Case History

Advanced Geothermal Fluids Enable Deep, High-Temperature Drilling in Croatia

Leveraging TerraTherm™ geothermal drilling fluid technology and decades of European field expertise, Newpark delivered a fully integrated fluids solution that enabled safe, efficient drilling in a high-temperature Croatian geothermal well.

CHALLENGE	SOLUTION	RESULT
• **Increasing geothermal well complexity in Eastern Europe, with wells exceeding 3,000 m depth and bottomhole temperatures approaching 200°C** • **Drilling through complex, heterogeneous lithologies requiring enhanced inhibition, wellbore stability, and efficient solutions to lost circulation events** • **Need for high-temperature-resistant fluid systems capable of maintaining rheology and fluid loss control** • **Strict environmental and economic constraints, including aquifer compatibility, waste minimization, and cost-effective fluid disposal**	• **Deployed TerraTherm™ high-temperature water-based geothermal fluid, engineered for rheological stability and low API fluid loss at temperatures up to 198°C** • **Implemented interval-specific fluid strategies, converting and upgrading fluid systems to reduce downtime, disposal volumes, and total fluid costs** • **Utilized advanced wellbore strengthening and inhibition technologies to maintain stability in reactive and fractured formations** • **Proactive field and office support from experienced Newpark Fluids team**	• **Successfully drilled and completed a deep geothermal well to 4,280 m, with recorded maximum downhole temperature of 198°C at TD during logging** • **Maintained stable fluid properties and effective hole cleaning, minimizing non-productive time** • **Reduced waste volumes and fluid-related costs through optimized solids control efficiency and fluid reuse strategies** • **Newpark recognized by the operator for proactive technical and operational support contributing directly to overall project success**

OVERVIEW

The drive for renewable energy resources has stimulated geothermal drilling activity in Eastern Europe, with multiple stakeholders exploring various potential projects. This project marked the first deep drilling project in Croatia for several years and is part of an expanding geothermal industry in the country. In response to this and driven by the extensive experience Newpark has accumulated in Croatia and across Europe, Newpark Drilling Fluids has established a local legal entity to support these initiatives and provide localized solutions.
Newpark's strong track record in Eastern Europe and our expertise in supporting drilling operations over the last three decades proved to be a decisive factor in the award of this challenging project. Newpark is focused on geothermal applications across Europe, solidifying its position as a leader in technical solutions. Over the past 30 years, the company has successfully designed and implemented geothermal and high-temperature drilling fluid solutions for some of the continent's hottest reservoirs.

These solutions have been developed through extensive laboratory testing using next-generation components, leading to the creation of TerraTherm™ water-based geothermal drilling fluid.

NEWPARK FLUIDS SYSTEMS

Case History

Newpark's objective is to deliver advanced technical solutions, supported by highly experienced Drilling Fluids Specialists familiar with country-specific drilling and HSE procedures. In addition to optimizing drilling performance, Newpark's High Temperature Water-Based fluid systems are designed to minimize hidden operational delays and environmental impact.

Safety remains the cornerstone of Newpark's core business. Every project is carried out in compliance with both company and customer HSE standards, ensuring a safe and incident-free work environment.

CHALLENGE

In Europe, geothermal drilling is expanding. This region often features hot source rocks with complex lithology profiles, making access particularly challenging. The number of complex wells exceeding 3,000 meters in depth is increasing, necessitating drilling fluids with progressively higher temperature resistance. Deep geothermal wells, characterized by low- to medium-enthalpy reservoirs, require fluid systems that address inhibition, high mud weight, and wellbore stabilization— as well as conventional drilling hazards, such as lost circulation.

Effective management of these risks is closely tied to the economic considerations of fluid formulation, disposal, and environmental compliance, particularly in ensuring fluid compatibility with local aquifers.

SOLUTION

The fluid design and execution strategy for this well utilized the following technical solutions by interval:

26" Top Hole Section

- A gypsum-polymer fluid was selected to ensure proper hole cleaning in this large-diameter section.
- Effective shaker, mud cleaning, and centrifuge setup helped maintain fluid properties within desired specifications.
- The dewatering unit, integrated into the circulating fluid system, reduced solids content and dilution rates, leading to lower waste volumes and cost savings.
- No operational or fluid-related issues were encountered during this interval.

17 ½" Section

- The gypsum-polymer fluid was converted to a KCl-polymer system by adding 4% KCl initially, minimizing downtime for pit cleaning and displacement while reducing the costs associated with mixing new fluid and disposal.
- As shale formations were encountered, the KCl concentration was increased to 8%, supplemented with Glycol (3%) and Newperm NF shale inhibitor (1%) to enhance wellbore stability.
- Rigorous solids control procedures and continued use of the dewatering unit maintained fluid quality at low dilution rates.

12 ¼" Section

- The KCl-polymer fluid was upgraded to TerraTherm, a high-temperature geothermal fluid designed for optimal rheology stability and tight API fluid loss.

- Formation stabilization was achieved using NanoStable wellbore strengthening agent, TrueCarb 100 sized ground marble, and NewSeal 600 resilient graphite for superior wellbore integrity.
- Additions of Ecol Lube ES lubricant minimized torque and friction.
- NewStabil fluid stabilizer was utilized to counter fluid degradation and extend polymer performance under high temperatures.
- Shale inhibition levels were maintained as per previous section using Glycol, KCl, and Newperm NF.
- Recorded downhole temperature: 150°C at section TD (4,068m).

8 ½" Section

- Prior to reservoir drilling, the TerraTherm fluid density was cut back to 1.10 sg by centrifugation before blending (50:50) with fresh solids-free TerraTherm to achieve 1.07 sg.
- At the end of the interval, a mechanical stuck pipe event occurred in hard quartz- and pyrite-based formations, leading to losses and tool damage.
- Remedial cementing and side-track operation were successfully performed without further incident.

A 7" liner was installed at 4,280m, followed by acid treatment, injectivity testing, and logging. A maximum downhole temperature of 198°C was recorded.

RESULTS

This project required the development of technical solutions to meet operational, environmental, and economic requirements. By leveraging innovative technologies alongside past field experience, Newpark successfully executed a geothermal well in Croatia's medium-enthalpy reservoir.

Drilling proceeded smoothly until the final interval, where expected fluid losses occurred. Thanks to the quick response and expertise of Newpark's field personnel—supported by experienced office-based staff—the challenges were successfully mitigated.

During the final well after action review, the customer emphasized that the planned technical solutions effectively addressed all anticipated challenges in drilling intermediate and top-hole intervals. While an unforeseen event unrelated to fluid performance occurred, the response and conclusions provided insights for further optimization.

Newpark's personnel—both on-site and in the office—were praised for their proactive contributions. Beyond fluid provision, their expertise and involvement in operational decision-making enhanced project performance, adding significant value to the overall drilling success.