

Desalter/WWTP Integration Improves Refinery Profitability, Reduces Chemical Costs and Improves Environmental Compliance when Processing Tight Oil Crudes

Challenge

In 2012, an Eastern Canadian refinery began experiencing high influent waste water turbidity caused by elevated levels of oily solids originating from the desalter brine as a result of processing a high-solids crude diet, containing highly profitable shale oil or “tight oil” crude. The high concentration of oily solids in the influent waste water was not being removed effectively in the Waste Water Treatment Plant’s (WWTP) primary treatment unit (Oily Water Separator/DAFs). The poor quality water leaving the primary treatment unit resulted in detrimental effects on the biological treatment unit, issues with final clarification and an oil sheen presenting on the final effluent.

In response to the environmental issues, the plant was forced to reduce the amount of high-solids “tight oil” crudes processed, reducing the refinery’s profitability. Costs related to contingency tertiary treatment (oil booms, vacuum trucks etc.) and waste water sludge dewatering issues compounded the costs incurred by this issue.

Solution

GE assembled a multi-functional team of desalter and waste water technical leaders to study the issue and recommend chemical and operational changes required to improve the desalter brine and final effluent quality while processing all desired crude slates. Extensive bench testing of both desalter and WWTP chemistry were conducted as part of this investigation to select a chemical program that would achieve this goal.

The resulting recommendations from this investigation focused around a new chemical package for both the desalter and WWTP. The new chemical package addressed all of the challenges of processing high-solids; tight oil crude slates and linked the interaction of all of these chemical treatments into a successful overall chemical program. The main recommendations included:

1. Transition of desalter primary emulsion breaker to GE’s Embreak* 2W2030 product to improve brine quality
2. Upgrade of KlarAid* coagulant chemical injection facilities for the DAF to improve chemical dosage control
3. Addition of GE’s PolyFloc* flocculant chemistry to the DAFs
4. Transition from coagulant chemistry to GE’s Novus* flocculant as the final clarification aid

Results

The implementation of the above recommendations has resulted in a number of key improvements in the desalter and WWTP operation that have reduced the variability of the operation relative to solids and oil contamination of water streams. Ultimately, they mitigated the possibility of a repeat of the final effluent quality issues previously experienced including:

1. Reduced frequency of the presence of free oil and oil-coated solids in desalter brine leading to reduced DAF influent turbidity



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- Improved oil/solids flocculation at the DAFs leading to improved contaminant removal and reduced DAF effluent turbidity
- Improved sludge-water separation in the DAF oily sludge holding tank
- Improved final clarifier bed compaction
- Reduced final effluent turbidity
- Reduced chemical usage
- Improved waste water sludge dewatering unit operation relative to chemical flocculation

Many of these improvements can be displayed statistically. Graphs and tables showing these statistical results are presented below:

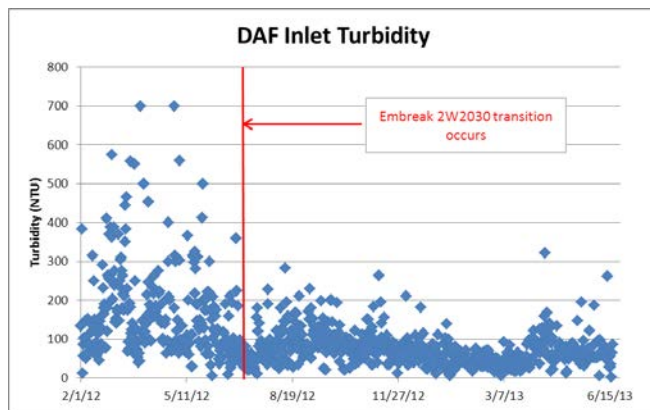


Table 1 - DAF Influent Turbidity (NTU)

	Prior to Transition to Embreak 2W2030	After Transition to Embreak 2W2030
Average	163.38	72.93
Standard Deviation	116.30	43.16

Table 2 - DAF Effluent Turbidity (NTU)

	Coagulant Only	Coagulant and PolyFloc Flocculant
Average	30.49	15.80
Standard Deviation	41.46	11.60

Table 3 - Final Effluent Turbidity (NTU)

	With Coagulant	With Novus Flocculant
Average	6.11	3.29
Standard Deviation	3.36	1.75

Customer Benefits

The above presented results show that a significant operational improvement has been effected by the implementation of the GE-recommended chemistries through integration of the desalter and WWTP performance. The more robust chemical program, coupled with an improved operational rigor and attention to maintenance items within the WWTP has led to a confidence in the customer's ability to process "tough-to-treat" high-solids crudes at both the desalter and WWTP.

More importantly, the changes made have allowed the refiner to run the most profitable crude slates without fear of WWTP effluent discharge issues.

Financial benefits resulting from the improvements are summarized below:

- \$9,100,000/yr increase in profitability from running higher percentages of high-solids tight oil crudes.
- \$1,000,000/yr in savings from eliminating contingencies associated with WWTP final effluent quality issues (i.e. vacuum trucks, oil booms etc.).
- \$1,000,000/yr in savings from eliminating the need for contracted dewatering services to handle excess oily sludge and biosludge inventories.
- \$250,000/yr savings in reduced WWTP chemical costs.