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DEVELOPMENT OF AVAILABLE MUD STABILIZERS BASED ON LOCAL MATERIAL

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Abstract. *The article discusses some issues of creating new affordable and cheap stabilizer-reagents for drilling fluids based on local and secondary resources. It has been established that in the process of drilling, in order to prevent rock falls, the mud should not decrease, but, if possible, increase the cohesion forces in the rocks. In order to maintain the stability of the wellbore, to prevent outbursts of formation fluids and losses, the mud must have, first of all, the required density. Stabilizing reagents are primarily designed to reduce filtration and viscosity of the drilling fluid. It has been established that in each specific case the optimal value of the density of the drilling fluid should be selected. It has been experimentally revealed that the drilling fluid containing the new stabilizer has a high lubricity. By lubricating the surface of pipes, bit bearings, hydraulic equipment, the solution helps to reduce energy costs for drilling. Shown are the basic applied, physicochemical and rheological properties of drilling fluids. The results obtained can be used in the production of stabilizing reagents, which can be used as components for rapidly dispersing drilling fluid concentrates in water, as well as for other compositions with other end uses. The development provides for the production of stable aqueous suspensions, characterized by optimal rheological properties and allowing to obtain such rapidly dispersing in water concentrates of drilling fluids. This results in a number of practical advantages, including the ability to produce and store a dry product - a powdered drilling fluid concentrate that can later be easily redispersed in the production of drilling fluids. Dry powder redispersible drilling fluid concentrates reduce the cost of transporting materials.*

Keywords: *stabilizer, drilling fluid, toxicity, viscosity, density, dispersion, drilling, reservoir, well.*

INTRODUCTION. Recently, more and more attention is paid to the problem of creating new, highly effective and affordable drilling fluids, because Basically, most of the components and modifiers of drilling fluids are imported from abroad, they are expensive, difficult to access, unstable to the climatic conditions of Central Asia, and in some cases toxic and harmful to the environment. The main and general technological functions of drilling fluids are cleaning the bottom hole and borehole from cuttings, cooling the rock cutting tool. Drilling fluids must also perform specific functions, such as preventing rock falls, water, gas, oil seepage and lost circulation in wells. To prevent collapse, the solution should not reduce, but, if possible, increase the cohesion forces in the rocks. In order to maintain the stability of the wellbore, to prevent outbursts of formation fluids and losses, the mud must have, first of all, the required density. The solution must be stable, that is, maintain the desired properties under the influence of various factors. Stabilizing reagents are designed primarily to reduce filtration and mud viscosity. These are organic compounds with high hydrophilicity and water solubility. Known reagents-stabilizers based on cellulose (carboxymethylcellulose, carbaminol, carbofen), lignosulfonates, lignin, polyphenols, acrylic polymers, biopolymers, sodium and potassium salts of humic acids, starches (technical starch, modified starch) [1-2].

To improve bottomhole cleaning, in practice, the viscosity of the drilling fluid or its supply to the bottomhole through the bit nozzles is increased.

The aim of this work is to develop new highly effective and affordable stabilizers for drilling fluids based on local and secondary raw materials of the Republic of Uzbekistan.

In scientific research, modern and highly effective methods of analyzing stabilizers and drilling fluids based on them were applied. Such as, rheometry to determine the rheological properties of drilling fluids, pycnometry to determine the density of the components of the solution, viscosimetry, to determine the viscosity of drilling fluids, elemental analysis, IR and NMR spectroscopy, to identify the composition and structure of stabilizers, and others[3-5]. Super high frequency (SHF)-modification of the samples was carried out on a SHF-emitter «MODI». Waste from chemical enterprises of our republic, such as phosphogypsum, waste of JSC «Maham-Ammophos», limestone waste formed in huge quantities at JSC «Ferganaazot», as well as industrial drilling fluids were used as the object of research. The determination of the toxicity index was carried out by gas chromatographic and analytical methods.

Currently, there is an acute problem of creating new, highly effective and affordable drilling fluids, that is, how drilling fluids perform functions that determine not only the success and speed of drilling, but also the commissioning of a well with maximum productivity. In addition, the drilling fluids used are difficult to obtain, expensive, multi-component, and in some cases toxic and harmful to the ecosystem and the environment in general [6].

