PROHIB 150 deposit inhibitor enhances evaporators and reduces fouling at biofuels plant

Decreased sulfamic acid & caustic use rates

1. Keywords

Evaporator fouling, dry grind ethanol industry

2. Background

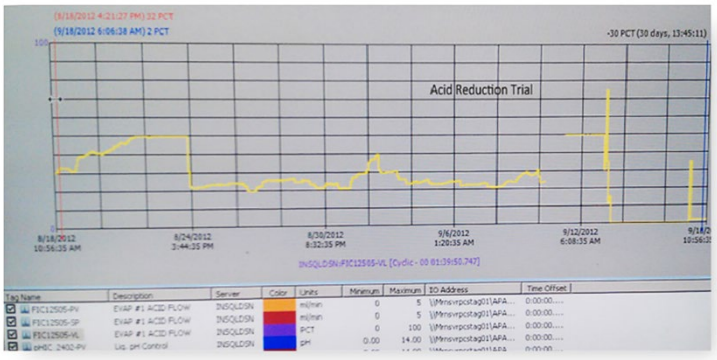
Evaporator fouling is a common issue seen throughout the dry grind ethanol industry. In the evaporation process the concentration of suspended and dissolved solids progressively increase. As a result, viscosity of the film thickens and hot spots develop. This type of fouling is often comprised of both organic and inorganic components and results in excessive acid use, major expenditures in CIP chemicals and manual cleaning.
The Kurita Process Technology team was asked to support production efficiency improvements by the ethanol facility plant management. A performance evaluation was conducted in a 100 MMGPY dry grind fuel ethanol plant where a number of opportunities for higher operational efficiency and better product quality were identified. We determined that during plant downtime for equipment cleaning-in-place (CIP) events, a significant decrease in ethanol and co-product production occurred. In addition, it was evident that the facility not only used large amount of chemistry during CIP events but also used periodic injections of sulfuric acid to temporarily improve performance to delay CIP. These actions significantly increased chemical cost. Lower heat transfer efficiencies were observed, as indicated by increased evaporator pressures, decreased condensate flows and increased steam use energy costs. Lastly, co-product quality and consistency was poor. Syrup lines to storage and dryers suffered from deposits that limited flow. As a result, the distillers' wet grains (DWG) and modified dried distillers' grains (DDG) had inconsistent nutritive composition and discoloration from overheating. Corn oil capture rates fluctuated with evaporator efficiency.

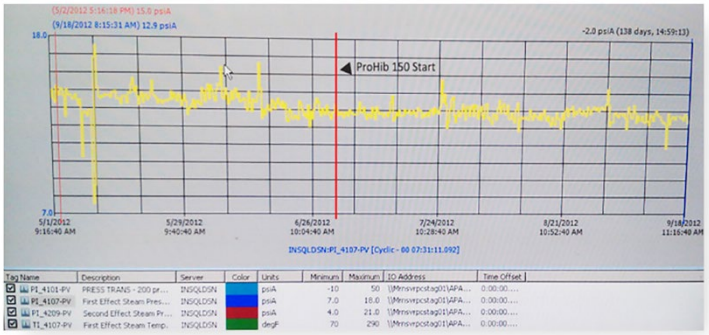
3. Action/Approach

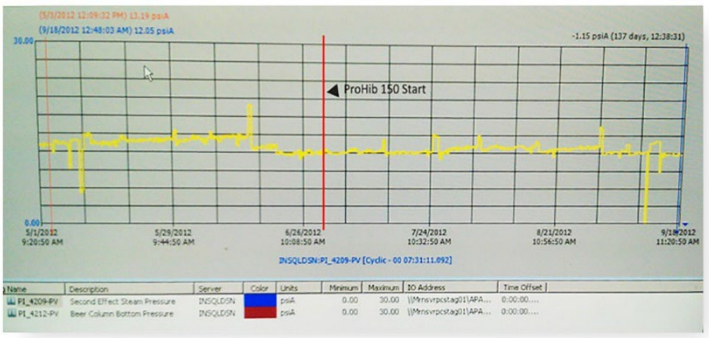
Kurita's Process Technology team conducted an extensive process audit collecting a library of samples for analysis from numerous facilities to determine the nature of the fouling. This data was also cross-referenced with operational data including distributed control system (DCS) and fermentation Historian data.
From the extensive evaporator deposit sample database, we developed a process deposit inhibitor – ProHib 150. ProHib 150 is a proprietary liquid deposit inhibitor to be fed to certain plant-dependent points in the evaporator unit operation to address process issues from deposit formation. Our research team developed a specific chemical formulation in ProHib 150 that, during the trial, neutralized fouling tendencies.
The trial was accomplished by monitoring first and second effect steam chest pressures, in partnership with the plant, aiming to reduce or have a zero slope increase in the DCS trend lines over time. To validate the study, the Kurita team assisted with evaporator inspections after the CIP process. We photographed and studied internal distribution equipment and the number of plugged tubes. Our team also targeted reduced CIP requirements and quantified over time utilizing the two criteria: DCS tracking and visual inspections. The syrup pump performance was targeted with the criteria of valve position, pressure or pump speed over time. We then performed syrup line inspections during shutdowns and compared this to conditions prior to the application of the ProHib program. The reduction in sulfuric acid requirement due to ProHib 150's impact was successfully documented.

4. Achievements

From implementing Kurita's ProHib technology, fouling in evaporators was greatly reduced resulting in lower and consistent steam chest pressures, as seen to the right. The evaporator heat transfer surfaces returned to optimal condition and the facility realizes an annual cost savings of 114,000€.
ProHib 150 reduced the number of CIP events for evaporators per year, significantly reducing major expenditures in CIP chemicals. With this, acid and caustic use rates decreased resulting in a positive impact on the plant water balance. From reducing acid use residual sulfate concentrations in co-product was also lowered, thereby improving the co-product quality. Consistent evaporator operation created greater and more predictable oil production strengthening the facility's bottom line.
As an innovator in the biofuels industry, Kurita consistently delivers new and groundbreaking technology designed to keep customers competitive. Our proven experience and thorough understanding of the dry grind ethanol industry allowed us to engineer a completely customized solution that solved this facility's challenging water, process and energy needs.







5. Conclusions

ProHib 150 controls fouling in evaporator, resulting in lower, consistent, steam chest pressures which in turn resulted in reduced sulfate concentrations in the co-product. ProHib 150 reduces CIP frequency, decreasing sulfamic acid & caustic use rates. It helped the plant to realize ongoing cost savings of 114k€ annually.

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