Automated Rheometer: Real-time mud properties that improve the software algorithm

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Abstract

Objective/Scope: The business drivers in today’s market are improved efficiency, cost reductions, and emission reductions via new technology, rig automation, and software solutions. To meet the needs of a changing market, it’s necessary to integrate new sensors to acquire better data and create better software algorithms needed to make well construction more efficient.

Methods, Procedures, Process: The automated rheometer sensor can measure the viscosity, density, and rheology continuously from the return mud flow in real time. Increasing the datapoints on typical rheology measurements from 4 to 100/d improves algorithm precision increasing the ability to predict potential wellbore incidents. This ensures the mud is in optimal condition for drilling to maintain well parameters throughout the process. The sensor can detect any changes in the mud properties as they occur, so the drilling team can take corrective action, as needed. As a result, the data can be integrated into an autonomous closed loop drilling process. This means measurements are automatically fed back into the drilling operations, enabling the drilling team to adjust the rig parameters in response mud property changes.

Results, Observations, Conclusions: Combining standard drilling sensor data with high frequency and 15+ new mud datapoints helps to develop an algorithm that can accurately predict potential incidents. With this new data, it is possible to identify trends in density and combine that knowledge with 600 rpm readings to identify the build-up of low gravity solids (LGS). High LGS content can influence viscosity, creating wear on equipment and downhole tools. A rapid increase in LGS can indicate other known problems as well. Identification and proactive LGS removal improve fluids quality, reduces friction, and optimize wellbore conditions.

The extra density data obtained using the RheoProfiler rheometer was utilized to analyze the mud data and identify where sagging might occur. At times, barite particles can settle out of suspension forming a dense, heavy layer at the bottom of the wellbore. This settling may cause excessive torque, drag, and fluid loss, resulting in increased drilling costs and reduced drill bit life.

The increased frequency of low-end rheology readings (3 rpm) improved the algorithms hole cleaning indicator (HCI), an important factor for successful drilling operations. The HCI have now increased knowledge of wellbore condition and removal of cuttings from the borehole.
Novel/Additive Information: A successful well has maximum productivity with minimum development cost, and no harm to personnel, environment, and material. Continuous standardized monitoring and maintenance of the primary well barrier is critical, and the wellbore fluids properties can reveal changes in the subsurface environment. Utilizing this information in real time while drilling can improve performance helping to maintain well conditions while simultaneously maintaining high safety and reliability standards throughout the process.