CASE STUDY
CH-1911

ARSENAL™ Antifoulant Program Brings Ethylene Plant Caustic Tower Under Control

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BACKGROUND

A fundamental process for petrochemicals production is steam cracking, which produces many desirable products such as ethylene, propylene, and butadiene that are the building blocks of the petrochemical industry. However, undesirable side reactions result in impurities in the cracked gas that can have deleterious effects on plant operation, even when existing in concentrations of only a few parts per million.

One such reactive byproduct is acetaldehyde. Formed in the furnaces, acetaldehyde travels with the cracked gas through the various processes areas. In the caustic tower, acetaldehyde is absorbed into the caustic along with the acid gases CO_2 and H_2S that the caustic tower is designed to neutralize. Under basic conditions, acetaldehyde can polymerize via an aldol condensation reaction.

The resulting aldol polymer can cause in fouling in the caustic tower and downstream equipment used to separate and process the spent caustic with potentially severe economic consequences including lost production due to reduced throughput, off-spec ethylene product due to CO_2 and H_2S contamination, increased cleaning costs and equipment turnaround time, and increased workload in the charge gas compressor due to back pressure from the fouled system.

To improve reliability, increase ethylene production, and reduce total cost of operation in the acid gas removal area, the Nalco Water ARSENAL program provides several options for inhibiting the formation and deposition of this polymer. Depending on the specific fouling location and severity in a particular caustic tower, the most cost-effective approach might be to inhibit the formation of aldol polymer altogether, disperse the polymer to prevent its agglomeration and deposition, or some combination of both approaches. In some cases, foaming or emulsions of pygas and caustic can cause further negative impacts on plant, the ARSENAL program also includes solutions for these problems.

VALUE DELIVERED

PRODUCTIVITY

100%

Differential pressure recovery

TOTAL VALUE DELIVERED

>$20M

Premature shutdown avoidance

The Nalco Water ARSENAL utilizes a variety of approaches based on the specific needs of each plant.

A North American ethylene producer began to experience high differential pressures across both the strong and weak sections of their caustic tower. The tower was being treated with a competitive antifoulant program that appeared ineffective at controlling fouling in the tower. The ΔP increased to the point where a plant shutdown was eminent to clean the caustic tower and restore performance.

In an attempt to combat the fouling and delay the shutdown, a series of pygas washes were employed. While showing some success in slowing the deposition of polymer and even some recovery in tower performance, the high levels of pygas caused severe emulsions, liquid holdup in the tower, and subsequent carryover of caustic to the next stage of the charge gas compressor. Even with the pygas washes, not all of the lost tower ΔP was recovered.

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SOLUTION

Nalco Water was asked by the customer to provide an alternative program to control the fouling in the caustic tower. After performing a survey of the system to include Mechanical, Operational, and Chemical aspects of unit operation, a thorough analysis of foulant material and spent caustic was developed.

Based on the results of the survey and the laboratory analysis, a multi-component ARSENAL program was proposed:

- Addition of the latest ARSENAL aldehyde scavenger, to inhibit polymer formation;
- Use of an ARSENAL dispersant, to remove foulant material and recover performance;
- Injection of an ARSENAL antipolymerant, to inhibit free radical polymerization;
- Application of an ARSENAL antifoam to minimize caustic carryover to the compressor.

Additionally, the volume and frequency of pygas washes were reduced, to lessen the impact of caustic/hydrocarbon emulsions in the spent caustic system. The ARSENAL dispersant addition was discontinued once maximum Pressure Differential recovery was achieved.

RESULTS

As shown in Figure 1, the tower differential pressure began to drop upon implementation of the Nalco Water recommendations. The tower's performance continued to improve until nearly all of the original ΔP loss had been reversed.

CONCLUSION

Working with the customer, Nalco Water was able to use market-leading experience treating caustic towers to provide a multi-component approach using a combination of antifoulants and antifoam to slow fouling in the system, recover performance, protect downstream equipment, remove a plant throughput restriction, and avert a unit shutdown.

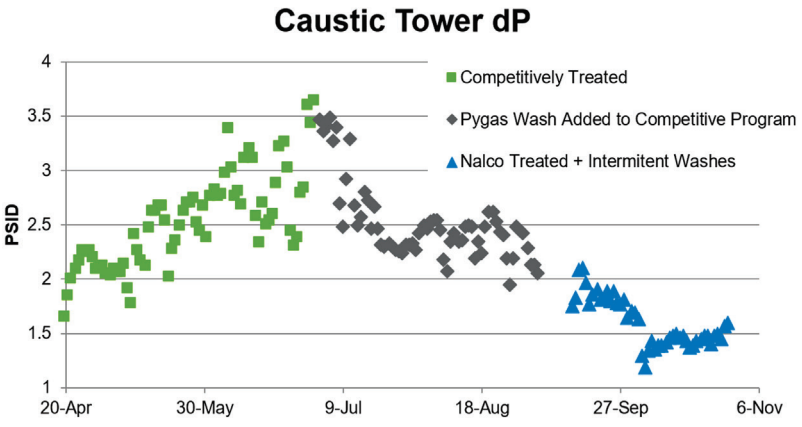

FIGURE 1: CAUSTIC TOWER DIFFERENTIAL PRESSURE

Nalco Water, an Ecolab Company
Downstream: 11177 S. Stadium Drive, Bldg 31, • Sugar Land, TX 77478
North America: 1601 West Diehl Road • Naperville, Illinois 60563 • USA
Europe: Richtistrasse 7 • 8304 Wallisellen • Switzerland
Asia Pacific: 52 Jurong Gateway Road • #16-01 Jem Office Tower • Singapore 608550
Greater China: 18G • Lane 168 • Da Du He Road • Shanghai China • 200062
Latin America: Av. Francisco Matarazzo • nº 1350 • Sao Paulo – SP Brazil • CEP: 05001-100
Middle East and Africa: Street 1010, Near Container Terminal 3, Jebel Ali Free Zone, PO BOX 262015, Dubai UAE

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