Synthetic Fuels

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Sunday, 26 August 2007
Last Updated Sunday, 26 August 2007

Fischer-Tropsch process From Wikipedia, the free encyclopedia. (Redirected from Fischer-tropsch) Jump to: navigation, search

The Fischer-Tropsch process is a catalyzed chemical reaction in which carbon monoxide and hydrogen are converted into liquid hydrocarbons of various forms. Typical catalysts used are based on iron and cobalt. The principal purpose of this process is to produce a synthetic petroleum substitute. Contents

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Original process

The original Fischer-Tropsch process is described by the following chemical equation:

The mixture of carbon monoxide and hydrogen is called synthesis gas or syngas. The resulting hydrocarbon products are refined to produce the desired synthetic fuel.

The carbon dioxide and carbon monoxide is generated by partial oxidation of coal and wood-based fuels. The utility of the process is primarily in its role in producing fluid hydrocarbons or hydrogen from a solid feedstock, such as coal or solid carbon-containing wastes of various types. Non-oxidative pyrolysis of the solid material produces syngas which can be used directly as a fuel without being taken through Fischer-Tropsch transformations. If liquid petroleum-like fuel, lubricant, or wax is required, the Fischer-Tropsch process can be applied. Finally, if hydrogen production is to be maximized, the water gas shift reaction can be performed, generating only carbon dioxide and hydrogen and leaving no hydrocarbons in the product stream. Fortunately shifts from liquid to gaseous fuels are relatively easy to make. [edit]

History

Since the invention of the original process by the German researchers Franz Fischer and Hans Tropsch, working at the Kaiser Wilhelm Institute in the 1920s, many refinements and adjustments have been made, and the term "Fischer-Tropsch" now applies to a wide variety of similar processes (Fischer-Tropsch synthesis or Fischer-Tropsch chemistry)

The process was invented in petroleum-poor but coal-rich Germany in the 1920s, to produce liquid fuels. It was used by Germany and Japan during World War II to produce alternative fuels. Germany's yearly synthetic oil production reached more than 124,000 barrels per day from 25 plants ~ 6.5 million tons in 1944 (http://www.fe.doe.gov/aboutus/history/syntheticfuels_history.html). After the war, captured German scientists continued to work on synthetic fuels in the United States in Operation Paperclip. [edit]

Utilization

Currently, two companies have commercialised their FT technology. Shell in Bintulu, Malaysia, uses natural gas as a feedstock, and produces primarily low-sulfur diesel fuels. Sasol in South Africa uses coal as a feedstock, and produces a variety of synthetic petroleum products. The process is today used in South Africa to produce most of the country's diesel fuel from coal by the company Sasol. The process was used in South Africa to meet its energy needs during its isolation under Apartheid. This process has received renewed attention in the quest to produce low sulfur diesel fuel in order to minimize the environmental impact from the use of diesel engines. A small US-based company, Rentech, is currently focussing on converting nitrogen-fertiliser plants from using a natural gas feedstock to using coal or coke, and producing liquid hydrocarbons as a by-product.

Also Choren in Germany and CWT (Changing World Technologies) have built FT plants or use similar processes.

The FT process is an established technology and already applied on a large scale, although its popularity is hampered by high capital costs, high operation and maintenance costs, and the relatively low price of crude oil. In particular,

the use of natural gas as a feedstock only becomes practical when using "stranded gas", i.e. sources of natural gas far from major cities which are impractical to exploit with conventional gas pipelines and LNG technology; otherwise, the direct sale of natural gas to consumers would become much more profitable. There are several companies developing the process to enable practical exploitation of so-called stranded gas reserves. It is expected by geologists that supplies of natural gas will peak 5-15 years after oil does.

There are large coal reserves which may increasingly be used as a fuel source during oil depletion. Since there are large coal reserves in the world, this technology could be used as an interim transportation fuel if conventional oil were to become more expensive. Combination of biomass gasification (BG) and Fischer-Tropsch (FT) synthesis is a very promising route to produce renewable or ‘green’ transportation fuels.

In Sept. 2005, Pennsylvania governor Edward Rendell announced [1] a venture with Waste Management and Processors Inc. -- using technology licensed from Shell and Sasol -- to build an FT plant that will convert so-called waste coal (leftovers from the mining process) into low-sulfur diesel fuel at a site outside of Mahanoy City, northwest of Philadelphia. [2]. The state of Pennsylvania has committed to buy a significant percentage of the plant's output and, together with the U.S. Dept. of Energy, has offered over $140 million in tax incentives. Other coal-producing states are exploring similar plans. Governor Brian Schweitzer of Montana has proposed developing a plant that would use the FT process to turn his state's coal reserves into fuel in order to help alleviate the United States' dependence on foreign oil. [3]

One issue that has yet to be addressed in the emerging discussion about large-scale development of synthetic fuels is the enormous increase in primary energy use and carbon emissions inherent in conversion of gaseous and solid carbon sources to a usable liquid form. Recent work by the National Renewable Energy Laboratory indicates that full fuel cycle greenhouse gas emissions for coal-based synfuels are nearly twice as high as their petroleum-based equivalent. Emissions of other pollutants are vastly increased as well, although many of these emissions can be captured during production. Carbon sequestration has been suggested as a mitigation strategy for greenhouse gas emissions. However, while sequestration is already in limited use, the science and economics around large-scale sequestration strategies are, as yet, unconvincing. [4] [edit]

See also

- Abiogenic petroleum origin
- non-conventional oil
- Hubbert peak
- Future energy development
- Thomas Gold [edit]

External links

- Development of the modern Fischer-Tropsch process (1958-1999)
- Abiogenic Gas Debate 11:2002 (EXPLORER)
- Unconventional Ideas About Unconventional Gas (Society of Petroleum Engineers)
- "Process of synthesis of liquid hydrocarbons" - GB309002 - Hermann Plauson
- Shell
- Sasolen:Fischer-Tropsch process Retrieved from "http://en.wikipedia.org/wiki/Fischer-Tropsch_process"