Cuttings transport evaluation reduces wellbore instability risks

The automated system tracks hole cleaning efficiency to optimize drilling in longer and more complex wellbores.

In any drilling environment, the removal of drill cuttings from the wellbore is critical for avoiding problems such as bit balling, pack-off and stuck pipe. If left unchecked, these problems can lead to formation damage, loss of circulation and nonproductive time, requiring the driller to pull the drillstring and clean out the well before drilling can continue.

The risks and costs associated with inadequate hole cleaning and wellbore instability are only increasing as operators continue drilling more complex boreholes, including extended-reach wells with long laterals, highly deviated wells, and horizontal and multilateral wells. In deepwater wells, operators are looking to reduce rig time by optimizing their hole cleaning practices and off-bottom circulating time.

Monitoring drill cuttings at the surface is a popular method of determining hole cleaning efficiency and potential borehole stability issues. However, conventional monitoring methodologies are non-automated, imprecise and do not provide real-time information that the driller requires to perform meaningful quality control and stay ahead of stability challenges downhole.

Automating cuttings analysis

Alleviating these concerns was the motivation behind the development of the Schlumberger CLEAR hole cleaning and wellbore risk reduction service, a real-time monitoring service that evaluates the transport of cuttings at the shale shaker to help the drilling team understand their progress in the well.

The service includes a cuttings flowmeter and weighing tray positioned at the end of each shale shaker, which catches cuttings as they fall off the screen. Cuttings accumulate on the tray and are weighed with strain gauges at predetermined intervals. At the end of each adjustable preset period, the tray swings down to discharge the wet cuttings and then returns to its previous horizontal position to begin collecting cuttings for the next measurement. The device is pneumatically powered by the rig’s own air supply and does not interfere with the shale shakers (Figure 1).

Each recorded weight is then sent digitally to an acquisition system, which computes a volumetric flow rate of the cuttings. This measured volumetric rock cuttings flow trend is compared with a theoretical volumetric flow trend calculated from the ROP of the drillbit. These comparisons provide early detection of downhole drilling conditions that might hinder wellbore stability. For example, if the actual volumetric flow is significantly less than the theoretical flow, this indicates inadequate hole cleaning. Conversely, an excess of cutting returns suggests wellbore instability, known as caving or formation damage.

The cuttings flow information is correlated with drilling parameters, cuttings geology, drilling fluid properties and MWD data, all of which are displayed on a real-time data dashboard. The dashboard has a simple, intuitive interface. The data also are transmitted to remote locations for analysis by well construction engineers. The dashboard allows better quality control of the data on the rig and in-depth analysis such that more informed drilling decisions can be made in a timely manner (Figure 2).

The service’s ease of use on site and its ability to connect rig crews with support expertise located in corporate offices enable operators to minimize the number of per-
sonnel on the rig floor, a major driver for reducing health and safety risks. Many times, the same well logging personnel already present at the rig site are used to run this additional service. After just one hour of training on the dashboard, well loggers can confidently operate the system and interpret results without a major time commitment that would distract them from their core responsibilities.

Optimizing drilling

The CLEAR service has been successfully deployed in a number of field scenarios. An operator in the Middle East deployed the service as part of an integrated drilling solution aimed at optimizing the drilling of a sidetrack in one run. This would require reducing the flat time associated with stuck-pipe incidents and wiper trips while maximizing ROP and footage drilled.

Schlumberger engineers recommended running the cuttings surveillance system in conjunction with mud monitoring and a robust rotary steerable system (RSS). The Schlumberger PowerDrive Orbit RSS has a multiaxial component for automatic hold inclination and azimuth capability, which provided additional directional control. The RSS also was proven to reduce drag, improve ROP, decrease sticking risks and deliver superior hole cleaning. A drill fluid expert from M-I SWACO, a Schlumberger company, provided continuous mud monitoring support to the fluid engineer on the rig.

Using this approach, which marked the first time the cuttings surveillance system was used in an integrated service offering, the operator was able to steer the well trajectory into the target zone with low tortuosity and increased ROP. The lateral section was drilled nearly 2.5 days ahead of plan and with minimal stick/slip, shock and vibration. The operator achieved optimal hole cleaning with a cumulative cutting recovery of 84.4% with a 51% reduction in cumulative pill volume.

The service also helped deliver a new field record for drilling a 6⅛-in. section with a standalone RSS. The operation’s average ROP was 28 m/hr (91 ft/hr), while previous jobs averaged 22 m/hr (72 ft/hr). Footage increased to 603 m/d (1,978 ft/d) compared with the previous record of 429 m/d (1,409 ft/d). The operator also reduced connection time by 60% toward the end of run, thus saving $148,000 in its authorization for expenditures spend.

Assuring wellbore stability

An operator in Southeast Asia deployed the hole cleaning service with an aim of mitigating anticipated wellbore instability challenges during a three-well extended-reach drilling operation. The operator needed to monitor and optimize its hole cleaning strategy while drilling 12¼-in. by 13½-in. sections at 70 degrees with an average departure greater than 1,524 m (5,000 ft).

The information provided by the CLEAR service indicated that the drilling fluid rheology was inefficient at lifting the cuttings to surface. The drilling team used this insight to raise the low-end fluid rheology, thus improving hole cleaning and avoiding the need for unplanned circulation.

Using the new service, the drilling team was able to enhance its pill strategy. Fewer pills were deployed with no detrimental impact on hole cleaning, which increased the net ROP and decreased the time spent on mud treatment. The size, frequency and type of pills used also were revised, which ultimately optimized efficiency and control time dedicated for a secondary hole cleaning. High-viscosity pills were maintained for the larger outer-diameter (OD) slant hole, and tandem pills were assessed and measured as having optimal performance in smaller ODs.

The solution led to an overall improvement in drilling performance and gave the operator greater confidence to drill faster. The average time spent per stand for circulating and pumping pills decreased by 11 minutes compared with previous wellbores. In total, the systematic approach saved the operator 16 hours of rig time and $194,000 in direct costs.

FIGURE 2. Real-time cuttings flow information is accessible through the online dashboard at the rig site or at a remote office. The information is integrated with other MWD data and presented in an easily accessible format, which helps the drilling team quickly assess hole cleaning effectiveness and minimize wellbore instability risks. (Source: Schlumberger)