Kinetics and Reactor Simulation of Medium Temperature Fischer-Tropsch (MTFT) Synthesis in a Bubble Column Reactor with an Iron Catalyst

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Abstract: The Medium Temperature Fischer-Tropsch synthesis (MTFT) has been successfully commercialized at large scale with an iron catalyst in a slurry bubble column reactor[1]. The fundamental understanding of Fischer-Tropsch synthesis catalysis and reaction engineering for designing a large bubble column reactor has been proven to be crucial for making the Fischer-Tropsch synthesis based CTL plants work practically. Kinetic models on the basis of "detailed mechanism" at the level of single-event have been developed to bridge the gap between lab-scale results and the design standards of large scale reactors[2]. However, it has been noticed that the real mechanism of Fischer-Tropsch synthesis has not fully been understood, and the several kinetic models from different (but similar essentially) mechanism cycles generally could fit experimental data equally well, suggesting that the conventional kinetic modeling could not discriminate among the real details of the mechanism of Fischer-Tropsch synthesis, but still useful as a basis of practical reactor scale-up[3,4]. The complexity of Fischer-Tropsch mechanism and kinetics found in the catalysis studies is mainly due to the fact of the dynamic nature of Fischer-Tropsch catalysts under synthesis conditions, namely the frequent changes between phases as well as surfaces on which reactions are taking place, and the kinetic models on the basis of those "detailed mechanism in one cycle" could all reflect the overall Fischer-Tropsch conversion performances correctly.

References

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