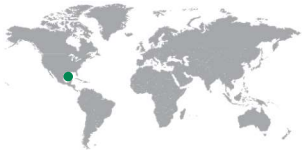
Case History



True™ Series Displacement Chemicals Effectively Clean Wellbore and Riser During Ultra-Deepwater Horizontal OHGP Completion, Gulf of Mexico

True™ Series Displacement Chemicals Offer Effective Mud Removal While Water-Wetting Tubulars in Ultra-Deepwater Horizontal Open-Hole Gravel Pack Completion

CHALLENGE	SOLUTION	RESULT
• Perform direct displacement of SBM • Perform direct displacement of CleanDrill™ • Minimize post-displacement fluid system clean-up	• Engineered True™ Series displacement chemical spacer train • ClearDepth™ displacement hydraulic modeling & WBCU tools • Systematic WBCU filtration process	• Effectively & safely displaced wellbore multiple times • Water-wet tubulars • Achieved or exceeded fluid cleanliness performance specifications

GOM Deepwater

OVERVIEW

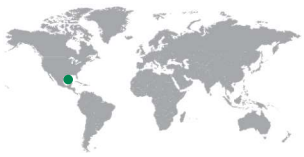
In the Gulf of Mexico deepwater market, operators with horizontal open hole gravel pack completions routinely utilize multiple types of fluids systems throughout the drilling and completion phases. These systems require seamless displacement or transition from one to the other through specifically designed procedures. Extreme water depths require large and longer marine risers making it problematic when cleaning up the wellbore and riser sections in a timely manner. A direct displacement is favored in order to accomplish the objectives of minimizing the volume and number of spacers pumped, maintaining hydrostatic control, and reducing rig circulating time. The selected rigs for these operations are ultra-deepwater, dual-activity drillships.

CHALLENGE

A major operator in the Gulf of Mexico required a solution to complete an 90° horizontal well while utilizing Controlled Mud Level (CML) managed pressure for an Ultra-Deepwater application at a water depth of 8,021'. This project represents the first use of CML to complete a well in the GOM. The operation included a solution to drill surface hole with spud mud, drill the intermediate hole section with SBM, drill the reservoir section with a formation friendly water-based RDF, and complete the well with reservoir compatible completion brine. The proposed sequence of operations involved a direct displacement of 9.2 lb/gal Kronos™ Low-ECD SBM to a 9.2 lb/gal CleanDrill™ water-based RDF and later to a 9.2 lb/gal KCl completion brine. This was a horizontal open-hole, gravel-pack completion with production casing to greater than 11,000' MD (3,353 meters) open hole to greater than 13,000' MD (3,962 meters). The operator set completion fluid cleanliness specifications for the displacement to completion brine at <30 NTUs out of the well and solids content at <0.05%.

Newpark utilized lab tested chemistry and formulated the specific displacement chemical spacer train that separated the SBM drilling fluid from the water-based RDF, provided water-wetting to the tubulars, and then from the RDF to the completion fluid. The displacement hydraulics were modeled with ClearDepth™ that optimized the pump rates, annular velocities, and spacer contact times for each displacement sequence. Wellbore cleanup (WBCU) tools were staged and placed for physical cleaning of the wellbore and filtration equipment was incorporated that allowed for the completion brine pump rates to be maintained for fluid cleanliness specifications.

