Fouling Mitigation in CDU Preheat Exchanger with Ultrasonic Clean-in-Process Technology

REFINERY PROFILE
CDU, Netherlands

EQUIPMENT PROFILE
Shell & Tube Reboiler

CRUDE CAPACITY
416 000 Barrels per day

PROCESSING CHALLENGES

Crude Distillation Unit 6 at this refinery located in the Netherlands, has two kerosene, shell-and-tube reboilers. Ongoing, they experience a scale-type fouling on the process-side along with sticky, polymerized depositions on the intermediate side.

The assets were cleaned in-situ every 6-8 weeks. Every 2-3 years, an extensive mechanical cleaning would cause a 10-16 day shutdown– often outside of a turnaround.

While various chemical cleaning options were tried, none were very successful. After only 8 years in service, the process team was considering replacement of these reboilers.

SHIFTING TO ONLINE CLEANING

The KPI's stated from the client's heat transfer group, were to increase the run-length between in-situ cleanings; avoid mechanical cleaning between turnarounds; and opt to maintain a minimum of 6MW duty.

A thorough review of the potential benefits from the Ultrasonic Scale Prevention(USP) technology were positioned against the following criteria:

1. Performance, relative to the stated KPI's as listed above;
2. Economics relative to the significant capital expenditure for two, new reboilers for CD6

The USP technology was adopted by the engineering team of CD6, in April 2015.

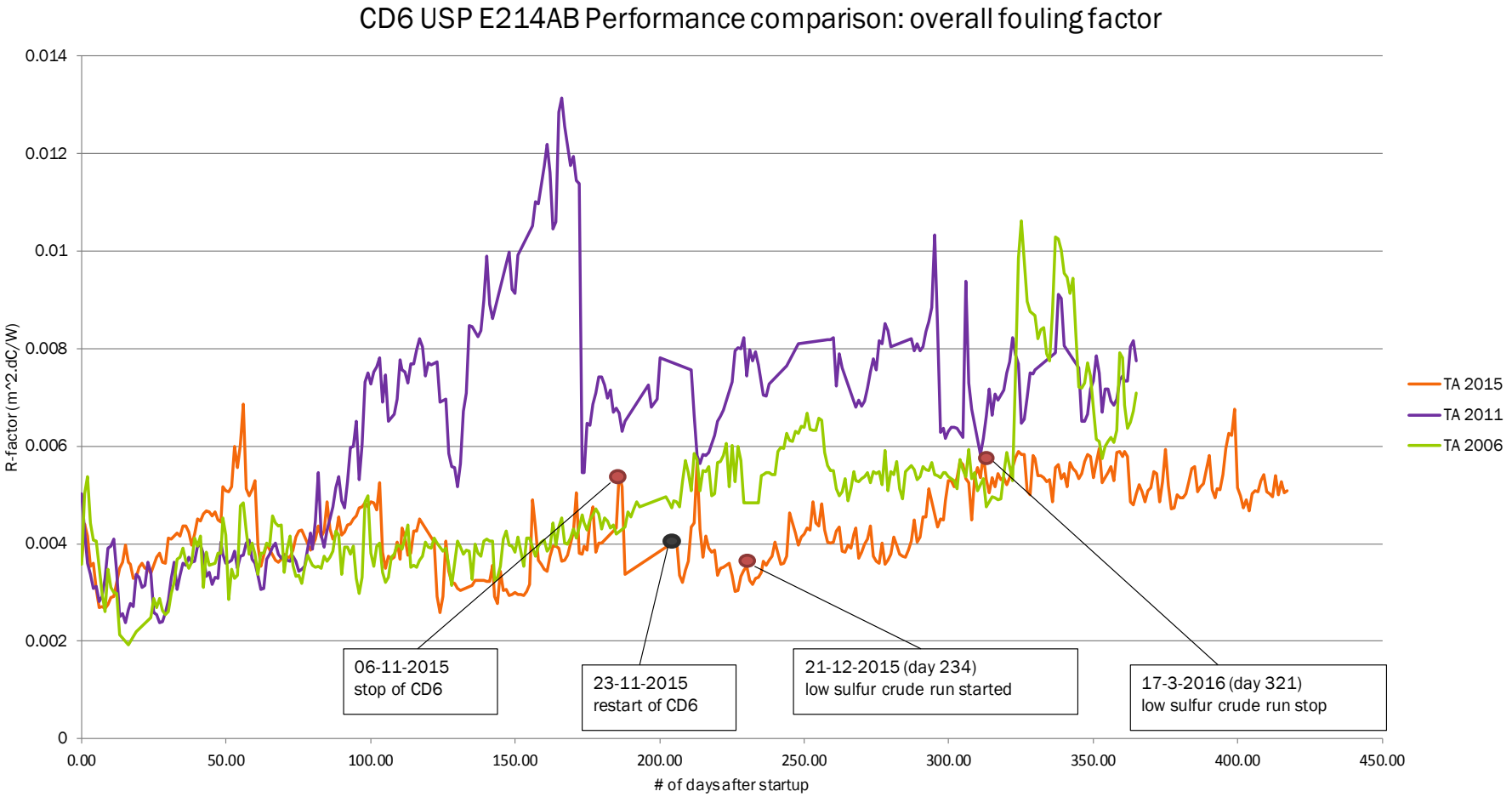
This technology delivers micro-pulse ultrasound, to disrupt fouling deposits and scale from adhering to heat transfer surfaces. The system employs specialized ultrasonic transducers and generators to allow cleaning to take place 24/7, with heat trains in full operation.

