MUHANDISLIK & IQTISODIYOT

ijtimoiy-iqtisodiy, innovatsion texnik, fan va ta'limga oid ilmiy-amaliy jurnal

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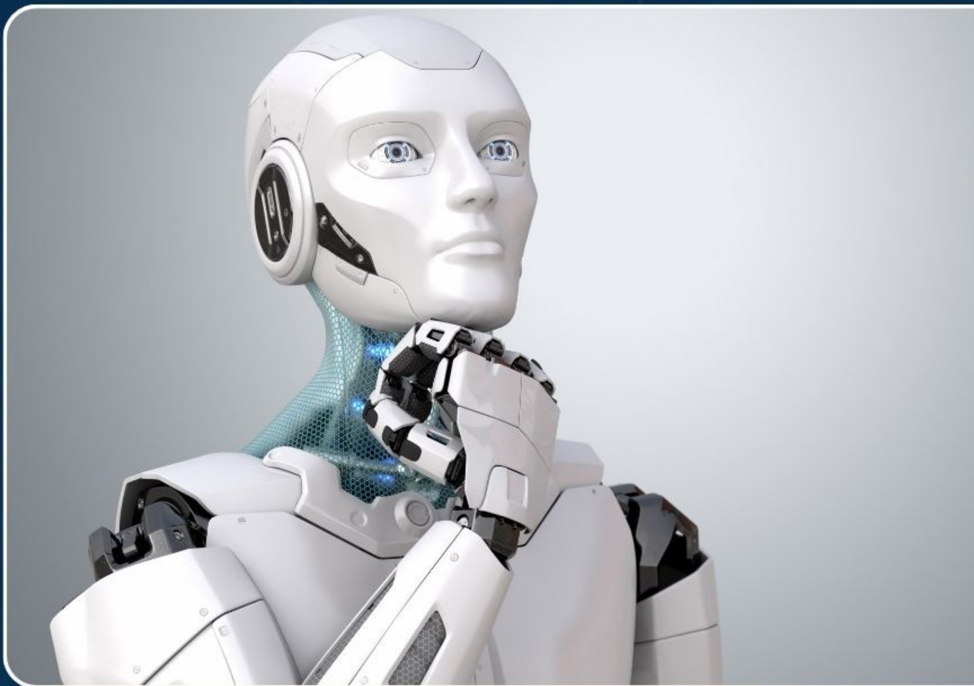

Milliy nashrlar

OAK: https://oak.uz/pages/4802

05.00.00 - Texnika fanlari
08.00.00 - Iqtisodiyot fanlar

Elektron nashr,
636 sahifa, aprel, 2025-yil.

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05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
05.01.03 – Informatikaning nazariy asoslari
05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
05.01.07 – Matematik modellashtirish
05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
05.02.00 – Mashinasozlik va mashinashunoslik
05.02.08 – Yer usti majmualari va uchish apparatlari
05.03.02 – Metrologiya va metrologiya ta'minoti
05.04.01 – Telekommunikasiya va kompyuter tizimlari, telekommunikasiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
05.05.05 – Issiqlik texnikasining nazariy asoslari
05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
05.08.03 – Temir yo'l transportini ishlatish
05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti

08.00.01 - Iqtisodiyot nazariyasi
08.00.02 - Makroiqtisodiyot
08.00.03 - Sanoat iqtisodiyoti
08.00.04 - Qishloq xo'jaligi iqtisodiyoti
08.00.05 - Xizmat ko'rsatish tarmoqlari iqtisodiyoti
08.00.06 - Ekonometrika va statistika
08.00.07 - Moliya, pul muomalasi va kredit
08.00.08 - Buxgalteriya hisobi, iqtisodiy tahlil va audit
08.00.09 - Jahon iqtisodiyoti
08.00.10 - Demografiya. Mehnat iqtisodiyoti
08.00.11 - Marketing
08.00.12 - Mintaqaviy iqtisodiyot
08.00.13 - Menejment
08.00.14 - Iqtisodiyotda axborot tizimlari va texnologiyalari
08.00.15 - Tadbirkorlik va kichik biznes iqtisodiyoti
08.00.16 - Raqamli iqtisodiyot va xalqaro raqamli integratsiya
08.00.17 - Turizm va mehmonxona faoliyati

Ma'lumot uchun, OAK Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan "Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

Muassis: "Tadbirkor va ishbilarmon" MChJ

Hamkorlarimiz:

