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ASH AND SLAG WASTE UTILIZATION IN CONSTRUCTION

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Environmental problems dictate the need to find ways to attract ash accumulated in ash dumps of thermal power plants to wide use in construction, construction materials industry and other industries to reduce the number of dumps, as well as to create dry ash removal units at thermal power plants [1-4].

According to the basic principles of the concept of sustainable development in construction, one of the promising directions for solving the problem of saving fuel and energy resources in the production of cement is the development of resource- and energy-saving technologies based on the comprehensive use of mineral raw materials with the wide introduction of industrial waste into production.

Industrial waste is a secondary raw material, the use of which after processing can reduce the cost of new construction and at the same time reduce the load on urban landfills, while eliminating the formation of unauthorized dumps [5-7]. In this regard, at present, the production of building materials requires the rational use of local materials and industrial waste [8–11].

The production of many materials is associated with the formation of a large amount of waste of various degrees of dispersion and radioactivity [12–14]. All this creates negative environmental conditions in the territories where enterprises producing these wastes operate. A particularly tense situation with the accumulation of waste develops when the production site of industrial enterprises is located close to large cities and towns [15-17].

One of the world's environmental problems is the accumulation of ash in ash pits and its disposal. The accumulation of these wastes prompts scientists to find ways to solve the disposal problem [18-21].

Fly ash is one of the additives that is most widely used in almost all countries of the world. At the same time, a certain instability of the properties of ash, namely, the variability of the degree of dispersion, chemical and mineralogical composition, the content of alkali metal oxides and unburned carbon particles, restrains its use in the production of concrete.

Under the conditions of increasing anthropogenic pressure on the environment, the problem of expanding the raw material base for road construction through the maximum use of industrial waste from various industries and by-product building materials is of particular importance [22-24]. At present, the results of scientific developments in terms of the use of production waste in road construction and the

production of building materials are not being sufficiently implemented in Ukraine. The problem of industrial waste disposal is acute throughout the civilized world.

The use of ash in cement concretes leads to an increase in sulphate resistance in the same way as other mineral additives. The test results showed that concrete containing fly ash cement is more resistant to sea water, even compared to concrete based on Portland slag cement.

Partial replacement of cement with fly ash leads to a decrease in shrinkage deformations of concrete, which manifests itself with a decrease in the amount of water in the concrete mixture. The decrease in charge is explained by the fact that ash adsorbs soluble alkalis from cement and forms stable, insoluble aluminosilicates.

The use of pre-activated fly ash as an aggregate in the composition of foam concrete forming solutions is one of the promising ways to save resources.

In the manufacture of concrete and mortar mixtures, the introduction of fly ash is also recommended as active mineral additives and fine fillers. Acid ash has found wide application as the most effective active mineral additives in concrete. Acid ash does not have astringent properties, but their pozzolanic activity is manifested in interaction with the cement binder. Depending on this characteristic in relation to a particular cement, water consumption and workability of the concrete mixture, conditions and duration of hardening, it is possible to significantly reduce the consumption of cement.

Fly ash has found wide application in the production of prefabricated reinforced concrete structures. Dry spinning top is introduced into concrete of classes B7.5-B40 in an amount of up to 20-30% by weight of cement. However, due to the excessive ash content, swelling of the surface of the steamed products is possible.

The optimal amount of fly ash does not increase the need for water in concrete mixtures, which is explained by the melting and relatively regular shape of the grains. The high dispersion of ash and the low content of unburned coal in it increases the workability of the mixture. To ensure the plasticity of the concrete mix, it is recommended to use ash and fine aggregate with a minimum amount of fine fractions.

The use of fly ash as an active mineral additive during its preliminary activation will reduce the consumption of mineral binders. Using the plasticizing properties of fly ash, in our opinion, it is possible to reduce the costs of expensive plasticizing additives, as well as to replace part of the natural microfillers with these wastes of the energy industry, which will lead to material and environmental savings.

The structure-forming role of mineral additives consists in shortening the induction period of structure formation due to the adsorption of hydrolysis products and in increasing the time to reach supersaturation of the liquid phase.

When a small amount of ash is added to the cement paste, the ash and cement particles flocculate due to electrostatic attraction, which causes a decrease in the mobility of the cement paste. In the case when the ash consumption is high enough, the negative integrated charge of the particles prevails in the system, while their electrostatic repulsion occurs, which ensures an increase in the mobility of the cement dough. In addition, the adhesion of smaller ash particles to the oppositely charged particles of the clinker phases leads to the repulsion of the latter with the release of water immobilized in the flocs.

Taking into account the multifunctional nature of the ash additive, its introduction only instead of part of the cement or part of the sand does not allow solving the problem of optimizing the compositions.

When selecting the composition of concrete, the ratio between the components, including ash, should be determined, while it must be taken into account that the required properties of the concrete mixture and concrete can be achieved with a minimum consumption of cement and with a maximum consumption of ash. Ash plays only the role of a binder, an active mineral additive to cement, but also the role of a fine aggregate and microfiller that improves sand granulometry and actively influences concrete structure formation.

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