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Formation Cleaning in Reinjection Wells: Learnings from New Zealand Field Trials

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INTRODUCTION

Oversaturation of silica in separated geothermal water (SGW) can lead to scaling in reinjection wells and the formation around these wells. Wellbore scaling is often best dealt with through mechanical means (Wilson 2020); however, formation scaling requires a different treatment. Deposits in the formation are typically dealt with by applying chemicals to the formation to remove part or all of the scale, recovering reinjection capacity. To build our capability in formation cleaning we have undertaken a research project to expand our knowledge, understand historic cleans, improve decision making (McLean 2024) and identify key parameters for success. Following this extensive research program studying the literature, previous results and conducting laboratory testing (Ferguson 2024 and 2025), we have begun to test our findings in the field. This poster outlines the successes, learnings and future outlook of our reinjection well formation cleaning program.

PROGRAM DESIGN AND FIELD TESTING

Key design parameters were identified from our laboratory studies and literature reviews to give the best chance of success in removing silica-based scale from the formation around our reinjection wells:

- 3% caustic solution gave best value when dissolving silica-based scale
- Temperature is an important driver of silica dissolution
- Taking the well offline to allow a soak period is beneficial
- Chelants, inhibitors and dispersants can reduce the risk of secondary precipitation

The results of field tests at WK304 are presented below. WK304 had been cleaned multiple times previously, providing an excellent opportunity to compare the different methodologies and assess the effectiveness of the changes we were making.

RESULTS

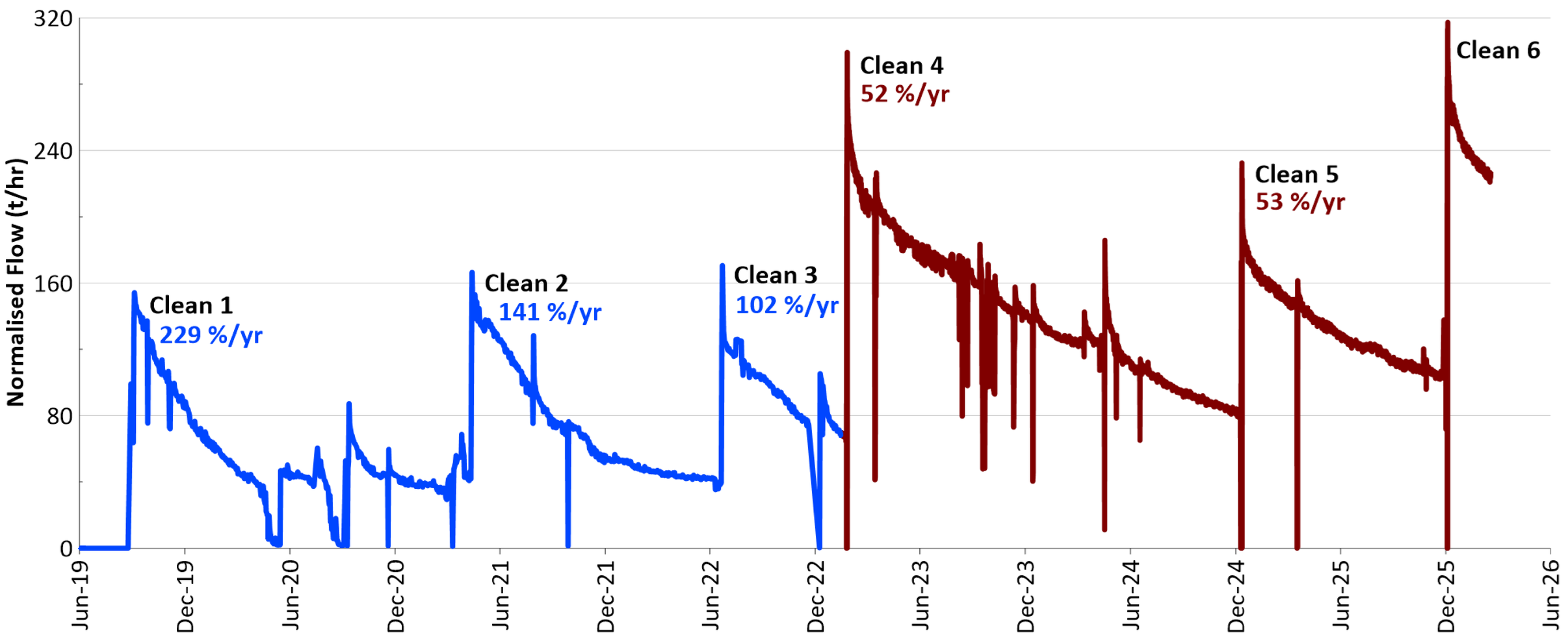


Figure 1. Cleans in blue (1,2 and 3) were designed by an external contractor, while the cleans in maroon (4, 5 and 6) were designed by Contact. Long-term exponential decline rates shown for each clean, with the exception of clean 6, as more data is needed to confirm the long-term decline rate.

KEY FINDINGS

- Field trials early in the project on other wells highlighted the importance of using sufficient chemical, with the chemical volumes employed yielding moderate results. Estimation of the formation penetration of the chemicals provided learnings that were taken forward to program design for future wells
- Successes observed at reinjection well WK304 include:
  - **Reduced long-term decline rate** from over 100 %/yr to ~50 %/yr
  - **Improved mass flow** with peak flows in the range 180 to 270 t/hr, while previous cleans achieved peak flows in the 120 to 160 t/hr range
  - Our most recent clean produced the **highest mass flow** of any clean on WK304
- The result of clean 5 was likely impacted by experimentation with the chemical program. These learnings and the results of further laboratory testing were applied to the design of clean 6
- The trial of a scale inhibitor post-clean 5 showed moderate benefit, reducing the short-term decline and extending the life of the clean by around 2 months. The long-term decline rate was unaffected, when compared with clean 4.

CONCLUSIONS AND FUTURE OUTLOOK

Following an extensive research program investigating all aspects of formation cleaning, from well selection through to program design and execution, we conducted a series of field trials. Our modified and optimised cleaning programs have:

- Simplified chemical programs
- Reduced chemical costs
- Recovered higher mass flows
- Reduced decline rates
- Resulted in longer-lived cleans
- Reduced the time taken to conduct the clean

Future work to further improve the viability and effectiveness of our formation cleans:

- The trial of an alternative, silica specific, inhibitor post-clean, with the aim of achieving further reductions in decline rate.
- Testing of alternative chelants in the field. Several were identified in laboratory testing, producing similar results to traditional chelants, such as EDTA, but at a much reduced cost.

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