Question 8: Do you have experience starting up an isomerization unit (an alumina chloride catalyst type) without first acidizing the reactor loop? What was the impact on catalyst activity?

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Honeywell UOP strongly recommends that acidizing of the reactor circuit should be included in the commissioning and startup of a new grassroots or revamped Penex™ or of Butamer™ units (isomerization units with chlorided alumina catalyst). If not, the consequence can be a significant amount of catalyst deactivation, as well as possible corrosion in the reactor section of the unit. A recent experience in which the customer elected to NOT complete the dry out and acidizing of a new reactor section resulted in an estimated deactivation of 60 to 85% of the new catalyst load.

For units undergoing a turnaround, the UOP guideline states that anytime equipment in the reactor circuit is exposed to air, it should be acidized. However, the actual scope of the work, how it is done, and the duration should be considered when determining if acidizing is required and the extent of the procedure needed. We are aware of units that suffered noticeable catalyst deactivation after restarting for a turnaround when acidizing was not done.

Acidizing is used primarily to prevent water from forming and deactivating catalyst, but it also serves an important function in preventing corrosion of the piping. The following outlines the mechanism for the generation of water during the normal operation of the unit. Acidizing the unit removes the source of the oxygen using the same mechanism, but before catalyst is loaded in the reactors.

1. The Penex™unit is constructed of carbon steel, so the pipe and vessel walls are mostly iron. When that iron is exposed to the atmosphere, it reacts with oxygen to form iron oxide. In new units, there is often a rust scale on the piping that has been exposed to air and moisture for months. After turnarounds, there should be much less scale, more like a light rouge coating of iron oxide on the piping or vessel walls.

2. During normal operation, the catalyst promoter PERChloroethylene (or PERC) is injected. PERC reacts with hydrogen in the presence of catalyst and heat to create hydrogen chloride (HCl). The HCl is carried throughout the reactors and through the heat exchange train and connecting piping. In the stabilizer column, the HCl is carried overhead into the caustic scrubber where the HCl is neutralized by the sodium hydroxide in solution. The HCl is necessary to maintain the acid sites on the catalyst so that the reactions will take place.

3.HCl reacts with iron to form iron chloride and H2. This is a harmless reaction; and in a dry environment, the iron chloride provides a protective layer to prevent exposed iron surfaces from further corrosive reactions.

4.The HCl will also react with iron oxide to form iron chloride and water; so, if rust is present in the reactor loop, water will be formed, resulting in permanent deactivation of some of the catalyst. Also, as iron chloride is soluble in water, when water is present, the protective iron chloride layer will breakdown and expose more iron to react with HCl. If water remains in the system, this cycle can continue until there is enough iron loss to result in a leak.

5.To prevent this corrosion, the piping is acidized with HCl before commissioning flow through the reactors and normal PERC injection. The iron oxide will be reduced to iron metal and water.The water generated must be drained from the system until the moisture readings indicate that the system is dry. Refer to the UOP General Operating Manualsfor more details on the acidizing procedure.

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