PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

CLEAN FUELS & CHEMICALS

Overview of Fischer-Tropsch Synthesis

Since its discovery in the 1920s, the Fischer-Tropsch (FT) synthesis has undergone periods of rapid development and periods of inaction. Within ten years of the discovery, German companies were building commercial plants. The expansion of these plants stopped about 1940 but existing plants continued to operate during WWII. Two types of reactors were used in Germany: the parallel plate reactors and a variety of fixed-bed tubular reactors. Various designs were utilized for the fixed bed reactor with the concentrical tubes being the preferred one. This type of reactor contained catalyst in the area between the two tubes with cooling water-steam flowing through the inner tube and on the exterior of the outer tube. Many of these tubes could be arranged in a shell (tube in shell) reactor system. A version of this type of reactor was utilized by Sasol (Arge reactor).

In the late 1940-early 1950 period of very active research and development, a variety of reactors were utilized. The circulating fluid bed reactor system had been developed by Standard Oil (NJ) for catalytic cracking (FCC process). Several organizations worked to develop versions of this reactor for FT synthesis. The group headed by HRI developed the fixed fluid bed reactor for their commercial plant located in Brownsville, TX; the supply of oil from the Middle East caused the plant to be closed just as the operating problems were being solved. The Kellogg Company was a leader in developing a circulating fluid bed reactor and this is the version adapted by Sasol. In spite of many operating problems that led to Kellogg abandoning the development to Sasol, the problems were overcome and Sasol eventually operated 16 of these reactors at Secunda (more than 100,000 bbl/d) and additional smaller ones at Sasolburg. Recently all of the 16 reactors at Secunda were replaced by 8 fixed fluid bed reactors.

Except for the fluid bed reactors, the US Bureau of mines utilized the other types of reactors and eventually the fluid bed reactor. A 50-70 bbl/d slurry phase reactor was built and operated at Louisiana, MO, but operation was terminated after only four runs had been made. In Germany, Köbel led a group that operated a bubble column reactor that utilized an iron catalyst to make predominantly gasoline range products. This latter effort provided much understanding of the scientific and engineering aspects of the bubble column reactor, but mass balance problems introduced many questions about the product distributions.

In the early 1990s, Sasol completed development of their slurry bubble column reactor and brought on-stream a 2,500 bbl/d, 5 meter diameter reactor and this has operated without problems for more than 10 years. For the commercial plant in Quatar, an 11-meter diameter reactor will be utilized with a cobalt-based catalyst.

While the reactor development has been slow, the transition in FT-process-developers has been very rapid. A comparison over a four-year period (1999 vs. 2003) shows many changes with mergers and dropouts dominating the scene.

PARTICIPANTS

University of Kentucky
Center for Applied Energy Research
2540 Research Park Dr.
Lexington, KY 40511

CONTACT

Burt Davis
UK CAER
2540 Research Park Dr.
Lexington, KY 40511
Tel: (859) 257-0251
Fax: (859) 257-0220
davis@caer.uky.edu