Key Performance Indicators

Digital Fluids Management (DFM)

Unlocking the **Value of Drilling Fluids Instrumentation**

The Right Information from the Right Instruments at the Right Time for the Right Reasons – that’s The Absmart Difference

Workflow Integration

Digital Fluids Management brings about "Data Valuation" using the Four Pillars of Drilling Fluids Management

Digital Fluids Management

Systems Engineering Approach:

1. Costs associated **Instrumentation & Advisory**
   - Flow Rate & Density
   - LGS / HGS / OWR
   - Analytical Lab Data

2. Costs associated to **Drilling Fluid Products**
   - Barite & Diesel
   - Lime & Salt
   - Emulsifiers & Wetting Agents
   - Rheological modifiers and Fluid Loss Control Agents
   - Generator Diesel Usage

3. Costs associated **Solids Control Equipment**
   - The Centrifuge(s) on location
   - Shaker screen usage
   - Reconditioning costs

4. Costs associated **Waste Management**
   - Trucking charges for Waste Hauling
   - Disposal charges for Waste Volumes
   - Greenhouse Gas Emissions

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Driving Innovation

DATA is the most valuable asset in the well delivery process

Measuring the Impossible

Instrumentation

Unprecedented Sensor Solutions:

- Flow Rate & Density at the Mud Pump Suction – **TPA Sensor**
- % Oil, % Water, % LGS/HGS at Mud Pump Suction – **SiCon Sensor**
- Flow Rate & Density at the Flowline Possum Belly – **PBD Sensor**
- Mud Density in the Primary Shaker Effluent Tank – **AFH Sensor**

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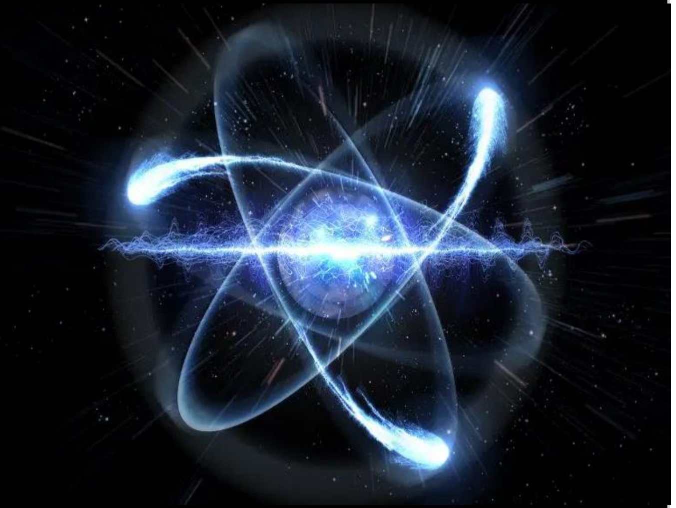

3rd Party Data

Analytical Lab Data:

Analytical Lab Analysis

Highest accuracy analytical data provides a window into the health of the mud system

Additional data analytics drives value:

- **Particle Size Distribution** – PSD data is the telltale as to the condition of the fluid that is being recirculated back down the well. Ultrafine, colloidal particles that cannot be mechanically removed has the highest associated cost.

- **XRF & XRD Measurements** – Quartz content and barite concentration in the mud system are valuable tools used to evaluate the Solids Removal Efficiency process and become tools for root cause analysis on equipment failures.

- **Barite Composition** – Barite can contain >25% low gravity solids, of which, 10-15% by weight can be Quartz, the most abrasive particle in the mud system. Because of their angularity, Quartz concentration is the most damaging to downhole tools, mud pump consumables, drill pipe & BOP erosion. Accurate barite density is used in the API-13B suite of calculations for low gravity solids.

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Drilling Fluid Additives

The use of empirical data to help reduce product usage and improve the quality of the mud

Mud Products additions

Cost/bbl of Hole Drilled

- **Emulsifier & Wetting Agents** - additional shear will help reduce the concentration of surfactants needed to maintain the same desired results, help reduce costs
- **Barite** - barite recovery configuration will help reduce costs.
- **Diesel Additions** - reduce diesel usage by removing more drilled solids, or possibly reduce the oil/water ratio and still achieve desired results, ultimately reducing costs.
- **Mud Chemical Additions** - reduce product usage through enhanced mixing/blending capabilities, high shear agitation, high shear hoppers – high quality mixing reduces the volume of product lost over the shakers or to tank bottom settling, help to lower costs.
- **Diesel Consumed via the Generators** - reduce generator energy consumption by running a lower viscosity, lower PV/YP - removing more drilled solids results in less energy required to rotate/reciprocate pipe & pump fluids around the system, reducing costs

Solids Removal Efficiency

The most important component of the digital drilling fluids management workflow

Solids Control Equipment

Costs/bbl of Hole Drilled

Centrifuge on Location - increase centrifuge utilization.