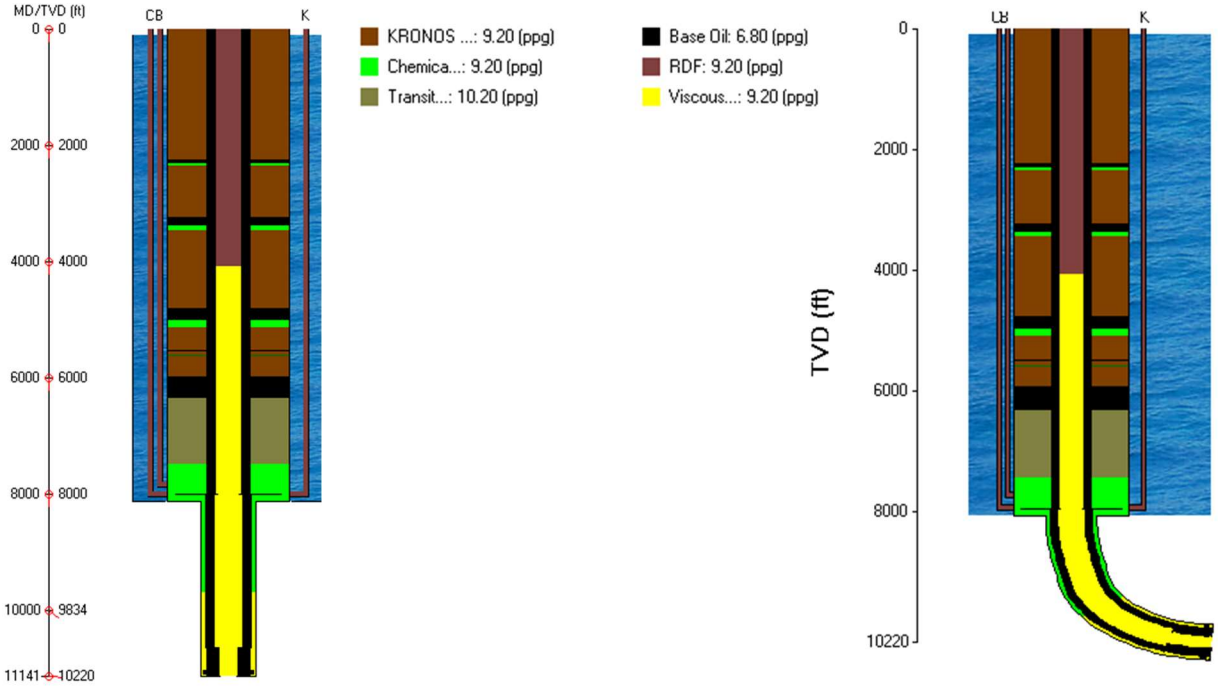
NEWPARK FLUIDS SYSTEMS

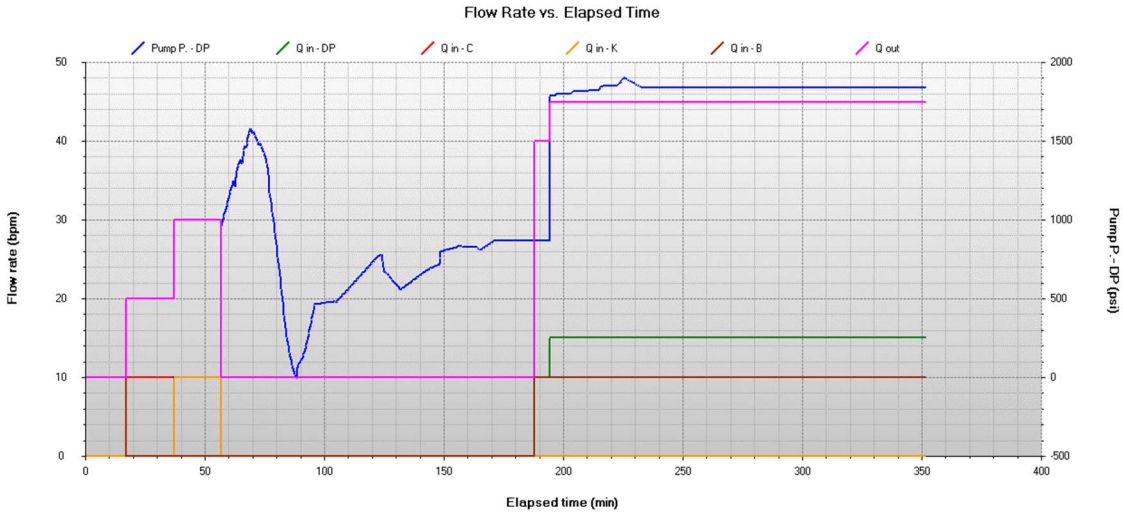


SOLUTION

The rig surface fluid handling system was thoroughly cleaned of residual SBM in preparation to receive water-based RDF while the drilling mud was circulated and conditioned to specifications prior to displacement. A True™ Series spacer train was formulated with TrueClean™ blended solvent/surfactant utilized in both the weighted transition and cleaning spacers. These concentrations were customized to the specific drilling mud being displaced.

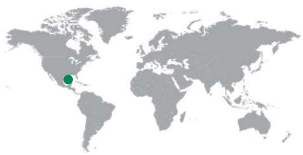
Spacer	Type	Description	True™ Series Products	Density	Volume
1	Thinning	Base oil		6.8 lb/gal	150 bbls
2	Transition	Weighted push	TrueClean™ [solvent/surfactant]	10.2 lb/gal	359 bbls
3	Cleaning	Weighted cleaning	TrueClean™ [solvent/surfactant]	9.2 lb/gal	238 bbls
4	Viscous	Weighted viscosified	Cleanvis™ [Viscosifier]	9.2 lb/gal	159 bbls





NEWPARK FLUIDS SYSTEMS

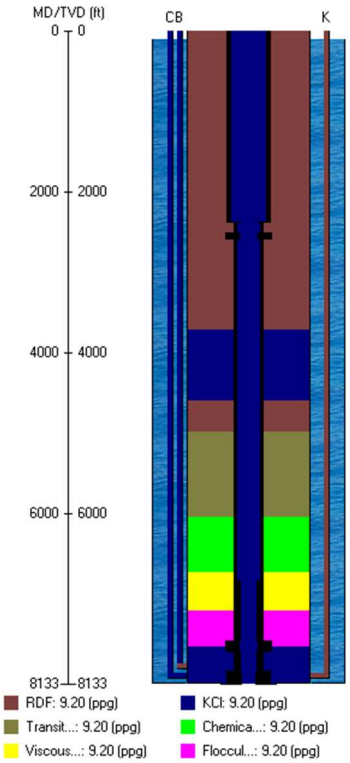
Case History



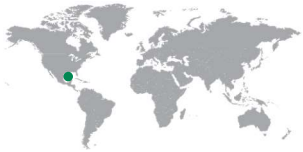
The spacers were pumped down the workstring at a target rate of 9-10 bpm. The displacement spacer train was followed by CleanDrill™ RDF and continued until the water-based RDF was observed at surface without issue. The open-hole section was then drilled to TD.

