Question 14: What are your strategies to reduce alky acid consumption?

ABIGAIL SLATER (HollyFrontier)
The most impactful parameter affecting alky acid consumption is feed quality. Reducing feed contamination will greatly reduce acid consumption. There are also operational changes that can be made to reduce acid consumption, but the biggest impact will be feed contaminants. Anything that will cause the alkylation reaction to reduce acid strength or polymerize will affect acid consumption.

There are several different feed contaminants that can affect acid consumption, and several strategies to combat these contaminants. For HF alkylation, sulfur can be a large factor in acid consumption. Sulfur, in the presence of the HF alkylation reaction, produces light Acid Soluble Oil (ASO) which can be difficult to remove from the unit. Generally, a low rerun temperature can get rid of the ASO, but it will result in additional free acid with it. Some strategies to remove sulfur in the feed is Fluidized Catalytic Cracking (FCC) feed pretreatment (hydrotreat), caustic skid treaters, and amine scrubber technology.

The presence of ethane in the feed, particular to HF alkylation, will make ethyl fluoride and cannot be alkylated. Ethyl fluoride is then vented from the Alky and the fluoride molecule is not recovered. FCC upstream fractionation or a de-ethanizer fractionator are strategies to reduce ethane in the feed.

Carbon chains higher than five carbons can cause polymerization during the alkylation reaction, which increases acid consumption and reduces alkylate production. Similarly, dienes have double bonds which tend to break and make longer fluorocarbon chains (polymerization) and reduce alky production and increase acid consumption. This can also be combated by proper upstream fractionation.
A typical contaminant for HF alkylation is water, or any molecules containing the hydroxide (OH) grouping (No CO, Aceto-Nitriles, ethers, esters, ketos, etc.) This includes caustic that can be carried over from the sulfur and mercaptan feed treating systems (caustic skids). The most common strategy to remove water is solid state feed driers (typically mole sieve or activated alumina). Mole sieve may last longer than alumina treaters as it can retain more water. Some refiners will also install an upstream water wash system, which is designed to absorb any molecules containing the OH group prior to entering the alky feed drying section.

Operationally, ensure that the reactor riser temperatures are within the designed range. If the riser temperature is too hot or too cold, acid consumption will increase. Incorrect riser temperatures tend to produce more polymerization reactions (ASO). Ensure that the isobutane to olefin ratio (HF specific) is within design range.

RICK DENNE (Norton Engineering Consultants, Inc.)
For sulfuric acid alkylation units, tight control and monitoring of spent acid strength is key. Acid titration should be performed on each shift (centrifuging of the acid is a must before titration). The online spent acid strength indication (Coriolis meter) should be checked against the laboratory results on a monthly

basis by the unit engineer.

For HF acid alkylation units, tight operation of the acid rerun/regeneration column is required. Consider infrequent gamma scans of the column and/or hydraulic study to determine tray performance and condition.

For both technologies, feed containments should be minimized. Good sulfur and water removal as well as butadiene saturation should all take place in the feed pre-treatment section.

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