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DEVELOPMENT OF A TECHNOLOGY FOR THE PREPARATION OF LIGHT-DENSITY DRILLING MUD BASED ON THE STUDY OF THE COMPOSITION AND PROPERTIES OF LOCAL BENTONITES

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Abstract. The article considers the scientific significance of the results of the study is to establish the chemical and mineralogical compositions and physico-chemical properties of bentonite compositions, as well as to identify the composition and properties of Navbakhor bentonites and Palygorskites and Shorsuv hydrosludes. The practical significance of the research results lies in the development of technology for producing clay compositions for drilling fluids based on local bentonites, palygorskites and hydrosludes.

Keywords: drilling mud, chemical and mineralogical composition, physico-chemical properties, composition of bentonites, composition of Navbakhor bentonites, properties of Navbakhor bentonites, palygorskite, hydrosludes, clay composition

Аннотация. В статье рассматривается научная значимость результатов исследования, заключающаяся в установлении химического и минералогического составов и физико-химических свойств бентонитовых композиций, а также в выявлении состава и свойств навбахорских бентонитов, палыгорскитов и шорсувских гидрошламей. Практическая значимость результатов исследований заключается в разработке технологии получения глинистых композиций для буровых растворов на основе местных бентонитов, палыгорскитов и гидрошламей.

Ключевые слова: буровой раствор, химико-минералогический состав, физико-химические свойства, состав бентонитов, состав навбахорских бентонитов, свойства навбахорских бентонитов, палыгорскит, гидрошламы, глинистый состав.

Annotatsiya. Maqolada tadqiqot natijalarining ilmiy ahamiyati bentonit kompozitsiyalarining kimyoviy va mineralogik tarkibi va fizik-kimyoviy xususiyatlarini aniqlash, shuningdek Navbaxor bentonitlari va Palygorskitlari va

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Shorsuv gidrosludiyalarining tarkibi va xususiyatlarini aniqlashdan iborat. Tadqiqot natijalarining amaliy ahamiyati mahalliy bentonitlar, paligorskitlar va gidroslyudalar asosida burg'ulash suyuqliklari uchun loy kompozitsiyalarini ishlab chiqarish texnologiyasini ishlab chiqishdan iborat.

Kalit so'zlar: burg'ulash loyi, kimyoviy va mineralogik tarkibi, fizik-kimyoviy xossalari, bentonitlarning tarkibi, "Navbahor" bentonitlarining tarkibi, "Navbahor" bentonitlarining xossalari, palygorskit, gidroshlyuzlar, loy tarkibi

I. INTRODUCTION.

All over the world, work is being carried out on the exploration of oil and gas deposits, as well as their development and exploitation, taking into account the structure of wells and drilling depth. Therefore, it is of great importance to create new types of drilling fluids using local clay minerals, chemical reagents, and stabilizing additives from synthetic and natural materials. Of all types of drilling fluids, clay drilling fluids are used the most and in the largest volume. Currently, three groups of clay minerals deserve great attention in the drilling process: bentonite (montmorillonite, beidellite, nontronite, saponite, etc.), kaolinite (kaolinite, halloysite, nacrite, etc.) and hydromica (illite, brawnsite, etc.). From the point of view of preparing drilling fluids, montmorillonite and other bentonite materials have the best quality [1].

If the drilling fluid has sufficient stability and does not form sediment when used, but retains its properties, it can be used in the drilling process. However, excessive or insufficient aggregate stability also does not lead to good results. In the first case, excessive pressure is created during the pumping of drilling fluids into the well, and in the second case, the holding properties are weak. Thus, sedimentation instability must be completely eliminated, and aggregate instability must be adjusted within the necessary limits.

At the present stage of development of technologies for drilling wells and oil and gas production, the main attention is paid to improving the processes of deep drilling in complicated conditions, where salt formations, rocks of solid minerals, etc. are overcome. Under these conditions, the temperature in wells rises above 200°C and reservoir water contains a lot of salt, especially chloride [2]. Such high mineralization of reservoir water destroys the stability of the drilling fluid, reduces its quality and thereby the efficiency of drilling operations. In addition, the unsatisfactory quality of the drilling mud leads to stoppage and emergency situations, which is more often observed when using clay solutions unstable to high temperatures and highly mineralized aqueous solutions [3].

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When drilling rotationally, a fluid flow constantly circulates in the well, which was previously considered only as a means for removing destruction products (sludge). Currently, it is perceived as one of the main factors ensuring the efficiency of the entire drilling process. When drilling operations are carried out, the liquid circulating in the well is commonly called-drilling mud or washing liquid.

Drilling mud, in addition to sludge removal, must perform other equally important functions aimed at efficient, economical, and safe execution and completion of the drilling process. For this reason, the composition of drilling fluids, the assessment of its properties, becomes the subject of a large volume of scientific and practical research and analysis [4].

