



# Online Corrosion Monitoring Returns Plant to Continuous Operation after Two-year Corrosion Shutdown



## BACKGROUND

Geothermal power plants extract high temperature, high pressure geothermal brine from deep earthen wells to transfer natural enthalpy into electrical power. Geothermal brine with low pH and high salinity can prove difficult to manage from a corrosion perspective. If corrosion is not well prevented, equipment life and plant assets are at risk. When corrosive failure occurs, plant productivity and revenue generation is also compromised.

## PROBLEM

A binary geothermal plant in Turkey experienced severe corrosion challenges due to the aggressive nature of the plant's brine. The corrosion led to damage in the plant's production wells and heat exchangers

that led to total plant shutdown after only one year of operation. Investigation results confirmed corrosive failure all over the plant with damage that took nearly two years of shutdown time to replace.

This geothermal customer not only lost two years' worth of revenue-generating productivity, they also had to pay the expensive costs of equipment replacement. After experiencing such severe corrosion damage and shutdown time with the plant's previous treatment program, the customer sought improved corrosion management. Their key business drivers of consistent productivity, system reliability, and asset protection required an improved corrosion management program.

### CUSTOMER IMPACT



### ECONOMIC RESULTS

Avoided 4 months additional corrosion-related shutdown



\$1M productivity in MW generation (Plant capacity 2.5-5 MW with seasonal fluctuation, MW sold at \$110/MW)

Avoided equipment cost for replacing heat exchanger tubes + 600m pipeline



\$500K equipment costs avoided

Reduced corrosion related maintenance and labor



\$50K labor and maintenance savings

Total cost savings



Combined cost savings of \$1.5 million

*eROI is our exponential value: the combined outcomes of improved performance, operational efficiency and sustainable impact delivered through our services and programs.*

## SOLUTION

Nalco Water implemented its geothermal corrosion program through a proprietary corrosion inhibitor and online corrosion monitoring. The solution was determined after an onsite investigation of corroded plant equipment by Nalco Water geothermal experts. The localized corrosion points of failure and total brine chemistry were analyzed to determine the suitability of GEO942 corrosion inhibitor for the plant's operating conditions.

To ensure performance and dosage of GEO942 onsite, trials with traditional carbon steel coupons were performed. The test compared a pipeline with no treatment to a pipeline with GEO942 treatment. After seven days, the coupon without treatment already began melting, whereas the Nalco Water treatment reduced the corrosion rate by 793 mpy, an 88% improvement. The customer confirmed that these were the best results they'd ever seen at their plant and agreed to move forward with the program.

Before starting continual dosing, the plant was prepared with a film of GEO942 dosed at 100ppm for 24 hours, followed by GEO942 dosed at 50ppm for the next 24 hours. After filming, the optimal dose was set at 8ppm of GEO942 based on trial results.

The second component of the solution for this Turkish customer is the use of the online Nalco corrosion monitor (NCM) technology. This system enables real-time corrosion rate readings to ensure short-term action can be taken if any issues arise. The NCM technology is more highly advanced than traditional coupon readings, as the monitor adjusts the speed of brine flow, temperature, and pressure for every part of the probe. Figure 2 shows



NALCO WATER CORROSION INHIBITOR TRIAL		Dosages	
		0 ppm	8 ppm
Putting the coupons and take off the coupons dates	5.02.2018	8,2180	8,1997
	12.02.2018	2,7227	7,5059
Coupon Mass Changes [mg]		5495	694
Corrosion Rate [mpy]		907,67	114,60

Figure 1: Corrosion coupon results comparing no treatment to GEO942 treatment after 7 days.



Figure 2: NCM skid for online corrosion monitoring.

the skid setup that displays changes immediately and enables enhanced protection for optimum results.

The customer has access to the NCM data 24/7 online from its website and if there is an extreme/sudden increase of the corrosion rate, the customer and the Nalco Water representative will be informed immediately via text message, e-mail and phone call from Nalco's System Assurance Center. The system is continually monitored and protected.



## RESULTS

Through continuous GEO942 feeding and NCM oversight, the corrosion rate results for the plant reduced by >90%. Without treatment, corrosion rates were 600-900 mpy, and they now range from 3-60 mpy. See Figure 3 for current corrosion rate results.

Dosage [ppm]		Corrosion Rates [mpy]				
Production Well 1	Production Well 2	Production Well 1	Production Well 2	ORC Entrance	ORC Exit	Injection Well
8	8	60	58	33	8	3

Figure 3: Unit operation corrosion rates after GEO942 treatment.

## CONCLUSION

The plant's new low corrosion rates will enable longevity in the plant's operations and prevent future equipment replacements. Nalco Water corrosion control avoided four months of additional plant shutdown, generating \$1M worth of power revenue (with MW sold at \$110/MW). The program also allowed \$500k USD worth of equipment changes in the heat exchanger and 600 m of pipeline to be avoided, while also reducing corrosion-related maintenance worth \$50k USD.



**Nalco Water, an Ecolab Company**

**North America:** 1601 West Diehl Road • Naperville, Illinois 60563 • USA

**Europe:** Richtstrasse 7 • 8304 Wallisellen • Switzerland

**Asia Pacific:** 2 International Business Park • #02-20 The Strategy Tower 2 • Singapore 609930

**Greater China:** 18G • Lane 168 • Da Du He Road • Shanghai China • 200062

**Latin America:** Av. Francisco Matarazzo • nº 1350 • Sao Paulo – SP Brazil • CEP: 05001-100

**Middle East and Africa:** Street 1010, Near Container Terminal 3, Jebel Ali Free Zone, PO BOX 262015, Dubai UAE

[ecolab.com/nalco-water](http://ecolab.com/nalco-water)

Ecolab, Nalco Water and the logos are Trademarks of Ecolab USA Inc.  
©2019 Ecolab USA Inc. All Rights Reserved 08/19 CH-2167

**NALCO**  **Water**  
An Ecolab Company