



Total Fluids Solution Deployed in Kuwait Reducing Days on Well by +50% and Improving Productivity

Newpark's expertise, ClearTrack™ hydraulic & bridging modelling software were combined with a customized product solution to provide critical wellbore strengthening, leading to successful drilling of both high-pressure formation and severely depleted zone in a single interval, significantly reducing drilling days and improving future production rates.

CHALLENGE	SOLUTION	RESULT
<ul style="list-style-type: none"> • Design customized fluid solution to safely drill high-pressure shale @ 17.0 lb/gal and depleted limestone @ 9.5 lb/gal in the same interval. • Maintain rheological properties while reducing drilling fluid weight after high pressure formations to continue drilling into the depleted formation. • Control risk of losses and differential sticking • Drill long, horizontal section (3,171 ft) 	<ul style="list-style-type: none"> • ClearTrack™ hydraulic & bridging software utilized to model optimal particle-size blend in fluid to match porosity of the formation. • Proprietary wellbore strengthening and stabilization materials included in formulation. 	<ul style="list-style-type: none"> • Successfully drilled high-pressure and severely depleted formations in same interval • Entered the Reservoir with a 6" vs 3 7/8" diameter hole, improving future production rates. • Saved over 50% drilling days as compared to best offset well drilled without the combination of proprietary Newpark software, products, and expert drilling fluid engineers

OVERVIEW

The Raudhatain Field in northern Kuwait requires drilling fluid expertise to safely address the challenges faced in unlocking the oil reserves from the deep formations. Improving access to the reserves in the lower Jurassic formations and reducing overall well cost can be achieved through the detailed design and execution of an engineered approach to address the drilling challenges of the lower Jurassic formations.

CHALLENGE

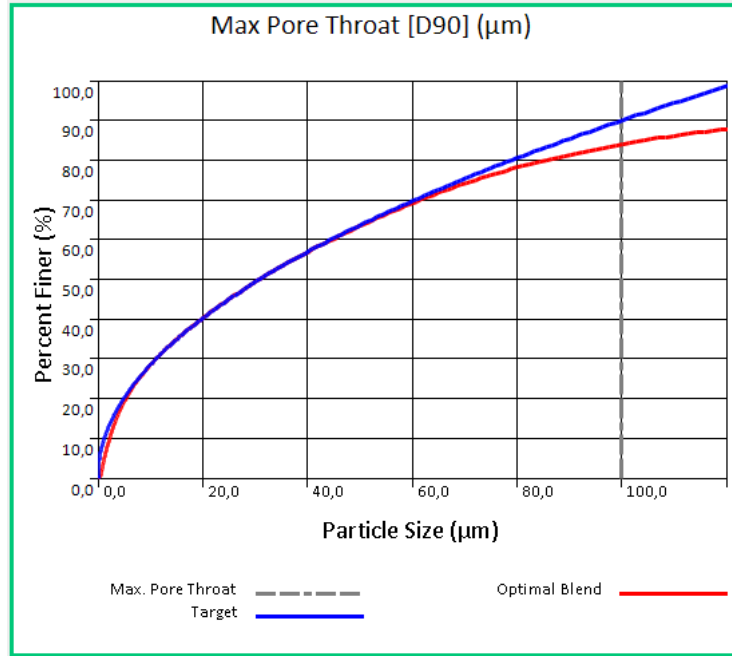
The previous 3 offset wells required a liner to isolate the high-pressure formation, resulting in 3 7/8-in. hole at TD. The drilling plan for this well called for both the high-pressure Najmah and the depleted Middle Marrat Formations to be drilled in a single 6" section using Managed Pressure Drilling (MPD), to significantly cut the drilling cost by reducing drilling days and increase production efficiency through the larger diameter completion bore.



SOLUTION

A wellbore strengthening package was developed utilizing proprietary ClearTrack hydraulic and bridging modelling software to optimize the blend of TRUECARB sized calcium carbonate to match the porosity of the various formations.

As you can see in the graphic below, the blue line represents the target particle size distribution to bridge the formation, while the red curve represents the best fit PSD based on the available.





Bridging/Wellbore Strengthening Package Optimisation using ClearTrack.

