INVESTIGATION OF THE PROPERTIES OF CLAY OF KULANTOBINSKY (ALMATY REGION) AND SOYUZNOE (AKTYUBINSK REGION) DEPOSITS IN THEIR FITNESS FOR THE PRODUCTION OF WALL CERAMICS

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Abstract: *this article is devoted to the investigation of the technological properties of the clays of the Kulantobinsky and Soyuznoe fields in order to determine their suitability for the production of wall ceramic products. Mineralogical and granulometric compositions of clays, plasticity, binding capacity of clay raw materials, as well as linear shrinkage and caking were studied.*
Keywords: *clay raw materials, granulometric composition, linear shrinkage, mineralogical composition, refractoriness, plasticity, binding capacity, sinterability.*

At the moment, the production of building ceramic bricks focuses on improving technology, improving the quality of products and expanding the range. Improving the quality of products necessitates an increase in the production culture, stricter compliance with technological parameters for all redistribution, improved processing, rational blending by introducing various additives, including expanding the raw material base. The purpose of this work was to study the possibility of using the clays of Kulantobinsky (Almaty region) and the Union (Aktobe region) deposits in the production of wall ceramic products. The accuracy of assessing the quality of clay raw materials largely depends on the correct selection of the average sample. The selection of an average sample for physical-mechanical and ceramic studies was performed by quarting [1]. To do this, the clay was spread a thin layer on an area of 1 m2, large clods were smashed with a wooden hammer, after which the clay was divided by two diagonals into four equal triangles. A sample was taken from two opposite triangles, thoroughly mixed, spread in a thin layer and divided again diagonals on four triangles. The quarting operation was repeated several times until an average sample of raw materials was obtained in the amount required for physico-mechanical research. The remaining clay was also considered averaged.The following types of clays were used in this work: Kulantobinsky (Almaty region) and Soyuznoe (Aktobe region) deposit.

Table 1. Mineral composition of clays in Almaty region

№	**Name of deposit**	**Mineral composition**					
		Montmorillonite	**Mica**	**Kaolinite + chlorite**	**Quartz**	**Feldspar**	**Other minerals**
1	Kulantobinsky №1 (8,7-14,1m)	40	7	2	48±6	3±1	-
2	Kulantobinsky №2 (8,7-15,1m)	43	5	2	46±6	4±1	-

For macroscopic description of clay raw materials, 2 samples were taken from different depths of the quarry. All samples were mixed by shoveling, and an average sample was taken from the averaged sample for macroscopic examination and evaluation of the structure and texture.

Table 2. Macroscopic description of clay raw materials

№	**Name of the raw material**	**Color in dry condition**	**Structure**	**The presence of limestone and its distribution (Sample 10% HC1)**	**Content of other impurities**
1	Kulantobinskaya clay Well # 1	brown	Lumpy	Weakly effervesces (+)	MnO, Fe_2O_3
2	Kulantobinskaya clay Well # 2	brown	Lumpy	Rough effervescence (++)	MnO, Fe_2O_3
3	Soyuznoe clay	brown	Lumpy	Rough effervescence (++)	MnO, Fe_2O_3,

The clay of the Kulantobinsky field of wells 1 and 2 has a color-brown, as well as the Soyuznoe field. Almaty clay: seamed raw materials of well No. 1 - with high and medium content of large inclusions, and well No. 2 - with low content (less than 1%). Inclusions mainly in the form of quartz and stony, carbonate.

By contamination with natural inclusions (less than 1%), the Soyuznoe deposit raw material belongs to the group with small quartz, carbonate, and ferruginous differences. Further, the content of sand particles was determined. The results of the analysis are presented in Table 3.

Table 3. Determination of the granulometric composition of clays according to Rutkovsky

Name of the raw material	**Type of clay according to the diagram Okhotina**
Kulantobinskaya clay Well # 1	loam
Kulantobinskaya clay Well # 2	clay
Soyuznoe clay	clay

According to the granulometric composition, according to the number of sandy, clayey and dusty particles in the sample of well No. 1, according to the diagram Okhotina refers to loam (the number of sand fractions is 33%, silty - 53.7%, clay - 13.6%); The clay of well No. 2 refers to clay (the amount of sand fractions - 0.5%, dusty - 1%, clay - 98.5%).

According to the diagram, Okhotin Allied clay refers to clays (sand fractions - 0.58%, dusty - 1%, clay- 98.42%.). Determination of the plasticity of clay raw materials was determined in accordance with the difference between the upper and lower limits of the plastic clay state, estimated by moisture[2].

The results of determining the plasticity of clays are shown in Table 4.

Table 4. Basic indicators for determining the plasticity of clays

Indicators	Values
Kulantobinskaya clay Well # 1	
The upper plasticity limit φ1 (%)	23,2
The lower plasticity limit φ2 (%)	12,8
Plasticity P	10,5
Classification of clay by the number of plasticity	Moderately plastic
Kulantobinskaya clay Well # 2	
The upper plasticity limit φ1 (%)	29,9
The lower plasticity limit φ2 (%)	16,4
Plasticity P	13,6
Classification of clay by the number of plasticity	Moderately plastic
Soyuznoe clay	
The upper plasticity limit φ1 (%)	26,8
The lower plasticity limit φ2 (%)	17,5
Plasticity P	9,4
Classification of clay by the number of plasticity	Moderately plastic

Tests to determine the plasticity of clay raw materials according to the plasticity number showed (Table 4) that all clays studied were calculated according to the plasticity number of 10.5; 13.6 and 9.4 refer to moderately plastic clays.

