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Fischer-Tropsch Refining

by

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Synopsis

Energy carriers, such as coal, natural gas and biomass, can be converted by Fischer-Tropsch technology into synthetic crude (syncrude). Fischer-Tropsch derived syncrude can then be refined to transportation fuels, such as motor-gasoline, jet fuel and diesel fuel. These fuels meet the same specifications as crude oil derived transportation fuels.

Conventional refining technologies have to be adapted to deal with Fischer-Tropsch syncrudes, because they differ significantly from crude oil with respect to composition. Some of the key differences are the high concentration of oxygenates and olefins and absence of sulphur in Fischer-Tropsch syncrude. Imposing a crude oil refining methodology on syncrude can lead to unwieldy and expensive refineries. Yet, despite an abundance of literature of Fischer-Tropsch synthesis, there is little literature that deals with the refining of Fischer-Tropsch syncrude.

The present study investigated current refining practice for both crude oil and Fischer-Tropsch syncrude in order to identify fundamental differences in their refining focus and conversion behaviour. This was followed by a critical evaluation of the compatibility of syncrudes from high temperature Fischer-Tropsch (HTFT) and low temperature Fischer-Tropsch (LTFT) synthesis with the chemistry and catalysis of various conversion processes. The conversion processes that were evaluated include isomerisation, oligomerisation, etherification, alkylation, metathesis, hydrogenation, hydroisomerisation, hydrocracking, catalytic cracking, coking, thermal cracking, catalytic reforming and dehydration. The recommendations from the technology evaluation provided the foundation for the development of Fischer-Tropsch syncrude based refinery designs.

Refinery designs were developed to determine configurations that would maximise the production of on-specification motor-gasoline, jet fuel and diesel fuel respectively. It

could be shown that less complex refinery designs were required to refine Fischer-Tropsch syncrude to motor-gasoline and jet fuel, than were required for crude oil refining. It was also shown that on a molecular level Fischer-Tropsch syncrude is unsuited for maximising the production of Euro-4 type diesel fuel.

The present study illustrates the advantage of considering fundamentals in developing refineries specifically for Fischer-Tropsch syncrude, rather than imposing crude oil design practises on Fischer-Tropsch syncrude refinery designs.

Keywords: Fischer-Tropsch, refining, syncrude, motor-gasoline, jet fuel, diesel fuel, refinery design, refining catalysis.

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