During drilling, the equilibrium of the rocks composing the walls of the wells is disturbed. The stability of the walls depends on the initial strength characteristics of the rocks, their change over time under the influence of various factors. A big role here belongs to the flushing process and the flushing agent. The main task of flushing is to ensure an efficient well drilling process, which includes maintaining both the stability of the well walls and the core [5].

In conditions where the integrity of the rock is violated, mountain pressure plays an important role. In the barrel part of the well, it manifests itself both vertically and horizontally. Lateral pressure is a consequence of vertical pressure and causes tangential directions-contributing to the bulging of rocks, narrowing of the trunk and collapse. The magnitude of tangential stresses depends not only on the rock pressure, but also on the pressure of the washing liquid.

When drilling wells, the flushing fluid must circulate through a closed hydraulic circuit. Depending on the type of hydraulic circuit , all existing flushing systems are divided into two groups:

1) washing systems with solution output to the surface
2) flushing systems with downhole circulation.

Accordingly, drilling fluids must meet a number of requirements:

– perform the assigned functions;
– do not have a harmful effect on drilling tools and downhole motors (corrosion, abrasive wear, etc.):
– easy to pump and clean from sludge and gas;
– be safe for maintenance personnel and the environment;
– be convenient for cooking and cleaning;
– be affordable, inexpensive, allow for multiple use.

II. METHODS.

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The creation of thermo and salt-resistant clay drilling fluids can be carried out in the following areas:

-creation of high-quality compositions of dispersed systems based on thermo and salt-resistant natural mineral raw materials;

-based on thermo salt-resistant reagents of stabilizers obtained by chemical and technological methods.

Of course, the predominant development of the first direction is considered promising and economically justified. Moreover, this does not exclude the need for work in the second direction.

As noted earlier, palygorskite minerals showed higher resistance to the aggression of electrolytes of reservoir waters and salt deposits than montmorillonite minerals. This made it possible to significantly reduce the cost of expensive chemical reagents in obtaining stable drilling fluids [6].

Known heat-resistant reagents-stabilizers (polyelectrolytes) obtained by hydrolysis of polyacrylonitrile and polyacrylamide or their copolymers greatly overestimate the cost of drilling fluids and hydrocarbon production in general. In practice, the following reagents-stabilizers are used to protect clay solutions from the coagulating action of electrolytes: condensed sulfite-alcohol bard (CSAB), carbosimethylcellulose (CMC), starch reagent (SR), cellulose sulfoesters, etc.

A common disadvantage of these stabilizers is their susceptibility to temperature influences. On the contrary, reagents such as HYPAN, RS-2, RS-3, K-4 and others are more resistant to thermal effects on clay solutions [7]. The paper proposes a lignin-containing reagent for the treatment of drilling fluids and water-based buffer fluids. A distinctive feature of this reagent from the known ones is that it contains lignin with a humidity of 20-44%, an alkaline agent is a product of condensation of JK cotton soapstock with silicic acid sodium, etc.

III. RESULTS.

From the table. 1 it can be seen that alkaline and alkaline-earth bentonites mainly differ in the contents of TiO_2, MgO, Na_2O, K_2O_2, etc. More significant differences in chemical composition are observed between bentonites and carbonate palygorskite, where the latter has significantly less Al_2O_3, SiO_2, MgO and more CaO. When bentonites are sealed with water, it penetrates into the interlayer space of montmorillonite, hydrates it and causes swelling. When further diluted with water, bentonites form a stable viscous suspension with pronounced thixotropic properties. These bentonites are considered to be good viscous-gelling agents and filtration reducers in the preparation of drilling fluids for drilling wells [8].

Carbonate palygorskite of the Navbakhor deposit (Navoi region) is an aqueous magnesium aluminosilicate with the ideal formula R_5 [Si_8 O_2] $(OH)_2$.

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$(OH_2)_4$, $4H_2O$. The crystal structure of this palygorskite, which has a layered structure, resembles the structure of an amphibole and has zeolite-like channels of 6.4. 3.7 Å In size, two types of water are located in them: molecules that are freely placed and connected to the electronegative surface of the bases of tetrahedra, and molecules that have a connection with octahedral cations on the side walls of the channels. These molecules are removed from the latter at higher temperatures, as are the water molecules of zeolites [9].

Of course, if necessary, the formation of calcium bentonites into sodium ones can be performed by treating them with sodium salts. Today, in the Bukhara-Khiva and Ustyurt regions of Uzbekistan, drilling of oil and gas wells is carried out in saline formations. According to, it is advisable to use solutions for such drilling, mainly obtained using palygorskite clays (atapulgite), which are rich in CaO (Table 1).

