The Austrian Journal of Technical and Natural Sciences, No 1–2
ISSN 2310-5607

PREMIER Publishing
ppublishing.org

DOI:10.29013/AJT-24-1.2-94-97

THE WAYS OF OBTAINING WEIGHTED DRILLING FLUIDS BASED ON LUBRICANTS FOR DRILLING OIL AND GAS WELLS

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Cite: *Kobilov N.S. (2024). The Ways of Obtaining Weighted Drilling Fluids Based on Lubricants for Drilling Oil and Gas Wells. Austrian Journal of Technical and Natural Sciences 2023, No 11-12.* https://doi.org/10.29013/AJT-24-1.2-94-97

Abstract

The article presents current state of chemical reagents, and lubricants for development and obtaining weighted drilling fluids for drilling oil and gas wells. Types and groups of weighting agents for drilling fluids are classified and their properties were studied.

Keywords: *drilling fluids, oil, gas, wells, lubricant, density, method*

Introduction

Currently in the process of building oil and gas wells to maintain the stability of the walls, to prevent the flow of salts, and to prevent the penetration of formation fluids into the well, it becomes necessary to increase the density of the drilling fluid, which can be accomplished by introducing components with increased density. A relatively small increase in density (1,1–1,2 g/sm^3) is possible by adding clays (bentonite), as is often done in practice. However, this solution cannot be considered correct, since for a small increase in density it is necessary to increase the concentration of the solid phase. Drilling fluids with a density of up to 1,6–1,8 g/sm^3 are obtained from sludge from carbonate and sulfate rocks (Bob De Wolfe, 2005). For obtaining and stabilization weighted drilling fluid were used powder water soluble gossypol resin and carboxymetylcellylose sodium. As weighting agents were used Okalina (waste of metallurgical production), hematite, barite and carbonate slug. However, this increases the concentration of the solid phase, the thickness of the clay crust, a negative effect is sharply manifested differential pressure. In these cases, increasing the density more 1,8 g/sm^3, barite and special weighting agents are used (Kobilov, 2012).

Materials and method

Lubricant additives volume consist of about 10–20% of all chemicals used for drilling oil and gas wells. Present time for obtaining and development of drilling fluids for drilling oil and gas wells use more than 3000 kind of chemicals in the world. Such as Carboxymethylcellulose, polyacrylamide, hydrolyzed polyacrylonitrile, ferrochrome-lignosulphonate, grafite, chrompick, NaOH, Na_2CO_3 and others. In the Republic of Uzbekistan for drilling oil and gas wells use about 2–3 thousand ton chemical reagents

every year. Domestic chemicals are not fully meet the requirements of geological and technical conditions of wells. The quality of the construction of oil and gas wells, and the quality of the opening of the productive formation, largely depends on the used drilling mud because the drilling fluid is a technological fluid that interacts with the newly opened rock. Based on the analysis of basic research in the field of chemistry and biochemistry of carbohydrates, generalizing the practice of drilling wells, polysaccharides are used as polymer reagents for regulating the filtration and rheological properties of lighted and weighted drilling fluids. The main reason for the choice of polysaccharides is their ability to chemical and biological destruction, due to which is possible to destroy and remove the formed clogging layer during the drilling process, and almost complete recovery of reservoir properties.

American Petroleum Institute (API) publishes documents relating to oilfield standards, including drilling fluids testing procedures. As with any laboratory procedure requiring the use of potentially hazardous chemicals and equipment, the user is expected to have received proper training and knowledge in the use and disposal of these potentially hazardous materials. The user is responsible for compliance with all applicable local, regional, and national requirements for worker and local health, safety, and environmental liability (Kobilov, 2023). The cost of the drilling fluid itself is relatively small in comparison to the overall cost of drilling a well, but the choice of the right fluid and maintenance of its properties while drilling profoundly influence the total well costs. For example, the number of rig days required to drill to total depth depends on the rate of penetration of the bit, and on the avoidance of delays caused by caving shale, stuck drill pipe, loss of circulation, etc., all of which are influenced by the properties of the drilling fluid. In the case of some critical wells, such as deep water operations, these excess costs can run into the millions of US dollars. In addition, the drilling fluid affects formation evaluation and the subsequent productivity of the well. The fluid also needs to be environmentally benign and generate minimal waste (Guanzheng Zhuang, 2017).

Most of global drilling operations use water-based drilling fluids, because of their lower environmental impact and lower costs. However, water-based drilling fluids are limited by their abilities of dissolving salts and interfering with the flow of oil and gas through porous rocks. Oil-based drilling fluids, owing to their excellent lubricity, high rate of penetration, shale inhibition, wellbore stability, high lubricity, high thermal stability, are expected to be used to drill difficult wells (Saborian-Jooybari, 2016).

