Effect of method of preparation lime-silica binders hidrotermal hardening on the kinetic hardening

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Abstract: *this work is devoted to trying to create products based on mechanically activated lime-silica binder. During the work it was found that the mechanical activation of mixtures of raw materials, can get away with autoclave technology for steaming at atmospheric pressure. The possibility of creating on the surface of the quartz solid solutions are able to hydrate during the steam treatment and give a bunch of providing sufficient strength products. Investigation of the kinetics of curing and changes in the structural properties of the material for steaming.*

Key words: *mechanical activation; lime-silica binder.*

INTRODUCTION

The aim of these work is studying curing of lime-silica binder hidrotermal harding, obtained by mechanical activation of the raw mix, which was carried out in vibratory mill CEM-7v for joint and separate (mechanical activation of quartz sand) dry grinding. Details of the source and the obtained mixtures are shown in Table 1.

Table 1. Characteristics of raw mixes.

Specific surface,m^2/kg	The condition of grinding	Content CaO_{free} in the mixture	
		Before grinding	After grinding
1050	separate	30	30
840	join	30	25

METHODS

Sample preparation consisted of grinding raw materials (joint / separate) quenching 2.5-fold excess of water and subsequent compression the samples 60×12×10 mm under a pressing pressure by10 MPa with forming humidity – 2,8%. The resulting samples was steamed at a temperature of 95 - 98 °C. After cooling and drying in air for a day underwent a comprehensive measurement structure - chemical properties and strength characteristics of the obtained samples.

RESULTS AND DISCUSSIONS

Through a comprehensive analysis of activated raw mixtures, it was found that about 5% of it`s total CaO content in the sample comes into mechanochemical interaction with quartz sand is when ground. As a result, a difference is observed between the activities of binding to, and co-grinding. Figure 1 shows changes in the mechanical properties of the samples in function of time at isothermal steaming.

A general view of the plots shown in the figures, the overall strength corresponds to a set of lime -silica binder with their autoclave treatment [1]. At the initial stage of steaming samples binder held separate grinding higher on the strength of a set of similar samples binder held a joint milling. In the later stages of curing the picture changes. This is due to the fact that the separate grinding , active silica with a large proportion of fine particles rapidly into a soluble form and precipitates in the form gel-like hydrosilicates then curing mechanism is changed to predominantly topochemical.

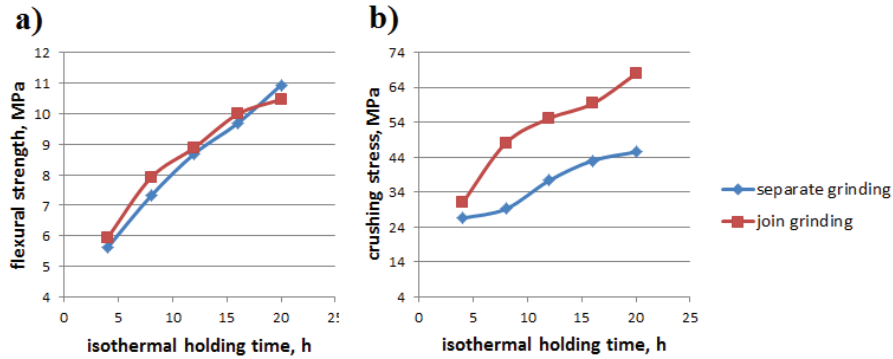

Figure 1. Changes in indicators of flexural strenght (a) and crushing stress (b) of steamed samples, depending on the method of grinding and isothermal holding time.

Calcium ions and water molecules diffuse through the layer of surface tumors and interact with the amorphized quartz. When grinding the surface of the quartz grains in the course of mechano-chemical processes is saturated with lime to form the surface phases of the irregular composition. This slows down the diffusion into grains, primarily calcium ions during the further hardening under steaming.

Based on the results of a comprehensive analysis [2] showed that in the raw number of surface phases after hydration of lime was at separate milling masses 20.54%, while the joint is significantly higher - 33.15 percents of all mass of the sample.