- Are the centrifuge process variables being optimized? With the addition of mass rate meters on both the suction & effluent line, all process variables are being controlled and optimized automatically.
- If the mud pumps are pumping, the centrifuge should be processing, anything less may offer room for improvement.

Shaker Screens - increase the cut point.

- Are the shaker screens adequately sized to maximize solids removal and minimize the volume of waste generated?

Reconditioning – reduce the volume of fluid sent back to the plant for reconditioning.

- Creating the opportunity to increase the usable lifecycle of the mud. Any fluid sent back to the mud plant for reconditioning has a cost associated to it plus trucking charges.

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Minimize Drilling Waste

Practice Good Environmental Stewardship

Waste Management

Costs/bbl of Hole Drilled

- **Waste Trucking** - minimize the number of trucks and maximize the volume that each truck carries off location using sensors/scales.
- **Disposal** - minimize the volume of waste generated. The volume of waste is attributed to shaker screen selection and the concentration of drilled solids accumulating in the mud system. Maximize the volume of solids removed with the minimum volume of mud on cuttings.
- **Mix-off Treatment Products** - dry up the waste stream using optimized centrifuge parameters and proper screening techniques so that less mix off products are required.
- **Katch Kan Spill Containment** – zero discharge, recover, reuse, recycle, circular economy

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Intangible Value Drivers

Drilling fluids touches every workflow in the process

Measuring Mud Matters

The Intangible Value Drivers

The Value of Efficiency

- **Non-Productive Time** i.e. unscheduled trips due to downhole tool failures.
- **Invisible Lost Time** i.e constant wear on rig components like mud pump liners, swabs, valves & seats, charge pump impellers, impacts efficiency.
- **Production Optimization** via optimum wellbore placement using a bed parallel guidance system. Higher production rates with lower production downtime is a huge value driver for real time drilling fluids data.
- **Risk Management** using mass balance to mitigate well control risk, mitigate the risk of hole cleaning problems, stuck pipe incidents, casing running issues. The sensors act as a form of insurance.
- **Condition Based Monitoring** brings about cost savings around predictive failure analysis. CBM is the foundation to Digital Twin development and Machine Learning Algorithms. Its all about the data, its how we unlock the value of this data and increase productivity.

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Industry 4.0

Transform Uncertainty into Opportunity

There are Two Fundamental Key Performance Indicators

Data Analytics

Industry 4.0:

- **Hole Cleaning Efficiency (HCE)** – The mass rate of drilled solids removed divided by the mass rate of drilled solids generated. This KPI is computed using flow rate, density & LGS/HGS going in and out of the well in real time.

- **Solids Removal System Performance (SRSP or SRE)** – The mass rate of drilled solids removed from the active system while drilling. It's a function of Shaker Screen selection and Centrifuge Utilization. The mass rate of drilled solids is tracked all the way through the process of mud product additions, volume transfers to/from the frac tanks, new drilled cuttings produced, drilled solids not removed from the well and drilled solids removed as waste.

- There are 700+ channels of data to get to an accurate Hole Cleaning Efficiency and Solids Removal Efficiency determination. The data analytics uses the laws of conservation of mass, it's the fundamentals of physics that drives a **Compositional Material Mass Balance.**

