CASE STUDY

Acrylic Acid Antifoulant Delivers ESG Results by Reducing Carbon Footprint, Saving Energy and Increasing Productivity for Asia Pacific Chemical Company

eROI℠ by Ecolab

BACKGROUND

Acrylic acid is prone to polymerize so it needs to be controlled by proper antifoulant during its production process. If not, columns and reboilers are vulnerable to fouling which results in frequent cleaning and unexpected shutdown that can erode productivity and escalate cost. The solvent recovery section has severe fouling problems in this process.

An acrylic acid producer located in Asia Pacific was looking for a better solution with superior performance in polymerization inhibition that is safer to handle. Aside from reliability, the customer aims to reduce carbon footprint, save energy consumption and increase the operation period.

Current commodity antifoulant, hydroquinone (HQ), is dangerous to handle and the powder product can damage an operators' health if they work with it daily. The average operation period of the recovery section is around 40 days even though the plant uses a substantial amount of traditional chemical in their process.

Energy consumption is increased because it's closed to a cleaning schedule due to fouling and loss of efficiency.

Therefore, the alternative of current commodity is key to increasing productivity, optimizing total production cost and improving profitability. Environmentally speaking, the solution can contribute to a reduction in Green House Gas (GHG) emission and water usage.

SOLUTION

While screening chemistries, it is discovered that a newly developed chemistry is a fit for the acrylic acid polymerization (Figure 1). The new program is faster to terminate polymerization and formulate with other functional components. The multifunctional formulation enables control of fouling mechanisms rather than radical polymerization.

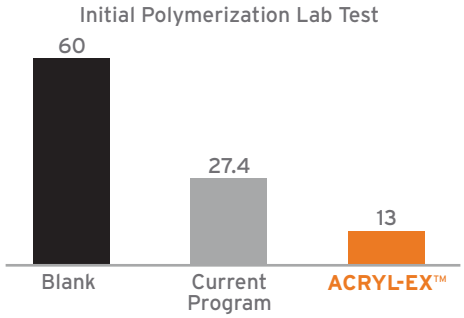

FIGURE 1: Initial lab test result (lower is better for the performance in polymer inhibition)

ANNUAL SAVINGS

ENERGY

Energy savings from stream reduction

1,473,575 kWh

HUMAN HEALTH & SAFETY

Reduced handling of toxic chemicals

1 day to 1/2 day

PRODUCTIVITY

Production increase

$960,000

COSTS

Reduced cleaning costs

$30,000

GREENHOUSE GASES

Lower steam usage resulted in reduction of CO_2 emissions by

372 metric tons

TOTAL VALUE DELIVERED

$990,000

NALCO Water
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The commodity antifoulant is slow to terminate the reaction and therefore required to inject large amounts to prevent polymerization.

In terms of Safety, Health and Environment (SHE), the new program is a liquid product that eliminates any handling issues because it's ready to pump onsite. When injected into the production process, the product fully meets process compatibility and ensures final product quality.

The products are injected into the feed and reflux of the solvent extraction column to effectively control polymerization by mitigating fouling symptoms to ensure reliability, extend run-length, save energy and reduce carbon footprint.

RESULTS

The producer monitors pressure drop and acetic acid concentration in the column. When foulant, including acrylic acid polymer, accumulates in the column the tower pressure is increased and starts to lose the tower's efficiency. The other indication of acrylic acid polymerization inside the column is an inclination of acetic acid concentration. Typically, acetic acid(%) at the bottom is maintained at approximately 800ppm on average but when it's increased and close to 1000ppm they are forced to clean the column.

In the first trial, we ensured no harm to the customer's operation. During the one-month, no harm trial period, the final acrylic acid product specification and other downstream operations were stable without any symptoms of off-specification or issues.

In the next trial, the two combination products are injected to the feed and reflux of the water separation unit. The conventional treatment chemistry is replaced with the ACRYL-EX applications.

As shown in Figure 2, the differential pressure is stable to run over 70 days comparing to the base line operation. In Figure 3, the acetic acid concentration at the bottom of column is maintained on average 260ppm.

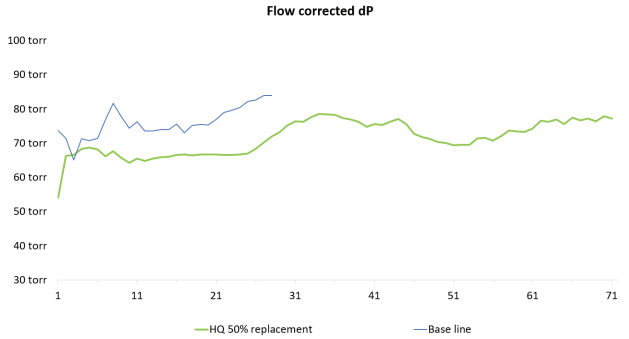

FIGURE 2: Flow corrected differential pressure off water separation unit

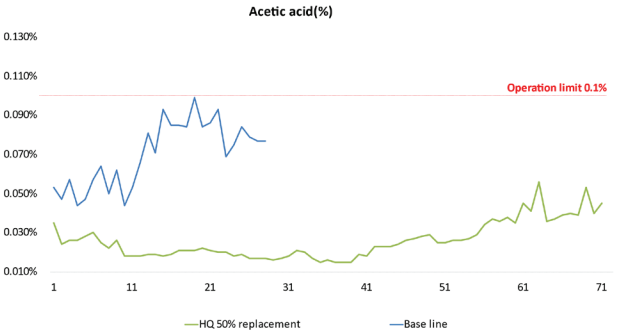

FIGURE 3: Acetic acid (%) at the bottom of water separation unit

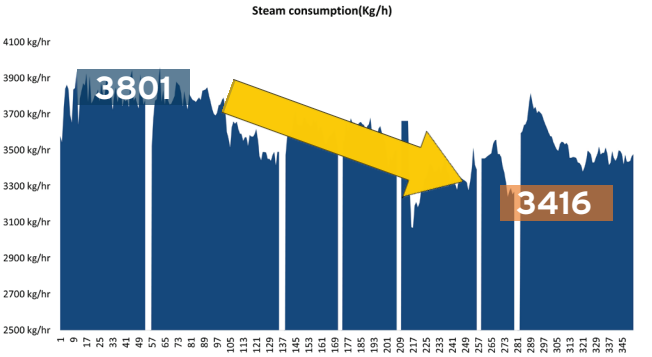

FIGURE 4: Steam consumption rate in the water separation column reboiler

During the column inspection, it is witnessed that the tray surface is much cleaner than before. (Photo 1)

PHOTO 1: Column inspection during turnaround – Blank (left) and ACRYL-EX (right)

With the superior inhibition of polymerization and mitigation of fouling, the column can maintain the efficiency during its operation. As a result, the customer can save steam consumption by 10% and about 1.4M kWh energy as well as reduce carbon dioxide emission by 372.36 metric tonnes, an equivalent of 17,102 trees.

CONCLUSION

During the trial, the ACRYL-EX inhibitor showed better inhibition performance than the commodity in acrylic acid process. With superior polymer inhibition and fouling control, the acrylic acid producers can optimize cost and extend the operational period while reducing downtime and asset maintenance costs associated with column and reboiler cleaning. In addition, the reduction of hydroquinone (HQ) is beneficial to the environment because it eliminates an additional process or chemical needed to treat HQ and reduces potential waste components in the sewers.

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