Volume 3, Issue 10 October 2025 **ISSN (E):** 2938-3757

DEVELOPMENT OF EFFECTIVE COMPOSITE CHEMICAL REAGENTS AND DRILLING FLUIDS BASED ON THEM USED FOR DRILLING OIL AND GAS WELLS

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Abstract
In this article are shown the results of researches of development of effective composite chemical reagents based on organic and inorganic ingredients for drilling fluids, used for the drilling of oil wells. In this article well give comparative properties of local drilling fluids compared with drilling fluids used in Russia, USA.

Keywords: Composition, chemical reagent, organic and inorganic ingredients, drilling fluids.

Introduction

The intensification and development of the oil and gas industry is of great economic importance for many oil and gas producing countries, especially for Uzbekistan. To develop oil and gas condensate fields in Uzbekistan, it is necessary to drill several million running meters of exploration and production wells.

Currently, in many fields, drilling of productive horizons is carried out using clay drilling mud treated with various chemical reagents. These drilling fluids always meet operational requirements in challenging geological conditions.

Clay drilling fluids using these chemicals in most cases plug channels and cracks in the walls of wells in the productive horizons with clay particles, which form a dense clay cake, which leads to a decrease in oil and gas production.

To solve this problem, we have developed and are recommending for development new compositions and technologies for producing clayless drilling fluids based on wastes of chemical, food and other local ingredients. When using the developed clayless drilling fluids, the cracks in the walls are not clogged and remain in their natural state, which leads to an increase in the yield of oil and gas products up to 40-50%. In addition, it becomes possible to prepare drilling fluids using highly mineralized formation waters.

In oil and gas producing countries, including Uzbekistan, in many fields, when drilling oil and gas wells in drilling mud, a wide variety of chemical reagents are used during their treatment, such as KMTS, K-4, K-9, GIPAN, SSB, KSSB, NaOH, $CaCO_3$, UShchR , sulfanol, starch and others that are expensive {1-5}.

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Thus, these reagents do not always meet the requirements for reagents used in complicated geological and technical conditions.

Research objects. The objects of research are caustic and soda ash, carboxymethylcellulose - CMC, nedopal - waste from the production of nitrogen fertilizers, polyacrylamide (PAA) and some inorganic mineral ingredients. Recently, in the course of research work on the development of effective composite chemical reagents for clayless drilling fluids, we have chosen a carbonate-polymer composition (CPC) as an object of research.

Carbonate-polymer composition waste from the production of nitrogen fertilizers is a homogeneous mass of white-dull color, well hydrophilized in water and quickly dissolves in hydrochloric acid, has a pH value of ≥ 12, density ρ = 3.05 ÷ 3.18 g / cm3. Nedopal - consists of finely dispersed chalk ($CaCO_3$) -70-80%; caustic soda (NaOH) -2-3%; soda ash (Na_2CO_3) - 1-2%; lime (CaO) -10-12%; polyacrylamide (PAA) -5-10%; moisture (water) - the rest.

Research Methods

When determining the physicochemical and operational characteristics of the developed composite materials, as well as organic and inorganic ingredients, methods, devices and installations were used in accordance with the relevant GOSTs adopted in the CIS.

Research Results

To assess the stabilizing properties of carbonate-polymer sludge, special laboratory studies were carried out. Were prepared clay solutions, both with and without the addition of carbonate-polymer sludge. For comparison, solutions with the addition of hypane and UShchR are shown. The solutions were prepared as follows: an aqueous solution of carbonate-polymer sludge was prepared. The solution was thoroughly mixed for 20 min - 30 min in a mixer, and then clay powder from the Nefteabad plant was added to the latter, which was thoroughly mixed for 20 min. Then the density, viscosity, filtration, fluid loss, SNS, pH of the solution were determined. The research results are shown in Table 1.

As can be seen from Table 1, the drilling mud prepared with the addition of CCP (carbonate-polymer cuttings) is characterized by low fluid loss, good pumpability and high stability.

The parameters of the drilling mud prepared with CPC additives (filtration, viscosity, SNS, pH), the initial measurement did not change until two days, which indicates the high stabilizing properties of the CPC, and the possibility of using it as a stabilizer of drilling fluids.