The engineering team leveraged critical T-in and T-out measuring devices on both reboilers for the capture of this operational data. Empirical performance computations were provided through the proprietary SmartPerform® platform. Energy consumption and product throughput for the two units: E-214 A/B, were captured via conventional measurements.

E-214AB OVERLL FOULING FACTOR

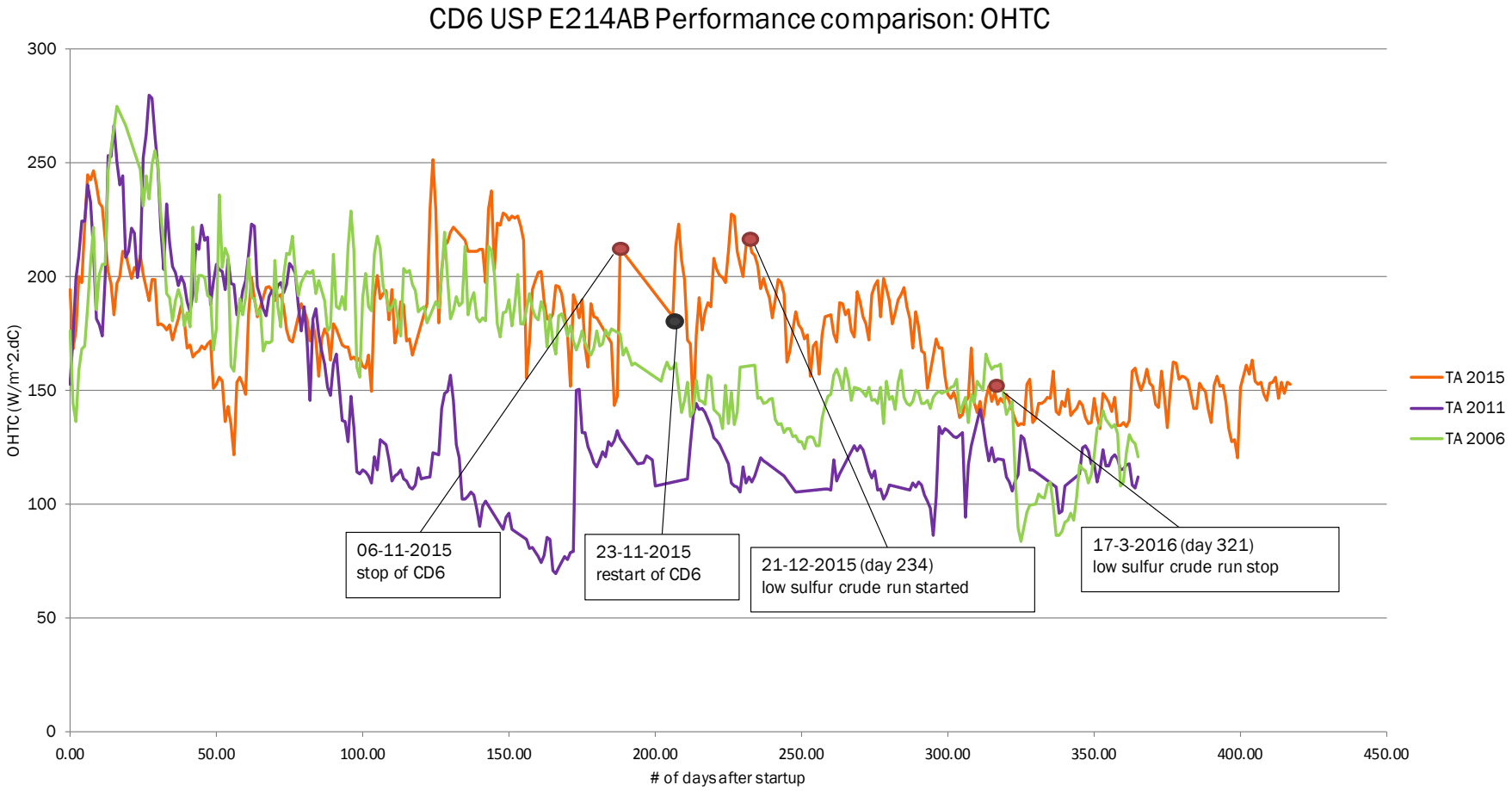
Overall fouling is a leading indicator of performance. The (green) line denotes new bundles put in, 2006. (Fig.1) Captured data reveals an expected fouling curve until 190 days in. By Day-325, operations realize they will need to come off-line for a yearly cleaning, as the unit cannot self-recover. By 2011, the (red) line shows that the residual fouling present in the exchangers is causing the unit to foul much faster, leading to interval chemical cleaning every 60 days. While not shown on this graph, the 2014 operational cycle had the unit coming down for cleaning approximately every 35 days.

