Question 43: How has the increased processing of synthetic and other opportunity crudes in a refinery impacted the buildup of HPNA's (Heavy Poly Nuclear Aromatics) in the hydrocracker and affected conversion? What are your strategies to address this?

Deepak Agarwal (Criterion Catalysts & Technologies)

PCA (Poly Cyclic Aromatics) formation is not a function of processing synthetic or opportunity crudes. Some opportunity crudes can be much easier to process by a HCU due to much lighter EPs thus providing extended run lengths. Feed type, quality, severity of the operation, unit configuration and catalyst choice in the HCU are determining factors for PCA formation.

Units which are designed for very high conversion and recycling back to feed are always candidates for dealing with PCA formation. Unfortunately, most refiners have to increase bleed rates to mitigate PCA issues since there are no easy catalytic solutions and buildup of PCAs is mostly a function of recycle rates. Since PCA formation is also a function of temperature, operating the catalyst systems as cool as possible will directionally minimize PCAs production. Selection of most active catalysts available will allow operation at lower temperatures.

Paul Zimmerman (UOP)

Processing of synthetic or opportunity crudes can often present challenges to hydrocrackers due to increased refractory sulfur and nitrogen, multi-ring aromatics, and asphaltenes. The multi-ring aromatics and asphaltenes directly contribute to HPNA formation at the acid sites of hydrocracking catalysts. In addition, refractory nitrogen leads to higher operating temperatures further promoting HPNA condensation reactions. If allowed to increase, operating with high HPNA will cause increased catalyst deactivation, fouling of effluent exchangers and air coolers, and decreased yields and product quality.

The traditional method for controlling HPNA is to reduce conversion. This in effect is removing HPNA by a bleed stream at the rate created in the reactor, of which HPNA will have an equilibrium level. Reducing feed endpoint has also been effective for managing HPNA. In general, feeds with greater amounts of HPNA precursors will require greater endpoint reduction. Endpoints are often limited to 750-850 °F for FCC cycle oils, 900-1000 °F for coker gas oils, and 1000-1100 °F for straight run oils. Forsynthetic crudes, this may require understanding of upstream processing at the upgrader to determine the HPNA potential. Additional operating factors to limit HPNA may include higher hydrogen partial pressure, higher H_2/oil ratio, and maximum saturation catalyst.

UOP also has engineered solutions to manage HPNA and allow higher conversion. These include technology solutions that remove HPNA via fractionation or selective adsorption. These HPNA solutions can often allow increasing conversion close to 100%. This may provide a significant advantage if the refiner doesn’t have the ability to upgrade the unconverted oil to a higher value product, such as in an FCC.

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