

ARSENAL™ Aldehyde Scavenger Reduces Carbonyl Levels in Crude C4 Streams



VALUE DELIVERED

COSTS

15%
Reduction in carbonyls yielded lower overall cost

BACKGROUND

Butadiene is an important co-product of ethylene production. The overhead product stream from the debutanizer - commonly known as "crude C4s", "mixed C4s", "crude butadiene", or "crude BD" - is used as a feedstock for butadiene extraction units. In addition to butadiene, the stream contains various other components such as butane, butenes, ethyl and vinyl acetylene, and carbonyls. Carbonyls, a by-product of ethylene production, are known to cause problems in the butadiene extraction process; thus, most butadiene processors specify a maximum allowable carbonyl concentration on the crude C4 streams they purchase. Many ethylene producers experience difficulty meeting this specification.

The consequences of high carbonyls can include blending of on- and off-spec product to meet the specification, selling the C4s at a reduced price, recycling the C4 stream to use as an ethylene feedstock, or reducing ethylene plant throughput.

Thus, effectively reducing the carbonyl concentration in crude C4s can have a significant impact on plant profitability. Acetaldehyde, the main source of

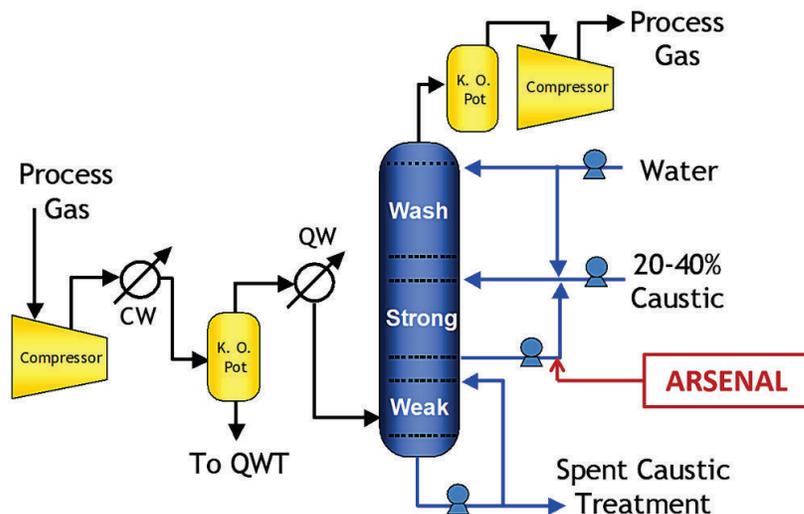
carbonyls in crude C4s, is produced in the ethylene furnaces and travels through the unit with the cracked gas. Most of the acetaldehyde is removed in the caustic tower through absorption into the caustic along with acid gases such as CO₂ and H₂S; many ethylene producers optimize caustic tower operation to maximize acetaldehyde removal.

In the caustic tower, the absorbed acetaldehyde polymerizes, resulting in fouling that can cause significant negative impacts on reliability and throughput in many ethylene plants. The Nalco Water ARSENAL program provides several options for inhibiting the formation and deposition of this polymer.

The carbonyls thus pose an issue regardless of their disposition: in the crude C4s, they are a product

contaminant; in the caustic tower, they are a potential foulant. ARSENAL programs can help improve plant performance in both areas.

A North American ethylene producer was experiencing high carbonyls in their debutanizer overhead product, making it difficult for them to meet the carbonyl specification in their mixed C4s. The producer responded by adjusting the temperatures and circulation rates in the caustic tower, but was still unable to reduce the acetaldehyde concentration enough to meet the maximum concentration specified by their downstream customer. Fouling in the caustic tower was not an issue at this location as a Nalco Water ARSENAL aldol polymer inhibitor was being used.



SOLUTION

Nalco Water was asked by the customer to provide a chemical solution to the carbonyl problem. A system survey and site audit were performed, considering Mechanical, Operational, and Chemical aspects of the operation of the unit. The result of the audit was a package of further recommendations for optimizing the caustic tower operation and a chemical recommendation. The original approach utilized a two aldehyde scavenger program, however, plant data showed that the new ARSENAL aldehyde scavenger was 15% more effective than the second scavenger at reducing carbonyls in the crude C4. Over time, the program was switched entirely to the new scavenger resulting in better carbonyl control in the crude C4s and lower overall cost.

RESULTS

Upon addition of aldehyde scavenger to the caustic tower, a reduction in carbonyls in the mixed C4 product was observed, as desired. As the temperature at which the caustic tower is operated impacts the absorption of acetaldehyde, the operational recommendations included lowering the tower temperature. Figure 1, below, shows the relationship between the dosage rate of aldehyde scavenger and the resulting concentration of carbonyls in the crude C4 stream at a constant temperature of 90°F.

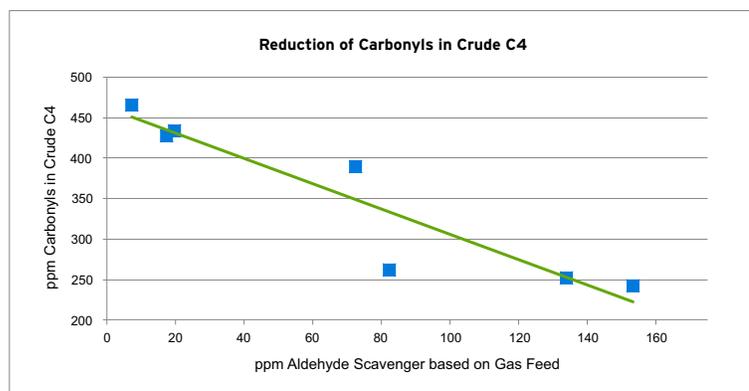


FIGURE 1: INHIBITOR IMPACT ON CARBONYL CONCENTRATION AT 90°F.

Addition of ARSENAL aldehyde scavenger resulted in a 15% reduction of carbonyls at constant temperature, while fouling control in the caustic scrubber was maintained.

CONCLUSION

Working with the customer, Nalco Water was able to use market-leading experience treating caustic towers to provide an innovative approach to a downstream problem. Use of the ARSENAL aldehyde scavenger was able to reduce the carbonyl concentration in the crude C4s, thus helping the customer meet a difficult but important product specification, while controlling fouling in the caustic tower.

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