DOW Oil & Gas

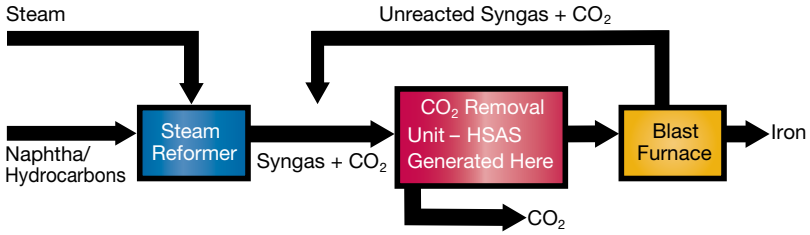
Krakatau Steel Mitigates Corrosion, Improves Amine Unit Capacity through the AMINE MANAGEMENT℠ Program

The Challenge

Krakatau Steel – located at Cilegon, west of Java Island, Indonesia – was looking for an efficient treatment solution for a carbon dioxide (CO_2) removal unit in its iron ore reduction plant. Corrosion is particularly problematic in these plants, as the generation of solid corrosion byproducts can increase the potential for foaming. If corrosion rates are left unchecked, leaks may result, forcing the operator to shut down the plant to make costly and time-consuming repairs.

The purification of iron from iron ore takes place when the ore reacts with carbon monoxide (CO) in a blast furnace to produce pure iron. CO is obtained from a steam reformer in the form of a syngas, which contains a rich mixture of CO and hydrogen (H_2). Syngas mixtures typically contain high concentrations of CO_2, a contaminant that must be removed prior to the reduction process in the blast furnace.

Figure 1: Simplified Flow Diagram for an Iron Ore Reduction Plant



Krakatau Steel's removal unit includes:

- Two CO_2 absorbers and one regenerator
- Amine-to-vapor flow rate (L/V) ratio of 1.68 kg/Nm^3, with 11 mol% of CO_2 in the feedgas
- Required treated gas CO_2 concentration of less than 1.5 mol% of CO_2

The removal of CO_2 typically occurs in reaction with an amine in a removal unit, upstream of the blast furnace, where CO_2 is reduced to concentrations less than 1.5 mol%. The CO present in the feed stream will react with water to yield formate salts, commonly known as heat-stable amine salts (HSAS).

These HSAS will not regenerate under normal unit operating conditions; instead, they will continuously recycle through with the amine solution in the unit. Their presence – even at concentrations of 2 mol% – will severely hinder the performance of the CO_2 removal unit, and the overall plant, by:

- Reducing the active amine concentration
- Increasing circulation rates
- Increasing energy usage
- Increasing the potential for corrosion

The Solution

Krakatau Steel selected Dow Oil & Gas to help it manage HSAS in this unit. The decision was based on a nearly 20-year working relationship with Dow, in which Krakatau Steel applied UCARSOL™ solvents to successfully keep its existing CO_2 removal units running efficiently. UCARSOL solvents are formulated methyl diethanolamine (MDEA)-based solvent packages that have been used in more than 250 units in the Asia-Pacific region, and more than 1,000 units worldwide.

For Krakatau Steel, Dow applied the AMINE MANAGEMENT℠ Program, a comprehensive service program for gas treating amine systems that aims to achieve environmental compliance while improving reliability, reducing energy costs and preserving asset integrity. Based on Krakatau Steel's on-site conditions, Dow selected ion exchange technology coupled with the UCARSOL Neutralizer solvent for removing the HSAS from the CO_2 removal unit. This process employs resin to extract the salt from the amine solution into an aqueous brine solution, a process that has proved to provide very low residual salt levels with a rapid reaction time.

The Result

Since implementing the AMINE MANAGEMENT℠ Program, Krakatau Steel has successfully kept HSAS content under tight control and well within operational limits. The ion exchange equipment has been running at optimal efficiency, and the overall plant is running at its maximum capacity.

Comprehensive Services, Customized for Krakatau

Dow combined many services to form the backbone of the AMINE MANAGEMENT℠ Program for Krakatau Steel, including:

- **Computer simulations of the amine system, using data collected from the unit.** By comparing real-world data with simulation data that suggest how the unit should actually be performing, Dow offered solutions that quickly optimized the CO_2 removal unit and improved overall plant efficiency.
- **An initial survey of the amine system, with ongoing monitoring.** Whether using one ton or 1,000 tons of UCARSOL™ solvent per year, the AMINE MANAGEMENT℠ Program provides the same level of service. Dow collects samples from Krakatau Steel's amine treatment system at least once per quarter and analyzes them to ensure the quality of the solvent is maintained throughout the treatment cycle. Unlike other solvent suppliers, who might take six to nine months to analyze samples and report their findings, Dow can report back in a matter of weeks. Ultimately, this helps ensure that the plant can be more quickly optimized to reduce amine consumption, corrosion and contaminant build-up.
- **Start-up support, training and ongoing optimization recommendations.** As part of the AMINE MANAGEMENT Program, Krakatau Steel's technicians and engineers received training on properly applying UCARSOL solvent to help avoid unnecessary outages. Dow also provided start-up support in the implementation of the ion exchange/UCARSOL system. As long as UCARSOL solvent is used, this training is provided at no cost.
- **A nimble supply chain.** Dow's robust supply chain ensures that Krakatau Steel receives quality product on time. Dow has exclusive arrangements with regional third parties that will store UCARSOL solvents on a continual basis. Dow is also increasing its supply chain infrastructure by building additional UCARSOL solvent manufacturing and storage facilities in the Asia-Pacific region. Rather than waiting for as long as 10 weeks for solvent to arrive from the U.S., Krakatau Steel receives shipments in as little as three weeks.

To Learn More...

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