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GENERATING COMBINED CEMENTING MATERIALS WITH MICROFILLER AND GEL-POLYMER ADMIXTURE

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Abstract: *In this article the way of generating combined cementing materials with microfiller and gel-polymer admixture is shown. Results of conducted research on an establishment of dependence of durability of the combined cementing materials from their dispersion are given. It is shown that durability of cement stone Rc.s. is regulated by its activity R *, and methods of definition of activity of cement in general method of designing of optimal ISK structure serve as the tool for an operational administration of the technological process of manufacturing of concrete (heavy, light). At the expense of increase in a subtlety of a grinding it is possible to increase activity of combined cementing, and proceeding from dependence of last on a dosage additive and duration of a grinding, it is possible to allocate three groups of the cementing. Increase of activity of combined cementing at the expense of introduction of gelpolymer in structure is found.*

Key Words: *combined cementing, a way of generating, grinding time, dispersion knitting, activity, a method of definition of activity, increase in a subtlety of a grinding, increase of activity, gel-polymer admixture.*

1. INTRODUCTION:

The shortage of cement today is obvious, as it is established that the volume of concrete production is ahead of the volume of cement production. Solving the problem of deficiency requires the search for effective types of cement and considering the actual properties of raw materials and their products. Questions of multicomponent cement making with use of various types of mineral fillers do not lose the relevance. However, the lack of general scientific and technological principles of complex application in the composition of binders of different components constrains the widespread use of multicomponent binders in construction.

To date, a number of concepts on technological methods for obtaining multicomponent binders, which most fully implement their activity, have been proposed. It is expedient to separate the method of preparation of mixed binders, providing for the production of Portland cement in the factory, followed by mixing it with other projected components directly at the site of consumption of the binder [3]. Among the many unsolved problems of the widespread use of the separate method, the main one remains the problem of obtaining a homogeneous product, which is associated with a number of technical difficulties.

The rational way of obtaining mixed binders by joint grinding of Portland cement clinker and mineral components, carried out in ball mills, deserves attention [1]. However, it is particularly important to determine the rational dispersion of the mixed cement binder. Dispersion of cement binder has a great influence on the structure and properties of cement stone. The thinner the particles of the substance, the more easily it passes into another phase (dissolves), becomes more active [2].

2. METHOD:

Scientific school of Professor I. A. Rubleva proved that the strength of cement stone $R_{и.к.}$ is regulated by its activity R*[4,5,6] the activity of the binder depends on its quantity in the conglomerate (concrete) and the greater the activity, the more the consumption of the binder is reduced. The need to increase the activity of the binder is sufficiently justified by the following reasons: R* - the calculated value included in the formula of strength of conglomerates of optimal structure:

$$R_б = \frac{R^*}{X^n}, \quad \text{where} \quad x = \frac{B/Ц}{B^*/Ц}$$

The amount of binder in the conglomerate depends on R *: the greater the value of R*, the greater the value of the ratio B / C reduces the consumption of binder. In addition, according to the law of congruence, or mandatory correspondence of properties, all strength, deformation and other qualitative indicators of the conglomerate are directly related to the same properties of the binder, and with optimal structures, their relationship is strictly natural. Therefore, it is necessary to have high-quality indicators of the properties of the binder and in particular strength. However, when designing concrete compositions, instead of the activity of cement, its brand is taken into consideration. Each brand has been proven to correspond to a wide range of activity values. In particular, the brand of Kuvasai cement M400 corresponds to cements with an activity of 38.0....77.6 MPa. Methods for determining the activity of cement according to the general method of designing the optimal composition of concrete serve as a tool for operational control of the technological process of manufacturing concrete (heavy, light). Thus it is possible to adjust production compositions of concrete mixes taking into consideration actual activity of cement.

3. DISCUSSION:

To establish the dependence of the strength of Portland cement and mixed binders on the dispersion, expressed in terms of specific surface area, a number of binders with different dispersion were obtained in laboratory conditions. Grinding of Portland cement clinker was carried out with the addition of 3-3. 5 % (by weight) of gypsum stone, respectively, during 30', 45', 60', 90',120', 180'. Gypsum was introduced to regulate the time of setting and served as a chemically active component of cement, reacting with tricalcium aluminate when cement was sealed with water and binding it to calcium hydrosulfoaluminate (ettringite) at the beginning of hydration of Portland cement.