Table 1

The content of chemical compounds in the composition of bentonites and palygorskite of the Navbakhor deposit (Navoi region)

Name of connections	Compound content, % per absolute dry matter		
	Bentonites		Carbonate palygorskite (attapulgite)
	alkaline	alkaline earth	
SiO_2	57,91	56,23	46,79
TiO_2	0,35	0,61	-
Al_2O_3	13,69	13,56	8,63
Fe_2O_3	%.10	6,50	-
MgO	1,84	3,76	2,74
CaO	0,48	0,69	10,08
Na_2O	1,53	0,98	-
K_2O	1,75	2,20	1,6
P_2O_3	0,43	0,92	1,99
SO_3	0,75	0,49	-
Fe_2O	-	-	3,41
P.P.P.	16,17	14,06	24,33
∑	99,98	99,95	99,75

The advantage of this reagent is that it is possible to use not only previously used brands of cotton and other types of lignins after pentose hydrolysis, but also more difficult-to-dissolve brands of lignins after hexose brews. Instead of the known stabilizing clay drilling fluids reagents CMC-600, K-4 and K-9, a composite polymer reagent is proposed, which consists mainly of caustic and soda ash and

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waste from the production of nitrogen fertilizers, which contains polyacrylamide [10].

Stronger ion binding enhances protection. Thus, protection is enhanced in two ways: by increasing the number of charges and by chemically strengthening the protective ions on the surface of the dispersed phase particles. It is known that most organic compounds are soluble in water.

Compared to inorganic compounds, organic compounds have a somewhat higher molecular weight. In these substances, carbon atoms; form bonds for the six-membered nucleus of benzene and other analogous constituent particles. The dissolution of these substances occurs due to the free dissociation of the phenol hydroxyl (OH), alcohol (CH_2OH), carboxyl (COOH) groups in their composition [11].

To increase their hydrophilicity, sulfo groups (SO2OH) are introduced into many such substances. The hydrogen of all of the above groups is replaced by sodium. Dissociation occurs as a result of dissolution in water. In this case, sodium ions are considered cations, and the highly hydrophilic residues of the molecules of organic compounds are anions.

As a result of the large number of groups mentioned above, these anions have a large electric charge, and as a result, their adsorption on the particles of the dispersed phase provides a significant increase in electrical protection. In a number of such substances, chemical fixation is also observed on the surface of the particles of the dispersed phase [12]. This is also an increase in protection. And finally, adsorbing on the surface of the particles, these substances form a strong adsorption shell that prevents coagulation.

The carbonate palygorskite of the Navbakhor deposit has more large fractions, compared with the alkaline and alkaline-earth bentonites of the same deposit (Table 2). The results are presented in table 2.

Table 2

Dispersed composition and specific surface area of alkaline, alkaline-earth bentonites and carbonate palygorskite Navbakhor deposit and hydrosluidic clay Shorsuvskoye field

Name of clay	Content of fractions, %			Specific surface area 10^3 м^2/kg
	less than 0,01 mm	less than 0,1 mm	less than 1,0 mm	

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Alkaline bentonite of the Navbakhor deposit (ABND)	80,2	18,9	0,9	305
Alkaline earth bentonite of the Navbakhor deposit (AEBND)	81,6	17,7	0,7	310
Carbonate palygorskite of the Navbakhor deposit (CPND)	76,5	21,4	2,1	286
Hydrosluidic clay of the Shorsuv deposit (HCSD)	82,7	16,2	1,1	295

This adsorption shell structure is called a mechanical barrier. Thus, these organic substances combine three protective factors: a large number of electric charges, chemisorption, and the mechanical strength of the protective barrier. Such a shell is less effective in preventing the accumulation of negatively charged particles around it, protecting them from coagulation. Therefore, such protection is called strong protection. The preservation of certain given properties under various conditions, despite various degrading effects, is called “stabilization” [13].

Table 3

Indicators of the heat of wetting and the amount of bound water in the clays of the Navbakhor and Shorsuv deposits

Name of clay	Wetting heat (Q), cal/g	Amount of bound water (A), %
Alkaline bentonite	25,8	33,54
Alkaline-earth bentonite	28,5	37,05
Carbonate palygorskite	19,5	25,35

