413e An Algorithm for Predicting the Hydrodynamics and Mass Transfer Parameters in Slurry Bubble Column Reactors for Fischer-Tropsch Synthesis

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Since its discovery in 1920's, Fischer-Tropsch synthesis (FTS) has been carried out in a fixed bed reactor (ARGE), a circulating fluidized bed (Synthol), and a "Fixed Fluidized bed" reactor, which is commercially known as the "Sasol Advanced Synthol Reactor" (SASR). Slurry bubble column reactors (SBCRs) for Fischer-Tropsch synthesis were reported to have several advantages over fixed bed reactor technology. For instance, SBCR enjoys a much higher "online factor" when compared with the ARGE reactor, which operates in short cycles due to catalyst deactivation and the consequence drop of wax yield and quality. Also, recent studies have shown that the SBCR is the most cost effective FTS technologies directed towards the production of middle distillates.

In this study, an algorithm was developed to predict the hydrodynamics and mass transfer parameters in SBCRs for FTS. Small and large gas bubbles were taken into account to model the behavior of the gas phase under the churn-turbulent flow regime conditions. The hydrodynamic and mass transfer data obtained in our laboratory using a pilot-scale reactor (3-m high and 0.3-m diameter) and under typical industrial conditions along with available literature correlations were employed in the development of the algorithm. This algorithm, along with available reaction kinetics and heat transfer characteristics, was used in computer model in order to predict the effects of reactor geometry and operating conditions, such as reactor diameter, length, superficial gas and slurry velocities, temperature, pressure, syngas composition and catalyst loading on the performance of SBCRs operating under FTS conditions. The model was also used to scaleup and optimizes SBCRs for FTS with iron and cobalt-based catalysts.