1. Toshkent shahridagi G.V.Plexanov nomidagi Rossiya iqtisodiyot universiteti
2. Toshkent davlat iqtisodiyot universiteti
3. Toshkent irrigatsiya va qishloq xo'jaligini mexanizatsiyalash muhandislari instituti" milliy tadqiqot universiteti
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ANALYSIS OF THE USE OF EQUIPMENT FOR CLEANING AND PREPARING A LIGHTWEIGHT DRILLING FLUID

Xolmuxammadiyev Abduxoliq Mahammadi o‘g‘li
Buxoro davlat texnika universiteti tadqiqotchisi

Toshev Sherzod Orziyevich
Buxoro davlat texnika universiteti, “Neft-gaz ishi” kafedrasi dotsenti

Annotatsiya: This article provides the main recommendations for the use of drilling fluids containing 3M glass microspheres. The article presents information on the preparation of lightweight drilling fluids used in the drilling of oil and gas wells under complex conditions, the development of their compositions, property management, changes in the fluid during drilling, fluid stability, and its purification.

Kalit so‘zlar: well construction, preparation of lightweight drilling fluid, specially selected composition, complex well conditions, fluid density, flow usage, liquid flow.

Abstract: Ushbu maqolada 3M shisha mikrosferalari tarkibiga ega burg‘ulash suyuqliklaridan foydalanish bo‘yicha asosiy tavsiyalar berilgan. Neft va gaz quduqlarini murakkab sharoitlarda burg‘ulashda qo‘llaniladigan engil burg‘ulash suyuqliklarini tayyorlash, ularning tarkibini ishlab chiqish, xossalarini boshqarish, burg‘ulash jarayonida suyuqlikda yuz beradigan o‘zgarishlar, uning barqarorligi va tozalash jarayoni haqidagi ma’lumotlar taqdim etilgan.

Keywords: quduq qurilishi, engil burg‘ulash suyuqligini tayyorlash, maxsus tanlangan tarkib, murakkab quduq sharoitlari, suyuqlik zichligi, oqim sarfi, suyuqlik harakati.

Аннотация: В статье представлены основные рекомендации по использованию буровых растворов, содержащих стеклянные микросферы 3М. Приведена информация о приготовлении облегчённых буровых растворов, применяемых при бурении нефтяных и газовых скважин в сложных условиях, разработке их составов, управлении свойствами, изменениях в растворе в процессе бурения, его стабильности и очистке.

Ключевые слова: строительство скважин, приготовление облегчённого бурового раствора, специально подобранный состав, сложные условия бурения, плотность раствора, расход раствора, движение жидкости.

INTRODUCTION

Today, there is a need in the world to develop and substantiate a number of scientific solutions for the use of bentonite, palygorskite, hydromica and other minerals and chemical reagents as the basis for drilling fluids for drilling oil and gas wells, including in the following areas: increasing the stabilization of drilling fluids; creating effective chemical reagents for drilling processes; developing polymineral compositions based on local clays and preparing effective drilling mixtures from them; studying the physicochemical characteristics of mixtures prepared on the basis of polymineral compositions; studying the patterns of thermal and salt resistance of drilling fluids based on clay compositions and developing their optimal modes [1].

Back in 1929, Cross and Hart patented a clay drilling fluid that used bentonite clay mixed with magnesium oxide. Of all types of drilling fluids, clay drilling fluids are used most often and in the largest quantities [2].

REVIEW OF LITERATURE ON THE SUBJECT

The use of specialized equipment for cleaning and preparing lightweight drilling fluids has been a subject of increasing interest in petroleum engineering, particularly due to its critical role in enhancing drilling efficiency and wellbore stability. According to Bourgoyne and colleagues, the performance of lightweight drilling fluids depends heavily on the effectiveness of solids control systems, especially during operations in low-density and high-pressure formations. They emphasize the role of shale shakers, centrifuges, and desanders in reducing the volume of drilled solids that could otherwise affect rheological properties and increase the risk of formation damage.

Mitchell and Miska underscore the importance of real-time monitoring and automated control in modern fluid systems, stating that the integration of sensor-equipped equipment has significantly improved the precision of fluid density and viscosity regulation. This is particularly crucial in maintaining the balance between hydrostatic pressure and formation pressure, which is vital when working with underbalanced or near-balanced drilling operations.

A study by Caenn, Darley, and Gray explores various configurations of mud cleaning systems and their compatibility with polymer-based and oil-in-water emulsified fluids. Their findings suggest that tailored configurations of hydrocyclones and vacuum degassers contribute to the efficient removal of low-gravity solids, ensuring minimal degradation of the base fluid components.

