COMPARATIVE STUDY OF PHYSICAL AND TECHNICAL PROPERTIES OF BENTONITE CLAY POWDERS VARIOUS DEPOSITS

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Annotation. This article presents the results of studies on the comparative study of the physical and technical properties of some samples of bentonite clay powders used as a plasticizing clay component and a binder in the preparation of drilling fluids, molding sands and sorbents for industrial wastewater treatment. Based on the results of the experiment, it was found that the modification of the alkaline earth form of bentonite clay with soda ash improves the basic physical and technical properties of bentonite clay.

Key words: bentonite, clay, mineral, montmorillonite, clay powder, solution density, solution output, plasticity, viscosity.

Introduction. The study of the chemical and mineralogical composition and the study of physical, technical and technological characteristics, the development of effective methods and technologies for the complex processing of bentonite clays and the production of new materials using them is one of the topical areas of research scientists. it is necessary to substantiate the following scientific solutions: physical and chemical compositions, increasing the swelling coefficient, establishing indicators of optimal methods for activating and modifying bentonite clay samples; determination of the influence and selection of various modifying additives to improve the functional properties of compositions based on bentonite clays; establishing a functional relationship between the composition, as well as the conditions for activation, modification and the main properties of the developed compositions.

So far, scientists from various countries have carried out comprehensive studies on the study of bentonite clays in a number of priority areas, including: obtaining activated and modified bentonites by various methods and substances, obtaining a commercial product with specified technical, operational and quality indicators; development of technology for obtaining new products based on bentonite clay; determination of physical, technical and operational indicators of the obtained new materials.

Research methodology. The work used standard physical and technical methods, test procedures according to the API standards system.

Experimental part. Bentonite is a finely dispersed clay, consisting of at least 70% smectite group minerals (montmorillonite, beidellite, nontronite, saponite, and hectorite), which have a high binding capacity, thermal stability, as well as adsorption and catalytic activity. This definition of bentonite reveals the general distinctive and technical properties of bentonite, which have been identified and established by research scientists relatively recently [1-6].

It has now been established that bentonite is a rock that mainly consists of smectite minerals, the group of which includes the following minerals: montmorillonite, beidellite, nontronite, and other less common ones. The crystal lattice of all smectites consists of layers. The unit cell includes three layers that form a package: the extreme upper and lower layers of the package consist of Al and SiO4 tetrahedra and are called tetrahedral. Between the tetrahedral layers there is a layer consisting of Al and Fe octahedra, called octahedral [7-8].

By genesis, montmorillonite is formed mainly in exogenous conditions - in an alkaline environment rich in bases, especially Mg, in the absence of noticeable amounts of K-montmorillonite is distinguished by a variety of methods and conditions of formation - it is formed in sedimentary, volcanic, metamorphic rocks, in soils, in deposits near hot springs [9-10].

Preliminarily, the presence of montmorillonite in the composition of clays can be determined by strong swelling upon hydration with water or other liquid solutions. In the process of hydration, the montmorillonite mineral, swelling, increases in volume several times. With dehydration, i.e. removal of moisture (water), montmorillonite acquires a powdery bulk form. This is a typical weathering product of aluminosilicates of basic igneous rocks under alkaline conditions. Montmorillonite is widely developed in the weathering crust of diabases, basalts, gabbro, and peridotites [11–12].

The main montmorillonite-bearing rock is bentonite clay, in which the mineral montmorillonite contains at least 70%. Currently, bentonite clays are widely used in more than 200 areas: in the preparation of drilling fluids, as a binder in the composition of molding sands, as a plasticizing component in the ceramic industry, as the main component in the production of various types of sorbents for cleaning oils, industrial waste water, in the food industry, in pharmaceuticals, etc.

Studies to determine the quality characteristics and physical and technical indicators of samples of bentonite clay powders were carried out in the testing laboratory of Bentonite LLC.

The following bentonite clay powders were chosen as the object of research:бентопорошок для производства хромитовых окатышей, произведенный из бентонитовой глины “10-хутор” (Россия);

- Bent powder from the Ibata deposit (Kazakhstan);
- Bent powder from the Vaush deposit (Uzbekistan);
- benton powder brand PBG, made from bentonite clay deposits "Navbakhor" (Uzbekistan);
- bentopowder brand PBMB, made from bentonite clay Navbakhor field (Uzbekistan).

Based on the existing equipment of the factory testing laboratory of Bentonite LLC, preliminary tests of the above samples of physical and technical indicators were carried out according to standard methods (Table № 1):

Table № 1

Physical and technical indicators of samples of various benthopowders

Name of sample of bento powder	The density of the solution according to GOST 26796-83, in g/cm^3	Viscosity according to Ts 18263094-01: 2017, in sec	Solution yield according to Ts 18263094-01: 2017, m^3/t
Bent powder from the 10-Khutor deposit	1,045	25	14,0
Bent powder from the Ibata deposit	1,3	25	2,1
Bent powder brand PBG	1,074	25	8,5
Bent powder brand PBMB	1,035	25	18,0
Bent powder from the Vaush deposit	1,20	25	3,15

