Question 15: In treating kerosene, what factors play into the decision to use hydrotreating versus sweetening processes such as caustic treating?

Kaspar Vogt (Albemarle)

Refiners make two types of product kerosene:

- Jet A-1 has a total maximum sulfur specification of 3000 ppm and a mercaptan sulfur concentration of no more than 30 wppm.

- Ultra low sulfur kerosene (ULSK): has a total sulfur concentration of less than 10 ppm

Sweetening processes, such as caustic treating or UOP Merox™, selectively remove mercaptans without otherwise affecting the kerosene composition. Hydrotreating, by contrast, affects several key properties of the kerosene including smoke point, aromatic, sulfur, and nitrogen content and other properties such as oxidation stability. This becomes important as ULSK becomes more prevalent in the market. As a result, kerosene sweetening can typically easily achieve the Jet A-1 specifications. Hydrotreating is typically required for nearly complete removal of kerosene sulfur.

Kerosene Merox™ Sweetening is not an extraction but conversion process that requires a catalyst and oxygen to convert mercaptans to disulfides. It takes mercaptan sulfur species and oxidizes them to form disulfide. The disulfides remain in the product but do not impact the corrosion properties to the same degree as mercaptans. The conversion of mercaptan to a less objectionable sulfur form, disulfide, will help meet final specs for the kerosene fraction. Merox™ Sweetening can typically achieve the Jet A-1 specifications. However, it is difficult to guarantee thermal stability due to the presence of mercaptan sulfur species.

Caustic extraction alone generally results in very low yields of extracted sulfur. The mercaptan sulfur species are just too difficult to extract via aqueous alkanolamine (e.g., caustic) solution. There may be very few cases where employing mercaptan extraction plus sweetening is feasible. For this application to occur the crude is likely to have a low amount of sulfur and the kerosene fraction is relatively light. This allows for a larger fraction of lighter mercaptan sulfur species which may be partially extracted.

In a few cases some aromatics saturation is required to achieve the smoke point and naphthalene’s specification. For these cases, hydrotreating is needed.

In ULSK hydrotreating, color issues can occur and are typically related to insufficient treat gas and hydrogen partial pressure

For hydrocracker kerosene, a caustic wash should be added if the product needs to meet Silver Strip Corrosion. However, if the product just needs to meet copper (Cu) Strip, then caustic wash is typically not needed.

Another factor that should be considered is the capital required for a hydrotreater versus a Merox™ unit.

Martin Gonzalez (BP)

The most obvious difference between sweetening and hydrotreating is that hydrotreating will reduce total sulfur, while sweetening processes simply convert mercaptan sulfur into disulfides without removing sulfur from oil. For production of jet fuel, the total sulfur in the kerosene is a key consideration. We have found that a shift to a sourer crude diet such as Canadian Extra Heavy Oils may precipitate the need for hydrotreating. Depending on the pressure of the hydrotreater, it may also be possible to improve the smoke point or aromatics content of the feed, where sweetening will not. Hydrotreating will also remove the surfactants responsible for water separation problems (WISM), thus eliminating the need for clay treating. In addition, thermal stability (JFTOT) of the fuel should be much improved by hydrotreating.

Dave Krenzke (ART)

The decision to use hydrotreating or a sweetening process depends on the types of sulfur in the kerosene and the product sulfur target. Hydrotreating can remove all types of sulfur compounds and therefore the sulfur content of the product is only limited by the process conditions and catalyst activity. The sweetening process only removes mercaptan sulfur, so the product sulfur is limited to the non-mercaptan sulfur in the feed.

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