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# Prevention of Wellbore Narrowing and Rock Collapse When Drilling Oil and Gas Wells Using Inhibitory Drilling Fluids Based on Local Raw Materials and Studying their Colloidal Properties

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**ABSTRACT:** This article examines the developed measures to prevent narrowing and collapse of well walls when drilling clay deposits and the composition of an inhibiting clay solution using local chemical reagents and materials based on the original flushing fluid to prevent complications and accidents associated with loss of stability of the well wall.

**KEYWORDS:** drilling, drilling fluid, drilling accidents, technological indicators, colloidal chemical properties, chemical reagents, inhibition, well, collapse, narrowing, well wall stability.

## I.INTRODUCTION

Currently, a lot of work is being done all over the world to create new types of drilling solutions used in oil and gas well drilling, and to localize and create substitutes for existing chemical reagents [1, 2]. Because every day the drilling of new areas and the increase in the requirements for drilling increasingly deep wells require the creation of new types of drilling solution recipes [3, 4].

The main requirement for drilling fluids used in drilling oil and gas wells is their low cost and, most importantly, ensuring that various accidents do not occur in the well during the drilling process [5]. Because accidents that occur in the process of drilling wells increase the cost of the well, increase the period of construction of the well, loss of the well, etc. can cause [6-10]. Therefore, in this work, we have devoted ourselves to the prevention of well accidents by studying the technological and colloidal chemical parameters of the drilling fluid prepared based on local raw materials.

## II. SIGNIFICANCE OF THE SYSTEM

This article examines the developed measures to prevent narrowing and collapse of well walls when drilling clay deposits. The study of methodology is explained in section III, section IV covers the experimental results of the study, and section V discusses the future study and conclusion.

## III. METHODOLOGY

Based on local raw materials, drilling fluids were prepared and put into practice. Based on scientific research, developed measures have been introduced to prevent narrowing and collapse of well walls when drilling clay deposits and the composition of an inhibiting clay solution using local chemical reagents and materials based on the original flushing fluid to prevent complications and accidents associated with loss of stability of the well wall.

At exploration well № 162 West Palvantash area, wells were drilled with a diamond bit with a diameter of 394 mm. When reaching a depth of 2194 m, an increase in the fluid yield of the circulating drilling fluid used was observed

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to a value of 10-12 cm3/30min. Due to the lack of polymer reagents, the drilling tool raised the casing shoe. After receiving and processing the drilling fluid with a liquid polymer reagent for 5100 kg, the drilling tool was lowered to a depth of 1930 m, despite this, the fluid yield remained unchanged. After that, chemical treatment of the circulating working drilling fluid was carried out using 3450 kg of dextrin in the form of a 10% aqueous solution. Despite this, the water yield rate also did not decrease. Next, polyacrylamide (PAA) produced by Navoiyazot JSC was hydrolyzed for 800 kg of 1.5% aqueous concentration in the presence of alkali. The finished aqueous solution of hydrolyzed polyacrylamide (55 m3) had the following technological parameters: density – 1020 kg/m3; conditional viscosity – 22-24 s; water loss – 1.0 cm3/30 min; crust thickness - film; pH=13.0. Table salt was added to the prepared aqueous solution of PAA until complete saturation, potassium chloride, graphite, and marble powder and barite were added to increase the density of the drilling mud.

## IV. EXPERIMENTAL RESULTS

After receiving the liquid polymer reagent in an amount of 10,170 kg, 40 m3 of an aqueous solution was prepared with the introduction of its composition of the above reagents and materials with the following technological parameters: density - 1340 kg/m3; conditional viscosity – 42-45 s; water loss – 0.5 sm3/min; crust thickness – 1mm; pH=10.0. After treatment, the water loss rate in the washing liquid decreased from 18 cm3/30 min to 12 cm3/30 min. It was decided to reduce the water yield of the drilling fluid to a value of 7-8 cm3/30 min and continue the process of deepening the well. We carried out chemical treatment with this solution and after treatment, the technological parameters and colloid-chemical properties of the working solution were as follows: density - 1340 kg/m3; conditional viscosity – 60-65 s; water loss – 8.0 cm3/30min; crust thickness – 2.0 mm; pH=7.0. We lowered the drilling tool to a depth of 2114 meters and began working through the wellbore. However, during well development, a decrease in density, pH of the solution and an increase in fluid yield were observed. Therefore, periodic chemical treatment of the circulating drilling fluid was carried out with an aqueous solution of the PAC Nitrogen reagent with the introduction of the above listed chemical reagents into its composition. The change in technological parameters indicated the presence of an exposed powerful water horizon with high pressure. With continuous chemical treatment of the drilling fluid, a depth of 2207 m was reached. To replace the bit, the tool was raised and when the tool was lowered at a depth of 2114 meters, a landing was obtained, after which they began to develop the well.

