

TK™-Liner Hanger Prevents Corrosion

Scab Liner Hanger Packer systems with glass-reinforced epoxy (GRE) tiedback liner provide cost-effective corrosion protection and thermal insulation.

Background

The Netherlands is actively transitioning away from the use of natural gas as the primary resource for heating buildings in the Netherlands, greenhouses, as well as industrial infrastructure, with ~90% of households currently using Natural Gas for heating – often through the use of conventional gas boilers. Sustainable heat provided through hot water produced from geothermal wells is an ideal solution to these challenges, allowing for heating greenhouses as well as district heating, improving the energy self-sufficiency of the Netherlands, and achieving ambitious renewable energy targets.

In the Netherlands high levels of corrosive carbon dioxide (CO₂) as well as high salinity content are present in the area currently used for geothermal projects. There can be a large variation in CO₂ levels based on location – even within the same reservoir. CO₂ corrosion and scaling are the primary internal corrosion and integrity threats for these geothermal wells.

Key factors affecting CO₂ corrosion rates in geothermal wells include:

- CO₂ concentration
- Temperature
- Fluid velocity and flow conditions
- Water content (presence of other acids or alkaline components)

Geothermal wells in the Netherlands require the use of ESP's to lift hot water to surface. The depths of these wells vary between 1,500 meters to 3,000 meters. Operator experience as well as studies have identified corrosion and scaling as major challenges for geothermal wells.

Solution

To overcome ID corrosion challenges due to the presence of CO₂, TK™-Liner was utilized. Developed by Tuboscope™, TK-Liner is a high-performance GRE lining system that provides exceptional corrosion protection that is well-suited to the unique demands of geothermal wells. The system is comprised of a thin wall GRE liner cemented inside a low-alloy carbon steel pipe. The combination of the cement grouting and fiberglass liner allows the pipe to withstand pressures and loads of the wellbore, provides corrosion protection and thermal insulation, with full coverage of the liner pipe ID.

Case study facts

Location: The Netherlands

Customer: ECW Energy

Well type: Five Geothermal wells; (Three injector wells and two producer wells)

Production fluid: ~80 °C

Well depth: Up to 2,300 m

Products

- VXP Liner Top Packers
- GSP and GSL Liner Hangers
- Landing Nipples
- Tie Back Seal Stems
- TK-Liner fiberglass liner system with TK-Ring II technology

General Well Information

- Host casing: 13.375-in. 68 and 72 ppf
- Drilling Liner: 9.625-in. 43.5 and 53.5 ppf
- Production Liner: 7-in. 26 and 29 ppf
- Combination Scab Liner:
7-in. x 9.625-in. size
11.750-in. x 13.375-in. size
- Tieback Production Strings used in scab liner:
8.625-in. 40 ppf L80 coated with TK-Coatings
10.750-in. 51 ppf L80 coated with TK-Liner (TK-II)
7.625-in. 33.7ppf L80 coated with TK-Liner (TK-II)

Results

- Liner top packer system was redesigned, tested, and manufactured in **two weeks** in order to set inside of 9.625-in. 43.5 ppf L80 host casing with ~35% reduction of material due to corrosion
- TK-Liner system provided cost-effective corrosion protection and thermal insulation for scab liner tieback string

Case Study

The TK-Liner system incorporates an end-flange design that allows for an internal centralized flush connection, is compatible with most existing oilfield tubular connections on the market, and it can be modified for certain proprietary premium connections. In conjunction with the TK-Ring II technology, this corrosion protection reaches to cover the threaded connections. With over 70 million feet of TK-Liner pipe installed in high-temperature applications around the world, the TK-Liner technology is a proven solution to the types of challenges being faced by geothermal wells in the Netherlands.

In order to maximize heat generated by a given geothermal well, it is desired to maximize the flow rate of the injected and produced fluids. To achieve these goals, well design programs often plan to place a larger casing relatively deep. Liner Hangers are a cost-effective natural solution to this challenge, while the addition of the TK-Liner results in a lower surface roughness, further enhancing production flow rates.

For this particular application, we combined the TK-Liner technology with our Completion Tool's well construction portfolio to work over five existing geothermal wells in order to mitigate and/or prevent ongoing degradation due to corrosion. To combat the extensive corrosion experienced by the customer on these existing wells – previously drilled and installed using L80 low alloy carbon steel materials – we utilized Alloy 28 liner hanger systems alongside our fully coated tieback string with TK-Liner (TK-Ring II technologies), thereby providing a cost-effective solution to serve as a coated, tiedback scab liner all the way to surface. These work over operations inside of existing 9.625-in. casing allowed for corrosion prevention.

During the planning phases and while ordering equipment, previous caliper logs indicated that ID of the host casing would allow for the use of the planned equipment. During the first job, issues were observed setting and testing the 7-in liner top packer in the preexisting 9.625-in. 43.5 ppf casing. An updated caliper log was provided indicating the corrosive effects of wellbore fluids were such that the ID was substantially more corroded than originally expected with approximately **~35% reduction of material on casing ID**. In other words, the 9.625-in. 43.5 ppf host casing had a measured ID larger than typical 9.625-in. 32.3 ppf casing.

We then initiated a task force to rapidly customize the equipment allowing for the customer to achieve the desired results with updated equipment **turned around in an impressive two week time frame**. This required updates to the packing elements, backup rings, and liner top packer design along with a liner top packer test to ensure the equipment would function in the washed out ID similar to 9.625-in. 32.3 ppf host casing. Then, the actual CRA Alloy 28 liner hanger equipment on the ground was comprehensively updated to the new design with a total turnaround time of only two weeks including design, testing, and manufacturing updates.

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