The displacement from CleanDrill to completion brine followed a similar procedure. The rig surface fluid handling system was thoroughly cleaned of residual water-based RDF in preparation to receive completion brine. A True Series spacer train was formulated with TrueClean solvent/surfactant utilized in both the cleaning spacers. These concentrations were customized to the specific water-based RDF being displaced.

Spacer	Type	Description	True™ Series Products	Density	Volume
1	Transition	Weighted push	TrueClean™ [solvent/surfactant]	9.2 lb/gal	359 bbls
2	Cleaning	Weighted cleaning	TrueClean™ [solvent/surfactant]	9.2 lb/gal	238 bbls
3	Viscous	Weighted viscosified	TrueCell™ [liquid HEC] TrueZan L [liquid Xanthan]	9.2 lb/gal	159 bbls
4	Flocculant	Weighted	TrueFloc™	9.2 lb/gal	150 bbls



Time (min)	Fluid (in/Btm/out)	Q in - DP (bpm)	Q in - C (bpm)	Q in - K (bpm)	Q in - B (bpm)	Vol. in - tot. (bbl)	ECD @ 8133.0 (ppg)
0.29	9/6/6	-	0.00	0.00	10.00	2.895	9.25
12.60	9/6/6	-	0.00	0.00	10.00	126.000	9.25
28.60	9/6/6	-	10.00	0.00	0.00	286.000	9.25
44.60	9/6/6	-	10.00	0.00	0.00	446.000	9.25
44.94	3/9/6	8.50	0.00	0.00	0.00	448.895	9.31
45.62	3/6/6	8.50	0.00	0.00	0.00	454.684	9.28
60.95	3/3/6	8.50	0.00	0.00	0.00	584.944	9.31
87.16	4/3/6	9.00	0.00	0.00	0.00	807.895	9.33
102.27	4/4/6	9.00	0.00	0.00	0.00	943.944	9.33
113.60	5/4/6	9.00	0.00	0.00	0.00	1045.895	9.28
128.72	5/5/6	9.00	0.00	0.00	0.00	1181.944	9.28
131.27	8/5/6	9.00	0.00	0.00	0.00	1204.895	9.32
146.38	8/8/6	9.00	0.00	0.00	0.00	1340.944	9.32
147.93	9/8/6	9.00	0.00	0.00	0.00	1354.895	9.28
163.05	9/9/6	9.00	0.00	0.00	0.00	1490.944	9.28
217.01	9/9/9	14.00	0.00	0.00	10.00	2492.390	9.32
225.49	9/9/6	14.00	0.00	0.00	10.00	2695.844	9.32
225.70	9/9/9	14.00	0.00	0.00	10.00	2700.806	9.32
225.90	9/9/6	14.00	0.00	0.00	10.00	2705.768	9.32
229.83	9/9/3	14.00	0.00	0.00	10.00	2800.052	9.31
240.38	9/9/4	14.00	0.00	0.00	10.00	3053.128	9.31
247.41	9/9/5	14.00	0.00	0.00	10.00	3221.846	9.31
251.96	9/9/8	14.00	0.00	0.00	10.00	3331.016	9.30
256.51	9/9/9	14.00	0.00	0.00	10.00	3440.186	9.30
374.89	9/9/9	14.00	0.00	0.00	10.00	6281.416	9.30



The spacers were pumped down the kill line at a target rate of 10 bpm followed by the 9.2 ppg KCl completion brine. The boost line was engaged once the tail end of the displacement spacer train was greater than 100' above the boost line. It was at this point that a target rate of 15 bpm down the boost line while circulating KCl completion brine was achieved. The pumping of 9.2 lb/gal KCl completion brine continued past the point it was observed at surface until it reached cleanliness specifications, which was only an additional 45 minutes.

The workstring and riser WBCU tool assemblies were pulled out of the hole prior to the displacement; however, the riser had been sufficiently scraped and brushed. The well filter tools captured associated debris for removal. With the available pit space all required completion fluid was on surface and within fluid cleanliness specifications prior to the displacement to avoid the need to filter while displacing.

RESULTS

All spacers returned to surface when expected. The total displacement time was 6.25 hours. There was just a little over 1x well volumes circulated. The final fluid clarity endpoint result was 47 NTUs and <0.01% solids out of the well, which exceeded the specified target established by the operator. The use of specific chemistries coupled with reliable hydraulics modeling, robust WBCU tool and proper filtration resulted in multiple successful displacements.