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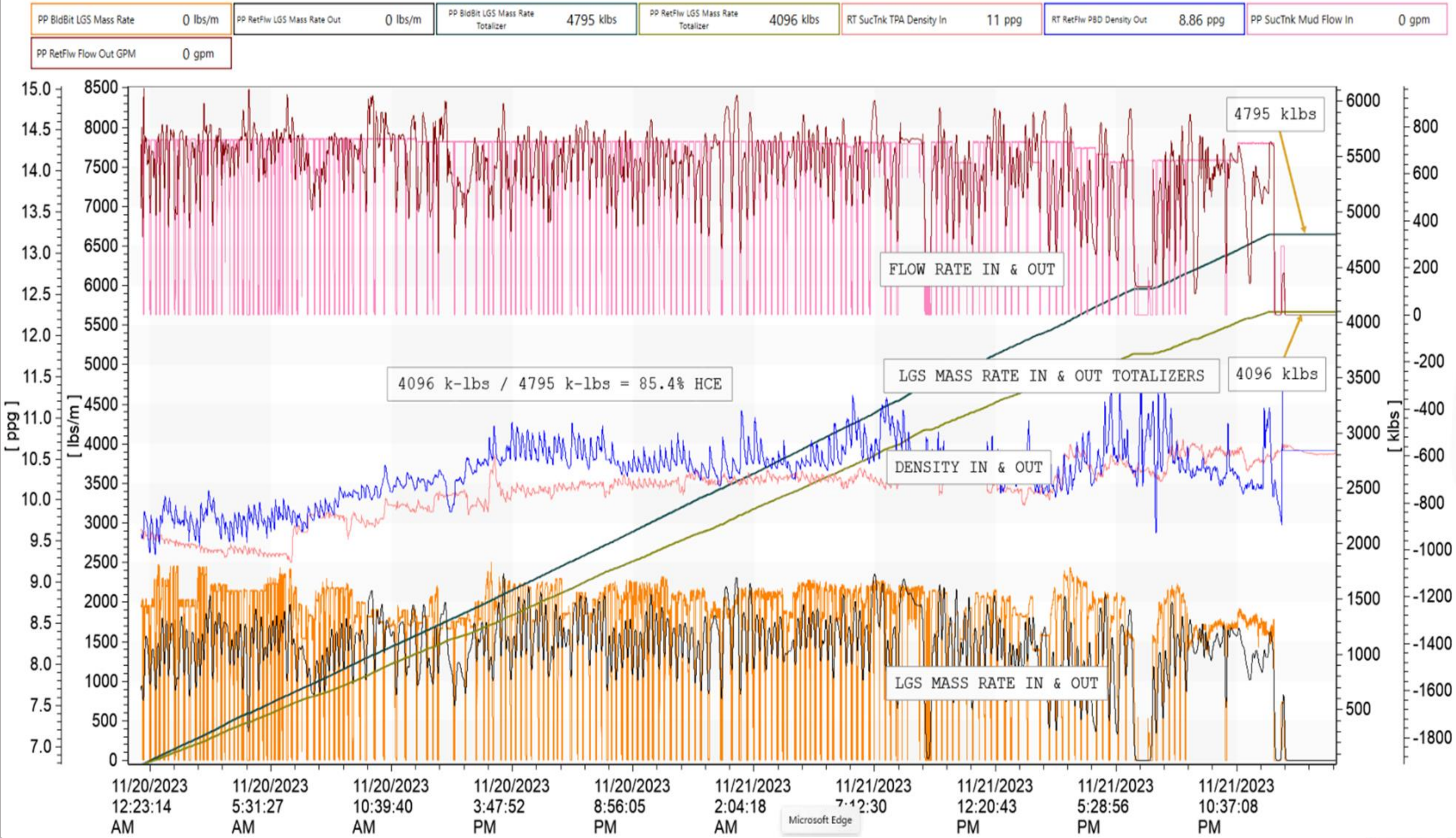
Real Time Operating Centers

New Data, New Value – Hole Cleaning Effciency

Real Time Command Center

Real Time Flow Rate & Density Data

LGS Mass Rate In & Out



www.EPA.gov

1 liter of Diesel weights 835 grams

Diesel consists of 86.2% Carbon, or 720 grams of Carbon per liter of diesel

To combust this Carbon to CO_2, 1920 grams of Oxygen is needed

The sum then is 720 + 1920 = 2640 grams of CO_2 / liter of diesel consumed

Or 10,180 grams of CO_2 per gallon of diesel fuel consumed

ESG Risk & Compliance

Managing Emerging Regulatory Challenges

Greenhouse Gas Emissions Scope 1, 2 & 3

Environmental Social Governance

Greenhouse Gas Emissions

Typical Diesel Pusher burns ~10 mpg
Typical Round Trip @ 200-mile
Mass of CO_2 per round trip = 203.6 kilograms

Typical Well Data:

- Waste Hauling 125 trips/well = 25,450 kg
- Mud Product 5 trips/well = 1018 kg
- $Diesel_{mud}$ 12 trips/well = 2443 kg
- $Diesel_{generators}$ 15 trips/well = 3054 kg
- Generator Diesel Burn CO_2/well = 356,300 kg

Total CO_2 per Well = 388,265 kg or 388.3 MT

With a 5 Rig Fleet @ 18 wells per year, per rig = ~90 wells/year
Total CO_2 Emissions/year @ ~34,944 MT

A 20% stretch target reduction in CO_2 emissions could save ~7000 MT/yr, just by applying good Digital Fluids Management principles.