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Increasing Longevity and Supply through Geothermal Wellbore Maintenance: A Lakeview, Oregon Case Study

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Summary

Geothermal energy, a sustainable and renewable resource, plays a vital role in the global energy supply. To guarantee peak performance and longevity of geothermal wells, it is essential to implement a wellbore operation and maintenance strategy.

A fundamental component of this strategy is to address the formation of scale attributed to mineral precipitation from the brine during the reinjection and production process. The accumulation of scale deposits significantly impacts the lifespan and efficiency of geothermal wells by restricting fluid flow, thus reducing wellbore performance. When scale is left to build up over time, it can also lead to premature well failure.

The Town of Lakeview, Oregon ("Lakeview") has two geothermal district heating (GDH) systems for a minimum-security correctional facility, local schools, the community hospital, emergency services station, and a dental clinic. Through the use of geothermal energy, the community is able to offset the high cost of using propane with a levelized cost solution to meet their heating needs. Without a proactive maintenance program in place, a significant drop in flow rates on one of the GDH systems has been observed that puts the security of supply for critical infrastructure at risk. Various methods for scale removal were considered with electro-hydraulic pulse technology applied to remove flow impediments and increase the well performance.

Hypothesis

If an appropriate wellbore maintenance strategy is implemented, then there will be efficient heat transfer for improved energy production because of the removal of flow impediments within the geothermal system. Implementing a proactive strategy for regular wellbore cleaning will extend the operational life of geothermal wells, reduce unplanned downtime, and ultimately enhance the economic viability of a geothermal project.

Method

Geothermal fluid reservoirs are susceptible to scale deposition due to various factors that include changes in temperature, pressure, and flow velocity, pH level, degree of supersaturation and presence of ions in solution. Magnesium-based silicates, carbonates (calcite, aragonite),

and iron-based corrosion products are the most common types of scale in geothermal wellbores.

Developing a wellbore operation and maintenance strategy requires the consideration and evaluation of several factors. These factors include: specific wellbore conditions, operational requirements, regulatory constraints, economic considerations, and various scale removal techniques.

In this case study, Lakeview (the operator) reviewed conventional chemical and mechanical scale removal techniques, as well as electro-hydraulic pulsing, a recent innovative method. The geothermal producer well contained goethite (iron oxide-hydroxide) scale that had been building up over a period of 14 years (Figures 1 & 2). With goethite being a challenging type of scale to remove, the operator decided to pursue the electro-hydraulic technique to ensure an effective cleanout and wellbore integrity of their geothermal system.

Figure 1: Goethite (Iron Oxide-Hydroxide) scale found in wellbore (Hudspeth, et al., 2023).

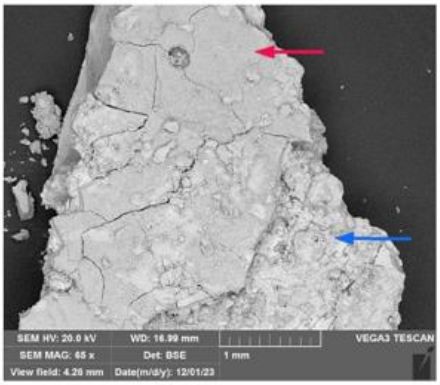

Figure 2: SEM photomicrograph of goethite scale particle. Red arrow indicates FeO-OH-rich surface; blue arrow shows the black Fe_3O_4 sub-surface. (Hudspeth, et al., 2023)

Once the treatment technique was determined, a comprehensive assessment of the wellbore conditions was completed. The workflow for implementing the wellbore cleaning in Lakeview involved evaluating the well design, mineral composition, water chemistry, wellbore pressures and wellbore temperatures to optimize the long-term maintenance plan.

Results

Through the newly implemented strategic maintenance plan for Lakeview, the electro-hydraulic pulse technology was deployed. The technology involves utilizing a small amount of energy that is released over an extremely short timespan to generate pressure waves. The pulsing technology targeted specific intervals totaling 105 feet of permeable water bearing zones that

were partially obstructed by scale deposits. The repetition of pulses effectively broke up the goethite scale (iron oxide-hydroxide) in the wellbore to eliminate any flow impediments.

Four years ago, the production rate was 160 gallons per minute (gpm), which had declined to a rate of 88 gpm due to flow impediments. To efficiently meet the heating needs of the buildings, a production rate of 130 gpm has been recommended. Following the targeted pulsing treatment, the production rate increased to 206 gpm. The use of this innovative technology in Lakeview achieved breakthrough results in scale removal, leading to increased fluid flow and well productivity.

Discussion

The importance of operations and maintenance plans for GDH operators cannot be understated. In the case of Lakeview, more costly repairs and replacement have been avoided through timely intervention. Through proactive planning on the part of the municipality, the system can remain in operation during the most critical periods of the heating season.

Such an achievement is not as common as it should be for other GDH operators. Of the more than 20 GDH operators in North America, allocating funds for such maintenance can be challenging. Most have a capacity under 8 MW_{th} and serve rural communities, though they fulfill an indispensable role – providing sustainable, affordable heat. With well health being a common concern for GDH operators across the continent, it is important to administer forward-looking maintenance plans before manageable fluids become unmitigated outages.

The Lakeview case study underscores the importance of regular maintenance and innovative approaches to managing geothermal wells.

Acknowledgements

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