As shown in table. 1 addition of KPK to the clay solution within the range of 3-8% helps to reduce filtration from 18 cm3 / 30 min to 16 cm3 / 30 min, which is characterized by high filtration, and the viscosity increases from 20 sec to 25 sec. With these PDC parameters, it is possible to drill a well in clay formations for normal conditions.

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The results of changing the parameters of the flushing fluid depending on the percentage of USHR, HIPANA and carbonate-polymer composition in the composition of the mud

	№	Drilling fluid formulation	Solution parameters						
			Raft, g /cm^3	Viscosity, sec	Water loss VM-6 cm^3/30min	Crusts, mm	SNS 1/10 mgf /cm^2	pH	Stability, g/cm^3
	1	Initial: 50%, clay + 50% H_2O	1,15	27	30	2,0	23/36	7	0,06
Variants with USHR	2	10% clay + 3% USHR + 87% H2O	1,20	25	20	2,0	18/40	8	0,06
	3	10% clay + 5% USHR + 85% H_2O	1,20	22	12	2,0	15/42	8,5	0,06
	4	10% clay + 10% USHR + 80% H_2O	1,20	18	10	2,0	15/46	8,5	0,06
Hypan options	5	10% clay + 0.5% HIPAN + 89.5% H_2O	1,20	27	30	2,0	39/75	7	0,06
	6	10% clay + 1% HIPAN + 89% H_2O	1,20	29	20	2,0	6/15	7,5	0,06
	7	10% clay + 1.5% HIPAN + 88.5% H_2O	1,20	31	10	2,0	6/12	8	0,06
	8	10% clay + 2.5% HIPAN + 87.5% H_2O	1,20	34	6	2,0	3/9	8,5	0,06
PDA options	9	10% clay + 3% KPC + 87% H_2O	1,10	20	18	2,0	18/40	7,5	0,04
	10	10% clay + 8% KPC + 82% H_2O	1,18	25	16	2,0	18/42	8,5	0,02
	11	10% clay + 20% KPC + 72% H_2O	1,28	35	10	1,5	15/42	9,0	0,02
	12	10% clay + 25% KPC + 65% H_2O	1,35	38	8	1,5	15/46	10,0	0,02
	13	10% clay + 30% KPC + 60% H_2O	1,40	40	6	1,5	16/48	12,0	0,02
	14	10% clay + 35% KPC + 55% H_2O	1,45	45	12	2,0	18/46	12,0	0,02

But for opening the productive horizon, as shown in Table 1, the addition of KPK to the clay solution is 20% to 30%, and the addition of KPK 35% contributes to an increase in viscosity for 45 sec, density of 1.45 g / cm3, filtration up to 12 cm3 / 30 min, which does not meet the conditions for opening the productive horizon. From table. 1 it is seen that the optimal parameters of the clay solutions processed by the CPC are achieved when the latter is added to the clay solution in the range from 20% to 30%.

Also, studies were carried out to develop special formulations of carbonate-polymer solutions for opening aquifers and oil and gas horizons. The essence of the study was to prepare an aqueous solution from carbonate-polymer sludge [4].

The addition of CPA to water was carried out in the amount of 5%, 10%, 20%, 30% and 40%. The solution was thoroughly mixed in a laboratory electric clay mixer for 1 hour at a shaft speed of 25-30 rpm. Then they began to determine the technological parameters of the carbonate-polymer solution according to a well-known method (density, viscosity, fluid loss, SNS, friction coefficient, filter cake permeability, flocculating ability).

The results of research on the development of special formulations of carbonate-polymer solutions for opening oil and gas horizons are shown in Table 2.

