CASE STUDY

think simulation | getting the chemistry right

Biofuel Production | **Stream Analysis**

Improving the Sustainability of Biofuel Production with Water Chemistry Analysis

FLINT HILLS resources®

OLI Systems has worked with Flint Hills Resources for the past eight years to enhance refining applications. Due to their joint success in this industry, Flint Hills Resources invoked the help of OLI Systems software and technical experts to help resolve an extremely corrosive environment at one of their biofuels sites. Utilizing state-of-the-art modeling capabilities and rigorous water chemistry analysis, the company was able to find an accurate and immediate solution.

Industry Trends

Creating a productive operating environment

Corrosion mitigation is a pressing issue for a wide range of industries. Particularly in the biofuels sector, operating environments can develop highly corrosive qualities that affect equipment, storage tanks, pipelines, and more. As these materials break down, the potential for leaks, reduced production, and risk of failure increases. Biofuel production has processes which can be more corrosive than traditional fuel refining processes, placing these facilities at even greater risk.

Today, biofuels producers are seeking new and more effective ways to pinpoint areas of corrosion, its specific causes, and timely resolutions—and more importantly, to predict issues before they occur. The ability to identify and understand the behavior of corrosive contaminants is essential to protecting materials and maintaining a safe, sustainable production environment.

Business Challenge

Ensuring sustainable processes

Flint Hills Resources operates in the Refining, Petrochemical, and Biofuels industries, producing a diverse range of fuels and ingredients for many household goods. In addition to producing high-quality products, Flint Hills Resources has led refining and manufacturing sectors in reducing air emissions for the past 60 years. Since 1997, their commitment to cleaner operations and collaboration with the Environmental Protection Agency has enabled them to reduce emissions by 70 percent.

Flints Hills Resources encountered an operational issue at one of their biofuels sites. Shortly after implementing a new biofuels process, they experienced extremely high corrosion rates—reaching 1.5 inches per year. The corrosion was concentrated on the reboiler loop of a methanol dryer column with carbon steel effluent piping. According to Mike Cayard, Corrosion & Materials Leader – Operations Excellence at Flint Hills Resources, the aggressiveness of the environment was unexpected, and the corrosion was some of the worst he had experienced in his career.

The internal business team requested assistance from the Flint Hills Resources Corporate Group to assist in identifying the cause of the corrosion as well as other susceptible areas within the process; however, finding methods to quickly predict, prevent, and resolve water chemistry issues was challenging. With no benchmarks and minimal literature available on the topic, the company was unable to gain immediate insight into the corrosiveness of the environment. Due to the severity of the issue, it was imperative to find a successful and immediate solution.

Approach

Harnessing field data for precision insight

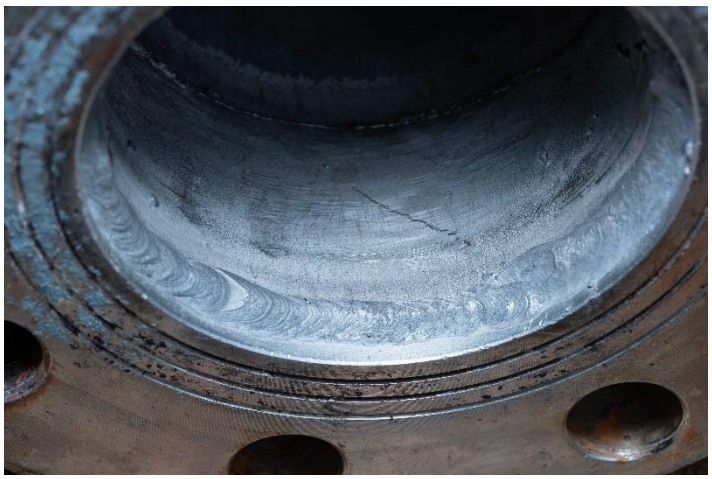
To answer these pressing questions, Flint Hills Resources contracted the help of OLI Systems software and technical support experts. The company had worked with OLI Systems for refining applications and felt confident in utilizing their modeling software to analyze the chemical behavior and corrosivity of the environment. Additionally, they planned to use OLI Systems simulation technology to identify the corrosive species affecting the carbon steel and obtain accurate estimates of the corrosion rates occurring in the field.

Solution

Leveraging simulation technology to fuel success

To overcome this issue, Flint Hills Resources first challenged field engineers to collect samples and send them to the lab for detailed analysis. Once data was extracted from the samples, they input the information into the OLI model. In the interim, the team gathered information on the extent of the corrosion and affected areas, and once the analyses were complete, they employed the OLI Stream Analyzer to create the stream.

Flint Hill Resources also gathered a number of pH sample measurements—from the reboiler bottoms and methanol column bottoms—to compare against the OLI thermodynamic model. This allowed them to estimate the pH range of the operating environment. Once the model determined these atmospheric conditions, the company elevated temperatures and pressures to calculate corrosion rates at various locations.



The OLI model was also used to simulate the effectiveness of films formed on the carbon steel pipes. The team conducted shear stress modeling on the 10” and 12” piping to evaluate the ability of different films to mitigate corrosion as well as the impact of shear stress on corrosion rates. The OLI model predicted that protectiveness of the corrosion films in this environment was poor, and instead of protecting the pipes, the films were loose and easily removed by the flowing stream—which was also confirmed in the field.

The OLI data bank played a critical role in the analysis of these water samples. Flint Hills Resources reported that having numerous chemistries at their fingertips enabled them to simulate the environment with precision. With the help of OLI Systems experts, the team utilized the extensive data bank to find the right chemical species to mimic their operating environment. As a result, they found that light organic acids in the environment were highly corrosive to carbon steel at their process conditions.

> "The OLI simulation package is a valuable tool in a corrosion engineer's toolbelt. OLI Systems' state-of-the-art technology and technical support gave us the confidence to effectively tackle our problem and quickly reach a solution."

Mike Cayard
Corrosion & Materials Leader – Operations Excellence, Flint Hills Resources

OLI Systems improves safety and reliability

Employing stream analysis in conjunction with the OLI data bank empowered Flint Hills Resources to gain rapid insight into corrosive constituents and changes in concentration over time. Identifying the reactive contaminants helped the company understand the adverse effects of low pH levels on carbon steel and determine the best solution. As a result, Flint Hills Resources upgraded their materials to stainless steel, which experiences less than 2 mils of corrosion per year.

Direct benefits of this approach:

- Improved safety and environmental measures
- Reduced timeline to provide a workable solution
- Targeted inspection of at-risk areas
- Identified suitable alloy candidates for upgrades over carbon steel
- Enhanced process availability and protected production targets
- Predicted the use of caustic to raise pH and minimize the number of alloy upgrades

The project took approximately three weeks to complete, from discovery to solution implementation. Flint Hills Resources projected that without the help of OLI software tools, their timeline would have at least doubled due to testing by trial and error and excessive follow-up inspections.

According to Cayard, chemistry modeling is a challenging, new area for their company: "The OLI simulation package is a valuable tool in a corrosion engineer's toolbelt. OLI Systems' state-of-the-art technology and technical support gave us the confidence to tackle our problem and quickly reach a solution."