Further, Amanullah and Longley investigate the environmental and operational impacts of using biodegradable and lightweight fluids, concluding that equipment designed for precise filtration and homogenization can extend the reusability of such fluids and reduce waste discharge at the surface. They also highlight the relevance of closed-loop systems in compliance with modern environmental standards.

In more recent developments, Zhang and colleagues evaluate the performance of nanomaterial-assisted fluid systems and note that equipment designed for high-shear mixing is essential for achieving proper dispersion of nanoparticles within low-density fluid matrices. This integration enhances thermal stability and reduces fluid loss in depleted zones, a common issue in mature wells.

Collectively, these studies confirm that the choice and optimization of cleaning and mixing equipment directly influence the functional properties of lightweight drilling fluids, and thus, the success and safety of drilling operations. The growing application of intelligent systems and modular designs reflects a broader industry shift toward more adaptive, efficient, and sustainable drilling technologies.

RESEARCH METHODOLOGY

Once the target density of 805–810 kg/m³ was reached, one batch (700 pounds) of microspheres was added every 3–4 hours to maintain this density until the entire interval was drilled to 2275 meters.

No high-pressure zones were encountered, which allowed drilling with reduced density and without background gas. The operator ran the intermediate casing using the same drilling fluid.

3M™ microspheres are hollow glass microspheres used as a lightweight additive in various well construction operations, including lightweight drilling muds. The additive is chemically stable, incompressible, and virtually insoluble in water and oil. 3M microspheres are specifically engineered to provide a high strength-to-weight ratio, enabling them to remain intact under challenging downhole conditions [5].

In drilling fluids, 3M microspheres can achieve densities as low as 0.66 kg/l. Drilling fluids with 3M microspheres enable balanced, near-balanced, and underbalanced drilling.

The use of microspheres in drilling fluids allows for Measurement While Drilling (MWD). Drilling fluids with 3M microspheres also have the potential to be reused at multiple sites, reducing overall mud costs [6].

ANALYSIS AND RESULTS

Since the establishment of independence in our Republic, large-scale measures have been implemented, and certain results have been achieved in the development of the oil and gas industry. In particular, it is important to note the creation of effective technologies for the production of new scientifically grounded chemical reagents based on local raw materials and secondary products for drilling oil wells and gas wells. However, despite the sufficient volume of raw materials in our republic for the production of chemical reagents to prepare drilling fluids, the available materials do not fully meet the requirements for drilling oil and gas wells with abnormally low formation pressures [3]. This, in turn, plays a significant role in the development of innovative technologies for utilizing local materials that ensure the efficiency of drilling oil and gas wells and solve the set challenges.

In Canada, the world's first well was drilled to a depth of 600 meters (1968 feet) using a lightweight drilling fluid in a well with complex conditions (abnormally low pressure). To reduce the density of the drilling fluid, a batch of 3M™ microspheres weighing 700 pounds (317.5 kg) was added to the fluid, which lowered the density (specific gravity) of the fluid while maintaining its stability [4].

Table 1 shows the change in the density of the drilling fluid after adding 3M™ microspheres to lighten the fluid in the well drilled with the lightweight drilling fluid. Table 1 displays the obtained densities of the drilling fluid at various depths (Table 1).

Table 1. Density of lightweight drilling mud after adding 3M™ microspheres during well drilling.

Depth	Density (kg/m³)	Density (lb/gal)
600 m	830	6.92
1000 m	810	6.76
1200 m	805	6.72

The overflow density from the centrifuge was 795 kg/m³ (6.63 lb/gal), indicating that the centrifuge was capable of retaining the 3M™ microspheres in the fluid rather than separating them. This allowed the centrifuge to remove cuttings during drilling while maintaining the drilling fluid density within the target range.

The main goal of this stage is to achieve the required drilling mud density.

1.Prepare the drilling mud according to standard procedures;

2.Check that the volume of the drilling mud and the amount of glass microspheres added match the mud formulation;

3.Add the microspheres into a mixing container and stir.

It should be noted that the addition of microspheres to the drilling fluid can be time-consuming and requires planning. Conventional additives are typically added through a Venturi hopper. Microspheres can be added the same way, but they tend to agglomerate and clog the system.

An alternative method for mixing microspheres with drilling fluid involves the use of compressed air or fluid flow.

