Question 27: What is your experience with chemical treatment to reduce furnace coking?

MICHAEL KIMBRELL (Becht Engineering)

For conventional fouling, which is the result of asphaltene destabilization due to temperature, chemical treatment programs have not been effective for Coker heaters. For premature asphaltene precipitation due to resid compatibility concerns, chemical treatment programs have been effective in reducing or eliminating fouling. These applications are very crude dependent, so they take continuous adjustment.

BRANDON PAYNE (SUEZ Water Technologies & Solutions)

Prior the introduction of tight-oils, crude furnace fouling was not a high priority in the industry because the fouling in these furnaces was typically not the limiting factor in the crude unit. The introduction of tight oils brought about an immediate and significant change to the severity of fouling observed in the furnaces, especially in facilities that processed the various forms of Eagle Ford crudes. The incompatibility and solids loading of these crudes coupled with the normal higher heat fluxes in atmospheric furnaces, resulted with high furnace fouling. The degree of fouling necessitated the drastic adjustment of the cleaning frequencies on certain crude furnaces from every few years to every 2-6 months. In response to these substantial operating paradigm shifts, an enhanced chemical treatment of these furnaces was developed which incorporated a multifunctional approach utilizing conventional dispersant chemistries or a combination of conventional dispersants, catalytic coke inhibitors and/or polymerization inhibitors. However, none of these approaches provided enough benefit to support long-term use of the programs.

Additional research from chemical treatment specialists into this furnace fouling challenge have yielded solutions that provided excellent fouling reductions (50-95% reduction) in laboratory testing across multiple crude blends from various sources and lots. The chemistry is a coke precursor suppressant with dispersant properties which is designed to inhibit the formation of coke and disperse existing particles. The coke precursor is a surface sacrificing agent that interacts with the coke precursor and “catalysts” that may be present in the fluid preventing them from interacting with one another and creating a repulsion.

The introduction of a new chemistry into the marketplace is one aspect of the comprehensive treatment program. Furthermore, the development of rapid analytical techniques, such as CrudePLUS* FPX from SUEZ Water Technologies & Solutions, to identify the variability in fouling potential and root-causes has provided an avenue to implement quantitative input of crude fouling quality to operating models enabling a much more proactive response to feed and or system changes.

It is also noteworthy to say that furnace optimization is an important aspect of controlling the rate of coking in the furnaces. The optimization includes burner maintenance, flame distribution, pass

balances, etc.

Coker Furnace:

Chemical treatment of coker furnaces has long been a substantial challenge for the industry. This difficulty is not because efficacious chemical treatment programs do not exist, but instead due to the frequent loss of the return on investment because the unit operational disruptions for non-fouling related reasons. Power failures, drum switching issues, and a host of other unexpected unit operational issues can immediately eliminate any benefits that were realized over the duration of the chemical treatment program. Due to the severity of the fouling experienced in the coker unit, these programs can be costly. Therefore, ensuring that the benefits of the program can be preserved by not having other bottlenecks that bring the unit down is critical. If the unit stability is preserved and the furnace fouling is truly the limiting factor, then multifunctional treatment programs that extend run lengths can be effective and beneficial in these systems.

DENNIS HAYNES (Nalco Champion)

There are several chemical methods available to reduce furnace coking. The inhibitor chosen would depend on the coking mechanism and furnace severity. The types of fouling reduction chemistries are coke suppressants, asphaltene dispersants, and surface passivators. The program chosen should be selected based on an analysis of the fouling deposit and mechanism.

RICHARD TODD (Norton Engineering)

Various additives have been proposed to reduce furnace coil coking over the years. Some have shown limited improvements and others have shown the opposite. Due to the myriad variables effecting coking rates it is difficult to tell if, in general, additives have had positive or negative results. Most coking incidents are the result of localized conditions in a coil which initiate internal surface fouling such as: (1) flame impingement, (2) loss or significant curtailment of coil flow, (3) changes in feed asphaltenes without changes in coil operating conditions, (4) unstable coil flow regimes, (5) subcooled boiling, and (6) combinations of the above.

The most promising additives to control coking rates are most likely those which passivate and change the morphology of the internal tube surface. Additives with these capabilities can reduce the propensity of coke to stick to the internal tube surface and can reduce any potential catalytic influence tube surfaces may have on coke formation.

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Coker

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Year

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