CASE STUDY

Nalco Water Scale Inhibition Program Helps Prevent $3.8M Annual Revenue Loss in a Two-phase Header at a Geothermal Field in the Philippines

eROI℠ by Ecolab

BACKGROUND

In harnessing geothermal power, both surface and subsurface facilities play a critical role in ensuring that every possible megawatt can be realized efficiently. A common problem experienced by geothermal plants with focus on surface facilities is pipeline scaling that causes constriction. This constriction increases line pressure and decreases output. In either binary or flash systems, scaling along these lines is common due to changes in physical and chemical properties of the geothermal fluid as it rises to the surface.

Scaling can have a detrimental effect in the production system of a geothermal power plant. Typically, the fluids coming from the wells in the same pad converge into a common two-phase pipeline. Without the operational flexibility to divert fluid to an alternate pipe or system, blockage of this two-phase pipeline will force the wells to be shutin. This will affect the power output of the plant and revenue generation directly. Also, deration of a geothermal power plant, which is a base load power plant, means that the output lost will be replaced by electricity from different sources, primarily coal, which makes up roughly 50% of the Philippine Energy Mix.

SITUATION

One of the leading geothermal power producers in the Philippines experiences mineral scaling along a two-phase header in one of its sites. Scaling occurs in the mixing point of the branch lines of two wells having high enthalpy (low pH, low water flow and high iron) and low enthalpy (high water flow) respectively. Without mitigation, the scaling rate is 15.6 inces per year which decreases the output of the 24-inch header by 65% a year. The stub-in point shows considerable decline in a matter of six months due to the blockage which requires manual scale removal twice per year at a cost of approximately USD $20,000. If the header becomes completely blocked, the lost capacity from the wells will directly affect the plant output. If there is no alternate diversion available, this can translate to USD $22,000 per day of lost revenue. The scale is a combination of amorphous silica and corrosion products. Figure 1 shows the deposition experienced by the pipeline before Nalco Water treatment.

ANNUAL SAVINGS

PRODUCTIVITY

US$3,800,000

Reduced energy losses from capacity decline and maintenance

ASSETS

US$15,000

Reduced cleaning frequency due to less scaling

AIR

Reduced CO_2 by 78,000 metric tons

TOTAL VALUE DELIVERED

US$3,815,000

Figure 1. Mineral deposition along the 24-inch two-phase header after more than six months.

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SOLUTION

The solution presented was to install a scale-inhibition system to address silica scaling and dispersion of corrosion products to prevent their co-precipitation. Product selection was based on laboratory-scale inhibition tests. Two products were selected based on laboratory-scale inhibition tests and scaling simulation of the mixed fluids using Nalco Water's Geomizer™ modeling tool. The first recommended product was Nalco® GEO980, which showed good silica inhibition. Performance was confirmed based on results from other sites. The second product, Nalco® GEO962, shows good dispersancy in controlling iron sulfide.

RESULTS

A technical evaluation of the effectiveness of GEO980 and GEO962 was first conducted on a sidestream to gain enough confidence before a commercial-scale application. The preliminary tests were done for 10 and 30 days respectively. In Figure 2 it can be seen that there was minimal to visually non-existent scaling observed for both testing durations.

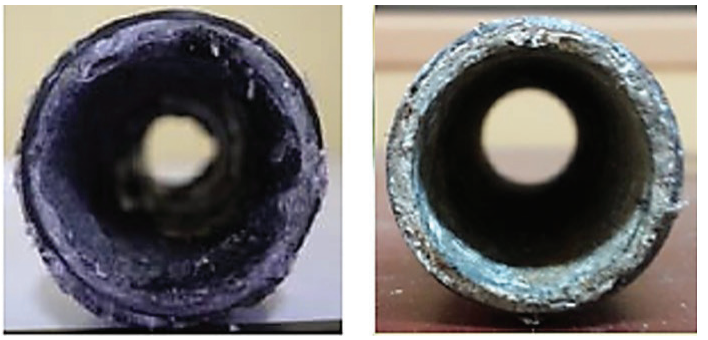

Figure 2. Visual inspection of 0.5 inch spools used in sidestream tests for 10 days (L) and 30 days (R) respectively.

With the success of the sidestream tests, the program was applied at the commercial scale. The commercial trial inhibition program started after the header was mechanically cleaned. Optimized dosages of GEO980 and GEO962 were 10-15 ppm and 5-10 ppm respectively. Within the first four months of dosing, the temperature profile of the pipeline showed no visible decline which indicated that no significant deposition occurred. This was further confirmed during the visual inspection of the pipeline as shown in Figure 3. In the visual inspection, scaling was significantly lower compared to the untreated scenario. Inspection spools were employed to determine the scaling rate with inhibition calculated at 4.8 in/year. This was equivalent to 70% scaling reduction per year. The dosing treatment can prolong the cleaning period from twice a year to once every two years assuming the same output reduction threshold to trigger mechanical cleaning.

Figure 3. Visual inspection of the 24-inch two-phase header after four months of dosing.

The successful commercial test provided a good business case for the customer to continue the program to significantly minimize capacity decline along the two-phase header and reduction of mechanical cleaning frequency. It was estimated that with the prevailing scaling rate with inhibition, the capacity decline prevention amounted to $9,700 per day of savings or $3.5 million per year. The program also helped prevent $300,000 cost of capacity decline due to the 7-day mechanical cleaning and saved $15,000 from the reduction of cleaning frequency. If the lost capacity was sourced from coal, the treatment program reduced around 78,000 metric tons of CO_2 emissions per year.

An introduction of an even more stable product was also performed (GEO981) with no expected change/decline on the performance of the actives. Dosage of this product was adjusted to 15-20 ppm (in comparison to GEO980).

CONCLUSION

The program helped prevent 70% capacity decline along the two-phase header. Without a bypass line, where the two-phase fluid can be diverted, this fouling could cause shut-in of production wells equivalent to $9,700 per day or $3.5 million per year revenue loss. The mechanical cleaning also contributed to seven days of downtime which was equivalent to $300,000 per year for two cleaning cycles. The program also helped reduce the mechanical cleaning frequency which equated to $15,000 per year of savings. This also eliminated the attributed human exposure to known hazards while performing the mechanical clean. The treatment also helped prevent 78,000 metric tons of CO_2 emission per year if the lost capacity was sourced from coal.

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