WARP Fluids Technology: PARATHERM System Offshore Norway

Performance Report

"WARP technology has proved to be the drilling and completion fluid of choice for high-temperature/high-pressure drilling offshore Norway."*

M-I SWACO Project Engineer

Well Information

Location	Offshore Norway
Spud	May 2005
Hole size	8½ in.
Interval drilled	16,952-17,825 ft (5167-5433 m)
Interval length	873 ft (266 m)
Maximum bottomhole temperature	365°F (169°C)
Bottomhole pressure	14,000 psi (966 bar)
Maximum angle	39.3°
Mud weight	16.94 lb/gal (2.03 SG)

The Situation

Controlling wellbore pressures is critical in high-temperature/high-pressure (HTHP) environments. Fluid rheology needed to be optimized to minimize the risk of sag while maintaining an acceptable equivalent circulating density (ECD) on a project on which a competitor's oil-base drilling fluid had been used. Control of the ECD had been problematic due to sag. On one offset well, fluid density at the surface unacceptably varied between 16.91 lb/gal (2.03 SG) and 19.16 lb/gal (2.30 SG). Because of the critical requirement to maintain constant pressure on another offset well, a high-density cesium formate brine was used as the drilling fluid at great expense to the client.

The Solution

A PARATHERM* system incorporating WARP technology was selected to drill the 8½-in. reservoir section. The unique, low rheology of the PARATHERM-WARP system ensured optimal suspension of barite and ECD management for drilling and allowed a screened completion to be run without blocking or other issues.

The Results

- No evidence of fluid density fluctuation after 3 days static at total depth (TD) with mud weight "in" measured at 16.95 lb/gal (2.035 SG) and mud weight "out" at 16.99 lb/gal (2.040 SG)
- The well was completed with a 325-mesh wire wrapped Reslink^ screen using the PARATHERM-WARP system as the completion fluid
- Production was better than predicted
- 310- and 250-mesh shaker screens were successfully deployed to control drilled solids concentration

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The Details

The short 266-m reservoir section was drilled to a TD of 5433 m in one bit run in 3 days. Circulation rate was 1,500 L/min (400 gal/min) at 310 bar (4500 psi) with an ECD of 2.13 SG (17.75 lb/gal) (compared to 2.03 SG (16.92 lb/gal) surface density) and the MWD recording a circulating temperature of 134ºC (273˚F). The 5 shakers could only be dressed with 175- and 210-mesh screens using the competitor system, but the interval drilled with the PARATHERM-WARP system utilizing 250- and 310-mesh screens. At TD, the hole cleaned up after 1.5 bottoms up and gas units dropped from 21% to less than 1%. Two wireline logs were run to TD without incident. After a routine wiper trip and 4 times bottom-up circulation time, production screen tests were conducted on the fluid using a sample of the 325-mesh Reslink screen prior to running the screens in the fluid. Production screens were successfully run and set at 5421 m (17,785 ft) with the 2.03-SG PARATHERM-WARP fluid in the well. No variation in mud weight was seen at any time. Once the screens were set, the well was displaced to cesium formate brine. Final production proved to be better than anticipated.

WARP technology has been used as the HTHP drilling and completion fluid in three other sections.

A typical HTHP PARATHERM-WARP formulation and properties are shown below.

Product	Function	lb/bbl
EDC99DW	Base Fluid	75
EMUL HT*	Emulsifier	15
EMI-783*	Viscosifier	1.0
Lime	Alkalinity	7.0
$CaCl_2$	Brine	23
VERSATROL* HT	Fluid Loss	7.0
WARP	Density	590

Rheology	50˚C (122˚F)	70˚C (158˚F)	80˚C (176˚F)
600/300 rpm	104/56	76/41	61/34
200/100 rpm	39/22	28/16	24/13
6/3 rpm	4/3	3/2	2.5/2
PV (cP)	48	35	27
YP (lb/100 sq ft)	8	6	10
Gel Strengths	6/7	3/4	3/4

Questions? We'll be glad to answer them.

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

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