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DEVELOPMENT OF EFFECTIVE LUBRICANTS FOR DRILLING FLUIDS

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Abstract

The paper shows the role of lubricants for obtaining drilling fluids. Methods of testing lubricant's chemical and physical properties. New compositions of lubricants for water based drilling fluids. Stabilization and antifriction indexes of drilling fluids based on lubricants have been given.

Keywords: *lubricant, property, viscosity, friction, drilling fluids, oil an gas*

Introduction

Importance of the use of lubricating additives — lubricants in drilling fluids and process of fluids occupy a particularly important place in the technical, technological, economic and environmental indicators of the success of the construction of oil and gas wells. The technology for drilling any wells consists of destroying rocks at the bottom with a chisel and removing destruction products from the bottom to the surface by forced circulation of the drilling fluid in the well. The main technical functions of the drilling fluids are to clean the bottom and wellbore from drilled rock, to create back pressure above the formation pressure in order to prevent the uncontrolled influx of formation fluid. Therefore drilling fluid must ensure lubrication and cooling of the drilling tool, stabilization of the walls of the open wellbore and maximum preservation of reservoir properties of the productive formation during initial drilling (Bulatov, A.I., 1984).

For drilling wells of drill cuttings during the drilling process, in most cases, water-based emulsion (WBO) is used; less often, direct or reverse hydrocarbon-based emulsion (HBO) is used. Modern water based mud (WBM) and oil based mud (OBM) are complex multifunctional poly disperse systems, the physicochemical and technological properties of which are regulated by a complex of chemical reagents: regulators of viscosity and thixotropic structure of the solution, filtration (water loss) reducers, lubricating and anti-seizing additives, clay inhibitors, bridging agents, defoamers, weighting agents and other additives. (Chubik, P.S., 1999).

Managing the technological parameters of a drilling fluids is the task of managing a complex non-traditional chemical-technological dispersed system, constantly changing in mineralogy. Technical and technological reasons for the use of lubricating additives in drilling fluids. During the construction of oil and gas wells, great importance is given to reducing energy intensity and accident rate of the drilling process through the use of drilling drills with improved tribotechnical (lubricating, anti-seizing, anti-wear) properties. Particularly serious problems arise associated with frictional forces and the increase in torque during rotation, with loads when lifting the drill string when drilling directional and horizontal wells, as well as when drilling sidetracks of small diameter with large deviations from the vertical. It is under such conditions that the use of BR with increased lubricity gives the most noticeable positive effect. Improvement in tribotechnical properties depends on the chemical nature of the organic base of the lubricant additive and its concentration in the drilling fluids, on the physicochemical ability to reduce the coefficient of friction in a multi disperse medium enriched with drilled solid mineral phase. Reducing the drilling fluids friction coefficient during drilling allows:

– reduce hydraulic resistance when flushing the wellbore;

– reduce the torque when rotating the drill string and reduce the resistance when it longitudinally moves in the well;

– reduce the likelihood of differential sticking and the costs of their elimination;

– increase the service life of drill pipes and their connections, hydraulic parts of mud pumps, downhole motors and rock cutting tools.

As indicators of tribological properties, they usually use the coefficient of friction of a metal-to-metal pair in the drilling fluids environment, the coefficient of potential differential sticking of the drill pipe — borehole wall system, as well as the coefficients of friction and stickiness (friction) at the boundary "metal-clay cake" (Chubik, P.S, 1999, Samota, A.K, 1979).

Materials and methods

As a material for obtaining new lubricant composition were used Gossypol resin (GR), Sodium, Carboxymethylcellulose sodium (CMC), Used motor oil (UO), Soap stock (SS) and Oil sludge (OS). Gossypol resin is obtained in the form of a distillation residue (tar) by distillation of fatty acids from cotton soap stock. In order to protect the health of citizens and protect the natural environment, this technological regulation has been established. In the oil and fat plant, before obtaining gossypol resin, products are obtained in the following order: — "inedible fat and oil products" — fat and oil products intended for technical and household purposes; — "soap stock" — a by-product obtained during alkaline neutralization of fats and oils; — "tar" — non-distilled vat residue; — "gossypol resin" — tar from the distillation of fatty acids of cotton soap stock.

CMC and Oil sludge are also used for obtaining lubricants as stabilizier of a solution (Kobilov, N.S. and other, 2023). Used motor oil. Used motor oil often contains metals (usually as the result of the engine or bearing wear, or the inclusion of these metals in oil additives), chlorinated hydrocarbons and other organic compounds, including a lot of that are listed as priority pollutants.

Determination of physical and chemical properties of drilling fluids

- Determination of the coefficient of friction of the filter cake of drilling fluid in field laboratories and on drilling rigs in order to identify the effectiveness of lubricant additives and prompt intervention in the drilling process in difficult conditions in the fields of the Republic of Uzbekistan, the KTK-2 device is widely used. The coefficient of friction (stickiness) at the "clay cake — metal" boundary is measured by the angle at which a standard load begins to slide over the filter cake, followed by determination of the coefficient value in the table attached to the KTK-2 device
- **Determination of Mud Density.** The weight of the mud samples was determined using the Baroid mud balance. The cup was filled completely with mud after calibration. The expelled mud was washed and the balanced arm was replaced on the base with the knife edge resting on the fulcrum. The rider was moved until the graduated arm was horizontal and the reading was taken.
- Viscosity is usually higher for higher density fluids due to the weight of the material. Here, the Marsh fun-

nel is used to monitor viscosity and is commonly reported as "Funnel viscosity". The Marsh funnel viscosity is reported as the number of seconds required for a given fluid to flow out of the funnel. Its design and calibration can be verified using water. One quart of fresh water should be collected in 26 (±0.5) sec at a temperature of 70 (±5) °F. The marsh funnel measures the apparent viscosity.

