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STUDYING THE POSSIBILITY OF USING MECHANICAL-CHEMICAL DISPERSION FOR INCREASING THE SALT-STABILITY OF CLAY DRILLING SOLUTIONS

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Abstract
This article explores the possibilities of using mechanochemical dispersion (MChD) to increase the salt tolerance of clay solutions and how to change some parameters of drilling fluids obtained from local clays and their compositions using a mechanochemical dispersant. Clay powders from local minerals, for example, the Navbahor deposit (ND) of the Navoi region, where there are many types of bentonite, palygorskite, etc., have been rationally used as raw materials for obtaining drilling fluids. Using laboratory mechanochemical dispersant (MChD), experiments have been carried out on processing clay suspensions at various engine speeds.

Keywords: drilling fluid, mechanochemical dispersion, salt tolerance, water loss, alkaline-earth bentonite, carbonate palygorskite, dispersion, coagulation, solid phase, clay mud.

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INTRODUCTION

The intensive development of oil and gas production in Uzbekistan dictates the continuous improvement of equipment and technology for drilling wells, taking into account geological complications. It is especially necessary to take into consideration the high salinity of formation water in Bukhara-Khiva and Ustyurt regions where drilling operations are carried out in saline reservoirs. Moreover, deep wells in difficult conditions are developed at high temperatures and pressures, which creates the need to use highly stable clay drilling fluids [6].

Of course, the use of expensive imported clay powders in the production of drilling fluids is not economically profitable as their price is added by significant transportation costs.

LITERATURE REVIEW

In the scientific and technical literature, works on the production of clay powders, bentonites, palygorites and chemical reagents for the preparation of drilling fluids are widely covered. The results of the analysis show that numerous works of foreign and local scientists have been devoted to the study of the structure and properties of bentonite clays as a basis for drilling fluids. In particular, foreign researchers I.P.Weichert, H.W.Percins, K.F.Gray, A.G.Heggem, J.A.Pollard, N.N.Kruglitsky, E.G.Agabalyants, B.S.Filatov, V.D.Gorodnov, K.F.Paus and many others were engaged in the study of the mineralogical and chemical compositions and their properties of clay powders [4,6].

The scientists of Uzbekistan K.S.Axmedov, Sh.O.Toshev and other scientists investigated the method of mechanochemical dispersion to increase the stability of clay drilling fluids and developed a complex of reagents and their compositions to create thermo- and salt-resistant drilling fluids [4].

In this study, it is rational to apply clay powders from local minerals as raw materials for producing drilling fluids, for example, the Navbahor deposit of the Navoi region, where there are many types of bentonite, palygorskite, etc. If we take into account that natural clays in Navbahor deposits have a polydisperse composition, it will become clear the need for their grinding to the required sizes used in drilling fluids [1].

RESEARCH METHODOLOGY AND DATA

If the technology for producing clay drilling fluids is carried out using a mechanochemical dispersant (MChD), then due to the intensive grinding of dispersed components in the solution, the polydispersity of the solid phase is significantly reduced which negatively affects the duration of operation of the drilling rigs.

Thus, in the process of clay formation in drilling fluids, their mineralogical and dispersed compositions play a significant role. If we calculate that the dispersion of clays depends on their mineralogical and chemical composition, then the reasons for their heterogeneity will become obvious.

In practice, a number of methods are used for additional grinding of clay minerals in order to increase the stability of the resulting drilling fluids. The dispersion of clay minerals and the completion of its crystals under the action of external forces leads to the appearance of greater free energy and the formation of much stronger coagulation structures [2].

It is known that an increase in the dispersion of clay minerals and the number of other contacts leads to an increase in fast elastic deformations, a decrease in the minimum concentration of the formation of a spatial network and therefore, an increase in the salt resistance coefficient [3]. During the dispersion of the clay composition, palygorskite needle crystals and rounded finely dispersed plates, for example, hydromica form in biomineral mixtures, in comparison with the corresponding minerals. This is a significantly larger number of strong contacts.

