



TerraTherm™ High-Performance Water-Based Drilling Fluid with Optimized Flocculation Ensures Success on Geothermal Wells and Compliance with Strict Environmental Regulations, Germany

Newpark's expertise and worldwide experience with Geothermal wells helped the operator solve potential problems while complying with strict German environmental regulations.

CHALLENGE	SOLUTION	RESULT
<ul style="list-style-type: none"> • Chemical degradation of drilling fluid component • Influx of water and gas • Torque and drag from hard rock and inclination • Environmental restrictions 	<ul style="list-style-type: none"> • TerraTherm™ high-performance water-based drilling fluid • Flocculation unit connected to centrifuge, based on Newpark's extensive experience in Geothermal 	<ul style="list-style-type: none"> • Expected large loss rates did not occur • Flocculation performance was optimized due to lab testing prior to operation • Torque and drag were drastically reduced

OVERVIEW

Newpark was chosen as the fluid supplier for a substantial Geothermal project in Germany, in which the operator had the goal of drilling wells for both production and re-injection. The wells are in the Landau region and used to produce hot water for the heating systems of the nearby towns.

A total of two dual production/injection wells were planned and drilled, namely Landau GT wells and Insheim GT wells.

The Landau wells were characterized by a depth of 2,250 mMD with a final inclination of 45°, a maximum mud weight required of 1.12 sg and a bottom hole temperature of 155° Celsius.

The Insheim wells were drilled to a final depth of 3,340 mMD, one vertical and one with a final inclination of 21°, utilizing a fluid with a maximum density of 1.14 sg and achieving a bottom hole static temperature of 158° Celsius.

Leveraging many years of experience in High Temperature and Geothermal wells worldwide, Newpark Fluids Systems proposed the TerraTherm™ high-performance water-based geothermal drilling fluid, which has been used successfully in over 100 geothermal wells.

CHALLENGE

The primary challenges expected during the drilling campaign included:

- Chemical degradation of the drilling fluid components



- Physical degradation requiring treatment and a high rate of dilution, which can impact waste management strategy
- Influx of water and gas
- Downhole losses
- Torque and drag due to hard rock and inclination

In addition, the strict regulations mandated in Germany presented added challenges for consideration:

- Limitations on selection of products
- Fluid composition required to optimize the flocculation and dewatering process
- Nearly zero waste discharge policy

German environmental rules demand that the fluid is treated on site in a dewatering process to reduce waste volumes and support recycling to minimize the water needed to build additional drilling fluid.

The TerraTherm formulation was refined to meet this requirement in-line with all the German environmental requirements.

SOLUTION

To comply with environmental rules, and provide a successful solution for the operator, TerraTherm a temperature extender was incorporated into the TerraTherm formulation to increase temperature resistance of the polymers.

The potential for high rates of dilution due to the shale encountered in the surface sections, as well as temperature degradation while drilling the reservoir, was avoided with the effective use of a dewatering process. Fluid is dosed with flocculant and then centrifuged to remove the flocculated solids allowing the water phase to be reused for building additional drilling fluid. Flocculant chemical selection is critical to optimize the process; thus minimizing the waste volumes and maximizing fluids recycling.

In addition to minimizing waste volumes, the flocculation unit prevented low gravity solids (LGS) build up in the drilling mud system and allowing effective control of mud weight.

The rate of dilution planned was 7.9m³ of new fluid per m³ of rock drilled, however Newpark engineers were able to reduce this in practice to 3.7m³. The flocculation unit operated without failure during the entire campaign thanks to the maintenance program put in place by Newpark engineers.

RESULTS

The effective use of a flocculating process in this project was one of the keys to success in reducing the overall volumes handled and minimizing disposal volumes, and of course related costs.

Optimized performance was in a large part due to careful pre-testing and selection of flocculant chemical in the Newpark laboratory, and then implementing accurate QA/QC protocols on locally sourced product.

Equivalent Circulating Density (ECD) management was also a key factor to limit the large downhole fluid loss rates expected.

Drastic reduction of torque and drag was achieved by adding Ecol Lube HT, our proprietary lubricant blend of mineral oil and esters used in water-based drilling fluid, and specially tailored for the TerraTherm system. It readily disperses into fluid with minimum shear, it reduces friction coefficient which enhancing drilling performances and is stable at high temperature above 150°C.



German Geothermal drilling campaign in numbers:

Max depth drilled	3,340m
Max temperature drilled	157°C
Max drill fluid density	1.14
Average day of drilling	29
Max losses	6,232 m ³ / well

Mud Flocculation facts:

Max flocculation per well	2,861 m ³ / well
Average flocculation per well	2,403 m ³ / well
Impact on rate of dilution	rate of dilution expected vs actual: 7.9 vs 3.7 (m ³ of new fluid to drill 1 m ³ of formation)