

G-SEAL PLUS Formation Sealing Stops Severe Losses While Drilling in Holland

“An optimized blend of G-SEAL* PLUS additive and sized calcium carbonate maintained in the active mud system minimized mud losses substantially while drilling the interval compared with the offset wells.”

International Operator

Well Information

Location	Netherlands
Interval start depth	7546-ft (2300-m) Measured Depth (MD)
Total depth	16,201-ft (4938-m) MD
Hole angle range	51-71°
Openhole size	12¼ in. (311 mm)
Fluid in hole	Mineral-oil-base drilling fluid
Max. bottomhole circulating temperature	176°F (80°C)

The Situation

The wells drilled by the operator in this particular field experienced severe losses while drilling, sometimes up to 1000 m³ (6,280 bbl). The lost circulation problems resulted in significant time delays, in addition to the costly mineral-oil-base mud used for drilling the 12¼-in. (311-mm) interval.

Approximately 8320 ft (2536 m) of sandstone and shale was to be drilled with a 1.30-SG (10.85- lb/gal) mud weight. Holland Greensand, de Lier, Berkel, Rijswijk and Delftland formations were all prone to mud losses while drilling, as experienced in the offset wells.

Designing a fluid with the proper type and concentration of Lost Circulation Material (LCM) that could effectively seal the troublesome formations was a key issue for the operator. Managing the solids control equipment while maintaining the background LCM in the system was also part of the planning process.

The Solution

M-I SWACO R & E in Houston compared the fracture sealing performance of three different blends of calcium carbonate, G-SEAL and G-SEAL PLUS additives in the mineral-oil-base mud formulation used by the operator. The best sealing performance observed was the blend containing G-SEAL PLUS industrial-carbon/graphite along with two grinds of calcium carbonate ($d_{50}=10$ and $d_{50}=40$).

Prior to drilling the 12¼-in. (311-mm) section, 130 kg/m³ (45.5 lb/gal) LCM was incorporated in the 1.30 SG (10.85 lb/gal) mineral-oil-base mud delivered to the rig. The LCM concentration consisted of 50 kg/m³ (17.5 lb/gal) of each calcium carbonate grind ($d_{50}=10$ and $d_{50}=40$) and 30 kg/m³ (10.5 lb/gal) G-SEAL PLUS additive. The concentration of LCM was maintained in the circulating system throughout the entire 12¼-in. (311-mm) section.

A 8441-ft (2573-m) interval was drilled at 71° angle through several weak-shale/sand reservoir sections with minimal losses; 63 m³ (395 bbl) were reported lost to formation while drilling compared with three offset wells which had encountered mud losses in excess of 1000 m³ (6280 bbl) each.

The Details

A steerable bottomhole assembly including a PowerDrive[^] unit was used to drill the 12¼-in. (311-mm) interval. The hole was displaced to 1.30 SG mineral-oil-base fluid initially treated with 50 kg/m³ (17.5 lb/gal) of each calcium carbonate grind (d₅₀=10 and d₅₀=40) and 30 kg/m³ (10.5 lb/gal) G-SEAL PLUS additive.

A formation integrity test was conducted to obtain an acceptable 1.42 SG (11.85 lb/gal) equivalent mud weight for drilling out.

When drilling commenced at 7376 ft (2248 m), the active mud was continuously treated with Wellbore Strengthening Materials (WBSM)—G-SEAL PLUS additive, calcium carbonate (d₅₀=10) and calcium carbonate (d₅₀=40)—at a rate of 4 sx/hr.

An additional 10 kg/m³ (3.5 lb/bbl) WBSM was added to any fresh pre-mix built on location. The 1.25-SG (10.40-lb/gal) mud weight pre-mix was used to maintain the active volume and control the density of the circulating system. Each batch consisted of 5 m³ (31 bbl) of base mineral oil and 5 m³ (31 bbl) of initial mud with G-SEAL PLUS additive and calcium carbonate.

As drilling progressed, it became evident that the best treatment was to use the pre-mix enriched with 10 kg/m³ (3.5 lb/bbl) G-SEAL PLUS additive and calcium carbonate to control mud weight and rheology. Maintaining WBSM in the active mud while drilling the interval was the key to successfully mitigating mud losses. Intermittent losses to the formation in the range of 1 to 2 m³/hr (6.3 to 12.6 bbl/hr) were recorded while drilling the Holland Greensland formation.

Solids control management was required throughout the interval while drilling sandstone/shale intervals. The shakers were all dressed to 3x30/4x84 while drilling the sandstone formations to allow as much retention of G-SEAL PLUS additive and calcium carbonate as possible. Finer screens 3x30/4x175 were used on the shakers when drilling shale intervals, and centrifuges on barite recovery mode were run occasionally to maintain low-gravity solids content below 10%. Mud properties remained excellent throughout. Some mud pump failures were reported, equipment wear was believed to be caused by the solids in the mud while running coarser shakers.

The mud weight was raised to 1.34 SG (11.16 lb/gal) for the last 2560 ft (780 m) prior to entering the Delftland formation. While drilling from 13,842 to 15,220 ft (4219 to 4639 m), the G-SEAL PLUS product addition rate for maintenance was halved, resulting in increases in torque and stick-slip shortly after. The addition of 4 sx/hr of G-SEAL PLUS additive was thereafter restored and no torque problems and mud losses were reported to the end of the interval.

Severe mud losses occurred while running the casing below 7218 ft (2200 m) and a further 300 m³ (1887 bbl) of mud was lost when total lost returns occurred during cementing operations at 16,191 ft (4935 m). Still the cumulative mud losses for the 12¼-in. (311-mm) interval were less than half that on the offset wells.

The wellbore strengthening technique for minimizing losses while drilling problematic formations was considered a success. It was also reported that the G-SEAL PLUS additive aided in reducing pipe torque while drilling the bottom of the 12¼-in. (311-mm) section.

Questions? We'll be glad to answer them.

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



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