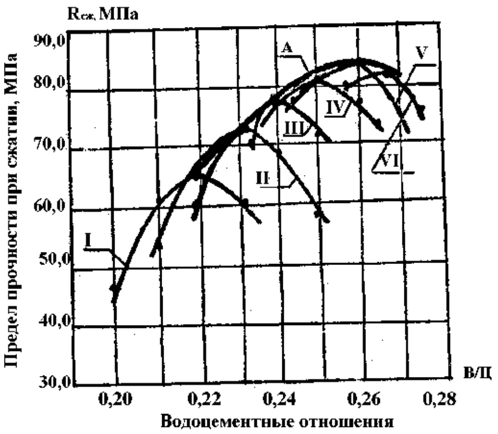
At the stage of coarse grinding of porous clinker grains, their destruction occurs, the degree of which depends on the mineralogical composition and structure of the clinker, its resistance to grinding [7,8,9]. Used in research, alite clinker Kuvasai cement plant, had a reduced resistance to grinding. In the initial period of grinding, the increase in specific surface area occurred quite quickly and reached 8-11. 5 cm2/(g. s). In the resulting cement binder (grinding time 30'), the number of large particles decreased, but the adsorption capacity of the obtained small particles, their activity is small, which can explain the reduced strength parameters of the cement stone (Fig.1).

4. ANALYSIS:

As the grinding time increases, fine grinding of clinker grains occurs, splices and individual crystals of clinker minerals are destroyed, chemical bonds between ions in the crystals are broken. Adsorption capacity of fine particles increases, water absorption of fine grinding cement increases. At fig.1 it can be seen that the optimal values of water-cement ratios (W/C) shifted to the right during the transition from coarse to fine grinding of cement.

With increasing duration of grinding process slowed down, and also slowed down and the increase in the specific surface area of the binder (2.5-4 cm2/(g. s). But each type of binder with a certain specific surface (under the same conditions of manufacture and testing of samples) corresponded to its optimal composition and structure with the highest activity set for it at the optimal water-cement ratio (Fig.1).

With a sufficiently high particle dispersion (specific surface area of the binder when grinding 180 ' reaches 5200 cm2/g there is a huge potential energy, which leads to spontaneous aggregation of particles, as it can be seen from the beginning of the process of reducing the activity of the binder (curve VI in Fig.1). The highest activity was determined for Portland cement binder at grinding 120' (=82.5 MPa with an optimal water-cement ratio V / C=0.26). Curve A in Fig.1-envelope curve of cement binders of optimal structure. The above data can be determined from the graph (Fig.1).



Rice. 1. Dependence of compressive strength of cement stone on water-cement ratio at different specific surface of Portland cement binder. Curve A is the envelope of cement binders of optimal structure; curve with indices I, II, III, IV, V, VI correspond to the specific surface area (m2 / kg) of Portland cement binder, respectively, at the time of its grinding 30’, 45’, 60’, 90’, 120’, 180’.
I-280 m2 / kg; II-320 m2 / kg; III-370 m2 / kg; IV-400 m2 / kg; V-450 m2/kg; VI-520 m2/kg/

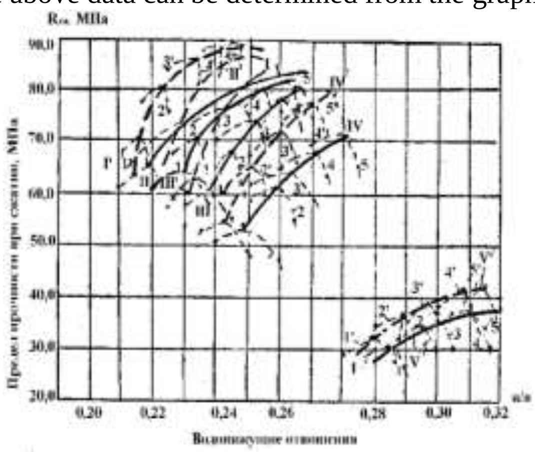


Figure 2. Dependence of the compressive strength of the cement-ash stone on the water-binding ratio at different specific surface of the cement-ash binder.
Curves: I-Portland cement; II-cement-resin binder with 15% ash, III - the same with 25% ash, IV - the same with 40% ash, M - the same with 60% ash.
Curves: I ' - Portland cement with 0.02% GP-2; II’ - cement-ash binder with 15% ash and 0.02% GP-2; III’ - the same with 25% ash and 0.02% GP-2; IV’ - the same with 40% ash and 0.02% GP-2; V-the same with 60% ash and 0.02% GP-2.

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At the next stage of the study of binders produced its seal filler-ash TPP.

5. FINDINGS:

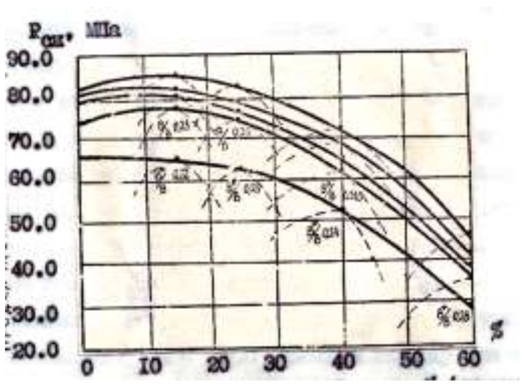
The joint grinding of Portland cement clinker, ash, gypsum stone was made by analogy with the grinding of one Portland cement clinker during 30', 45', 60', 90',120', 180'. At the same time, the efficiency of the ash impact on the grinding process, the change in the specific surface of the mixed binder, the optimal amount of ash were established. The amount of ash filler varied from 15 to 60%.

