

Fischer-Tropsch reaction

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The **Fischer-Tropsch reaction** converts hydrogen and carbon monoxide into various hydrocarbons. The process is likely to be an essential part of the In Situ resource utilization of a Martian settlement.

The process follows the bellow equation:

$(2n+1)H_2 + nCO \rightarrow C_nH_{(2n+2)} + nH_2O$ where 'n' is any positive number.

Hydrogen for the process can be obtained from water through electrolysis. Carbon monoxide on Mars will be available through the Reverse Water-Gas Shift Reaction.

Fischer Tropsch Process

The process is carried out in reactors at various temperatures and pressures depending on the catalysts and the desired products. Reactor cooling is an important part of the process to obtain the desired reactions. The end result is a mixture of hydrocarbons, and further processing is required to separate the mixture into individual usable products.

Reactors

The processes are highly exothermic and efficient cooling is required in the reactors. Multi tubular fixed-bed reactors, Entrained flow reactors, Slurry reactors and fluid-bed and circulating catalyst (riser) reactors are the main types of reactors used.

Processes are generally carried out at 150–300 °C. Production of paraffin is one of the products of the reaction and care must be taken not to create blockages in the equipment. Higher temperatures have higher production rates but tend to create methane, which is counter productive as methane can be more effectively produced by the Sabatier reaction.

Catalysts

Catalysts for this reaction include iron, cobalt, ruthenium, and nickel.

Process efficiency

Using conventional Fischer-Tropsch technology, the process ranges in carbon efficiency from 25 to 50% and a thermal efficiency of about 50%. For CTL facilities idealized at 60% with GTL facilities at about 60% efficiency is idealized to 80% efficiency (from Wikipedia).

Existing examples

A large scale implementation of Fischer–Tropsch technology is a series of plants operated by Sasol in South Africa, a country with large coal reserves, but little oil. The first commercial plant opened in 1952. Sasol uses coal and now natural gas as feedstocks and produces a variety of synthetic petroleum products, including most of the

country's diesel fuel. there are multiple other examples. Historically, the process was used in Germany during the Second World War to produce gasoline from coal.

On Mars

The process would be a path to the synthesis of complex hydrocarbons on Mars from abundant Water and CO₂ resources. It will be in competition with synthesis from biomass as this resource builds up from the presence of humans on Mars and food production. Fischer–Tropsch catalysts are sensitive to poisoning by sulfur-containing compounds. Cobalt-based catalysts are more sensitive than their iron counterparts. As sulfur is more common on Mars than on Earth precautions may need to be taken in the preparation of the feedstocks to the reaction.

See Also

- Hydrocarbon Synthesis

References

Wikipedia article

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