

# South Korean Refinery Saves \$4 Million Using Nalco Water's THERMOGAIN™ Crude Unit Antifoulant Program and Monitor™ Heat Exchanger Modelling Software

## CASE STUDY



### ▶ BACKGROUND

A South Korean refinery with a crude processing capacity of 840,000 barrels per day was experiencing elevated fouling rates within the crude preheat exchangers of one of its crude distillation units. This fouling significantly impacted operational performance by reducing heat transfer efficiency, evidenced by a 5°C temperature drop in less than six months. Several consequences occurred due to this fouling:

- **Increased Energy Consumption:** To maintain the desired process temperatures, additional fuel needed to be burned due to diminished heat transfer efficiency. This increased operational costs and fuel usage.
- **Higher CO<sub>2</sub> Emissions:** The increased fuel combustion resulted in elevated carbon dioxide emissions, amplifying the refinery's environmental footprint.
- **Pressure Drop and Process Instability:** Fouling causes pressure drops across the

heat exchangers, leading to inconsistent process performance, potential safety risks, and frequent maintenance.

- **Reduced Equipment Reliability and Increased Downtime:** Fouling accelerates equipment wear and necessitates more frequent cleaning and repairs, resulting in increased downtime and operational disruptions.
- **Financial Impact:** Increased energy use, heightened maintenance demands, and potential delays directly and collectively reduced the refinery's profitability and operational efficiency.

The heat exchanger network of the crude distillation unit is depicted in Figure 1. Notably, fouling risk is particularly elevated in the hot preheat section, particularly near the end of the system where temperatures are highest, further intensifying these operational challenges.

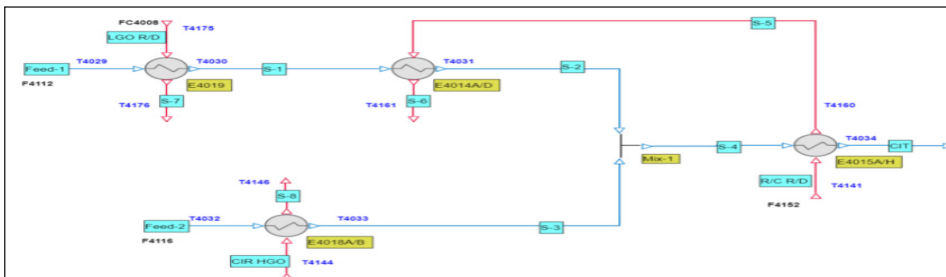


FIGURE 1: Heat exchanger network of the crude distillation unit

### ▶ SOLUTION

Following six months of implementation of a legacy antifoulant program post-turnaround, the expected operational improvement — namely, the elimination of temperature

drops caused by fouling in the preheat heat exchangers—was not achieved. In response, Nalco Water proposed a new antifouling strategy designed to further mitigate fouling



#### ANNUAL SAVINGS



ENERGY

**47,000 Gcal/year**



GREENHOUSE GASES

**12,000 metric tonnes**



TOTAL VALUE DELIVERED

**\$4 million Annually**

accumulation, improve heat exchanger performance, and reduce both fuel consumption and CO<sub>2</sub> emissions. This initiative aims to enhance overall operational efficiency and cost-effectiveness while supporting sustainable operational practices.

A comprehensive system survey was conducted, and Nalco Water's advanced Monitor™ Simulation Software was employed to accurately model the pre-heat exchanger network. This data, integrated with laboratory analyses, formed the foundation for developing an optimized mitigation approach. Nalco Water recommended deploying the Monitor Simulation Software alongside the injection of the new THERMOGAIN™ Crude Unit Antifoulant to effectively mitigate fouling within the crude pre-heat exchangers.

Of course, initial fouling after startup cannot be entirely avoided in refinery operations, but based on Nalco Water's field experience and data, the new THERMOGAIN antifoulant has demonstrated a distinctly strong fouling suppression effect.

