INVESTIGATION OF THE STRUCTURE, COMPOSITION AND PHYSICO-CHEMICAL PROPERTIES OF BENTONITE

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The traditional raw materials for the production of ceramic products with a dense shard are refractory and refractory hydrosludistokaolinite clays, mainly deposits of Ukraine. Due to the collapse of the former Soviet Union and the formation of an independent Republic of Uzbekistan, the supply of refractory refractory clays from the CIS countries has become more complicated and the scarcity of these clays for the production of ceramics for various purposes has increased. In this regard, the study of the possibility of using new raw materials, in particular, bentonite, in the production of ceramic products is of urgent importance.

This work is devoted to the study of new sources of local raw materials for the production of fine ceramic products – montmorillonite (bentonite) clays of Uzbekistan, because there are huge deposits of such clays. Several deposits of alkaline and alkaline-earth bentonites of volcanogenic-sedimentary type have been explored and developed: Azkamarskoye with reserves of 6.5 million tons, Kattakurganskoye with reserves of 25.6 million tons, Darbazinskoye - 44.8 million tons, Kelesskoye -29.7 million tons, and a number of manifestations are also known [1]. There are many dilute deposits of bentonite clays, which are used in a wide variety of industries, mainly in the production of building materials.

The high dispersion of bentonite clays provides them with significant plasticity. These properties of clay are related to the mineralogical composition, where the main clay-forming mineral is montmorillonite, which occurs in the form of small particles.

Bentonite clay from the Navoi deposit has been studied as an affordable high-plastic raw material for ceramics.

Clay is a representative of widespread alkaline earth bentonite clays of Uzbekistan. Bentonite clay has a yellow color, an earthy knot, and is characterized by a low amount of coloring oxides compared to other deposits.

Table 1 shows the chemical composition of bentonite clay of the Navoi deposit.

Table 1
Chemical composition of Navoi bentonite clay

Sample number	Content of oxides, wt. %								
	П.п.п	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2
1	5,13	66,24	16,92	2,61	1,64	1,51	1,95	3,22	0,81
2	4,23	61,55	14,60	3,65	8,66	2,61	1,82	2,23	0,65
3	4,56	65,76	15,58	3,78	3,36	2,32	1,90	2,70	0,80

The high content of SiO2 in the chemical composition of clay indicates its sandiness. The high content of alkaline oxides indicates a significantly high content of hydroslude, in addition, a high content of K2O compared to Na2O is characteristic of many samples of bentonite clays in the region [2]. The content of coloring oxides slightly exceeds the requirements of technical specifications. The high content of oxides of alkaline earth elements is the result of filling the clay exchange complex with Ca and Md ions.

Diffraction maxima of illite (d/n) were detected on the bentonite clay X-ray = 1,019; 0,501; 0,373; 0,334; 0,256; 0,247; 0,239; 0,223; 0,198; nm), montmorillonite (d/n = 1,377; 0,449; 0,303; 0,257; 0,229 nm), quartz (d/n = 0.475; 0,425; 0,334; 0,247; 0,229; 0,223; 0,213; 0,201; 0,199; 0,198; 0,181 nm), albita (d/n = 0,590; 0,406; 0,308; 0,373; 0,355; 0,334; 0,322; 0,296; 0,239 nm), oligoclase (d/n = 0.647; 0.451; 0.406; 0,318; 0,257; 0,251; 0,229; 0.,82 nm), kaolinite (d/n = 0.700; 0.350; 0.255; 0.239 nm), anorthite (d/n = 0,406; 0,381; 0,318; 0,296; 0,251; 0,213; 0,201 nm) and others. The intensity of the lines is quantitatively dominated by hydrosludes and quartz.

The thermogram of bentonite clay revealed the first deep endothermic effect at a temperature of 1300 ° C. The first endothermic effect is followed by a slight bend on the curve. The first endothermic effect corresponds to the release of layered minerals in the interpackage water, the weak bending detected at 265oC after the first endoeffect is due to the predominance of divalent cations in the absorbed montmorillonite complex. At a temperature of 555 °C, a second endothermic effect is observed, caused by the loss of hydroxyl water and modification changes in the quartz present. At a temperature of 935oC, there is a weak exothermic effect associated with the recrystallization of amorphous decomposition products.

To obtain a more complete characteristic of Navoi bentonite clay, a complex of physicochemical and technological properties was studied, as a result of which the following results were obtained: clay density - 2.50 g/cm3; volume weight – 1.8 g/cm3; swelling – 150-200%; plasticity number – 35; colloidality up to 60%; water absorption – 14.5-15.7%.

Binding capacity at a ratio of bentonite and sand 1:3 = 2.1÷3.0 MPa. Granulometric composition of clay: the content of particles with a size of <0.001 mm to 63%; particles with a size of 0.01-0.005 mm is 9.2–31.3%.

In order to study the physical and mechanical properties of the burnt samples, we studied the resistance of the latter to compression and bending stresses. The results obtained are shown in Table 3.2. As expected, the mechanical strength of the samples is in a certain dependence on the ceramic-technological properties of the samples. In all prototypes, the mechanical strength values gradually increase with an increase in the firing temperature and the percentage of quartz. This dependence is more clearly expressed in the values of mechanical strength during bending. However, the mechanical strength of the samples at a temperature of 1100 ° C is somewhat reduced.

Table 2

Ceramic-technological properties of bentonite from the Navoi deposit

Name of indicators	After drying	Firing temperature, ^{0}C				
		950	1000	1050	1100	1150
Fire shrinkage, %	-	9,76	10,68	10,10	9,86	9,05
Water absorption, %	-	6,96	3,32	4,82	8,46	12,5
Apparent density g/cm3	-	1,69	1,84	1,75	1,61	1,33
Mechanical bending strength, MPa	-	30,42	32,70	30,48	21,03	8,28
Open porosity, %	-	18,95	12,92	14,27	17,88	24,82

As can be seen from the data in Table..2, the nature of the shrinkage change changes somewhat as the firing temperature increases. At a temperature of 950-1000oC, the values of density and mechanical strength have a maximum value. Therefore, we can say that the optimal firing temperature of bentonite from the Navoi deposit is 1000oC.

Thus, Navoi bentonite clay is polymineral with a predominance of hydroslude and quartz. According to the number of plasticity, it refers to highly plastic clays. In the chemical composition of clay, the content of chromogenic oxides slightly exceeds the requirements of the technical specifications for bentonite clays for fine ceramics.

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