When using compressed air, dust generation is possible, and loading personnel must wear appropriate personal protective equipment (PPE) (for more detailed information, refer to the material safety data sheet).

This method of introducing microspheres into the drilling fluid can be implemented in two ways:

1. Use gravity discharge directly into the drilling fluid tank. This is the recommended method, although some modifications to the unloading process may be required. Introducing a fluid stream can help reduce dust generation. In this case, the fluid stream-circulating drilling mud-creates a siphon effect that reduces the amount of airborne dust. The size of the gravity chute and the volume of fluid should match the volume of microspheres being injected [7]. To improve the loading process of microspheres into the drilling fluid, it may be helpful to "fluidize" the microspheres in the container by injecting compressed air at a reduced pressure just below the outlet at the bottom of the bag (Figure 1).

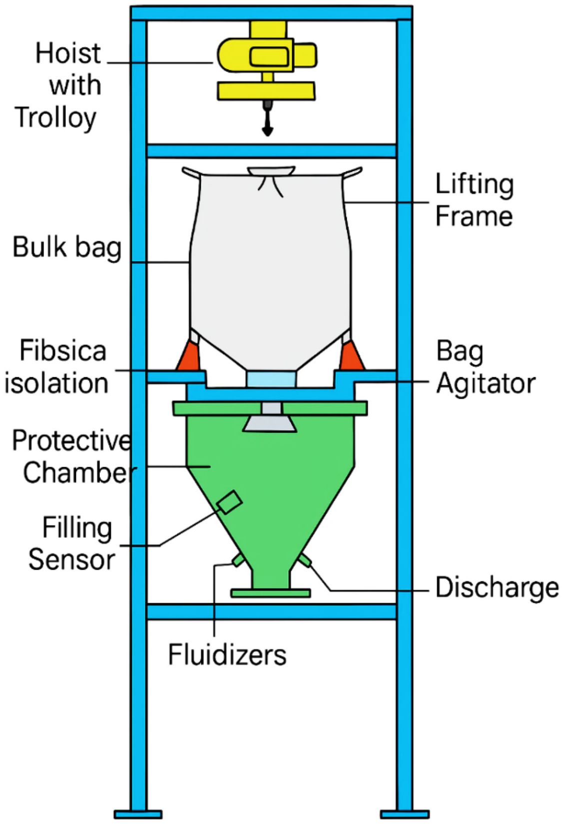

Figure 1. Unloading of microspheres using the direct gravity feed method.

2. Use a diaphragm pump to transfer directly from the bag to the drilling fluid tank. When using an alignment device, care must be taken to ensure that the liner material does not block the flow. Attention should also be paid to the pump itself. Periodic cleaning is required to prevent pump failure due to microsphere buildup in the diaphragm. When using this method, unloading a single bag may take more than 10 minutes (Figure 2).

1. Make sure the mixture is homogeneous. Initially, microspheres tend to float on the surface of the drilling fluid. However, since the drilling fluid already has a yield point (contains viscosity-building additives), the homogenization process is relatively simple. High shear forces are not required.

2. Ensure that the target density and rheological properties of the fluid have been achieved.

Drilling fluid cleaning equipment is used to maximize the removal of solids and cuttings while retaining as much fluid and microspheres as possible. Drilled cuttings are removed from the fluid using shale shakers, hydrocyclones, and centrifuges. This equipment must be properly configured to prevent microsphere loss, separation from the mud, and equipment clogging (Figure 2) [5].