It should be noted that while drilling a well in the interval of 2207-2243 meters, the fluid loss rate was maintained within the limit of 15 cm3/30 min due to the continuous chemical treatment of the circulating drilling fluid with the polymer reagent PAC Nitrogen. However, despite the high water yield, the lifting of the drilling tool was carried out without tightening and no landing of the tool was observed during lowering. This indicated that the developed formulation inhibited the clayey rocks composing the walls of the well in the Western Palvantash area of well № 162.

For chemical treatment of drilling mud, we used the following local chemical reagents and materials in 25 days: liquid polymer reagent - 15270 kg, soda ash - 4350 kg; dextrin – 3450 kg; PAA – 800 kg; PAC Nitrogen – 9000 kg; technical table salt – 77,000 kg; potassium chloride – 13000 kg; AF reagent (analogue of FHLS) – 1000 kg; oil – 30 m3; graphite 8000 kg; marble powder – 48 kg; barite – 30 kg.

For one day, the technological parameters of the working drilling fluid remained unchanged; by establishing pressure equilibrium in the well-formation system, it was possible to prevent the entry of aggressive formation water into the well. In order to reduce the conditional viscosity and fluid loss of the working circulating drilling fluid, a clay inhibitory drilling fluid with a low fluid loss index was prepared, which was introduced into the composition of the circulating drilling fluid. After the first chemical treatment, a decrease in water loss was observed from 14 cm3 to 11 cm3/30 min.

Based on the implementation of the development of measures to prevent the narrowing and collapse of rocks when drilling a well and the developed compositions of inhibitory drilling fluid using local chemical reagents and materials, positive results were obtained in the technological properties of the drilling fluid to prevent the collapse of the walls of the well when drilling clayey rocks.

The technological parameters of the inhibitory drilling fluid were selected based on the conditions for drilling wells into clayey deposits. Tables 1-3 present the results of laboratory studies on the development of compositions of inhibitory drilling fluids.

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**Table 1.**
**Composition and properties of inhibitory drilling fluid based on a local reagent**

| № | Drilling fluid composition | ρ, kg/m$^3$ | $T_{500}$, c | F, cm3/min | Tk, mm | pH | SNS, mgf/cm$^2$ | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 min | 10 min |
| 1. | 900ml water 3 g $Na_2CO_3$ + 100g UShR + 20g MK + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 35 | 7,0 | 1,0 | 10,5 | 18 | 26 |
| 2. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 25g MK + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 40 | 5,0 | 1,0 | 11,0 | 12 | 19 |
| 3. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g MK + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 45 | 4,0 | 1,0 | 11,5 | 7 | 9 |
| 4. | 900 ml water 3g $Na_2CO_3$ + 100g UShR + 30g MK + 250g NaCl + 50g KCl + 100ml oil + 30g graphite when heated to 90$^0$C | 1200 | 25 | 8,5 | 1,0 | 11,5 | - | - |
| 5. | 900ml water 3g $Na_2CO_3$ + 100g UShR + 30g MK + 250g NaCl + 50g KCl + 100ml oil + 30g graphite after cooling to room temperature | 1200 | 45 | 4,0 | 1,0 | 11,5 | 7 | 9 |
| 6. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g MK + 250g NaCl + 50g KCl + 100ml oil + 30g graphite + 250g marble powder | 1250 | 45 | 4,0 | 1,0 | 11,5 | 11 | 19 |
| 7. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g MK + 250g NaCl + 50g KCl + 100ml oil + 30g graphite + 350 gram marble powder | 1290 | 50 | 4,0 | 1,0 | 11,5 | 13 | 22 |