Results and discussions

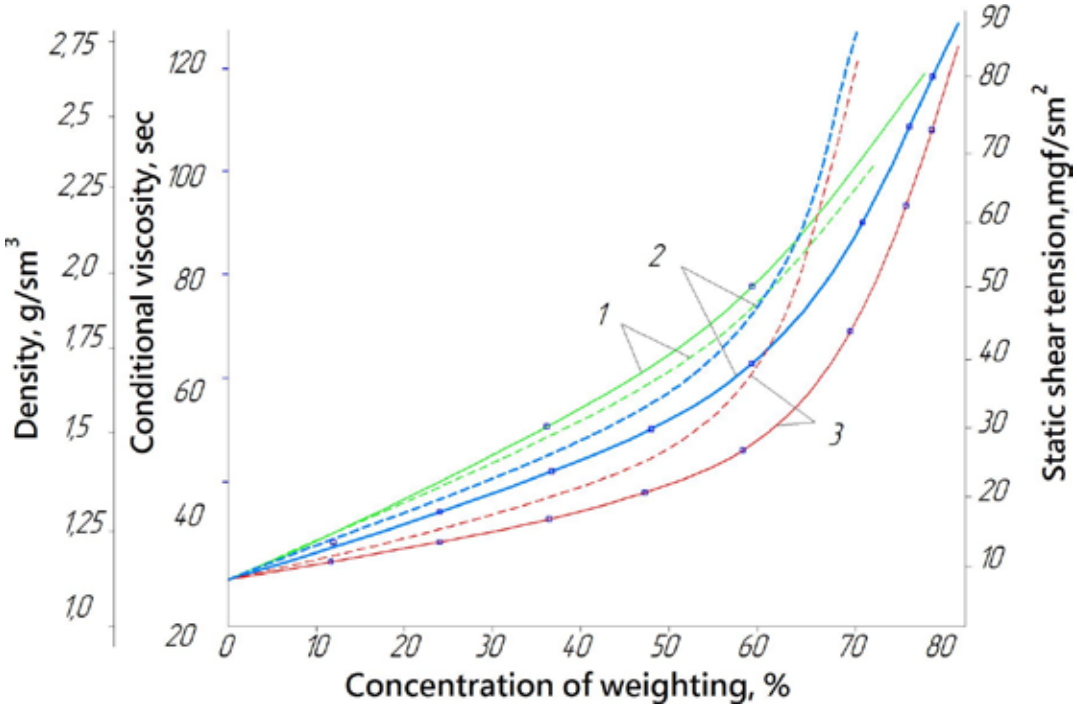
The structure, composition and physicochemical properties of the domestic lubricants for drilling fluids, the waste of oil and fat production –gossypol resin, soap stock, oil sludge, soda ash and caustic soda, used motor oil and Na-carboxymethylcellulose “Carbonam” with 600 polymerization degree were studied.

Preparation of weighted drilling fluids by adding lubricant additive and needed weighting materials in the water necessary concentration. Concentration lubricants on the drilling fluids consist of about 2–3% and bentonite 5–10% and weighting agents 50–70%. Developed weighted drilling fluids based on lubricants for drilling in salt and high pressure layer, as they are stable to cations of polyvalent salts (Mg^{++}, Ca^{++}, Na^{+}, K^{+}). Developed lubricant is mainly about 15–20% gossypol resin and has a high lubricity due to the content in its composition of polymerized fatty acids, pigment, glycerin and other components. These reagents as a surfactants serve to emulsify oil with water, increase drilling speed because of low coefficient of friction, play role as corrosion inhibitor.

It can be seen from testing analyses, that with a weighting of the drilling fluid of hematite up to 68–70%, the density of the solution increases to 2,35–2,44 g/cm^3, and the shear stresss is in the range 40–45–60 mgf/cm^2. The water loss values hardly change and amount to 4–5 cm^3/30 min, the hydrogen index is 9. When adding barite weighting agents in an amount of 62–64%, the density of the solution is 2,11–2,21 g/cm^3, while the nominal viscosity of the drilling fluid is 90–95 s and the Shear stress of the solution is 50–52 mgf/cm^2 for 10 min. It should be noted mineral weighting

agents, depending on the nature, are divided into carbonate, barite, glandular and galena. Depending on the density, they are classified into 3 main groups.

Figure 1. *Main technological properties of weighted drilling fluids by weightin concentration*



The first group of weighting agents are heavy (slightly colloidal) clays, marl, chalk, limestone, etc. These materials have a density in the range of 2,6–2,9 g/cm³ and are characterized by a relatively small structure-forming ability in drilling fluids, due to which their amount in the drilling fluid can be significant, while the rheological properties of the fluid do not deteriorate. However, the solids content in the drilling fluid increases dramatically, which adversely affects drilling efficiency.

The second group of weighting agents are materials with a density of 3,8–4,5 g/cm³, which includes barite and glandular weighting agents. These weighting agents are essential for the preparation of weighted drilling fluids. The hydrostatic pressure generated by drilling fluids with a density of 2,30––2,35 g/cm³ is sufficient for most wells. The third group of weighting agents (with a density of 5,0–7,0 g/cm³) includes materials consisting mainly of lead and iron. These weighting agents are used to prepare drilling fluids with a density of 2,5 g/cm³ or more. Such drilling fluids are necessary for drilling deposits with cross-sectional formations with a pressure exceeding geostatic.

Conclusion

In conclusion we can inform that developed weighted drilling fluids based on lubricants have a multifunction. As a result of research and study of the physical and chemical properties of the developed weighted drilling fluids based on local and raw materials and wastes recommended for use in drilling oil and gas wells with abnormally high reservoir pressure and with difficult geological layers.

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submitted 13.02.2024;
accepted for publication 29.02.2024;
published 18.03.2024

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