The mechanochemical method of dispersing clays is used in the processes of obtaining various types of clay powders for building materials, ceramic products, etc. The role of this treatment in increasing the salt tolerance of a drilling mud obtained from polymineral compositions in this work is being studied for the first time. Using laboratory mechanochemical dispersant

(MChD), we have carried out experiments on the processing of clay suspensions at various engine speeds.

From table 1. it can be seen that using the mechanochemical dispersant (MChD), the dispersion of clays increases under the influence of the mechanochemical effect. In addition, this is observed both when using individual clays and their compositions.

Table 1Changes in some parameters of drilling fluids obtained from local clays and their compositions by using a mechanochemical dispersant (MChD) at 1000 rpm.

Clay composition in solution	Traditional way (without MChD)			Using MChD		
	Total exchange complex mEq / 100 g	Swelling (N) cm^3 / g	Q/$T_к$	Total exchange complex mEq / 100 g	Swelling (N) cm^3 / g	Q/$T_к$
Alkaline bentonite (AB) of the Navbahor deposit (ND)	65,4	0,45	0,52	66,1	0,56	0,63
Alkaline-earth bentonite (AEB) of the Navbahor deposit (ND)	55,7	0,49	0,54	56,3	0,61	0,66
Carbonate palygorskite (CP) of the Navbahor deposit (ND)	27,8	0,77	1,09	28,2	0,82	1,15
“Shursuv” hydromica clay (HC)	12,5	0,16	1,43	13,0	0,22	1,51
Suspensions obtained on a clay composition:						
(CP) = (AB) (ND) = (60:40)	43,7	0,68	0,94	44,9	0,79	1,02
(CP) = (AB) (ND) = (50:50)	47,5	0,62	0,81	47,8	0,74	0,93
(CP) (ND): (HC) = (60:40)	23,1	0,50	1,31	23,9	0,62	1,41
(CP) (ND): (HC) = (50:50)	21,2	0,47	1,26	21,8	0,59	1,38
(CP): (AEB) (ND): (CH) = (60:40)	39,4	0,68	0,85	39,7	0,79	0,96
(CP): (AEB) (ND) =(50:50)	42,0	0,64	0,82	42,6	0,75	0,93

Mechanochemical dispersion, like other electro-mechanical effects,affecting on the crystalline structures of clay minerals and on the coagulation structures of their aqueous dispersions rebuilds hydrated films, breaks the bonds between particles of clay minerals, disperses particles, destroys their crystal lattice and form secondary crystals forming a sequential series of new structures that are significantly different from the first and from each other. On top of that, in the coagulation structure of alkaline or alkaline-earth bentonites of MChD, bonds between the dispersed phase of the dispersion medium are broken. This occurs a more uniform distribution of particles in the volume and the formation of more advanced hydration shells, as evidenced by the growth of slow elastic deformations [4].

During the MChD of palygorskite clays, first of all, contact breaks between crystalline and their dispersion occur with the breaking of Si – O – Si bonds along the ribbons. This structure has the highest binding energy and stability [5].

In clay compositions "palygorskite-bentonite" when using MChD, the crystals of minerals adhere very strongly to aggregates. From table 1 it is visible that the larger the value of the energy characteristic-heat of wetting of the Q-suspension of clay in relation to the value of the exchange capacity T_k, the more salt-resistant is this mineral. We have studied the salt tolerance and water loss of 10% drilling fluids from polymineral compositions based on clays of the Navbahor deposit. The results are presented in Fig. 1.

