

FEATURES OF THE USE OF TECHNOGENIC WASTE FROM THE CHEMICAL INDUSTRY FOR THE PRODUCTION OF FIRE-RESISTANT MATERIALS

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Fires have a great impact on buildings and structures both directly, when the source of the fire is on the site itself, and indirectly. Therefore, the number of emergency effects should include fire effects arising from a fire. For example, the effect of fire significantly changes the creep parameters of concrete, the thermal stress state in massive concrete structures during a fire is equivalent to that which occurs during hardening of concrete, which causes the formation of cracks[1]. Thus, the design of fire protection is a mandatory requirement in the design of fire-resistant structures.

Complex physico-chemical and mechanical processes take place in concrete during high-temperature heating. The strength of concrete under the influence of high temperatures depends on the properties of binders, as well as on the composition of aggregates and their properties.

Heavy high-strength concrete has such a significant drawback as a tendency to explosive splitting under the influence of fire[2]. This is due to the tensile stresses arising from the vapor pressure of physical moisture in the pores, as well as from the softening of concrete after the loss of bound water. According to observations of real fires and fire tests of reinforced concrete structures, pieces of concrete at a distance of up to 10-15 meters begin to fly away with bangs from the heated surfaces of the structures and crack within 9-15 minutes[3]. As a result, there is a rapid reduction of the working section of the structure, the destruction of the protective concrete layer, the exposure of the working fittings, the appearance of through cracks and holes, a sharp decrease in the fire resistance of the entire structure. [4]

Gypsum-based binders, as well as products made from them, are widely used as fire-retardant materials. In terms of heat-insulating, sound-insulating properties and fire resistance, gypsum materials are superior to cement-based materials, and in terms of decorative, comfortable and ecological indicators, they have no equal in construction.

Phosphogypsum was studied as a potential raw material for the production of gypsum binder and as an additive to cement, which allows to regulate the hardening time of the cement mixture [5-6]. However, the use of phosphogypsum from a technological point of view requires special preparation, such as drying and briquetting [7]. Therefore, this method of disposal of phosphogypsum is used only in countries that do not have natural gypsum.

In the production of phosphoric acid using the extraction method, by-products are formed in the form of phosphogypsum waste. The solid phase of calcium sulfate in these wastes can be dihydrate, hemihydrate or anhydrite, depending on the conditions of temperature and concentration during the decomposition of phosphate raw materials. Phosphogypsum waste is gypsum raw material, as it consists of 80-95% of calcium sulfate [8].

In their works [9-12], scientists found that the most effective way to use phosphogypsum in construction is to obtain clinker-free phosphate, metal phosphate and metal ash phosphate binders. This type of binder can be obtained without significant expenditure of energy and preliminary purification of phosphogypsum from harmful substances.

In the works [13-15], the authors established that the main process in the synthesis of a phosphate binder is the dissolution of oxidizing compounds in phosphoric acids. The regulation of this process depends on the concentration of the acid, the chemical composition of the compound that contains the cation, the optimal modification from the point of view of solubility, as well as the method and temperature regime of its introduction into the reaction mixture. [6] The speed of interaction processes can be regulated by changing the reactivity of the filler by compaction, thickening of its parts, use of dispersions of oxidized metal filler, and passivation of components that react excessively actively [16].

It should be taken into account that due to the content of undesirable impurities in the composition of phosphogypsum, the processing of phosphogypsum into fire-resistant binders requires significant costs associated with its preparation for the production of fire-resistant gypsum compounds [17].

Analysis of the existing methods of preparing phosphogypsum for fire-resistant gypsum binders showed that today four methods are mainly used to remove impurities [18-19]: washing phosphogypsum with water; washing in combination with neutralization and sedimentation of impurities; method of thermal decomposition of impurities; introduction of neutralizing, mineralizing and regulating additives.

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