Low ECD Profiles Characteristic of Oil-Base WARP Technology Prove Essential in North Sea Well

Performance Report

"Oil-base WARP Technology, used in conjunction with the PRESSPRO* RT service, provided unsurpassed hydraulic control to enable the successful completion of a problematic well that otherwise could not have been drilled."*

Alan Mackay, Operations Manager

Well Information

Location	U.K. North Sea
Well type	Exploration
Date	July 2006
Hole size	6-in.
Angle	3.8° at TD
Borehole temperature	275°F (135°C)
Depth (MD)	15,850 ft (4831 m)
Depth (TVD)	13,806 ft (4208 m)
Section drilled	808 ft (246 m)

The Situation

After two well-control incidents, a challenging pressure window of 0.6 lb/gal (16.6 to 17.2 lb/gal eq.) was set to drill the final section. Control of the equivalent circulating density (ECD) within this critical narrow window became the number-one priority.

The Solution

A VERSACLEAN* fluid with oil-base WARP Technology was selected based on its ability to provide reduced ECD profiles compared to conventional fluids. As low flow rates would be part of the ECD management, this fluid's virtual zero potential for sag, even at these high drilling fluid weights, was also considered essential to success. In addition, the PRESSPRO RT service was chosen to provide optimum ECD management.

The Results

The 6-in. section was drilled without issue, showing good hole cleaning throughout the section even at extremely low flow rates of 175 gal/min, which dropped to 110 gal/min through the choke at one point. The drilling fluid weight remained constant throughout while the yield point was run as low as 1 lb/100 ft² and the PV as low as 28 cP to provide maximum ECD benefits.

The PRESSPRO RT service proved to be indispensable for ECD management in this section. The combination of low rheology fluid and restricted flow rates kept the ECD within 0.5 lb/gal (3%) of base weight and never exceeded 17.1 lb/gal.

The well was logged for 2½ days. A 4½-in. liner was run to bottom and cemented in place without incident. No mud weight variations were seen after 4½ days static in the hole.

The Details

The fluid properties are shown in Table 1.

Property	Programmed	Typical
Density, lb/gal	16.7	16.6
Plastic viscosity (120°F), cP	<35	30
Yield point (120°F), lb/100 sq ft	3-5	3
6 rpm (120°F), dial reading	>3	2
Gels 10 sec/10 min	3/5	1/2
HTHP fluid loss @ 250°F, mL	<3	3
Excess lime, lb/bbl	>4	4
Oil:Water Ratio	85/15-95/5	92/8
BPS chlorides, g/L	160-200	240

The 400-mesh, XR DURA-FLO* screens were utilized for most of this section. The bridging package for this fluid was built with SAFE-CARB* carbonate bridging material ranging from a D_{50} of 16µ to 300µ. The majority of this was ground down and was not removed by the 400-mesh screens. From 15,156 ft to 15,335 ft (4619.5 to 4674.0 m) additional carbonate was added (300µ) to maintain coarse bridging particles. Emulsifier, fluid-loss additive and lime were added to maintain fluid properties.

The predicted vs. actual hydraulic measurements are shown in Table 2.

	ECD Calculations/Measurements (lb/gal eq.)		
Activity	Drilling	Circulating at TD	Circulating Liner
Pressure sub	16.98	16.9	-
VIRTUAL HYDRAULICS*	17.02	16.98	16.93
PRESSPRO RT	17.00	16.86	16.97

The Conclusion

At this depth, the customer agreed that no conventional fluid could deliver the ECD target. VERSACLEAN oil-base WARP fluid provided the rheological profile that allowed the ECD to be maintained within the required range. The PRESSPRO RT service provided the assurance that all other contributing factors were being sufficiently controlled, especially during tripping operations where pressure sub figures were not available. The combination of VERSACLEAN oil-base WARP fluid and the PRESSPRO RT service delivered impressive ECD management.

Questions? We'll be glad to answer them.

If you'd like to know more about the oil-base WARP Technology product and how it's performing for our other customers, please call the M-I SWACO office nearest you.

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P.O. Box 42842
Houston, Texas 77242-2842
Tel: 281·561·1300
Fax: 281·561·1441
www.miswaco.com
E-mail: questions@miswaco.com