

## Downstream Oil &amp; Gas

## Corrosion Analysis



## Mitigating Corrosion in Refining Operations with Rigorous Thermodynamic Models

OLI Systems has worked with Athlon, a Halliburton Service, for several years, stemming from our joint involvement in the Chemistry in Refining Overheads Consortium. The project was designed to address the formation of amine hydrochloride salt deposits, a major cause of overhead corrosion. OLI Systems operationalized these insights by developing model parameters to quickly and accurately identify corrosion issues and recommend solutions, enabling Athlon to help refining customers mitigate ongoing corrosion issues.





## Industry Trends

### Optimizing performance for increased yield

Corrosion is a persistent and complex problem in the crude oil refining industry. As materials, equipment, and labor become increasingly expensive, there is a growing urgency to optimize productivity and mitigate corrosion issues. To achieve this, today's refining companies are striving to better understand corrosive elements, calculate their effects on equipment and industrial operations, and determine preventative actions to minimize the effects.

The understanding of the causes of corrosion has evolved rapidly over the past decade; however, accurately predicting and mitigating corrosion poses a massive challenge for companies who lack the water chemistry expertise to enhance their processes.

## Business Challenge

### Advancing refinery efficiency and reliability

Athlon provides industrial water, process, and finished fuel additive treatments to companies in the Refining, Petrochemical, Fertilizer, and Power industries, as well as contract manufacturing of specialty chemicals. For 50 years, Athlon has empowered customers to enhance their industrial operations through mechanical change, operational change, and specialty chemical applications.

In this study, Athlon assisted a refining company who was struggling with ongoing corrosion in their atmospheric crude column and top pumparound. The crude column separates crude oil into its various factions (mixtures of hydrocarbons with similar boiling points). This particular crude column operated with a cooler overhead temperature. During the fractionation process, amines reacted with hydrochloric acid from the desalted crude while ascending the column. The reaction resulted in the formation of corrosive amine hydrochloride salts, which built up in high concentrations inside the equipment. The growing deposit of salts led to increasing under-deposit corrosion and fouling of the crude column and top pumparound. As a result, the refining company experienced reduced crude oil throughput and the escalating risk of damaged equipment.

### Leveraging analysis to drive productivity

To resolve these issues, Athlon used OLI Systems software to build a base case model from their existing operating information. The base case model enabled Athlon engineers to identify and predict the impact of corrosion-causing amine contaminants as well as operational practices exacerbating salt formation. Athlon anticipated that utilizing the data-driven model would allow them to predict the impact of various step changes to the refinery, actively monitor improvements, and confirm the impact of step changes against the base case model.

The goal was to leverage analyses from process streams in conjunction with inputted data to provide recommendations to the refinery and deliver measurable results—from a reduction of various contaminants, to greater operational performance and reliability.



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**Rusty Strong**  
Senior Technical Services Manager  
Athlon, a Halliburton Service

### Modeling process streams for precision insight

Athlon employed the OLI MSE Framework (a component of the OLI MSE-SRK Thermodynamic Model) to analyze process streams in order to predict the chemical behavior of a range of amine concentrations. The MSE calculates water chemistry speciation by analyzing a number of factors:

- Electrical conductivity
- Viscosity
- Self-diffusivity
- Thermal conductivity
- Surface tension
- Interfacial tension
- Dielectric constants

The software enabled Athlon to analyze extractions of hydrocarbon streams to rapidly determine the corrosion risk in different areas. They began by sampling the system, detecting the presence of different ionic species and inputting collected data into the OLI MSE.

*Solution continued*

Modeling process conditions helped engineers understand the differences between water dew point, ionic dew point, and salt point throughout the refinery system. OLI Systems has expanded the application of these measurements by allowing companies to calculate them simultaneously, in addition to considering multiple acids and amines at one time. According to Rusty Strong, Senior Technical Services Manager at Athlon, the “OLI MSE easily demonstrates how varying process conditions and neutralizing compounds will affect water behaviors, and how to interpret their relationship—information which is key to predict and mitigate corrosion.”

Utilizing OLI Systems software, Athlon quickly and accurately identified corrosion issues in the crude column and top pumparound and made recommendations for the refinery to resolve the issues. As step changes were made in the field, Athlon was able to establish a baseline with modeling, make operational changes in the field, recalculate the model, and measure the impact of the operational changes.

## Results

“The flexibility of the model and technical support OLI Systems provides are innovative and give us a great technical tool to support our customers.”

**Kathleen Wills**  
Technical Advisor  
Athlon, a Halliburton Service



## OLI Systems drives risk prediction and prevention

The implementation of the OLI MSE allowed engineers to correctly identify areas of concern. Once recommended step changes were made, a significant reduction in corrosion rate was measured in the top pumparound, decreasing from 16 mpy to 4 mpy. This vast improvement not only transformed the reliability of the system, but it also increased the overall performance of the refinery to drive productivity and competitive advantage.

According to Kathleen Wills, Technical Advisor at Athlon, OLI Systems is a go-to source for comprehensive industry solutions: “Athlon has worked with OLI software for several years now, and OLI software helps us provide better engineering and technical support for our customers. It helps us identify risk areas in refinery process streams, monitor their ongoing operations, and also measure any step change improvements that we’re able to make through chemical or operational changes. The flexibility of the model and technical support OLI Systems provides are innovative and give us a great technical tool to support our customers.”

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