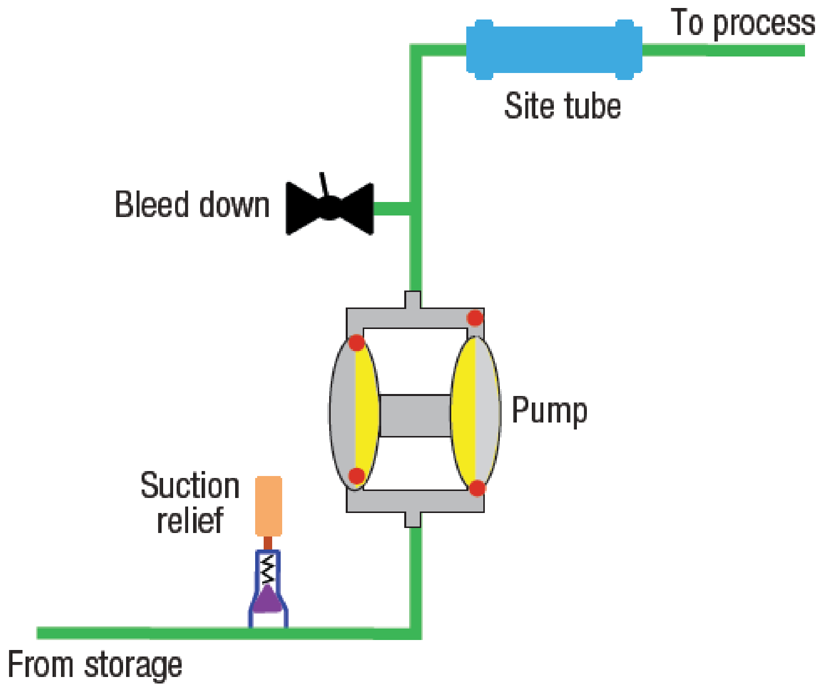

Figure 2. Unloading of microspheres through a double diaphragm pump.

Shale Shakers. Shale shakers are used to remove the largest particles of drilled rock from the fluid. The vibration of the shaker screen enables rapid separation of the mud and coarse rock particles. Particles too large to pass through the screen are separated and discarded. The screen surface is typically made of interwoven wire mesh [6,7].

Single-layer screens have one mesh layer. The mesh opening size (API screen number) is defined as the number of openings per inch of screen length [8]. To prevent microsphere loss, it is recommended to initially use an API #180 mesh. As a backup, #160 or #150 mesh screens should be prepared [9].

Hydrocyclones. Hydrocyclones consist of a top cylindrical section connected to a tangential feed section, and a bottom conical section that is open at the base to discharge cuttings. Drilling fluid from a centrifugal pump is fed tangentially into the hydrocyclone at high velocity through an inlet nozzle near the top cylinder [10].

As the fluid enters, centrifugal force in the vortex accelerates the heavier particles toward the cone wall. The fluid spins at high speed, moving downward toward the outlet. Cuttings move along the cone wall toward the underflow outlet.

Lighter particles, including fine rock and microspheres (which have a similar weight scale but are lighter than rock particles), are carried by an upward swirling stream toward the center of the cone and exit through the overflow outlet.

Hydrocyclones effectively remove particles as small as 20 microns without separating microspheres. There are two types of hydrocyclones:

Desilters (2–6 inches), which can operate continuously

Desanders (6–12 inches), which should operate intermittently

Centrifuges. A centrifuge consists of a rotating conical drum. Drilling fluid is fed into one end, and the separated solids are conveyed upward along the cylinder by a rotating screw for discharge at the opposite end.

Centrifuges can separate finer particles than hydrocyclones or shale shakers. To prevent clogging and to avoid separating microspheres, two centrifuges should be used in parallel, with each handling half of the total flow.

Start at low rotational speeds and gradually increase to find the maximum speed that does not result in microsphere separation (typically around 50% of the maximum possible speed).

3. Circulation of Lightweight Drilling Fluid

The density of the drilling fluid must be continuously maintained to ensure optimal drilling performance. Reducing the mud density to a certain level may not completely eliminate fluid losses, especially if obstructions in the formation prevent achieving the desired fluid parameters.

Total mud losses and circulation losses should be addressed according to approved drilling methods.

When using lightweight drilling fluids during well drilling, special attention should be paid to the following:

-Ensure that the calculated flow rate, bit type, and bit nozzle size are selected for the most gentle operating mode;

-Monitor the drilling fluid properties as usual;

-Watch for increases in drilling fluid density. An increase in density may be caused by the accumulation of cuttings, rain, or other sources of fluid. If the fluid density increases, take appropriate corrective action;

-Manage drilling fluid density by periodically adding fresh batches of microspheres.

4. Opportunities for Reuse of Lightweight Drilling Fluid

-Helps reduce drilling fluid costs through recovery and reuse;

-After drilling is completed, check the quality of the used drilling fluid. It may be reused at another location;

-Add a fresh batch of microspheres to restore the drilling fluid.

CONCLUSION AND SUGGESTIONS

The frequency of adding new batches depends on the drilling regime and geological conditions. A “drain and refill” approach is recommended, which can be combined with periodic microsphere additions. This method involves discharging part of the used drilling fluid and replacing it with freshly prepared drilling fluid, ensuring the new mixture matches the target density of the drilling fluid.

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Musahhih: Zokir Alibekov

Sahifalovchi va dizayner: Oloviddin Sobir o‘g‘li

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