

## The Novel Application of Utilizing MPD and Brine in HPHT Formations

### CHALLENGE

Specific Deep Basin formation groups in Western Canada have been drilled successfully utilizing strategies that incorporated Invert as a drilling fluid. These wells typically have a TVD of about 3000m and a TD exceeding 5000 and 6000m with higher bottom-hole temperatures. MPD has been employed in these wells, which often have very narrow drilling windows, to great success.

Economics became a driving force to utilize Brine as a drilling fluid.

Brine presents its own set of challenges. Formate Brines would be the ideal to use as a drilling fluid as they reach higher weights and present less corrosive opportunities than Chloride based Brines. However, economics required a solution with Chloride based brines which can realistically achieve about 1390 kg/m<sup>3</sup>. When the formation pressures reach 1550-1600 kg/m<sup>3</sup> Equivalent Mud Weight and drilling windows are small, MPD can provide a solution.

### SOLUTION

Incorporating MPD into Brine drilling allows the operator to Dynamically modify the drilling fluid’s mud weight using surface Back Pressure.

For reference, in a 3000m TVD well, 1000 kPa applied on surface provides about 34 kg/m<sup>3</sup> on bottom.

The specific Beyond surface equipment utilized in these presented cases are capable of applying 10,300 kPa on connections which would provide 350 kg/m<sup>3</sup> on bottom. Such high continuous pressures are not recommended, but it does provide the drilling team with an additional assurance since:

- 1350MW + 350MW from Back Pressure > 1600 PP

With MPD, Confidence in drilling ahead with Brine can be achieved as the Dynamic Mud Weight it provides helps diminish corrosive concerns to see the following benefits:

- Prevent Formation Plug off from Barite
- Prevent use of Cal Carb in non-frac’d wells
- Reduced Equivalent Circulating Density
- Higher likelihood of turbulent flow = Better Hole Cleaning
- Reduced Low Gravity Solids
- Improved Trips (if kill brine can be utilized)
- Increase Tool Life

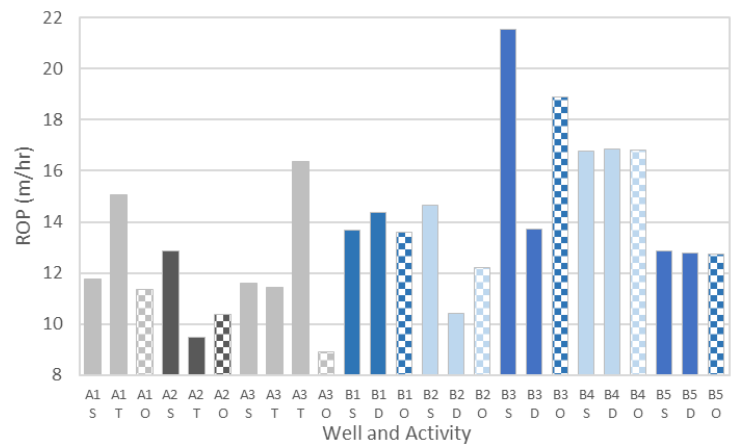
### RESULTS

Provided below are the drilling results of 3 Deep Basing Invert wells and 5 Deep Basing Brine/Invert wells with similar targets.

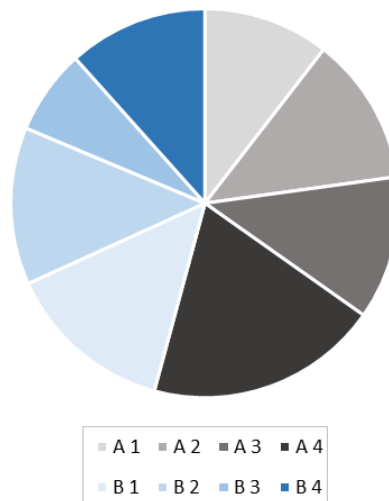
**Figure 1** presents the 3 Invert Wells in Grey and the 5 Brine wells in Blue. “S” indicates the start of ~3200mMD, “T” indicates after a Trip Event, O Indicates overall and D Indicates after displacing to Invert prior to TD. Brine and Invert Densities were similar. No premature bit trips were performed when drilling with Brine for this area/target zone.

These results would suggest that invert drilling is not necessarily slower than brine drilling, but overall ROP from reduced bit trips due to Brine drilling helped increase overall ROP by as little as 7% and as much as 112%.

**Figure 1: Sectional and Overall ROP per Well (3200mMD to TD)**



**Figure 2: Lateral Cost/m for Associated Drilling Fluid Strategies**



**Figure 2** Presents a cost/m lateral drilling average for select Deep Basin wells (Grey Invert, Blue Brine).

Comparison of 4 wells each suggests an overall savings of 16 percent / m when utilizing Brine as a drilling strategy for HPHT Lateral drilling vs Invert.