Problems of waste management for semi-submersible drilling rig «polar star»

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Abstract. The development of hydrocarbon deposits on the Sakhalin shelf is one of the main components of JSC Gazprom's Eastern gas program. When drilling mud is used in the process of drilling wells, one of the most important components in the installation is a circulation system designed for cleaning the drilling mud from solid and gaseous phases, storing it and then feeding it into the well. In the light of the above, the study of this field, the chemical nature and directions of rational use of condensates is particularly relevant and modern. The purpose of the work is to conduct an audit of the Polar Star drilling platform, study the operation of the installed equipment for the possibility of using hydrocarbon-based solutions. In the course of research and calculations, there were identified problematic equipment nodes that need to be completed. It is concluded that at the moment the Polyarnaya Zvezda oil drilling platform is not ready to use hydrocarbon-based solutions, but it is also not ready for safe and organized drilling operations. Without fixing the identified problem systems, drilling operations will be very difficult and environmentally unsafe.

1 Introduction

The aim is the audit of semi-submersible drilling rig (SSDR) "Polar Star" (Fig.1), study of installed equipment and for use of hydrocarbon based muds (HBM) [1], a proposal and feasibility assessment of using the equipment, which will be similar to other global companies in terms of import substitution policy in the Russian Federation [2].

In order to reduce environmental pollution by the oil and gas production complex, developments are underway [4] and new technologies and equipment are being introduced. In this regard, the purpose of these studies is also to consider and justify the choice of a rational design of the circulation system (CS), [5].

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2 Methods

Research methodology:
- analysis of the design features of existing CS on drilling platforms, world experience in installing effective CS taking into account the policy of "zero discharge" [6] and rational use of natural resources [7];
- design of a typical well structure of type P4 at the Kirinskoye gas condensate field, taking into account the initial data for the field;
- calculation of technological reserves for Autonomous drilling of a single well with a length of 3500 m along the trunk, at a commercial rate of penetration 2000 m / machine-month, taking into account the specifics of work in the Arctic region;
- drawing up a list of major importers of equipment for drilling mud treatment systems, as well as Russian manufacturers with a comparative analysis of cost and technological characteristics;
- assessment of the main factors of negative impact of the CA and its equipment on the environment (methodological aspects of environmental impact assessment are discussed in [8]);
- inspection of major systems and equipment associated with the circulation and purification, preparation and storage of drilling mud that are performed during the winter Parking SSDR "Polar Star" with potential to assess the possibility of HBM based on the work rig in the Arctic region [9] (Fig. 2, 3);
- formation of recommendations to improve equipment related to the circulation and purification, preparation and storage of drilling mud.
3 Results and Discussion

So, in the course of research and calculations, we will list the problematic hardware components that need to be completed in the first place and do not directly relate to the possibility of using HBM.

It is not possible to clean the solution in the working and reserve tanks using centrifuges. The process of selecting centrifuges for cleaning drilling fluids is discussed in the article [10], and the research and development of methods and technologies for regulating the properties of drilling flushing fluids using centrifuges is discussed in [11].

At the well outlet, there is no flow distributor for uniform loading of the vibrosite, and there is also no air line for purging blocked sections of the vibrosite loading chute.

Vibrating screens are not tilt-controlled. Finishing is considered only as a replacement for new and modern vibrating screens.
Low supply of drilling mud to the drilling separator (pump of insufficient power), low efficiency of drilling mud cleaning

The chemical warehouse does not have a conveyor line for feeding and entering large bags.

Weak pressure in the funnels in the solution preparation unit, the need to install additional discharge pumps.

Transportation and loading of sludge—the entire system is problematic.

The following points, the necessary modifications and the use of additional systems are directly related to the use of the HBM.

You must install a dispersant (at least one)

Connect the high-pressure washers to the base oil tanks

Install a ventilation system in the base oil storage tanks, install fire and gas alarm sensors there, as well as on each pump that pumps drilling mud or flammable liquids. Reconfigure existing fire and gas alarm sensors for the HBM.

Provide the drilling team with additional personal protective equipment (PPE) and individual gas content sensors. The rules for issuing PPE funds.

To deal with local spills (in the area of augers, skips with sludge, decks, vibro-plates, hydrofoils), it is necessary to have a stock of surfactants such as sulfanol, rags and absorbents on the drill.

Purchase or install a nozzle on the drill pipes for flushing the divertor before unpacking, to avoid spills of ore into the sea.

A comprehensive assessment of the quality of steel drill pipes is considered in [12].

Mount the candlestick railing on the rotor table so that the HBM flowing from the drill pipes does not fall into the General drain system, but only into the discharge line on the vibrating screen.

In the course of the inspection, positive aspects were also identified that allow the use of the HBM on the polar Star SSDR.

The examined rubber seals of valves, pipes, tank covers, etc. are made of oil-resistant materials (an experiment was conducted – within 3 days, various types of rubber seals were soaked in diesel fuel). Methods of control and testing of valves are considered in the national standard of the Russian Federation. Gas and fire alarm systems are available at almost all facilities, as well as the ventilation system. Fire safety requirements for oil and gas field development facilities are set.

The paint coating of base oil reserve storage tanks is resistant to aggressive environments.

The calculation of technological reserves showed the weight of waste when drilling a single well with a length of 3500 m along the trunk. in 2.5 months, it will amount to 978 tons of sludge and 375 tons of drilling waste water. To work with the above – mentioned numerical indicators and to minimize the negative impact on the environment, it is necessary to modernize the installed equipment of the ppbu taking into account the identified shortcomings, to study in detail the possible installation of domestic systems (the Russian equivalent is JSC "Khadyzhensk machine-building plant") and others according to the list of organizations developed during this study.

Negative impact on the environment during the work of the CS brings:
- drilling mud;
- residual drilling mud and drilling waste water;
- noise and vibration.

After correcting the above shortcomings, it is necessary to test the entire CS by closing it inside the drilling rig, and pump the hydrocarbon base of the HBM through all lines and tanks, including the cleaning equipment.
4 Conclusions

At the moment, Polyarnaya Zvezda is not ready to use the HBM, but it is also not ready for safe and organized drilling operations. Without fixing the identified problem systems, drilling operations will be very difficult and environmentally unsafe for the sensitive Arctic region of the sea of Okhotsk.

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