

Chapter 3

Review on Fisher–Tropsch Synthesis Method in Liquid Fuel Production: FTS Method in Fuel Production


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ABSTRACT

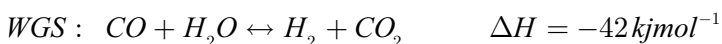
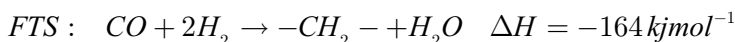
This chapter describes the Fisher-Tropsch Synthesis (FTS) method. Although it has been already applied at industrial scale for a century, the FTS has gained renewed interests as it is a key step for converting alternative feedstocks, including biomass to transportation fuels. It is the means by which synthesis gas containing hydrogen and carbon monoxide is converted to hydrocarbon products. The chapter explores that interest in FTS technology is increasing rapidly. In addition, the FTS process and products upgrading are discussed.

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INTRODUCTION

During the past twenty years, tremendous investments from the major players in the energy market have been directed towards Gas-to-Liquid (GTL) technology. This has resulted from a significant increase in global demand for crude oil. The advantages of GTL technology in energy production are that it furnishes a broad range of environmentally clean fuels, additives and value-added chemicals that can be obtained from abundant natural resources such as natural gas, coal, or biomass (Hall, 2005; Keshav & Basu, 2007). The primary commercial technology of GTL for the production of liquid hydrocarbons and value-added chemicals involve the Fisher-Tropsch Synthesis (FTS) process (Bao *et al.*, 2010). Among the various options for the conversion of gas to liquids, FTS is a proven process for the production of linear hydrocarbons in the diesel range, from synthesis gas (produced via the reforming or partial oxidation of natural gas) (Demirbas, 2007).

The FTS looks back to a lively history of about seventy years (Fischer & Tropsch, 1923; Rofer-DePoorter, 1981). Fischer himself was well aware of the importance of the discovery, giving access to industrial organic chemistry on the basis of simple inorganic molecules. The FTS represents technology from the 1920s that has continuously been revived to provide synthetic hydrocarbon fuels and chemicals from initially coal, later natural gas, and nowadays also biomass (Fischer & Tropsch, 1923). FTS stands for the reactions of synthesis gas to predominantly straight-chain hydrocarbons, which can be kinds of paraffin from CH_4 to waxes ($\text{C}_n\text{H}_{2n+2}$ with n from 1 to over 100), olefins from ethylene to much longer molecules (C_nH_{2n} , with n_2), and to a lesser extent oxygenated products such as alcohols. It produces as main byproducts water and/or carbon dioxide, that is, due to the water-gas shift reaction. Being a highly exothermic reaction, it generates large amounts of heat. The process is represented by the simplified reaction equations:



Reaction represents a polymerization, implying that the product will be a mixture of hydrocarbons with distribution in molecular weights. Selectivity and control thereof are therefore of key importance in FTS technology (Rofer-DePoorter, 1981). FTS represents a subject of intensive research both in industry and in academia (Dry & Hoogendoorn, 1981).

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