

# Hungary: ENVIROTHERM NT pushes HTHP limits to new level

“When drilling hot wells with very high density mud, an oil-base mud (OBM) is usually the only option. The new ENVIROTHERM<sup>\*</sup> NT water-base drilling fluid provided stability and high performance in a very challenging environment.”

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## Well Information

Location .....	Hungary
Spud.....	May 5, 2009
Interval drilled.....	8 3/8 in. hole for 442 m (1,450 ft) and 5 7/8 in. hole for 408 m (1,339 ft)
Maximum Bottomhole Temperature.....	168° C (335° F)
Completion type.....	Cemented Liner
Maximum Mud weight.....	2.28 s.g. (19.0 lb/gal)
Total well depth .....	3,750 m (12,303 ft)

## The Situation

A major operator wanted to drill an exploration well with the target a high-temperature high-pressure (HTHP) tight gas reservoir. Other challenges that had to be considered were acid gas contamination (CO<sub>2</sub> and H<sub>2</sub>S) and environmental limitations that would put constraints on cuttings disposal and OBM usage.

## The Solution

Based on previous experiences in the area and extended lab testing, M-I SWACO recommended the newly engineered ENVIROTHERM NT HTHP water-based drilling fluid. The polymer-based drilling fluid not only resists gelling at high temperatures, but its chrome-free water-base fluid formulation is designed to meet or exceed most environmental regulations. The system has been shown to resist temperatures as high as 400° F (204° C).

## The Results

The well was drilled safely to total depth (TD) with the drilling fluid proving to be very stable for this harsh environment. The HTHP fluid loss was controlled easily while the rheology was actually lower than that shown in the lab tests. The reduced rheology helped minimize the equivalent circulating density (ECD) for the extremely high mud weight.

## The Details

After the 9 5/8-in casing was run and cemented, the drilling fluid used in the previous interval (KCl/K<sub>2</sub>CO<sub>3</sub>/GLYDRIL\*) was treated for HTHP conditions. The first step was cleaning with centrifuges and flocculation to lower drilled solids content. Afterwards, the standard rheology and fluid loss polymers were replaced with HTHP-resistant additives. To provide solids suspension, hole cleaning and HTHP fluid loss control, high-temperature polymers, including CALOVIS FL, were used. In addition, ASPHASOL SUPREME\* and BLACK FURY\* were added to improve filter cake quality and help stabilize HTHP filtration. With increasing density to control pore pressure, the addition of high-temperature stabilizers were required (CALOTHIN, CALOSPERSER Zr and K-17). Same strategy was used during both 8 3/8 in and 5 7/8 in sections, HTHP product concentrations being gradually increased towards well TD.

The level of reactive and drilled solids was minimized to prevent high viscosity. The solids control equipment included two MONGOOSE\* PT shakers dressed with 230-mesh screens; two high-speed centrifuges in the barite recovery mode and a flocculation unit. This configuration proved to be very effective. The pH ranged between 10.5 and 11.5 and total hardness was maintained at 300-400 mg/l by continuous addition of caustic soda, lime and gypsum to prevent CO<sub>2</sub> contamination. The VIRTUAL HYDRAULICS\* engineering software proved invaluable in predicting ECD for drilling and surge / swab pressures while tripping.

**Table 1: Key products function and concentration**

Product	Function	Concentration
CALOVIS FL	HTHP Fluid Loss control/Rheology Stabilizer	5.0 – 9.2 kg/m <sup>3</sup>
CALOTHIN	HTHP Thinner	2.0 – 6.4 kg/m <sup>3</sup>
CALOSPERSER ZR	HTHP Thinner	2.0 – 6.5 kg/m <sup>3</sup>
BLACK FURY	Cake & Microfractures sealing/Shale control	1.0 – 1.6 %vol/vol
ASPHASOL SUPREME	HTHP Fluid Loss/Shale control	5.0 – 29.0 kg/m <sup>3</sup>
K-17	Thinner	2.0 – 12.5 kg/m <sup>3</sup>
Synthetic Polymer	HTHP Fluid Loss control/Rheology Stabilizer	0.5 – 1.5 kg/m <sup>3</sup>

**Table 2: Main drilling fluid properties**

Property	Interval 8 3/8 in	Interval 5 7/8 in
Mud Weight (SG)	1.60 – 1.85 (13.3 – 15.4 lb/gal)	2.0 – 2.28 (16.6 – 19 lb/gal)
Plastic Viscosity (cP)	22 – 44	36 – 53
Yield Point (lb/100ft <sup>2</sup> )	11 – 34	10 – 25
Gels 10"/10' (lb/100ft <sup>2</sup> )	2 – 7 / 5 – 24	3 – 11 / 4 – 24
HTHP Fluid Loss (cm <sup>3</sup> /30min)	20 – 28	18 – 24
MBT (kg/m <sup>3</sup> )	28.0 – 31.5	14.0 – 17.5

## Questions? We'll be glad to answer them.

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



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