HF Alkylation Unit One Step Cleaning & Neutralization

Our particular specialty is the HF Alkylation Unit one-step cleaning and neutralization process. With this revolutionary process the Alkylation unit is cleaned for entry by circulating ETI Cleaning & Gas Freeing Solution™. The cleaning solution neutralizes acidity immediately in addition to dissolving any Iron Fluoride Scale and removing Polymer found throughout the Alky equipment. This type of cleaning is completely non-corrosive to the process unit and can be completed in less than 24 hours. In most locations the used cleaning solution can be drained directly to the plant sewer. Where fluoride removal is required, a method is available to achieve < 0.05ppm F^-.

Overview of Past Methods

The best way to demonstrate the advantages of our proprietary one-step cleaning and neutralization process is by comparing it with alternative HF Alkylation unit chemical cleaning techniques.

Inhibited HCL

When inhibited hydrochloric acid is used to remove iron fluoride scale, the equilibrium in the solution could be described as:

$$2H^+ + 2Cl^- + FeF_2\ (H_2O) \rightarrow 2H^+ + 2F^- + Fe^{-2} + 2Cl^-\ (H_2O)$$

The actual amount of HF ($H^+ + F^-$) available in the circulating cleaning solution depends on the amount of iron fluoride scale dissolved, and on the quantity of HF remaining in the system after it is evacuated for the cleaning.

The problems with this mixture as a cleaning solution for HF Alkylation units concern both corrosion rates and cleaning performance:

- Corrosion inhibitors are inhibitors not preventers. Inhibitors slow down the corrosion rate of hydrochloric acid on carbon steel, but high temperatures or high liquid velocities compromise this performance. Any cleaning solution must be heated to at least 180°F for effective polymer removal, but even hydrochloric acid alone (without the fluoride in the solution) is effectively inhibited to only 140°F.

- The HF is not inhibited nearly as effectively as the HCl. In utility boiler cleanings, where HCL + HF mixtures are often used to remove silica scale, EPRI (Electric Power Research Institute) guidelines dictate that no more than 0.25% HF should be present in cleaning solutions due to excessive corrosion rates encountered where more HF is present.

- The addition of Boric acid or other organic acids to these HCL mixtures makes them more corrosive and less susceptible to inhibition.

- When HCl solutions are re-used on multiple circulations in an HF alkylation unit (or in any equipment) the solution becomes corrosive due to the total concentration of dissolved iron. This becomes a severe problem at about 1% total iron (ferric iron, which would rarely be seen in an alkylation unit cleaning, and can be reduced to ferrous iron by simple means, is a problem at much lower concentrations). Accelerated corrosion resulting from high iron concentrations is due to a mechanism that is unaffected by conventional inhibitors.

In addition to high corrosion rates and polymer removal problems, the fact that acid cleanings require both rinsing and neutralization creates two distinct disadvantages to this method. The first is added downtime. Our method saves valuable time by including the neutralization in the same step as the cleaning. The second disadvantage is the increased volume of waste liquids created by the rinsing and neutralization. This extra volume is very significant when a large system like an HF Alkylation unit is cleaned.

Furthermore, there is always the risk of leaving something full of acid in a large, complex system like an entire HF Alkylation unit. The failure of even a small piece of piping is a big problem when the unit is started up.

Finally, acid cleanings leave carbon steel surfaces in a very "active" condition. In other words, the surfaces are very susceptible to additional corrosion.

Ammonium Citrate

One alternative is ammonium citrate. The ammonium citrate is typically applied in the low pH / high pH mode (as in the "Citrisolve" process).

A significant down side to this method is that ammonium citrate is **not** a very strong buffer system. When the system is inventoried, the pH of the circulating solution will often drop to 2.0 (or lower), requiring the addition of ammonia to restore the system to neutral pH. This in turn means that some small areas could be left at an acid pH. Ammonia is also (usually) a very significant problem in refinery effluent.

The EnvTech Difference

Our proprietary "Clean & Gas-Free" process utilizes a strong 8.8-pH buffer with appropriate chelants, eliminating even more of the disadvantages of the acid cleaning, and avoiding the use of ammonia in the cleaning solution.

Because of the strong buffer, everything that comes into contact with the cleaning solution is neutralized immediately, avoiding potential high corrosion rates while pH is being adjusted and eliminating the chance of leaving any area at an acid pH. This mixture has proven excellent for polymer removal and can be heated too much as 225°F without adverse effects. In most locations, the cleaning solution can be drained directly to the plant sewer when the cleaning has been completed.

References are available upon request. For further information, please contact us at (916) 455-9690, fax (916) 455-9693 or e-mail: info@envtechinc.com.