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Of Lime-Belite Materials Obtained on the Basis from Local Marls of the Republic of Karakalpakstan

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Abstract: The article presents the results of the chemical and physico - mechanical properties of silicate brick based on calcite – whiteite binders. The results of the mineralogical composition of marl and the temperature of the heat treatment of calcareous – calcite binders (LBB) are presented. General technology for producing silicate products.

Keywords: quartz sand, marl, lime, cement, Portland cement, binders, lime-belite, autoclave

Introduction. Silicate materials and products are unfired materials and products based on mineral binders' asbestos-cement, gypsum, silicate (based on lime) and magnesia with aggregates (quartz, sand, slag, sawdust, etc.) their areas of application are extremely extensive - from bearing and enclosing structures to finishing buildings and construction. Silicate materials and products are unfired materials and products based on mineral binders' asbestos-cement, gypsum, silicate (based on lime) and magnesia with aggregates (quartz, sand, slag, sawdust, etc.) their areas of application are extremely extensive - from bearing and enclosing structures to finishing buildings and construction.

Silicate products are obtained as a result of the formation of subsequent autoclave treatment of a mixture of lime or other binders based on fine silica additives, sand and water. The general technology for obtaining silicate products usually consists of the following stages:

1. Obtaining a raw mixture
2. Pressing products
3. Processing products in an autoclave
4. Holding finished products.

Silicate concrete products are commonly called artificial stones molded from homogeneous mixtures of quartz sand, binder and water, which are taken in strictly defined quantities and treated with saturated water vapor at a pressure of at least 0.8 MPa. Various building materials are made from silicate concrete - bricks, blocks and panels for external and internal walls of residential and industrial buildings, floor slabs, heat-insulating and facade slabs.

It is possible to increase the production volumes of wall materials through the wide involvement in the production of local mineral raw materials, such as local marls. For the production of autoclave building materials, various binders are used, including lime-cement binders, for which Portland cement is preferably used with a maximum content of belite and a minimum content of aluminate and aluminoferrite minerals, which is due to the specificity of hardening of mineral binders during autoclave treatment [1, 2].

From our previous experiments, it was found that the optimal characteristics of autoclaved samples are obtained using lime-belite binder (LBB) by firing chalk marl at a temperature of 1000˚ C [3, p.471; 4, p.29-31].

Material and Methods. In this work, as a binder for autoclave hardening, a lime-belite binder (LBB) was studied, which was obtained by high-speed firing of chalk marl from the Ustyurt deposit of Karakalpakstan with the following mineralogical compositions, %: SiO_2 – 20,5; R_2O_3 – 3,87; CaO -38,65; MgO – 1,34; l.d.c. – 35,46; hydraulic activity - 116 mg CaO.

Lime-belite binder was obtained on a sintering machine by high-speed firing of a mixture of granular marl and crushed solid fuel (14% of the mass of the charge) brand A III Q p/h =5200 kcal/kg. Clinker (CaO_{free} - 1.1%) was crushed to a specific surface Ssp=350 m²/kg. The activity of the calcium lime used in the

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experiments was 89%. [5, p.101-103; 6, p.174-178]. Samples (2x2x2 cm) were molded by casting (W/H-0.35). Autoclave processing mode 2+6+2 hours at a pressure of 0.8 MPa and a temperature of 174.5˚C.

Results. The composition was studied: LBB - quartz sand - water. The optimal amount of sand in mixtures was determined: CaO - quartz sand - water, as well as LBB - quartz sand - water. In the lime–quartz sand–water system, the amount of CaO was varied from 20 to 35% with an interval of 5%, and in the system IBV–quartz sand–water, the content of LBB was varied from 70 to 85% with an interval of 5%. Samples made with 25% calcium lime and 75% ground quartz sand showed a maximum strength of 11.8 MPa. In mixtures of LBB - quartz sand - water, the highest strength - 12.9 MPa had samples in which there was 80% LBB and 20% quartz sand.

In the LBB–CaO–quartz–water system, the CaO content was varied from 10 to 60% with an interval of 10%. Quantity of quartz sand was calculated from previously established compositions in systems LBB - quartz sand and CaO - quartz sand. The maximum strength - 12.4 MPa was found in samples of lime-belite binder (80% LBB + 20% lime) with the optimal amount of quartz sand - 46%. The optimal content of sand in other mixtures of IBV has been established. The density of the samples varied within 1500-1700 kg/m³.

Thus, studies of LBB under hydrothermal conditions show that autoclave treatment contributes to an increase in strength due to the intensification of the formation of hydrocompounds. In the conditions of a plant of building materials based on LBB, obtained by heat treatment at 1000 ° C and with an exposure of 90 minutes, marls from the Ustyurt deposit and quartz sand from the Nukus deposit, a pilot batch of silicate brick was produced.

After mixing LBB with sand, the mixture was loaded into an SMS-152 molding machine and steamed in an AT 2x17 dead-end autoclave at a pressure of 0.8 MPa. The duration of the cycle was 11 hours. 10 hours after extraction, the brick samples were tested for bending and compression on a ZIM-P-125 hydraulic press. [7, p. 223-225; 8, p. 67-74]. The physical and mechanical properties of silicate brick were determined according to GOST 379-95, the results are shown in table 1.

Table 1

Results of studies of the physical and mechanical properties of silicate brick based on LBB

№	Composition of the mixture, %			Water absorption %	Bulk density	Ultimate strength, MPa	
	LBB	sand	water			bending	for compression
1	0	90	8	11,3	1738	3,12	11,3
2	0	90	7,6	11,5	1743	3,90	11,6
3	5	85	8	12,2	1750	4,30	12,4
4	5	85	7,9	11,9	1747	4,46	12,8
5	0	80	7,7	13,5	1656	4,12	12,7
6	0	80	7,5	10,5	1678	4,30	12,9

Discussion. According to GOST 379-95, the samples of brick tested for compression correspond to grade 100-125. The density of the samples varied within 1500–1700 kg/m³.

It should be noted that the released silicate brick is one of the types of products based on LBB, because. on its basis, it is possible to obtain other silicate products (blocks, cellular concrete, etc.) that are not inferior in their properties to products obtained on the basis of other binders.

Summarizing the results of the study, we can conclude that lime-belite materials based on local chalk marls, in particular, the Ustyurt deposit of Karakalpakstan, are an effective binder for the manufacture of high-strength autoclaved silicate products.

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