USP installed for 2015. Early on, 52 days in, the unit suffered a “burp” in the process that started early, heavy fouling. Because of the USP system, the process bounced back to better performance throughout the year.



E-214AB HEAT TRANSFER COEFFICIENT

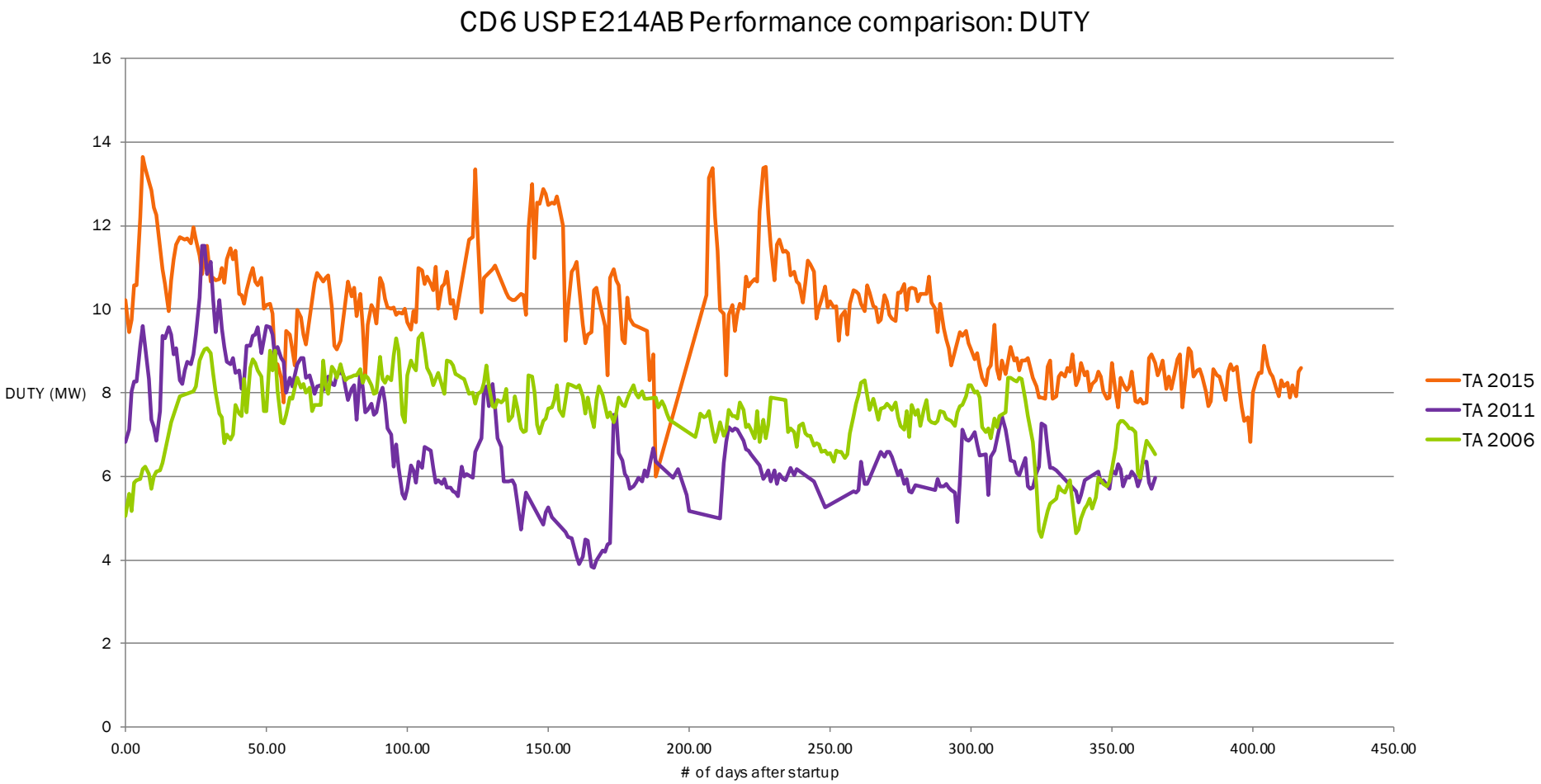
One of the other key metrics for evaluating the technology was the Overall Heat Transfer Coefficient. Given the age of the asset, the 2015 interval as denoted in purple, continued to achieve improved performance over previous years.