Tables 1 & 2 shows the drilling fluid properties:

TABLE 1: Laboratory Test Results for the Formulated NAF		
	Before Heat Rolling	After Heat Rolling (12 hr @ 250°F)
Mud Density (lb/gal)	15.1	15.1
PV (cP)	42	41
YP (lb/100 ft ²)	16	14
6-rpm Dial Reading	8	7
3-rpm Dial Reading	7	6
10-sec/10-min Gels (lb/100 ft ²)	8/15	7/14
Oil/Water Ratio	81/19	81/19
ES (v)	696	690
HPHT (ml, 300°F)	2.2	2.6
PPT, 10-micron aloxite disk (ml, 300°F @ 2500 psi)	-	4.4



TABLE 2: PPT Fluid Loss Results, Field Mud	
PPT Filtrate @ 2,500 psi overbalance, 300°F on 10-µm ceramic disc (mL)	
Spurt Loss	0.2
Fluid recovered in 30 min	2.2
Total	4.6

NANOSTABLE fluid loss additive with sub-micronized particles was designed to reinforce the wellbore strengthening, improve filter cake quality and further reduce the HPHT fluid loss value of the fluid on disk.

NAF density management during the interval required detailed planning and engineering:

- Drilling the section began with 17.0 lb/gal density in the upper part of the section, before decreasing to 9.5 lb/gal to drill the depleted Middle Marrat.
- Developed and executed an operational plan to manage the decreasing density in open hole while drilling this interval, diluting with unweighted fresh pre-mix, while also making additions to maintain the concentration of bridging/sealant package (Figure 1)
- Highly experienced Newpark Fluid System specialists on location to oversee and manage the complex operation.

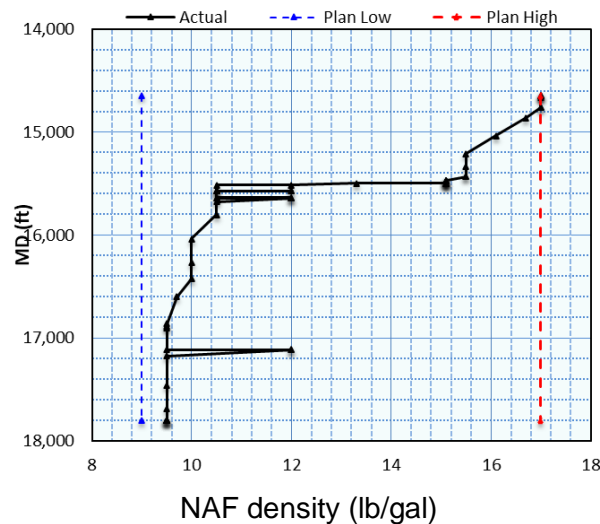


Figure 2: NAF density vs depth during the interval.



RESULTS

First successful application of wellbore strengthening technologies to drill the high-pressure Najmah formation and the depleted Middle Marrat limestone Formation in ONE extended reach horizontal section of 3,171 ft.

The elimination of a casing string enabled the production zone to be entered with a 6-in. hole rather than a 3 $\frac{7}{8}$ -in. slimehole completion thus significantly increasing the potential production rate.

No recorded major borehole instability problems while drilling the section.

Drilling days were less than 50% of the lowest of three offset wells which have been all drilled in two different diameters (Figure 2).

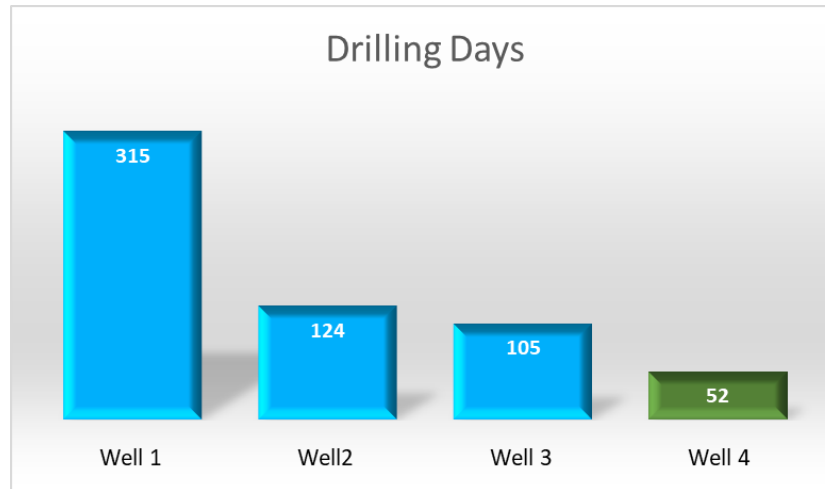


Figure 2: Improvement in drilling days. Wells #1-3 are offset wells using conventional OBM without the TRUECARB 100 calcium carbonate and NANOSTABLE wellbore strengthening package. In all three cases, Wells 1-3, a liner had to be run to isolate the high-pressure formations and the low-pressure formations.