The Absmart Difference
The Mud Density Conundrum

Mud Density at face value might seem like a simple measurement to capture in real time. While it is relatively easy to measure, beware, the mud density measurement can be difficult to interpret due to the inherent nuances that causes data anomalies. We have made great strides in doing the tough upfront work for you.

Here are the Conundrums

What is accuracy? It's defined as the degree to which the result of a measurement conforms to the correct value or standard…. the question is "what is standard"?

- **Conundrum # 1:** We calibrate our real time sensors to a 70 yr old technology that has an industry accepted high % error. Meaning we, use a conventional mud balance as our reference data, while non-sensical, it is our industry standard.

What is the accuracy of the real time density sensors vs mud balance?

- It's been statistically validated using TEV (total equipment variance) that a conventional mud balance has an error margin of +/- 0.316 ppg at a 97% confidence interval, meaning 97 samples out of 100 should be within +/- .316 ppg. The real time sensors have a factory error acceptance at +/- .05%.
- **Conundrum # 2:** even when we use a more accurate industry accepted method (i.e. gravimetric methods) to calibrate the sensors, we discover that compared to the mud balance, it's error leads us to trust issues. Meaning, the derrick hand is not using gravimetric methods to collect his data, he is using the conventional mud balance. When he gets a 9.4 ppg all day everyday while the real time data is moving around as much as .3 ppg fluctuations, its difficult for him to trust the new technology.

What is perceived as accurate or inaccurate is likely the biggest conundrum.

- The derrickman collects his mud density measurement using a mud balance every hour. For 70 years the industry has learned to trust the mud balance even with its inherent flaws and accepted inaccuracy
- When a measurement from the real time sensors suggests a different reading than that from the mud balance, it is immediately deduced that the sensors must be wrong.
- **Conundrum # 3:** Perception is everything in trying to reshape an industry wide standard, when a derrick hand collects his 1 mud check per hour, he compares his value to the one on the screen and makes a silent decision as to his acceptance or not. It's difficult for our field guys to accept the real time data as true when they have only ever seen data from a mud balance.

Sample Time	3/11/22 @ 11:00 am		3/12/22 @ 9:00 am		3/13/22 @ 11:00 am		3/14/22 @ 9:00 am		3/23/22 @ 9:00 am		4/10/22 @ 7:15 pm		4/11/22 @ 6:30 pm	
Source	3rd Party	Mud Report	3rd Party	Mud Report	3rd Party	Mud Report	3rd Party	Mud Report	3rd Party	Mud Report	3rd Party	Mud Report	3rd Party	Mud Report
Barite Density HGS	3860	4100	3860	4100	3860	4100	3860	4100	3860	4100	3860	4100	3860	4100
Solids Density LGS	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
Density Base Oil	846	837	846	837	846	837	846	837	846	837	846.1	836.7	846.1	836.7
Fluid Density (ppg)	9.2	9.4	9.4	9.4	9.6	9.4	9.4	9.4	9.1	8.8	9.70	9.40	10.00	9.40
% Oil v/v	75.0	69.6	74.6	68.7	72.7	68.5	73.8	67	67.2	70.7	64.0	64.7	64.4	65
% Water v/v	13.5	19.5	10.5	20.3	13.6	20.5	11.9	22.0	24.9	21.8	22.2	24.6	24.9	24
% Solids v/v	11.5	10.9	14.9	11.0	13.7	11.0	14.3	11.0	7.95	7.5	13.8	10.7	10.75	11
% LGS	8.4	5.5	11.4	5.9	8.3	5.8	8.2	5.9	2.7	3.5	9.4	5.6	9.7	6.1
% HGS	2.0	3.6	0.7	3.3	3.0	3.4	1.1	3.1	3	2.1	1.7	3.1	3.2	2.8
Oil/Water Ratio	85.0 / 15.0	78.0 / 22.0	87.0 / 13.0	77.0 / 23.0	85.0 / 15.0	77.0 / 23.0	86.0 / 14.0	75.0 / 25.0	75.0 / 25.0	74.8 / 25.2	76.0 / 24.0	72.0 / 28.0	77.0 / 23.0	71.5 / 28.5