To establish the optimal comparative composition of the composition for obtaining chromite brex based on aspiration dust PC4 AktZF with the addition of benthic powders of the above samples, several experimental formulations were compiled (Table№2):

Table № 2

Compositions of experimental compositions for obtaining brex based on aspiration dust PTS4 AktZF with the addition of samples of various benthic powders

Sample name	Designation of the experimental composition and the content of the component in%				
	SX-6	SI-6	CNS -6	SNM-6	SV-6
Aspiration dust ПЦ4 AktZF	94	94	94	94	94
Bent powder produced by Bentonit Khakassia LLC	6	---	---	---	---
Bent powder from the Ibata deposit	---	6	---	---	---
Bentopowder brand PBG, produced by LLC "Bentonite"	---	---	6	---	---
Bent powder brand PBMB, produced by LLC "Bentonite"	---	---	---	6	
Bent powder from the Vaush deposit	---	---	---	---	6

Taking into account the small number of samples submitted for laboratory testing of aspiration dust (± 1.2 kg) and bento powder of Khakass bentonite (± 1.5 kg) and the Ibata deposit (± 1.0 kg), laboratory tests were carried out only at the same ratios of aspiration dust (94 wt.%) and bentonite powders 6 wt.%), 300 g of each experimental composition, which consumed 1.120 kg of aspiration dust). Therefore, when conducting laboratory tests, it was necessary to confine ourselves to the preparation and conduct of an experimental composition with the introduction of bentopowders only in 6 wt.%.

From the indicated experimental compositions of the compositions with the addition of water, masses of plastic consistency were prepared in an amount of 300 g, which, after aging for 1 hour, were molded into samples of an elongated cylindrical shape by manual extrusion.

Table No. 3 shows the results of obtaining brex based on aspiration dust PC4 AktZF with the addition of samples of various benthic powders.

In the process of extrusion, samples with a diameter of 7 mm from the experimental composition **SX** -6, CIS-6, SNM-6 and SV-6 with the addition of benthop powder from the 10-Khutor deposit, grade PBMB and benthop powder from the Vaushskoye deposit turned out to be longer in appearance , dense plastic structure, without defects, with clear edges, without delamination and preservation of the cylindrical shape given by extrusion. A sample of the composition SI-6 with the addition of bento powder from the Ibata deposit in the process of molding by extrusion turned out to be short in length relative to the previous experimental compositions, had molding defects, could not withstand its own weight and was separated into parts.

Table № 3

Visual characteristics of test specimens of cylindrical shape for obtaining brex based on aspiration dust PC4 AktZF with the addition of samples of various benthic powders

Name of the experimental composition	**View during extrusion**	**Sample condition**	**View after natural drying**	**Condition of dried samples**
Samples from CX-6		Dense in structure, plastic, without defects		Smooth, even surface, durable, break when broken, no cracks
Ltd. (with the addition of Bentonite Khakassia powder)		Uneven in structure, with frequent rupture, with molding defects in the form of voids and delamination.		There are cracks; when broken, they break relatively easily into pieces

Samples from SI-6 (with the addition of benthic powder from the Ibata deposit)		Dense in structure, plastic, without defects		Smooth, flat surface, durable, break when broken
Samples from the CIS-6 (with the addition of PBG grade benton powder, manufactured by Bentonite LLC)		Dense in structure, plastic, without defects		Smooth, flat surface, durable, break when broken
Образцы из СВ-6 (с добавкой бентопорошка “Ваушского” месторождения)		Dense in structure, continuous plasticity, no defects		Smooth, even surface, no cracks after drying, durable, breaking when broken

Conclusion. Based on the results of laboratory tests to determine the main physical and technical indicators and establish the possibility of obtaining brex based on aspiration dust PC4 AktZF with the addition of samples of various benthic powders, we can conclude the following.

The high content of clay minerals in the composition of bentonite powders, primarily the presence of montmorillonite (Na,Ca)0.3(Al,Mg)2[Si4O10](OH)2 nH2O, a mineral from the group of smectites of the subclass of layered silicates, providing a binder and plasticizer properties, as well as high viscosity.

The low content of clay minerals, namely montmorillonite, in the composition of the bentonite powder of the Ibata deposit does not make it possible to obtain high-quality and mechanically strong brex from aspiration dust by extrusion. Traditionally, in practice, for the transfer of Ca-forms (alkaline-earth, characterized by low plastic properties, less plastic, with the ability to swell an average of 3-5 times) bentonites to Na-bentonites (alkaline, which are significantly plastic, with an average swelling ability of 8 -14 times). For this, soda ash (Na2CO3) is usually used in an amount of 1.0-3.0%.

Soda ash modification of bentonite from the Ibata deposit did not give the expected results. Modification of bentonite of the Ibata deposit cannot be modified by treatment with various

sodium-containing reagents, and therefore plasticizing and binding properties are not improved.

On the basis of the results obtained, it is recommended to use as a binder during the extrusion process benthic powders from the 10-Khutor deposit, grade PBMB and benthic powder from the Vaushskoye deposit or similar in chemical-mineralogical composition and physical and technical indicators.

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