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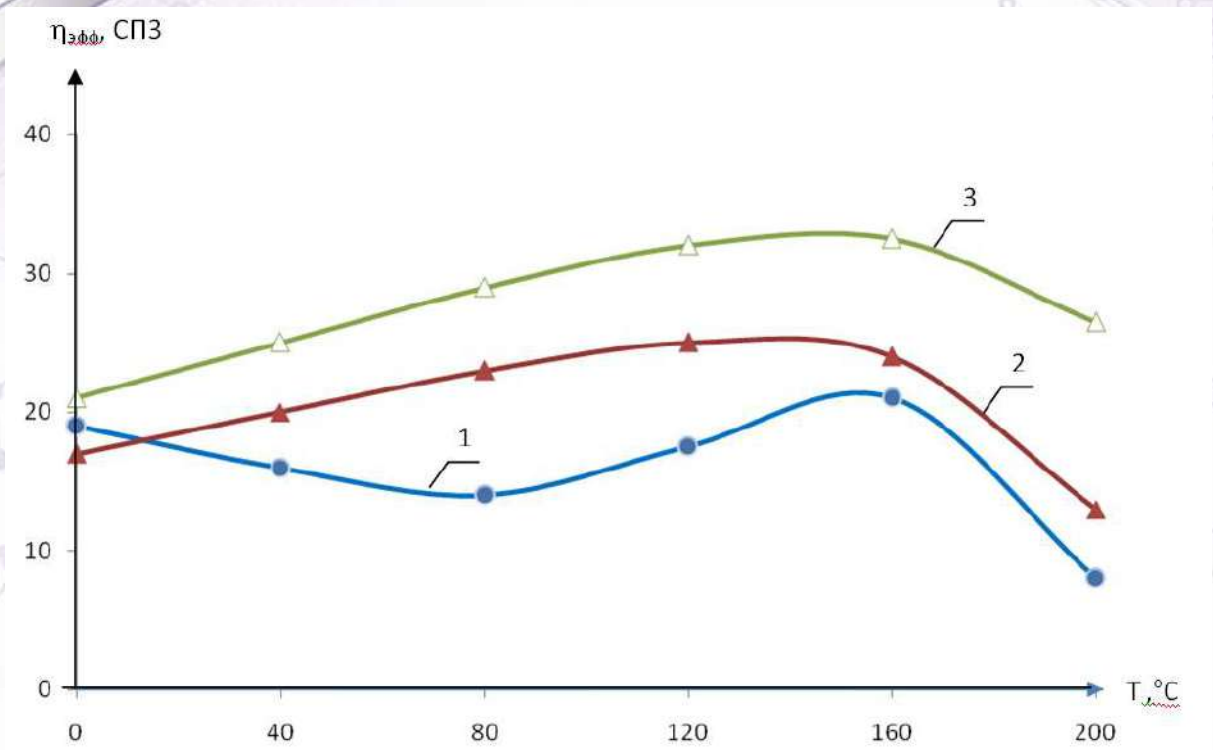


Figure 1. Change in the effective viscosity (η eff) of the clay solution depending on the temperature of its hydrothermal treatment: 1-for ShB NM; 2-for KP NM, 3-for the composition KP: SHB NM=50:50

Figure 1 shows that when using NM ShB and NM KP individually in a 10% aqueous suspension, their effective viscosity (ηeff) increases up to 1500C and then decreases significantly. This is explained by the fact that during hydrothermal treatment of NM ShB, a slight increase in its dispersion is observed and, simultaneously, a change in the submicroscopic region (from 69 to 105 Å) of heterogeneity occurs. Above 1500C, the number of crystals participating in the formation of coagulation structures decreases, which is reflected in a drop in the effective viscosity of the solution [14]. In the case of NM KP, elasticity and plasticity increase, as does the stability coefficient of the coagulation structure.

IV. DISCUSSION.

Substances that provide strong protection are called "stabilizers". Methods for preparing dispersed systems. There are two opposing methods for preparing dispersed systems. The first is dispersion, which is based on crushing large bodies to obtain a system of the required size. The second is condensation, which is based on increasing the size of particles of molecular size and forming a second dispersed phase [15].

Table 4

Indicators of swelling of bentonites and carbonate palygorskite Navbakhor deposit and hydrosluidic clay Shorsuvskoye field (ShF)

	Bentonite		

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Name of the swelling index	alkaline	alkaline-earth	carbonate palygorskite	hydrosluidic clay ShF
Degree of swelling (h), cm^3/g	1,398	1,425	1,235	1,321
Swelling time (τ), hour	762	776	675	689
Average swelling rate (ω_{cp}. 10^{-3}), cm^3/g. hour	1,720	1,735	1,689	1,578
Limiting shear stress (Pm), $g.s/cm^2$	125	121	127	122

Dispersion of an insoluble body differs from dispersion of a soluble body in that it is impossible to achieve the degree of molecular crushing. This is explained by two reasons. The first reason is determined by the stresses, moments of forces that destroy the body. In crushing devices, the magnitude of the forces is increased only up to a certain limit, therefore, the crushing must also be limited.

V. CONCLUSION.

The second reason is that with an increase in the specific surface area, the effect of the free interfacial energy increases. The attractive forces between the particles increase rapidly with grinding. As a result, the attraction of the particles to each other increases, and the particles coalesce and grow larger. This enlargement process causes an increase in the size of the dispersed phase particles. Simultaneously with the dispersion of the particles, their growth - particle condensation - begins. The smaller the particles, the more intense the condensation.

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