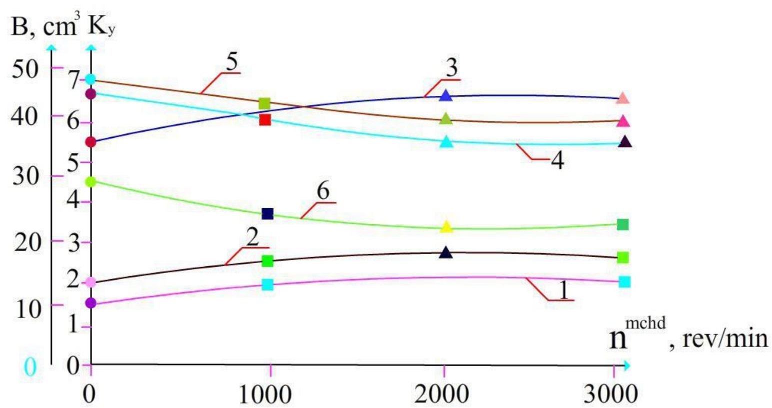

Figure 1. Change in salt resistance of coefficients (1,2 and 3) and water loss (4,5 and 6) of drilling fluids obtained from clay compositions “CP: AEB ND” (1,4), “CP: AEB ND” (2,5) and "CP ND: HC" (3.6)

It can be marked from Fig. 1 that the MChD of the drilling fluid, regardless of the composition of the clay contributes to an increase in its salt resistance (K_y) due to the additional dispersion of minerals and the formation of stable coagulation structures with good thixotropy. If we consider that MChD has undergone various compositions, then its role in obtaining salt-resistant drilling fluids from local clays will become clear. MChD also reduces the water loss (B) of the resulting drilling fluids which also depends on the dispersion of the clay used [2].

Besides, the best results are obtained from clay compositions consisting of CP NM and HC at a ratio of 50:50. In other compositions, the above indicators are quantitatively inferior to the latter. No less important technological parameters of clay solutions are crust thickness (K) and viscosity conditions (T^{200}_{100}) which determine the efficiency of drilling operations. The use of MCD to obtain drilling fluids from various clay compositions has made it possible to reduce their nominal viscosity and increase the thickness of the crust [3].

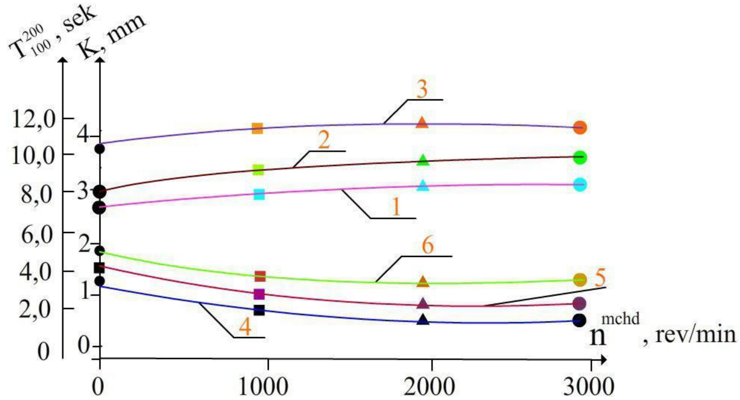

Figure 2. Change in the thickness of the crust (1,2 and 3) and viscosity conditions (4,5 and 6) of drilling fluids obtained from clay compositions “CP: AEB ND” (1,4), “CP: AEB ND” (2, 5) and “CP NM: HC” (5.6)

Here, the best results have also been obtained with MCD of drilling fluid obtained from CP NM with HC "Shursuv" at a ratio of 50:50.

One can see from Fig. 2 that clay solutions containing carbonate palygorskite after processing with NaCl and $CaCl_2$ slightly increase water loss and maintain high stability, which is confirmed by high values of the stability coefficient (K_y). In this case, the exercise of the structural frame occurs without changing the structural and mechanical indicators.

CONCLUSION

The results of applying a mechanochemical dispersant in the production of drilling fluids from polymineral compositions show its effectiveness in increasing their salt resistance. Furthermore, the consumption of surfactants and other chemical reagents, which is necessary for stabilizing clay solutions, is also reduced.

The application of a mechanochemical dispersant helps to increase the dispersion of clay aggregates and the formation of new particles that is capable of developing coagulation structures of high stability and increased strength.

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