PROJECT FACTS

UNIVERSITY OF KENTUCKY
CENTER FOR APPLIED ENERGY RESEARCH

Separation of Fischer-Tropsch Wax Products from Iron Catalyst Particles

Fischer-Tropsch Synthesis (FTS) is an established catalytic process for producing hydrocarbons and other chemicals from coal and natural gas. Still, many barriers exist for FTS to become an economical alternative for the production of hydrocarbon fuels. Slurry-phase FTS is the preferred reaction medium since the process is highly exothermic. Consequently, heavy wax products must be separated from catalyst particles before being removed from the reactor system.

Achieving an efficient wax product separation from iron-based catalysts is one of the most challenging technical problems associated with slurry-phase FTS. The separation problem is further compounded by catalyst particle attrition and the formation of ultra-fine carbide particles. Numerous separation processes have been proposed in the literature based on a variety of filtration media along with washing/cleaning techniques. Some limited fundamental studies have shown that attrition resistance of iron-based catalysts depends on the type of activation the catalyst receives. However, these studies have not attempted to correlate the change in filtration properties of catalyst slurries with physical and chemical changes of the particles under real-world conditions. Therefore, in the proposed research program, we intend to "bridge" the gap between industrial filtration techniques and fundamental chemical/physical changes of iron-based catalyst particles under FTS conditions.

The overall goal of this effort is to correlate the filtration properties of various iron-based catalyst slurries with the chemical and physical changes occurring during activation and FTS synthesis. The result of this program will be the development of an improved separation process that will drastically improve the economics of the FTS process by reducing catalyst losses.

Our program focuses on understanding of the phase changes during activation/reduction and their associated effects on filtration properties. A state-of-the-art pilot plant has been modified to include a filtration test apparatus. Large batches of activated slurries will be prepared in an existing pilot-scale slurry bubble column reactor. The filtration test unit is capable of simulating the FTS activation conditions while the slurry properties are continuously monitored. Simultaneously, modular filtration media will be tested under various filtration rates and operating modes. Initial analyses of the slurry and filter permeate particles will be used by the research team to design improved filter media and cleaning strategies. Finally, the improved separation method will be integrated in the SBCR and tested during FTS synthesis.

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SPONSORS

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PROJECT VALUE

U.S. DOE: $492,470
UK CAER: $125,550

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