Additionally, fixed sensors were strategically installed on the four critical heat exchangers, enabling real-time monitoring and management through the Monitor program. Recognizing the program's excellence and reliability, the customer expressed interest in expanding the deployment by installing fixed sensors to additional heat exchangers. This expansion aims to enhance the reliability of heat exchanger network monitoring, and support greater operational safety. This targeted approach helps ensure precise control and sustained operational excellence across key units.

## ▶ RESULTS

Following the major turnaround in June and a six-month legacy antifoulant program, the refiner initiated a trial with a THERMOGAIN antifoulant product. To assess the efficacy of this intervention, the Normalized Furnace Inlet Temperature (NFIT) was utilized as a primary performance indicator. NFIT is a key indicator that consolidates the impact of fouling across the entire heat exchanger network into a single representative temperature value. This allows for a clear and quantifiable evaluation of heat transfer efficiency loss caused by fouling throughout the system. In contrast, Furnace Inlet Temperature (FIT) reflects temperature variations influenced not only by fouling but also by operational changes, making it a more complex and less specific measure of fouling behavior.

Consequently, NFIT trends serve as a powerful metric for evaluating the impact of fouling by isolating the effect of fouling from other operational variables—particularly flow rate. By normalizing these influences, NFIT enables a fair and precise comparison of fouling factors over time, providing a more accurate assessment of fouling behavior across the entire heat exchanger network.

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

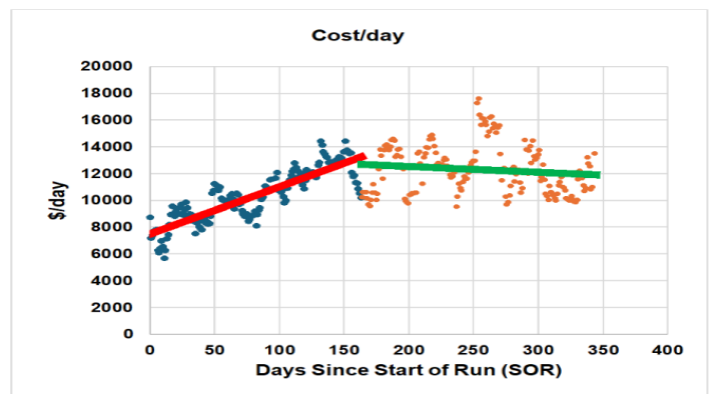
Figure 2 displays the NFIT data recorded prior to and following the implementation of the THERMOGAIN antifoulant trial, demonstrating its effectiveness in reducing fouling and sustaining optimal heat exchanger performance. This integrated approach achieved a 97.9% reduction in fouling, surpassing the refiner expectations and significantly enhancing heat exchanger performance.



**FIGURE 2:** NFIT data recorded prior to and following the implementation of the THERMOGAIN antifoulant trial

## ▶ CONCLUSION

Nalco Water's THERMOGAIN Crude Unit Antifoulant Program, in conjunction with Nalco Water's Monitor Simulation Software, were strategically implemented to effectively reduce fouling rates within the pre-heat exchanger train. As a result, the refiner was able to lower their total cost of ownership (TCO) by decreasing fuel consumption required to maintain furnace inlet temperatures. The initiative demonstrated an estimated return on investment exceeding 4:1 (Return \$4M, Investment \$1M), underscoring its economic and operational efficacy. This solution saved 47,000 Gcal/year and 12,000 metric tons of greenhouse gas emissions.



**FIGURE 3:** Cost/Day

*Disclosure: Nalco Water Case Study CH-2435 (2025). The results in this case study are specific to this individual customer. Results will vary for other customers based on factors and circumstances in their operations. Because of factors outside of Ecolab's control, such as water conditions, operational procedures and any other factors, results to be obtained including but not limited to water and cost savings cannot be predicted or guaranteed by Ecolab.*