

SONAR Flow Meter for Measuring Drilling Fluids

Drilling fluids flow measurement

Summary

Expro's ActiveSONAR™ clamp-on flow meter is ideally suited for measuring the flow of drilling fluids and has been qualified for use in Conventional and Managed Pressure Drilling operations.



Significance of drilling fluids

The measurement of the flow rate of drilling fluids is critically important for safe and effective drilling and logging operations. Accurately measuring the balance of the drilling fluids as a system (barrels-in versus barrels-out) provides important information to the driller and mud logger, for example:

- Early warning kick detection - formation fluids flowing into the wellbore and up the drill string due to imbalance of hydrostatic pressures
- Tracking ballooning and allowing the driller to differentiate between ballooning and kick
- Accurate mud flow rate - used by mud loggers to compute transport velocity and lag time (the time it takes for the mud to circulate from the drill bit to the surface)

Industry measurement challenges

Drilling mud flow measurement can be a very challenging measurement for traditional flow meter technologies. Wide variations in the type of mud (water based, oil based, synthetic, emulsion), the solids content, the type of solids and other factors requires flow meters that have the ability to measure drilling fluids with wide ranges of fluid viscosity, density, conductivity and resistivity.

Variations in drilling operations in terms of depth, rate of penetration, pump pressure and other factors result in a wide range of potential drilling mud flow rates (referred to as "turndown"). Most traditional flow meters are designed for a specific operability range and do not have wide turndown.

In addition, flow meters with components that are intrusive into the flow are highly susceptible to wear and damage due to solids, chemicals and cuttings in the drilling mud flow stream. Safety is of course of highest importance in any drilling operation, and flow meters must be designed to operate in high pressures and harsh environments without risk of safety critical failure. These variables make it challenging to find one type of flow metering technology that can be cost effectively applied to a wide range of drilling operations and provide the accuracy that is demanded in today's high tech drilling operations.

Traditional measurement methods

To date, measurement of drilling fluids into the wellbore has by-and-large been carried out by simple counting of pump strokes to calculate the flow rates. However, this method of calculation raises a number of issues such as:

- Human error – risk of miscount, especially when switching between varies pump sizes and having multiple pumps run concurrently
- Reactive approach – lack of real time flow rates at the rig control system hinders the driller's ability to identify potential operational issues or make changes in the system to optimise operations
- Drilling mud pump efficiency – counting the pump strokes does not account for physical wear on the pump liner, which can cause differences between theoretical and actual pumping rates

Key deliverables

- Non-intrusive design
- No wear parts
- Real time measurement
- No process shut down
- Oil & Water based drilling fluids
- Cost effective
- Accurate

Technology Used

- ActiveSONAR™ Flow Meter

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Ideally, drillers and mud loggers want to measure the flow of mud into the well downstream of the discharge of the mud pumps. This gives a true reading of the mud “inflow” flow rates and a true picture of the efficiency of the mud pumps.

Outflow from the well, if measured, is typically measured using paddle type meters, which tend to be inaccurate and prone to wear due to contact with the drilling fluids and cuttings.

Coriolis type meters are sometimes used for measuring drilling mud flow rates, however, the large size and the potential for operating pressures which exceed the pressure ratings of those devices make them a less than ideal solution for measuring mud flow rates. Due to pressure limitations, Coriolis type meters are typically not installed on the high pressure side of the Mud pumps. If installed on the suction side of the pumps, one meter for each mud pump is required. For jobs with multiple pumps, this can be cost prohibitive and occupies a large space on the rig floor.



Traditional clamp-on ultrasonic flow meters are typically not used in this application due to their inability to deal with high solids content or entrained gas, and inability to measure through the thick pipe walls generally employed in drilling operations. Additionally, traditional clamp-on ultrasonic meters are not engineered and manufactured for the harsh operating environments typically found on drilling rigs.

Expro's solution

Expro Meters' **ActiveSONAR™** flow meter has been successfully deployed on drilling operations and has attributes that make it the ideal flow meter for this application.

Expro's SONAR clamp-on flow meter technology attaches to the outside of the existing drilling fluids flow line. For the inflow measurement, the SONAR meter is well suited for installation on the standpipe, off the rig floor to conserve rig space and downstream of the mud pumps to provide a true measurement of the flow rate of mud into the wellbore. For mud returns measurement, the SONAR meter can be installed on existing pipework (the pipe must be full, so special consideration should be given to piping geometry to ensure the pipe is full of liquid at the measurement point). Due to its non-intrusive design, the SONAR meter can be installed and rigged down without flanging-in pipe work and shutting down the process. SONAR meters are calibrated to +/- 2% accuracy and can be, easily, interfaced to rig data collection system to provide real-time flow rates.



Expro's non-intrusive clamp-on SONAR meters additional benefits include:

- One man rig up
- Non-intrusive design, no wear-parts, maintenance free and rugged, reliable design
- No in situ calibration requirements
- Suited for oil based and water based drilling fluids
- High accuracy flow measurement in fluids with high solids content
- Wide turn-down to cover all expected flow rates during drilling operations. Changes in fluid properties do not affect measurement performance
- Location on high pressure discharge side of pump; can be mounted on the standpipe, conserving rig floor space and eliminating the need for a flow meter on the suction side of each mud pump.
- ATEX./IECEx Zone 1 and US/Canada Class1/Div2 rated for rig floor operations
- Compatible with industry standard mud logging systems