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FUTURE CHALLENGES IN DOWNSTREAM PETROLEUM REFINING

Mohan S Rana
Petroleum Research Center-Kuwait Institute for Scientific Research, Kuwait

Worldwide petroleum refining industry is entering into a new era, where light crudes are being replaced by heavy or unconventional (heavy or extra heavy) crudes. The unconventional crudes usually have low American Petroleum Institute (API) gravity; contain enormous amounts of contaminants, and higher carbon-to-hydrogen ratios, which means lower quality and less desirable feedstock in terms of cost and refining. These crudes have high percentage (>60%) of 350 °C+ fraction (i.e., bottom of barrel). The refining of such feeds is most difficult task and not only may that some of the existing refineries not be able to operate with heavy and extra heavy crude oil. Thus, due to the complex feedstock refinery processes and their operations must advance and include next-generation processes and catalysts to fulfil the clean fuel products demand and supply. The key for achieving deep removal of contaminants (S, N, O and metals) during the refining is to understand the factors that influence the removal of the different types of hetero-atoms present in the feed. The chemistry of composition at molecular level remain one of the challenging task particularly asphaltene. On the other hand, nature of catalyst properties (a balance between textural properties and catalytic sites) to heavy oil processing require further investigation particularly catalyst deactivation (life cycle) as a function of time-on-stream. The role of catalyst along with process parameters, and interaction involved during the conversion require deeper insight. Apart from the operating parameters, one of the most challenging tasks for heavy oil is molecular analysis that is specifically for the fraction of bottom barrel (residue), which contains large amount of asphaltene and CCR. Asphaltene is the most unpredictable and unstable cluster molecule, which is considered as a forerunner carrier for hetero atoms. Metals in the asphaltene aggregates are believed to be associated with the asphaltene sheets, making the asphaltene molecule more complex. Therefore, a design of catalyst formulation required a balance between textural properties, number of active sites and suitable operating conditions. This study focuses on the relationship between the various parameters of crude oil composition, physicochemical properties, and their impact on catalytic activities.

mrana@kisr.edu.kw