METHODOLOGICAL METHODS. The main function of the drilling fluid is also to clean the bottom from the rock destroyed by the bit and carry cuttings from the well. The faster the flow of drilling fluid removes rock fragments from the bottom hole, the more efficiently the bit works. The requirement to remove cuttings from the bottomhole is mandatory, since otherwise it is impossible to deepen the wellbore. To improve bottomhole cleaning, in practice, the viscosity of the drilling fluid or its supply to the bottomhole through the bit nozzles is increased [7]. The second method is most preferable, since an increase in the viscosity of the solution is accompanied by a decrease in the drilling speed and an increase in energy costs. However, the second method in each specific case requires a feasibility study, since with an increase in the circulation rate, the erosion of the wellbore walls intensifies, as a result of which the amount of cuttings in the drilling fluid increases, and the borehole toughness increases. These negative phenomena lead to a decrease in the efficiency of the equipment for cleaning drilling fluids, an increase in the cost of repairing pumps and swivels, an overconsumption of materials for the preparation and processing of drilling fluids, unnecessary energy costs, and a deterioration in the quality of well casing.

Thus, the amount of drilling fluid supply to the bottom of the well must have a feasibility study in accordance with the specific geological and technical drilling conditions and be selected within the optimal range. A mandatory requirement for the well flushing process is the performance of the function of transporting cuttings to the day surface. Obviously, the higher the circulation rate, density and viscosity of the drilling fluid, the more intensively the cuttings are transported from the bottom hole to the day surface. Therefore, the rate of cuttings removal from the well can be controlled by changing the pump flow, density and viscosity of the drilling fluid. But with an increase in the viscosity and density of the mud, the operating conditions of the bit deteriorate the hydrostatic and hydrodynamic pressure on the formations increases, which can lead to losses of the drilling mud, other complications and even accidents. It is somewhat safer to intensify the hydraulic transport of cuttings to the day surface by increasing the circulation rate in the annular space. However, the circulation rate should also be limited from above to avoid borehole erosion, large head losses, significant excess of hydrodynamic pressure in the well over hydrostatic pressure. Practical data on the rates and cost of drilling wells show that there is a certain optimal value of the circulation rate, at which this solution satisfactorily carries cuttings to the day surface under specific conditions and no accumulation of cuttings is observed in the well to concentrations that impede the drilling process. Thus, for a satisfactory cleaning of the wellbore from cuttings, the optimal ratio of the components of the drilling mud, a reasonable supply of the mud by mud pumps, the density and indicators of the rheological properties of the mud must be selected.

It is well known that the main parameter that compensates for reservoir pressure at the boundary with the well is the density of the drilling fluid, as it increases, the safety of

penetration, as a rule, increases. At the same time, with an increase in density, the differential pressure at the bottom increases, the concentration of the solid phase in the drilling fluid increases, this can lead to a noticeable drop in ROP and contamination of productive horizons. Consequently, the density of the drilling fluid should be such that, together with other technological factors and techniques, it would be possible to provide sufficient back pressure on the permeable formations, but at the same time it should not significantly worsen the operating conditions of the bit and the performance characteristics of the productive horizons. In other words, in each specific case, the optimal value of the density of the drilling fluid should be selected. Density is also one of the main factors in maintaining wellbore stability. With its increase, the intensity of debris and collapse of the wellbore, as a rule, decreases, but at the same time another type of complications - loss of drilling fluid - becomes more and more dangerous. Therefore, in practice, to increase the stability of the borehole walls, the density, filtration rate, and salinity of the drilling fluid are simultaneously adjusted in order to reduce the degree of penetration of the drilling fluid filtrate into the pores of the rock due to filtration, osmosis, and others. However, talus is a type of complication that usually develops slowly and does not always significantly hinder the drilling process. In this regard, in some cases, it is economically feasible to abandon complex chemical treatments and weighting of the drilling fluid at the expense of wellbore stability. At the same time, high penetration rates are maintained and a lot of time is not spent on auxiliary work. Therefore, in order to prevent sloughs and collapses of the borehole walls, taking into account the possibility of other types of complications and ensuring high rates of borehole penetration, it is necessary to comprehensively approach the selection of the optimal density value. An important technological quality of the drilling fluid is keeping the particles in it in suspension, especially during interruptions in circulation. As the rheological characteristics of the drilling fluid improve, its retention capacity increases. However, at the same time, energy costs and time spent on circulation increase, significant pressure fluctuations in the well during tripping operations occur, which can cause various complications.

EXPERIMENTAL METHODS. In this aspect, we have carried out research on the development of new highly effective, affordable and cheap stabilizer-reagents for drilling fluids based on local and secondary resources [8]. For this purpose were used - phosphogypsum, waste of JSC «Maham-Ammophos» and lime waste generated in huge quantities (from 3 to 20 tons per day) during the chemical treatment of industrial wastewater «milk of lime» in the process of water treatment at JSC «Ferganaazot».