Data collected by our refinery partner

E-214AB FURNACE DUTY

As shown in figure 3, adoption of USP has exceeded target Duty of 6MW, allowing this refinery to average 8MW Duty, and avoid all in-situ or mechanical cleaning for the year.



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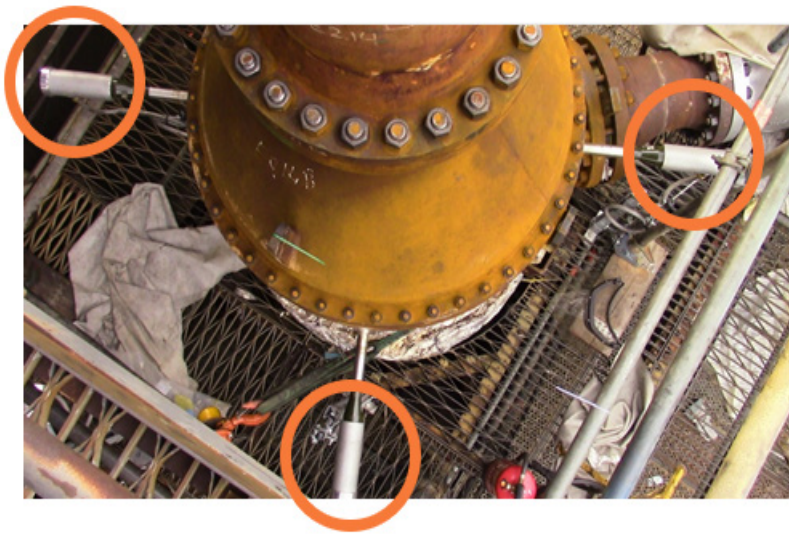
CONCLUSION

A one-time investment of US$280k, outfitted E-214 A/B heat exchangers with the USP Technology. This created an annual energy savings of US$1.4M. Not having to shut down for cleaning throughout the year, allowed for cost-avoidance for mechanical and contracted services of $170K.

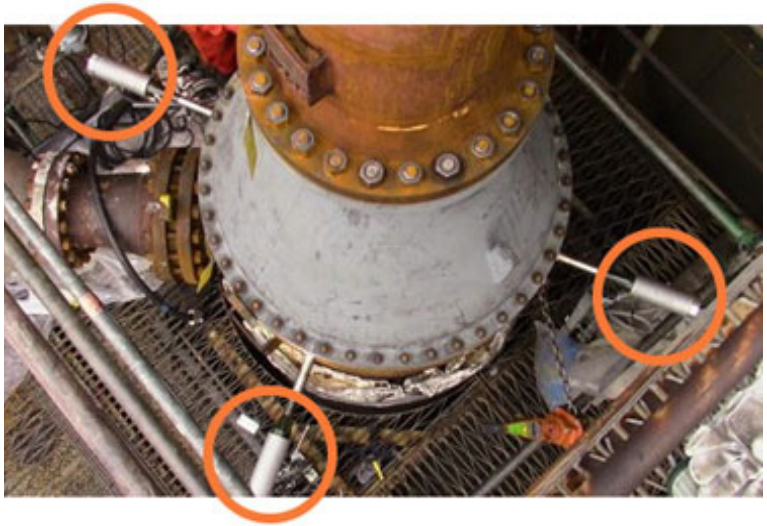
In addition to the annualized savings for both energy recovery and cost-avoidance as stated above, the single, most over-arching benefit of the 2015 operation interval, was the UPTIME gained in opportunity process throughput.

While we are not at liberty to share specific ongoing data, this processing organization continues to benefit from the adoption of this technology to extend processing run-length. With installation of USP in April 2015, this organization has not had to shut this unit down to date, for performance or cleaning related issues.

Is your heat exchanger a candidate for USP Technology? **Visit our website** to get started.



E-214A



E-214B