Question 10: What impact does silicon have on an isomerization catalyst? What are the symptoms that occur as evidence of a breakthrough?

SUGG (Honeywell UOP)

Silicon is not expected in the feed to UOP's various isomerization technologies. Some refineries that process coke naphtha in upstream hydrotreating units may have silicon breakthrough. In such instances, the typical molecular sieves placed upstream of the isomerization reactors would not trap this component and the silica would pass on to the reactor.

Silica is not routinely tested in the liquid feed. Consequently, there is not much commercial information about its impact on the chloride and alumina catalyst. Many believe that silicon would cause some catalyst metal function deactivation due to potential interaction with the platinum, which could be observed in the reduction of benzene saturation reactions. On the other hand, the silicon could also deactivate acid sites by blocking sites that would otherwise be attached to chlorides. However, in both cases, the deactivation will not be as strong as the one caused by oxygenated compounds.

We had one case where a silicon incident was reported; but under investigation, the cause was found to be the presence of organic fluorides in the feed. Organic fluorides reacted with the

molecular sieve material and formed HF aluminum fluoride and silica-fluoride. Since silica-fluoride was in the vapor phase, it was displaced through the molecular sieve bed into the reactors where it deactivated the catalyst.

DUBIN (Axens North America)

Like Patrick said, we would see a plug flow deactivation of the reactor bed. So, if you anticipate some sort of poisoning event, you will have to rule out other issues, in addition to silicon poisoning, as being the culprit.

GEOFFREY DUBIN (Axens North America, Inc.)

When looking at chlorinated alumina-type catalyst, we have observed silicon will deposit on the catalyst in a similar fashion as other precious metal catalyst, distributing silicon throughout the pores and blocking access to active sites. The silicon can also become chemically bound with the chlorides, reducing the acid function of the catalyst, which will lead to a permanent deactivation of the catalyst.

The poisoning of the catalyst, due to silicon, will cause plug flow decrease in isomerization performance

with the migration of temperature rise from the top to the bottom of the catalytic bed. This type of deactivation can be similar to other poisons, so any troubleshooting should also be conducted to identify or reject other sources.

FERNANDA LOPES (Honeywell UOP)

Silicon (mostly in silica form) is generally not expected in the feed to a Honeywell UOP Penex™, Butamer™, Par-Isom™, zeolitic isomerization, or TIP™ unit. However, some refineries that process coker naphtha in upstream NHT units may have a silicon breakthrough that allows SiO2 (silicon dioxide) to be carried into the isomerization unit. In case of a NHT silicon breakthrough, the typical molecular sieves placed upstream of isomerization reactors would not be able to trap this component, and the silica would pass to the reactor.

Due to the rarity of this situation, SiO2 is not routinely tested in the liquid feed; consequently, there is not much commercial information about its impact on chlorided alumina catalyst. Many believe that silicon would cause some catalyst metal function deactivation due to a potential interaction with platinum, which could be observed by the reduction of benzene saturation reaction. On the other hand, silicon could also deactivate acid sites by blocking sites that would otherwise be attached to chlorine. However, in both cases the deactivation would not be as strong as the one caused by oxygenated compounds.

AMIR TAIYABI (CRI Catalyst Company)

Silicon (Si) usually originates from antifoam agents based on silicones. The catalyst can absorb quite some percentage of the Si, but its activity will be depressed as the silicon content increases. Si is a permanent poison to Pt (platinum) and cannot be removed by regeneration. Si also poisons the catalyst by blocking access to the pores of the catalyst and can even contribute to increased pressure drop across the reactor.

The symptoms of Si poisoning include 1) the loss of conversion of isoparaffins due to depressed activity because temperature compensation (higher temperatures) is required to maintain the same conversion (from normal paraffin to isoparaffinic), and 2) yield shift, e.g., more gas make at higher temperatures.

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