Case History

Tailored for Success: CleanDrill™ HD Reservoir Drill-in Fluid successfully applied to achieve optimized well productivity, US Gulf Coast Land

Newpark's low-solids Reservoir Drill-in Fluid (RDF) successfully drills challenging reservoir section, mitigating reservoir damage impact to maximize production potential of the field

CHALLENGE	SOLUTION	RESULT
• **Drill & complete challenging horizontal open-hole interval** • **Historically had trouble reaching TD** • **Highly reactive shale** • **Mud Weight window of 10.6-10.8 lb/gal** • **Minimize risk of fluid losses and screen plugging during installation of lower completion**	• **CleanDrill HD™ minimally damaging divalent brine-based RDF** • **Provide necessary rheology for excellent cuttings transport efficiency** • **Proprietary shale inhibitor for highly reactive clays** • **Specially formulated for formation compatibility and density**	• **Successfully drilled open-hole interval** • **Maintained superior filter cake quality while drilling interval** • **Maintained mud weight between 10.6-10.8 lb/gal** • **Able to run completion screen assembly to TD without incident**

OVERVIEW

Newpark was selected by an operator in North America to design and execute an integrated fluid system combining a divalent brine-based reservoir drill-in fluid (RDF) with a compatible and effective delayed breaker fluid treatment to drill and complete a challenging horizontal open-hole interval while efficiently remove the drilling fluid filter cake with minimal damage to the reservoir formation. The RDF was designed to provide a high density, minimally damaging fluid tailored to enhance wellbore stability while maximizing productivity across the entire reservoir interval.

The operator required the use of a 10.6 ppg divalent brine-based CleanDrill™ HD RDF system to drill an open hole horizontal completion well with areas characterized by high inclinations, varying formation pressures, and highly reactive, stressed interbedded shale and sandstone sections. In addition, all fluids were planned to be built on location, requiring exceptional logistical management and pre-well planning.

CHALLENGE

After evaluating the expected reservoir drilling challenges, the operator and Newpark team established the benchmarks listed below for the design of an applicable technical and cost-effective fluid solution:

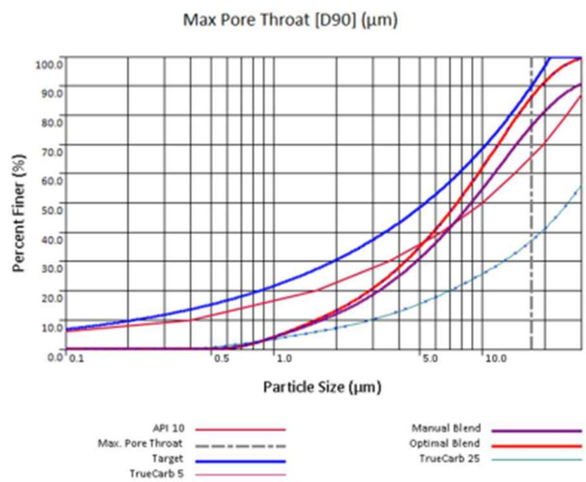
- Minimize formation damage
- Bottom hole static temperature of 164°F
- 200-600 mD reservoir permeability

- Formulate an RDF using only acid-soluble solids between 30-50 ppb loading to a density range of 10.6-10.8 ppg
- High fluid density requires use of divalent base brine (calcium chloride) to manage fluid cost
- Achieve superior fluid loss control while drilling
- Provide exceptional shale stability
- Using Newpark proprietary software ClearTrack™,design a bespoke bridging package, to cure microfractures and bridge on reservoir, with results validated in the laboratory
- Build all fluids on location

SOLUTION

Following Newpark's extensive lab testing, the operator and Newpark fluid specialists selected the divalent brine- based CleanDrill HD RDF system to be used to drill the 4-well project.

Performance of the RDF was rigorously tested to achieve maximum field execution. The test data confirmed the selection of the following Newpark Fluids System and products:



- CleanDrill HD RDF utilizing calcium chloride brine (10.6 ppg) as base fluid
- NewPerm™ proprietary Shale Inhibitor to manage highly reactive clays
- Laboratory-validated blend of Truecarb sized metamorphic calcium carbonate to control losses to microfractures, optimise filter cake quality and minimise fluid loss while drilling.
- Clarified xanthan gum for rheology control
- Proprietary starch for use in divalent brine types for fluid loss control

After an optimized bridging package was designed for the fluid, laboratory testing was conducted to confirm filter cake quality and the capability to flow the fluid back through the completion screen. The flowback tests were conducted using a Production Screen Tester (PST) fitted with a sample of the completion screen to be used on the field development. Fluids were contaminated with clay to assess the impact this would have on flowback (see Figure 1 and Table 1 below).

Table 1: *PST Results Comparing Lab Pilot Tests with and without Contamination vs. Field RDF*

Cum. Volume, mL	RDF, sec	RDF with 4% Clay Contam, sec	RDF at TD while circulating the hole clean, seconds		
	Lab Pilot	Lab Pilot	Active	Active	Flowline
1,000	26.76	31.51	29.1	30.1	30.5
2,000	26.92	36.81	30.3	30.4	30.8
3,000	29.05	42.67	30.5	30.5	31.3
4,000	31.80	46.59	30.8	30.7	31.7

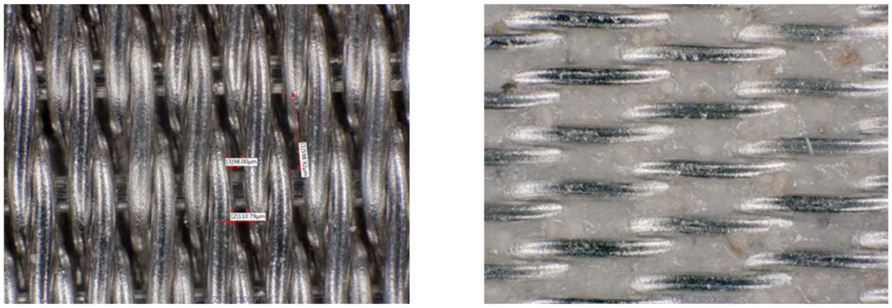


Figure** 1: **Completion screen after PST Pilot test under 100X Magnification
***Left**: Uncontaminated RDF; **Right**: RDF contaminated with 4% clays*

RESULTS

The reservoir sections were drilled in accordance with plan with zero issues or downtime for a total of 4 wells. All of the RDF, and sweep base fluids were built on location to provide better logistical management and reduction of contamination.

Prior to drilling out of the intermediate casing shoe, the wellbore was displaced from freshwater to RDF with two cleaning spacers preceding. Cement, casing shoe, and formation were all drilled prior to performing a successful FIT. Drilling of the well to TD and cleaning of the well with a reamer run were both performed without issue. Prior to pulling out after the reamer run, three PST’s (production screen tests) were performed with all tests passing, signaling clean fluid for lowering the completion screens into the open hole.

All key properties were maintained within desired specifications including mud weight (10.6-10.8 ppg), LGS %(less than 8%), MBT (less than 10 ppbe), and average particle size distribution (15-25 microns).

With these fluid designs, the operator was able to successfully deliver twice as much completed lateral with fewer wells than a previous operator in nearby offset wells.