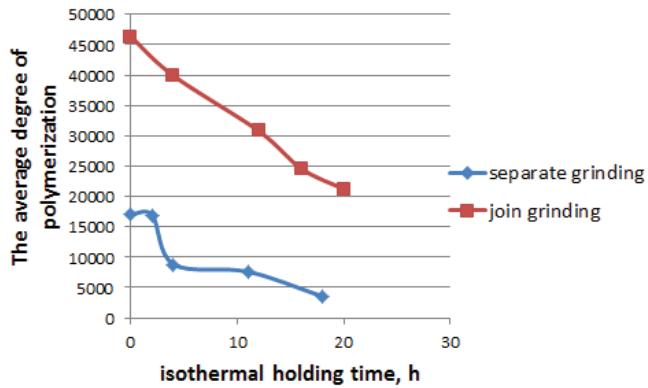

Fig. 2 presents data on changes in average degree of polymerization of tumors, depending on the method of sample preparation and isothermal holding time.

Calculation of these values represents the degree of polymerization of the acid-tumors (relatively highly basic low-polimerized gel-like phases) determined by the method of molibdate kinetic analysis and insoluble in acid neoplasms (pseudomorphosis) which have high-polymer structure so that they are closer to the amorphous silica than to hydrous calcium. It should be noted that the proportion acid-soluble phase compared with the content in the raw pseudomorphosis (PM) is only 0,4-0,5 % for the separate and the joint grinding. In the course of curing to 20 hours of steaming their share is growing: for separate grinding up to 4.5% and to share - to 8,5 %. The degree of polymerization of the acid-soluble phase change differently. For separate grinding it increases from 4,7 (in adobe) to 17,4 to 20 hours of steaming. To share the grinding of quartz and lime clearly observed depolymerization - from 814 (in adobe) to 17,8. This trend is more clearly seen in

tumors PM , but the starting positions for different ways of cooking the mixture in this case is significantly different. At a separate grinding average degree of polymerization of the PM was 18200, for 20 hours hydrothermal hardening is reduced to 14,500 , with the join grinding – from 47000 (in adobe) to 13400 by 20 hours. The number of tumors with a steaming increases significantly for the samples obtained from the co- milled raw mix - up 45,03 % vs. 24,26 % - to try to beat the components separately. In Figure 3 shows the change in the number of superficial tumors in the samples depending on the method of their preparation and isothermal holding time at steaming.

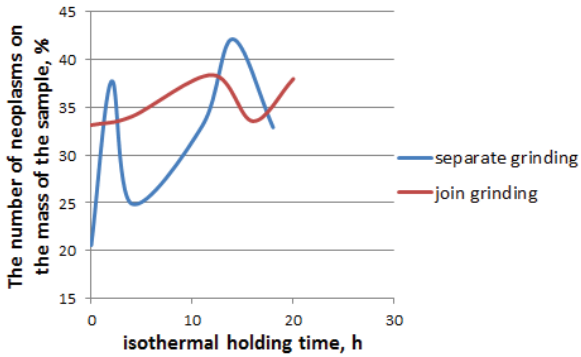

Figure 3. The dependence of the number of neoplasms in the samples depending on the method of their preparation and isothermal holding time at steaming.

On the strength characteristics of both these factors affect - and of neoplasms and their structure is evaluated in this case, average degree of polymerization of silicon anionic surfactant phases.

CONCLUSIONS

• due to the mechanical activation of mixtures of lime , silica becomes possible to obtain a sufficiently strong construction materials in steaming at atmospheric pressure.

• the method used for the analysis of highly polymerized silicates allowed to quantify the depth of the process of amorphization of the surface layer of quartz and its anionic structure.

• analysis of the experimental data allowed us to make some assumptions about the possible mechanisms of pattern formation during solidification of mechanically activated lime- silica mixtures in a steaming , which seem to differ from those in autoclaved .

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This paper has been reviewed