried out by dry sieving with a set of sieves certified by RUE BelGIM in accordance with MA MH 63-98 "Laboratory construction sieves". The granulometric composition of chemical water treatment sediments of CHP is the following: 0.315-1.25 mm – 5.8 %; 0.0071-0.315 mm – 18.6 %; fraction < 0.0071 mm – 75.6 % [4].

The main material for the production of clinker is shale clay. The composition of shale clay is optimal for the manufacture of high-strength products: it contains no impurities of minerals, chalk or alkali metal salts. Shale clay has a homogeneous composition, is elastic and refractory. A good clay should have the following properties:

– during sintering, it does not soften in the mass so much that deformation can occur;

– it's likely to contain very limited amounts of CaO and MgO (1.25–2.0 %), which at high contents cause their sharp and sudden softening;

– it must contain at least 6–9 % Fe2O3 and at least 3.3–7.8 % alkalis that promote sintering.

The results of studies of the phase and oxide composition of technogenic products of chemical water treatment of cogeneration plants showed the presence of a significant number of adverse phases of calcite and FeO (OH). As a result of this, to reduce the harmful effect on the clinker of the presence of (Ca, Mg) CO_3 and FeO oxides in waste, the technogenic products of chemical treatment of thermal power plants should be crushed in a ball mill.

The preliminary studies on the use of technogenic products of chemical water treatment of cogeneration plants as exhaust additives in the production of clinker ceramic materials showed that when using these wastes, the quality of the products does not deteriorate.

For the production of clinker ceramic materials under laboratory conditions, JSC Obolsky Ceramic Plant obtained clinker from three clay feed compositions: clay from the Rudnya-2 deposit – 25–35 %; clay of the Latnenskoye deposit in the Voronezh region – 35–45 %; clay of the Zapolye deposit – the rest. According to STB 1450-2010 "Process documentation. Compounding. General Requirements for Development" we have developed a formula and compositions of raw materials for the production of experimental copies of ceramic paving tiles using chemical water treatment deposits of CHP. Technogenic products of chemical water treatment of thermal power plants were used as exhaust additives.

Preliminary studies have shown that the inclusion of a prepared additive of technogenic products of chemical water treatment of heat and power plants as a thinner additive in the clinker does not impair the quality characteristics of the products. Due to the complexity of

structure formation and strict requirements for water absorption – clinker brick no more than 6 %, and tiles no more than 4 % - further studies are needed to identify the positive effect of fine-dispersed additives of technogenic chemical water treatment plants of heat and power plants on the properties of ceramic clinker products.

Thus, as a result of the studies carried out, the chemical, phase and oxide composition of the deposits of chemical water treatment of thermal power centers is determined. Man-made products of energy complex (waste of chemical water treatment of CHP) according to chemical, phase, oxide and granulometric composition can be used as annealing additives or replacement of part of initial raw materials in production of clinker ceramic materials. This will lead to an expansion of the range of ceramic products produced, to improvement of the environmental situation and reduction of energy costs at the enterprise.

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