**Table 2.**
**Composition and composition of inhibitory drilling fluid based on local reagent**

| № | Drilling fluid composition | ρ, kg/m$^3$ | $T_{500}$, c | F, cm$^3$/min | Tk, mm | pH |
|---|---|---|---|---|---|---|
| 1. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 20g Ecoline + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 45 | 3,0 | 1,0 | 10,5 |
| 2. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 25g Ecoline + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 50 | 2,0 | 1,0 | 11,0 |
| 3. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g Ecoline + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 55 | 1,5 | 1,0 | 11,5 |
| 4. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g Ecoline + 250g NaCl + 50g KCl + 100ml oil + 30g graphite when heated to 90$^0$C | 1200 | 33 | 3,5 | 1,0 | 11,5 |
| 5. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g Ecoline + 250g NaCl + 50g KCl + 100ml oil + 30g graphite after cooling to room temperature | 1200 | 55 | 1,5 | 1,0 | 11,5 |
| 6. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g Ecoline + 250g NaCl + 50g KCl + 100ml oil + 30g graphite + 250g marble powder | 1250 | 55 | 1,5 | 1,0 | 11,5 |
| 7. | 900ml water + 3g $Na_2CO_3$ + 100g UShR + 30g Ecoline + 250g NaCl + 50g KCl + 100ml oil + 30g graphite + 350g marble powder | 1290 | 0 | 1,5 | 1,0 | 11,5 |

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**Table 3.**
**Composition and properties of inhibitory drilling fluid based on local raw materials**

| № | Drilling fluid composition | ρ, kg/m$^3$ | $T_{500}$, c | F, cm$^3$/min | Tk, mm | pH |
|---|---|---|---|---|---|---|
| 1. | 900ml water + 20g PAA + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1190 | 35 | 3,0 | 1,0 | 6,0 |
| 2. | 900ml water + 25g PAA + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 45 | 2,5 | 1,0 | 6,0 |
| 3. | 900ml water + 30g PAA + 250g NaCl + 50g KCl + 100ml oil + 30g graphite | 1200 | 75 | 1,5 | 1,0 | 6,0 |
| 4. | 900ml water + 20g PAA + 250g NaCl + 50g KCl + 100ml oil + 30g graphite when heated to 90$^0$C | 1200 | 23 | 6,0 | 1,0 | 6,0 |
| 5. | 900ml water + 30g PAA + 250g NaCl + 50g KCl + 100ml oil + 30g graphite after cooling to room temperature | 1200 | 75 | 1,5 | 1,0 | 6,0 |
| 6. | 900ml water + 30g PAA + 250g NaCl + 50g KCl + 100ml oil + 30 g graphite + 250g marble powder | 1250 | 75 | 1,5 | 1,0 | 6,0 |
| 7. | 900ml water + 30g PAA + 250g NaCl + 50g KCl + 100ml oil + 30 g graphite + 350g marble powder | 1290 | 80 | 1,5 | 1,0 | 6,0 |

From tables 1-3 it can be seen that the prepared inhibitory drilling fluids based on CSR, modified starch, polymer reagent "Ekolin", modified polymer reagent (MPR), and non-hydrolyzed polyacrylamide, as well as sodium and potassium chloride, are stable in their technological properties and retain their original properties at high temperatures.

Technological parameters of inhibitory clay-free drilling fluids:

it is possible to increase the density depending on the drilling conditions of the wellbore from 1200 to 2200 kg/m3;

it is possible to adjust the filtration rate depending on the drilling conditions of the wellbore from 1.5 to 5.0 cm3/30 min.

the time and consumption of chemical reagents during the preparation and chemical processing of drilling fluids intended for drilling wells in unstable clay deposits is reduced;

the use of organic reagents and thinners in the preparation and chemical processing of drilling fluids is excluded;

the stability of clayey rocks is ensured due to the simultaneous action of two inhibitory additives and the formation of a thin hydrophobic polymer film on the surface of the well wall;

Prevents oil seal formation and sticking of the drilling tool when drilling wells in clay deposits.

## V. CONCLUSION AND FUTURE WORK

When drilling wells in complex mining and geological conditions, we can recommend the use of inhibitory drilling fluids based on local and developed measures to prevent the narrowing and collapse of rocks, as well as the compositions of inhibitory drilling fluids when drilling wells in clay deposits that are susceptible to collapse and slides in oil and gas fields (areas) of Uzbekneftegaz JSC..

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