The next stage of the work was devoted to the study of the binding capacity of clay raw materials, which is expressed by the compressive strength of specimens molded in a plastic way in the form of cubes and dried in a drying cabinet at a temperature of 105°C.

To determine the binder capacity from the normal humidity test, cubes of 50 × 50 × 50 mm were molded by a plastic method and dried under normal conditions room conditions with drying in an oven at a temperature of 105-110 ° C. Then the cubes were tested on a laboratory hydraulic press. The test data for determining the binding capacity of clays are given in Table 5.

Optimum values for Rc = 45 - 50 kgf / cm2, for Ras = 16 - 19 kgf / cm2 for ceramic products.

Table 5. Determination of the binding capacity of clay raw materials

Name of raw materials	Dimensions of the	Area S,	Load according to the	Strength for axial

	dried sample, cm		cm2	gauge of the hydraulic press, kgf	compression, MPa
	h	d			
Kulantobinskaya clay Well # 1	2,64	2,34	4,31	151	4,6
Kulantobinskaya clay Well # 2	2,65	2,28	4,07	235	5,9
Soyuznoe clay	2,67	2,27	4,05	155	3,9

The results of the test showed that the binding capacity of clay raw materials on the clays of Kulantobinsky (well # 1, 2), the Soyuuznoe deposit of deposits is 4.6 MPa, 5.9 MPa and 3.9 MPa, respectively.Further studies were devoted to determining the sensitivity of clays to drying by the method of Chizhsky. The results of determining the sensitivity of clays to drying by the method of Chizhsky are given in Table 6.

Table 6. Determination of clay sensitivity to drying by the Chizhsky method

№	Name of raw materials	Forming humidity,%, abs.	Classification of sensitivity to drying
1	***Kulantobinskaya clay Well #1***	16,08	Insensitive
2	***Kulantobinskaya clay Well #2***	24,10	Insensitive
3	***Soyuznoe***	25	Highly sensitive

The next stage of the work was devoted to determining the air shrinkage of samples from clay.Air linear shrinkage was determined from changes in the linear dimensions of the clay samples after drying. Determination of shrinkage was carried out on tiles 50x50x5 mm in size with plastic molding. To produce a measurement on the molded samples, two diagonals were marked. The test results are listed in Table 7.

Table 7. Determination of linear shrinkage

№	Name of raw materials	Moisture content,%	Linear shrinkage,% After drying at t = 105 ° C
1	***Kulantobinskaya clay Well #1***	16	6,3
2	***Kulantobinskaya clay Well #2***	21	7,4
3	***Soyuznoe***	25	7,9

The experimental results showed (Table. 7) that the value of the linear shrinkage after drying at a temperature of 105 ° C at Kulantobinsky clay deposit wells №1 and №2 (6,3 and 7,4%) and the Federal clay (7.9%), respectively .

Refractoriness of the material corresponds to the temperature at which the tip of the test specimen, when lowered, touches the support. According to the classification of clay raw materials make a conclusion about fire resistance.

All clays investigated by us are fusible, which completely satisfies the requirements of GOST for clays for the production of ceramic bricks [3].

Determination of the sinterability of clays was carried out on 50 × 50 × 5 mm tiles baked at specified temperatures. Water saturation occurred for 48 hours at the water level above the top of the samples is not less than 2 *cm.* Samples saturated with water were wiped off with a damp cloth before weighing.

The water absorption was calculated as the arithmetic mean of the results of the determinations for the three samples. The results of the determination of clay sintering are given in Table 8.

Table 8. Determination of caking of clays [4, 360]

Name of raw materials	The name of indicators	Firing temperature, ºC			Classification of raw materials By degree of sintering
		950	1000	1050	
Kulantobinskaya clay Well #1	Water absorption,%	9,60	9,54	9,53	Non-caking
	Density, g / cm ^{3}	2,206	2,207	2,214	
Kulantobinskaya clay Well #2	Water absorption,%	10,19	9,73	8,93	Non-caking
	Density, g / cm ^{3}	2,196	2,198	2,201	
	Density, g / cm ^{3}	1,87	1,89	1,96	
Soyuznoe	Water absorption,%	11,59	10,13	9,56	Non-caking
	Density, g / cm ^{3}	1,88	1,9	1,93	

	Density, g / cm^3	2,15	2,14	2,132	

As can be seen from the results of tests of clays for sintering (Table 8), all clays in the degree of sintering are non-caking.

Thus, the carried out researches on technological properties have shown, that all investigated clays can be used at manufacture of ceramic wall products.

References

1. GOST 21216.0-93 Raw clay. General requirements for analysis methods. Date of introduction 01.01.95.
2. GOST 21216.1-93 Interstate Standard. Raw clay. Method for determining plasticity. Clay raw materials. Method for determination of plasticity. GOST 21216.1-93. Date of introduction 01.01.95.
3. GOST 9169-59 Clay raw materials for the ceramic industry. Date of introduction 01.07.76.
4. *Geguzin Ya.E.* / Physics of sintering / M.: Nauka, 1967. 360 p.