Table 2 **Research results on the development of special formulations of carbonate-polymer compositions for opening oil and gas horizons**

Solution composition	Flushing fluid parameters						
	Raft g /cm^3	Viscosity according to SPV-5, sec	Water loss VM-6 cm^3 /30min	SNS 1/10 mgf /cm^2	Friction coefficient	Filter cake permeability, md	Flocculating ability,%
95% water + 5% PDA	1,05	20	18	10/14	0	0,20	78
90% water + 10% PDA	1,10	22	14	12/16	0	0,16	95

80% water + 20% PDA	1,21	28	8	20/24	0	0,10	91
70% water + 30% PDA	1,32	35	4	40/49	0	0,06	82
60% water + 40% PDA	1,40	52	18	120/134	0	0,20	73

As shown in table. 2 the addition of 5% CCP to the natural flushing fluid is characterized by low viscosity, high fluid loss up to 18 cm3 / 30 min and low structure-forming ability at CHG-10/14 mgf / cm2, while the addition of CCP from 10% to 30% to the natural flushing fluid improves the quality flushing liquid, which is characterized by a decrease in the filtration of the solution from 14 cm3 / 30 min to 4 cm3 / 30 min, an increase in viscosity from 22 sec to 35 sec, good structure-forming properties of CHC - I2 / I4 at 10% CPC, 20/24 at 20% CPC and 40 / 49 at 30% CCP, the friction coefficient is 0, is characterized by a decrease in the filter cake from 0.16 ppm to 0.06 ppm, is characterized by a good flocculating ability of self-cleaning within 82% -95%.

Taking this into account, our employees of the State Unitary Enterprise "Fan va tarakkiyot", together with scientists, the NTTS Scientific and Technological Center "KOMPOZIT" and the Scientific and Technical Center "MEXANOKIMYO TEXNOLOGIYA" in Uzbekistan and abroad with the use of food waste and other ingredients that can replace the above reagents and differ from them in availability, cheapness and high efficiency in geological and technical conditions of drilling wells in Uzbekistan, and drilling fluids based on them are brine resistant. This material is developed on the basis of wastes of the chemical and fat-and-oil industries and other ingredients and is an effective stabilizer of drilling fluids prepared using highly mineralized formation waters and has the following physicochemical and technological characteristics: density - 1.040-1.120 g / cm3; conditional viscosity - 30-40 sec .; fluid loss - 7-9 cm3 / 30 min; clay crust thickness - 2.5-3.0 mm; pH - 7-10.

The composite chemical reagent developed by us is conventionally named KPM. The developed composite chemical reagents, due to their good physicochemical interaction with the components that make up the compositions, provide a synergistic effect and have a strong stabilizing effect on the properties of drilling fluids, improve the quality of enveloping from under the drill bit and provide good flushing of the bottom hole, prevent secondary crushing rock and thereby provide an increase in the ROP and, accordingly, the productivity of the drilling process. Studies have established that this does not calmate the drilling fluid into the depth of the productive formation and qualitatively penetrate the productive gas-condensate horizons in the well.

The success of drilling deep and ultra-deep wells largely depends on the correct choice of the type of drilling fluids and methods for preparing and regulating their properties. In conditions of a wide variety of types of complications and great depths of drilling, and especially in case of breakdowns, this becomes especially important.

The drilling of deep exploration wells in the areas of the Ustyurt region of Uzbekistan takes place in difficult geological conditions and is associated with the need to use thermosalt-resistant drilling fluids.

High bottomhole temperatures (100-1800C), the presence of complications and the use of salt-saturated systems put forward new problems related to the stabilization of drilling fluids and their provision with the necessary technological, structural-geological and filtration parameters.

Findings

Thus, the KPM reagent developed by us makes it possible to comprehensively solve these problems and fully meets the requirements for drilling fluids used in complicated geological conditions and in areas with highly mineralized formation waters and brine. The composite polymeric chemicals (CPM) developed by us using wastes from various industries and local raw materials help to solve this problem and intensify oil and gas production, hence increasing their production volume. On the basis of the studies carried out, a good compatibility of KPM with widely used chemical reagents (USHR, K-4, CMC and Hypan) in the composition of drilling fluids was revealed. On the basis of the studies carried out, we propose to add 3-20% (depending on the amount) chemical KPM to the composition of the drilling fluid as an acid-soluble additive when opening fractured oil and gas reservoirs. The addition of KPM to the composition of the drilling fluid will prevent irreversible clogging of cracks and pores of the productive formation with clay and the solid phase of the solution, will help preserve the natural permeability of oil and gas reservoirs, reduce the development time of wells and lead to an increase in oil production.

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