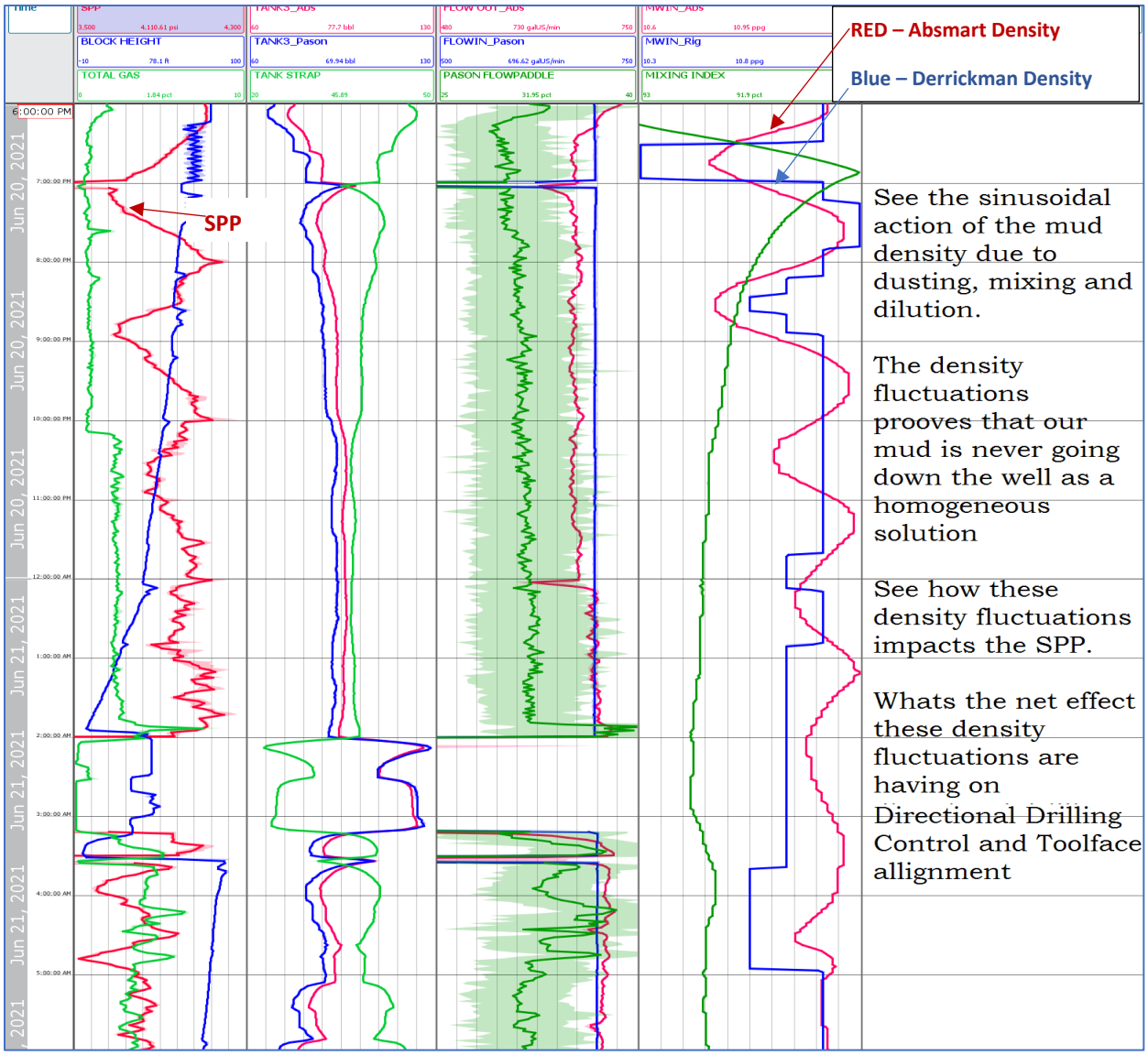
Directional Drilling – The Value of Real Time Density



It has been identified on several occasions that our mud is almost never homogeneous throughout. We have picked it up in the real time data that this sinusoidal wave action is happening often and while it's good to identify that it is happening, but the real value comes from understanding why it is happening and put procedures in place to help mitigate. In this particular case, it was identified that the way we are mixing, and the equipment used could be the culprit. Lining the mix pump up on the active mud pit and returning to the active pit is a common procedure on most rigs. What this does is it doesn't give the products adequate mixing time before being pumped down the well. A better method would be to line up to mix from the active pit and return to the first agitated pit after the settling pits. This will mitigate many of the humps and bumps in the system due to inadequate mixing. One "best practices" initiative could

be to install a high shear mixing hopper equipped with mixing eductors, this is the best way to ensure adequate mixing is being done at all times.

The question then becomes, what is the net effect that these density fluctuations are having on the well, drilling performance, drilling efficiency or wellbore placement? We do know a few things about directional drilling and how real time density plays a huge role in getting a quality wellbore path with minimum dogleg severity. Density plays into a couple of directional drilling KPI's, the first is through pressure variations while the second is the drag impact that cuttings beds have on tool face control.

While drilling with MWD and mud motor, a mud pulse MWD uses a poppet valve to create pressure fluctuations in the mud stream inside the drill pipe. The poppet is on the bottom end of the tool sonde inside the collar. When the poppet activates, a solenoid drives the poppet down into a seat in the collar which momentarily stops all mud flow. Since the mud motor is a positive displacement motor, stopping the volume of mud from flowing temporarily stops the motor from turning. Stopping rotation of the mud motor means no additional torque is being delivered to the bit. The cuttings currently being freed from the formation face releases and the torsion is relieved. At that point, the tool face will change in response to the loss of torque and torsion. When the poppet opens, the motor restarts, the shaft rotates the bit enough to re-engage the cuttings and the system torques back up. The poppet cycles in a period between about 0.25 and 0.5 seconds. A stream of data may take up to 30 seconds or about 100 pressure cycles. The directional driller is relying on the standpipe pressure to see the differential pressure that tells him the motor is holding constant torque and therefore the tool face is steady in the direction indicated by the signal. When the mud weight is varying, unbeknownst to the directional driller, the standpipe pressure is varying, but the directional driller is trying to hold it steady. The result is he is changing tool face trying to keep the standpipe constant! So if the mud weight is constantly changing, tool face is constantly changing and the hole is not drilled in a single plane with a smooth curve as desired.

Under poor hole cleaning conditions, the tool face can also vary a lot, the extra drag caused by the cuttings bed acts to prevent torque from being transmitted down the drill string to the motor. The cuttings also interacts with the motor to cause the torsion to be over a shorter distance which means the torque creates a larger amount of angular variance in the tool face.

There you have it folks, yet another compelling reason way we should be measuring density in real time on all our rigs

Measuring Mud Matters

Jason Norman

jasonn@absmartusa.com