Iron catalysts for the Fischer-Tropsch process. Past, present and future.

Mark E Dry
University of Cape Town
South Africa

Abstract

In 1923 Fischer and Tropsch reported that when synthesis gas was passed over an alkalised iron catalyst at very high pressures a liquid very rich in oxygenates was produced. (Later this process was developed further and was known as the Synol process.) When Fischer lowered the operating pressure to 7 bar the liquid product consisted mainly of hydrocarbons, which at that stage was the desired product. The catalyst activity, however, declined too fast. In 1937 Pichler found that when operating at "medium" pressures the catalyst was more stable and this lead to a revived interest in iron catalysts, especially because the supply of cobalt from the then Belgium Congo had been cut off. In 1943 six German firms carried out tests to compare their different iron catalysts at Schwarzheide. Iron catalysts, however, were never used on a commercial scale in Germany. The firms Lurgi and Ruhrchemie combined efforts and developed the multitubular ARGE reactors using precipitated, silica supported catalyst. These reactors and catalysts were installed in the Sasol plant in the early 1950's and this was the first commercial FT operation based on iron catalysts.

From 1928 onwards FT research was carried out at the U.S. Bureau of Mines laboratories using various types of iron catalysts including those prepared by fusing iron oxide together with various promoters. Hydrocarbon Research investigated the use of fused catalysts in high temperature fluidised bed reactors (the Hydrocol process). A commercial plant operated in Brownsville, Texas for a number of years in the 1950's. Kellogg developed a circulating fluidised bed reactor also using a fused iron catalyst. Two of these reactors were installed at the Sasol plant in the mid 1950's.

At this stage interest in the FT process waned worldwide and for many years all further development of iron based catalysts and of improved reactors was carried out at Sasol. Since the oil crises of the late 1970's and early1980's there has been a strong revival of interest in the FT process. Even though most current work is focussed on the more active cobalt based catalysts for the production of diesel fuel there is no doubt that iron catalysts will still have a role to play for the production of gasoline and, more importantly, of various chemicals.

Technical detail of all the above iron based catalysts will be presented.