The use of clayey rocks as stabilizing reagents is due to the rather high dispersibility, cation exchange properties of some of them, and most importantly, the relatively low cost and availability (as a local material).

The chemical composition of the original clay, determined by electron microscopic analysis with an energy dispersive spectrum, is presented in table 1 and fig. 1.

Table 1.

Chemical composition of Navbakhor clay containing phosphogypsum

Substance	Na_2O	Mg0	$A1_20_3$	SiO_2	K_2O	CaO	TiO_2	MnO	Fe_3O_3	CuO
Content.,% Mass.	0,72	1,98	16,43	63,90	2,90	1,29	1,33	0,47	10,24	0,74

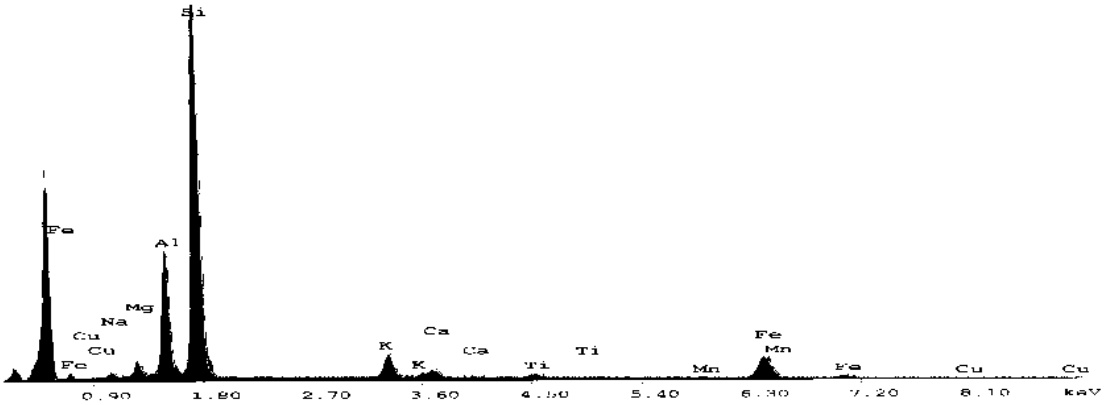

Figure-1. Chemical composition of Navbakhor clay containing phosphogypsum

We used as a filler a SHF-modified Navbakhor clay containing phosphogypsum - a waste of JSC «Maham-Ammophos». The resulting stabilizer is a finely dispersed powder with a number of valuable properties that determine its area of application: high degree of dispersion; high chemical resistance in different environments; well-developed active specific surface; environmental friendliness and safety of use.

The physicochemical properties of the original clay (OC) and the resulting stabilizer-reagent are given in table. 2.

Table 2.

Physical and chemical properties of clay

Product	Colour	pH	Density, kg/m^3	Bulk volume, m^3/kg	Particle size, mm	Specific surface, m^2/g
OC	sandy	5,65	1420	816	0,1-0,315	196,98-53,96
SHF-processed	brick	4,83	1289	731	0,05-0,1	211,2-67,06

We have carried out experimental studies on the use of SHF-modified clays containing phosphogypsum and lime waste as a stabilizer for drilling fluids. Laboratory studies of the properties of modified clay during drilling have shown that SHF processing of natural clay increases its specific surface area, while the sorption area decreases. In accordance with the size of the sorption area, it can be concluded that as a result of the sorption of active components of the drilling fluid on the surface of clay sorbents, a monolayer is formed, consisting of adsorbed molecules, the number is very small and is due only to the dissociation (at certain pH values of the medium) of functional groups - SiOH – AlOH and SiOH – POH formed on the crystal faces. A large negative charge is concentrated mainly on the basal surface of elementary packages and is neutralized by exchangeable cations of alkali and alkaline earth metals, located mainly in inter-package spaces and in the form of aquacomplexes that communicate between packages. Clay minerals are highly dispersed, have a developed surface and are good stabilizers for drilling fluids.

It has been experimentally revealed that the drilling fluid containing the new stabilizer has a high lubricity. By lubricating the surface of pipes, bit bearings, hydraulic equipment, the solution helps to reduce energy costs for drilling, reduce accidents with drill strings, which is especially important in rotary drilling.

