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Korobov A.A. student group 185m-23-1**Scientific supervisor: Khomenko V.L., Candidate of Sciences, Senior Lecturer of the Oil and Gas Engineering and Drilling Department***(Dnipro University of Technology, Dnipro, Ukraine)***TECHNOLOGICAL FACTORS AFFECTING DRILL STRING STICKING:
PREVENTION AND CONTROL STRATEGIES****Introduction**

In drilling operations, technological factors play a crucial role in influencing the occurrence of drill string sticking, a condition where the drill string becomes immobile within the wellbore. Stuck pipe incidents can severely disrupt operations, leading to significant time delays and increased costs. To minimize these occurrences, it is essential to understand and manage the technological aspects of drilling, which include the selection and configuration of equipment, operational parameters, wellbore stability techniques, and adherence to optimized drilling practices. Poorly chosen or executed technological solutions can heighten the risk of drill string sticking, complicate the drilling process, or lead to a full operational shutdown.

Results

Conventional rotary drilling, one of the most widely used drilling methods, relies on continuous rotation of the drill string. However, this approach often leads to increased friction between the drill string and the wellbore wall. In certain formations, particularly when traversing unstable or tight sections, this heightened friction can raise the risk of the drill string becoming immobilized. High-torque rotary drilling uses advanced rotary systems designed to improve energy efficiency and reduce rotational resistance. By generating greater torque, these systems can help reduce the force required to rotate the drill string, thus mitigating some frictional effects. However, high torque also introduces the potential for increased localized stress on the drill string and the surrounding wellbore, which can inadvertently contribute to sticking if not carefully monitored [1].

The choice of drill bit plays a pivotal role in preventing stuck pipe situations. Selecting a bit type suited to the specific formation – considering factors like bit geometry, design, and material hardness – ensures that drilling forces are evenly distributed. Drill bits with improper geometry or worn cutting elements can exert uneven forces on the drill string, increasing the risk of jamming, particularly in harder or fractured formations [2]. The drill string must be configured to optimize its stability and minimize the risk of sticking. This involves selecting appropriate drill collars, stabilizers, and heavyweight drill pipes. Proper placement of stabilizers helps centralize the drill string, reducing the chance of wall contact that can lead to increased friction and eventual sticking. Misalignment or incorrect weight distribution along the drill string can lead to a phenomenon called differential sticking, where the drill string becomes immobilized due to pressure differentials along its length [3].

The rate of penetration (ROP) must be carefully controlled. Excessively high ROP can lead to tool overheating, excessive vibrations, and increased mechanical stresses, all of which can exacerbate friction and lead to sticking [4]. On the other hand, too low an ROP can result in accumulation of cuttings in the wellbore, restricting drill string movement and increasing the likelihood of jamming. Proper circulation of drilling mud and efficient cuttings removal are essential for preventing stuck pipe. Insufficient circulation velocity may leave cuttings suspended in the wellbore, impeding the free movement of the drill string. Adjusting mud viscosity and flow rate to enhance cuttings transport is critical, especially when drilling through loose or unconsolidated formations that can easily collapse.

Optimizing rotational speed and WOB is crucial to avoid excessive sidewall pressure and maintain consistent tool performance. Too much WOB or rotation speed can lead to excessive wear on the drill bit and drill string, which increases the risk of differential sticking. Conversely, insufficient WOB may result in inefficient drilling and increased time spent in the wellbore, heightening the risk of sticking over time [5].

Hydrostatic pressure, generated by drilling mud weight, must be carefully balanced to maintain wellbore stability without overloading the formation. An optimal mud weight stabilizes the wellbore, while an excessive mud weight can increase wellbore wall pressure and lead to potential collapse. Insufficient hydrostatic pressure can create conditions for influxes or kicks, which may destabilize the wellbore and elevate the risk of drill string sticking.

Effective lubrication reduces friction between the drill string and the wellbore wall. Lubricants, both synthetic and water-based, are introduced into the drilling fluid to lower surface friction. In challenging wellbores, advanced additives designed to enhance lubricity and reduce torque are applied to mitigate sticking risks further.

Following appropriate drilling stages and intervals minimizes stress accumulation within the wellbore. Each stage of the drilling process should be precisely timed and monitored, particularly when transitioning between formations or sections. Failing to adhere to these guidelines can create local stress concentrations, leading to wellbore instability and increased risk of drill string sticking.

Routine inspection and maintenance of drilling equipment, including bits, drill collars, and stabilizers, are vital for efficient operations. Damaged or worn components increase the likelihood of sticking and can compromise the integrity of the entire drill string assembly.

Conclusion

Technological factors – including drilling methods, equipment selection, drilling process parameters, and operational practices – play a pivotal role in preventing drill string sticking incidents. Effective management of these factors, coupled with advanced technological solutions, can reduce the risks associated with stuck pipe and enhance both the safety and efficiency of drilling operations. By prioritizing well-maintained equipment, real-time monitoring, and optimized process controls, operators can significantly mitigate the likelihood of drill string sticking and ensure uninterrupted drilling progress.

References:

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