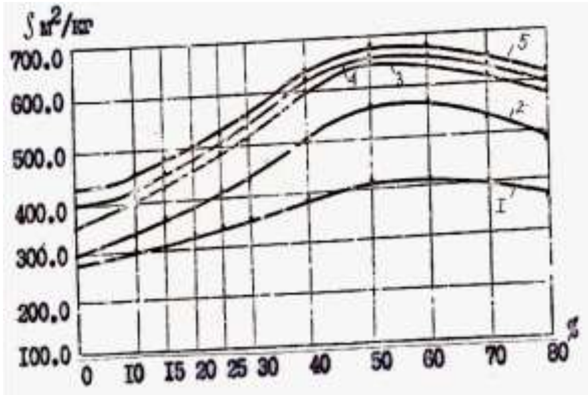
The presence of filler ash in the cement binder, which has a microporosity and, as a consequence, a high sensitivity to water, leads to the need to adjust the water-binding ratio (V/V) with an increase in the ash content in the cement-ash binder.

It is impractical to grind the binder more than 120' (see Fig.2), since as a result of agrigation and adhesion of particles to grinding bodies in ball mills, "peculiar pillows"can be formed. At the same time, part of the strikes of the grinding bodies will be non-working.

Rational dispersion of the mixed binder can be established by the activity of one of the obtained types of binder, which is necessary in the design of the composition of concrete dense structure. The recommended grinding time for obtaining the required specific surface area and activity of the binder is also justified by appropriate calculations. The above data can be determined from the graph (Fig.1.).

At the fig.2 the dependence of the compressive strength of the cement-ash stone on the water-binding ratio at different specific surface of the cement-ash binder is given. In addition, Fig.3 and Fig.4 shows the dependence of the compressive strength of the cement-ash stone on the amount of introduced ash at different grinding times and the dependence of the specific surface of the cement-ash binder on the amount of introduced ash, respectively.





Quantity of introduced ash,% (by weight) Rice.3.The dependence of the ultimate strength in Compression cement-ash stone from the amount of input ash at different grinding times The curve numbers correspond to the grinding time Accordingly: 1-30' ; 2-45; 3-60'; 4-90'; 5-120'	Rice.4. The dependence of the specific surface of the cement-ash binder on the amount of ash introduced. The curve numbers correspond to the grinding time Accordingly: 1-30' ; 2-45; 3-60'; 4-90'; 5-120'

Forming, hardening and testing of samples was carried out according to the same regime. For each composition of the cement-ash binder, depending on the duration of grinding, its extreme curve in the coordinate system Rcj/(V/V) is obtained, having a vertex for optimal compositions (Fig.2).

6. RESULT:

As seen at Fig. 1., with each duration of grinding, the specific surface of the binder increases to a certain maximum, characterized by a percentage of the introduced (optimal) amount of ash, which has an intensifying effect on the process up to a certain limit. Then there is not only stabilization, but also the decline of the piost specific surface, which is fashionable to replace the following. When ash is introduced in excess of the optimal amount (45-60%), depending on the grinding time, the grinding process slows down due to the lack of grinding media of small diameter.

7. CONCLUSION:

Thus, by increasing the fineness of grinding, it is possible to increase the activity of the cement-ash mixed binder, and based on the dependence of the latter on the dosage of ash and the duration of grinding (Fig.3,4) it is possible to allocate three groups of the binder:

- - with ash dosage up to 20%, when the activity of cement-ash binder practically does not differ from the original additive-free cement at the same energy costs for grinding;
- - with a dosage of ash from 20 to 40-50%, when there is a proportional decrease in the activity of the binder and then in this range it is rational to compensate for the decline in the strength of the binder by increasing the dosage of ash by increasing the fineness of grinding;
- - with a dosage of ash more than 50%, when there is a noticeable decrease in the activity of the binder, and the latter is difficult to compensate for the increase in the fineness of the binder due to the increase in the duration of grinding.

An increase in the activity of the mixed binder was found due to the introduction of a gelpolymer additive into the composition during grinding of the binder [10,11]. The reagent polymer polyacrylonitrile hydrolyzed stabilizing was used. In the course of preliminary experiments, it was found that the greatest effect is achieved when it is introduced in hundredths of the mass of cement. On the basis of the above, it follows that the methods of determining the activity of cement by the General method of designing the optimal composition of concrete serve as a tool for operational control of the technological process of manufacturing concrete (heavy, light). Thus it is possible to adjust production compositions of concrete mixes taking into consideration actual activity of cement.

To adjust the production compositions of concrete mixtures, it is possible to use specially designed nomograms that establish the dependence of the activity of cement, concrete class, In / C and, as noted above, the higher the value of R*, the more the consumption of the binder is reduced.

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