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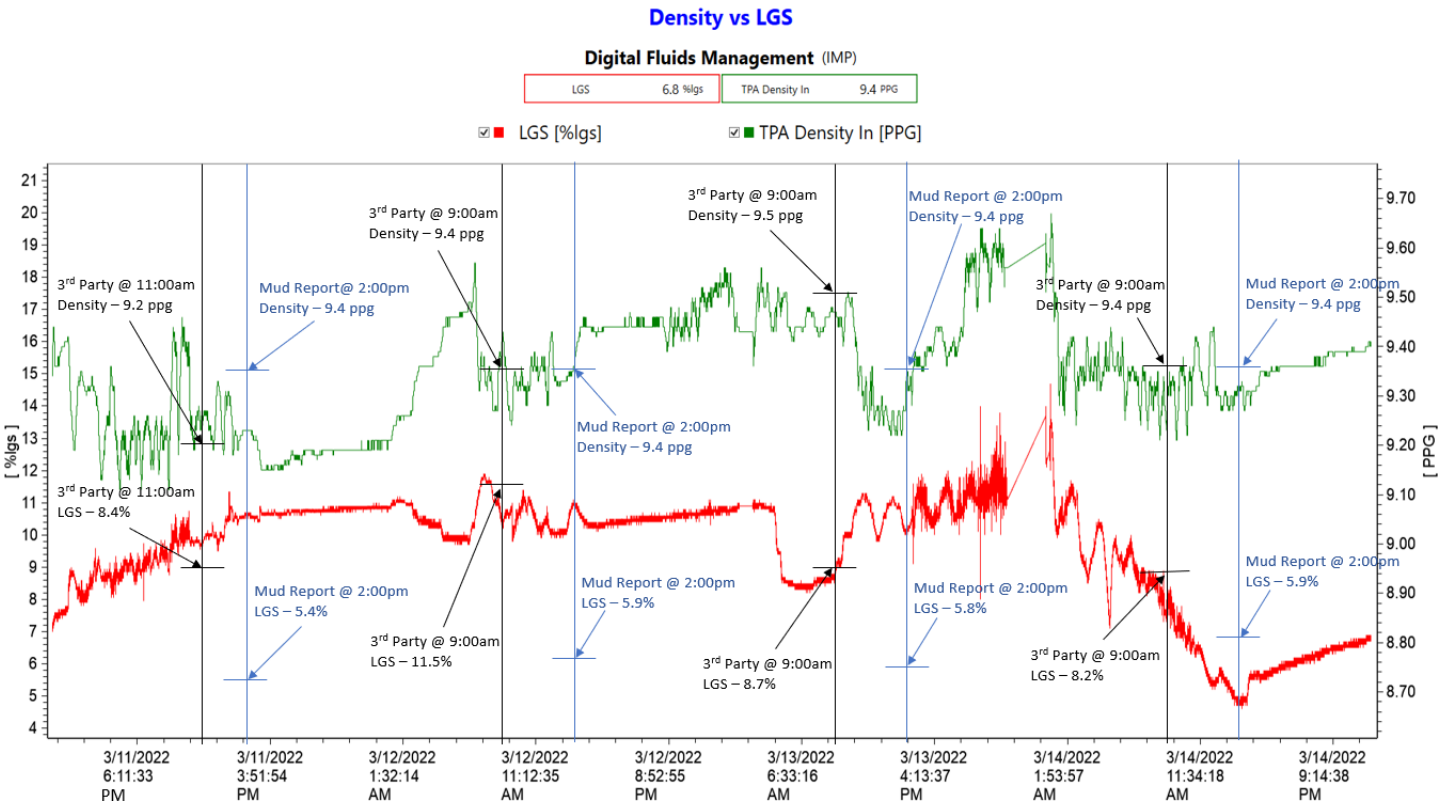
When we look at the data graphically represented, we can see that over the course of 4 days, the mud density data moves around, as demonstrated from 9.15 ppg to 9.65 ppg, and of course is the largest contributor to our % LGS measurement. The good news is that there are things we can do to make this data flatten out.



Most of the contributing factors that leads to large data fluctuations can be ironed out with just a few simple behavioral changes, here's a few noteworthy adjustments that can easily be applied:

1. When adding barite, base oil, water, emulsifier, lime or salt, each of these additions will impact the mud density. Mix all mud product additions into the first agitated tank downstream from the settling pits and let this newly mixed fluid overflow into the active tank, this will remove many of the humps & bumps in the mud.
2. Whenever possible, mix all your product additions into a premix and bleed that premix into the mud system over the course of several hours is the best approach.
3. Whenever possible run all mixing through the gun lines to maximize the amount of energy that can be applied to the mud.
4. Add low-cost tank eductors to the gun lines to increase the shearing capability, a tight emulsion will save you from poor suspension characteristics.
5. Add a low-cost chaos mixer to the transfer line going to/from the frac tanks. We want to give ourselves every opportunity to introduce an adequately mixed fluid to the wellbore environment.

These are simple enhancements that will immediately improve your well delivery process – **Measuring Mud Matters**

Jason Norman
Absmart Inc

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