With an increase in the amount of stabilizers developed by us in the composition of drilling fluids, the liquid base of drilling fluids becomes low-viscosity (Fig. 2) and has a low surface tension at the boundary with rocks, the concentration of clay particles in the solid phase of the solution decreases to a minimum, and the volume-weighted average density the solid phase rises (Fig. 3), in addition, the drilling fluids are non-dispersive under the influence of

changing thermodynamic conditions in the wells and have stable performance, as well as the aggressiveness and corrosiveness of drilling fluids decreases, that is, they become chemically neutral with respect to the formations being drilled, do not cause their swelling and corrosion of metal parts of drilling rigs and bits. The performance of these functions depends on the interaction of the solution with the permeable rocks. The nature and intensity of this interaction are determined by the nature and composition of the dispersion medium.

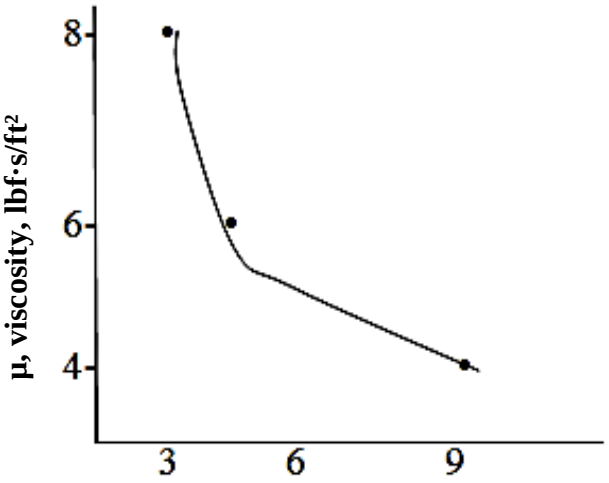

Figure-2. Effect of the amount of added stabilizer on the viscosity of the drilling fluid

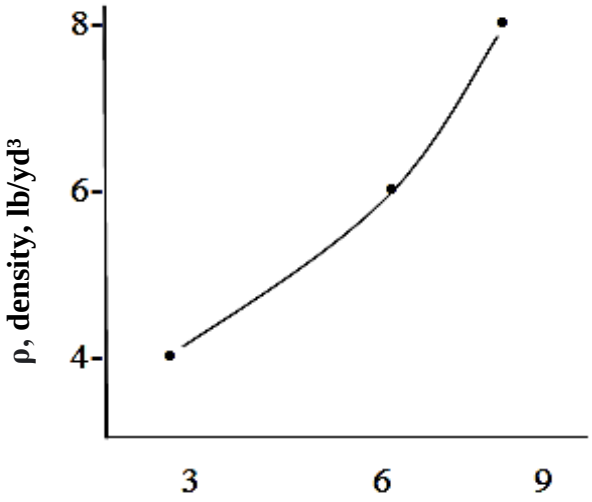

Figure-3. Effect of the amount of added stabilizer on the density of the drilling mud

As can be seen (Fig. 3), with an increase in the amount of stabilizer added to the composition of drilling fluids, the density of the drilling fluid increases, which, together with other technological factors and techniques, provides sufficient back pressure on the permeable formations, but at the same time it does not worsen the operating conditions of the bit and characteristics of productive horizons and not lead to complications. Density is also one of the main factors in maintaining wellbore stability. With its increase, the intensity of debris and collapse of the wellbore, as a rule, decreases, while also reducing another type of danger of complications - loss of drilling fluid. Therefore, the introduction of new stabilizers increases the stability of the borehole walls, the filtration rate, and the salinity of the drilling fluid. A decrease in the viscosity of drilling fluids (Fig. 2) leads to an increase in the penetration of the drilling fluid filtrate into the pores of the rock due to filtration, osmosis and others.

RESULTS. An important technological quality of the drilling fluid is keeping the particles in it in suspension, especially during interruptions in circulation. With an increase in the rheological characteristics of the drilling fluid, its retention capacity increases. However, at the same time, energy costs and time spent on circulation increase, significant pressure fluctuations in the well occur during tripping operations, which can cause other complications.

The results obtained can be used in the production of stabilizing reagents, which can be used as components for rapidly dispersing drilling fluid concentrates in water, as well as for other compositions with other end uses. The development provides for the production of stable aqueous suspensions, characterized by optimal rheological properties and allowing to obtain such rapidly dispersing in water concentrates of drilling fluids. This results in a number of practical advantages, including the ability to produce and store a dry product - a powdered drilling fluid concentrate that can later be easily redispersed in the production of drilling fluids. Dry powder redispersible drilling fluid concentrates reduce the cost of transporting materials.

CONCLUSION. Thus, we have developed new highly efficient and affordable stabilizers for drilling fluids based on waste from chemical enterprises of our republic and secondary local resources.

The main applied, physicochemical and rheological properties of drilling fluids have been identified. Practical application of the development can solve many economic and technological problems of the industry.

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