- **Determination of Fluid loss and mud cake thickness.** The filter press (100 psi pressure and room temperature) was used to measure the fluid loss and mud cake thickness of the drilling fluid samples after 30 min.
- used to determine the gel strength of the mud samples. The mud samples were stirred thoroughly at 600 rpm. The lift gear was shifted slowly to the first position, and the motor was shut off. The motor switch was turned to low after 10 seconds. The dial was read at maximum deflection units in Ib/100ft2 that is 10 second gel. The steps were repeated for 10 minutes. The Gel strength was obtained for the different mud weights.
- **Determination of pH.** The pH meter which consists of a glass electrode system, an electronic amplifier and a meter calibrated in pH units was used to test the pH of galena mud. The electrical connection with the mud was established through saturated KCl solution contained in a tube surrounding the calomel cell. The electrical potential generated in the glass — electrode system by the hydrogen ions in the drilling mud was amplified and operated the calibrated meter which indicated the pH. The pH of the mud was noted.
- **Determination of stability and sedimentation indicators.**
- Stability — the ability of a solution to its density over a period of time. The stability index S0 is a value determined by the difference in densities of the lower and upper parts of the drilling mud settled for a certain time.
- Sedimentation index S,%, is the value determined by the amount of the dispersed phase, separated from a certain volume of the drilling fluid as a result of gravitational separation of its components for a certain time. The sedimentation rate indirectly characterizes the stability of the drilling fluid (Kobilov N. S, 2023).

Therefore determination of the filtration index and the coefficient of friction of the filter cake of drilling fluid in field laboratories and on drilling rigs in order to identify the effectiveness of lubricant additives and prompt intervention in the drilling process in difficult conditions in the fields of the Republic of Uzbekistan, the KTK-2 device is widely used. The coefficient of friction (stickiness) at the "clay cake — metal" boundary is measured by the angle at which a standard load begins to slide over the filter cake, followed by determination of the coefficient value in the table attached to the KTK-2 device.

Results and discussion

Application of oil and petroleum products in drilling fluids.

For development lubricant additives were used following compositions of gossypol resin (GR), soap stock (SS), soda caustic, used motor oil (UMO), oil sludge (OS), carboxymethyl cellulose (CMC) and water (W). The first stage of obtaining lubricants were used modificated gossypol resin with sodium (MGR). Next process of obtaining its water solution about 20–30% with CMC and about 10–20% of UMO or OS. The results of the testing were given in the table 1.

Laboratory testing shows that examples of lubricants have high antifriction properties coefficient of friction of № 1 is equal 0,1228, viscosity is 28 filtration index is more than 3 sm^3. Less density is in the № 3 example because of in the composition there is soap stock. Soap stock is consist of more stearin acid comparing to other compositions. Water solution of stearin acid appears penetration process. Modificated gossypol resin play role as a emulsifier and used motor oil emulsion formed in the water. Oil fraction of the used motor oil and fatty acid of gossypol resin decreased coefficient of friction. Coefficient of friction is 1.15 times less than other drilling fluids that obtained by adding other lubricant as Graphite G, SMAD.

Table 1. *Compositions and chemical physical properties of the developed lubricants*

Lubricant composition	Physical and chemical properties					
	Density g/sm³	Viscosity, sec	Filtration index, sm³	Stability, g/sm³	Coefficient of friction	pH
MGR: W: CMC: UMO	0.97	28	3	0.02	0.1228	9
MGR: W: CMC: OS	0.98	32	3	0.04	0.1228	9
MGR: W: CMC: SS	0.92	33	3	0.03	0.1228	9
SS: W: CMC	0.9	34	3	0.04	0.1228	9

Until this time in drilling operations used petroleum as a lubricant material petroleum and petroleum products have a number of significant disadvantages when used in WBM: they distort the results of geophysical research, pollute the environment, are fire-explosive and freeze at subzero temperatures. In addition, when drilling is stopped and wellbore cleaning is stopped for technical and technological reasons, lubricating additives based on oil and petroleum products migrate along the wellbore to the surface, creating sticking conditions for the bottom of the drill string. Field data has also repeatedly established that when drilling deep wells, where bottomhole temperatures are more than 150 °C, there is a decrease in the lubrication properties of oil-treated BRs. Another aspect of the use of oil and oil products in OBM systems also has a number of significant technological limitations in terms of fire and explosion safety and environmental friendliness. The price of lubricants also will be decreased because of using industry and production wastes.

Conclusion

Research work shows that lubricants that based on modificated gossypol resin and used motor have antifricton properties when application for water based drilling fluids. Coefficient of friction is less than currently used reagent as Graphite. Experiment works show that the effectiveness of lubricant additives is often increased by introducing surface-active substances (surfactants, detergents, dispersants) that ensure high colloidal solubility of fats, oils and hydrocarbons in the drilling fluids.

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