

GENERAL INFORMATION ABOUT THE PROCESS OF SYNTHESIZING HYDROCARBONS FROM CO₂ AND H₂

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Abstract

The process of catalytic synthesis of hydrocarbons from syngas to high molecular weight synthetic pentane to nonadecane is a strongly exothermic reaction. Its thermal effect is equal to 41 kcal/mol, activation energy is equal to 24 kcal/mol [1]. Thermodynamic calculations [1–3] show that at pressures of 1–100 atm and temperatures of 20–700°C, the formation of saturated hydrocarbons, especially methane, is likely. At 1 atm, the upper temperature limit for the formation of hydrocarbons ranging from high molecular weight synthetic pentane to nonadecane is 400–500°C.

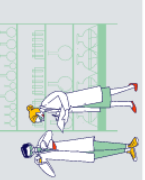
Introduction

The synthesis of high molecular weight synthetic hydrocarbons from pentane to nonadecane is obtained from synthesis gas by catalytic reaction with Group VIII intermediate metals. One of the most promising methods for obtaining motor fuel from carbon-containing sources as an alternative to oil is gas-to-liquid technology. In nature, the raw material base of synthetic fuel is widely spread, and they consist of carbon-containing materials - natural, petroleum gas, coal, biomass, etc. [2-4].

Gas-To-Liquid technology includes the following stages: obtaining a mixture of carbon monoxide and hydrogen; catalytic conversion of the mixture of carbon monoxide and hydrogen into high-molecular synthetic hydrocarbons from pentane to nonadecane; separation of the products into gasoline (C₅-C₁₀), diesel (C₁₁-C₁₈), and wax (C₁₉+) fractions [5].

Under the conditions of the synthesis of high-molecular-weight synthetic hydrocarbons from carbon dioxide and hydrogen, from pentane to nonadecane, oxygen-retaining compounds alcohols and aldehydes are also formed under high pressure.

The main stage of gas-to-liquid technology is the catalytic conversion of a mixture of carbon dioxide and hydrogen into hydrocarbons. In the catalytic conversion of a mixture of carbon dioxide and hydrogen into hydrocarbons, group VIII metals with variable valence, such as cobalt, nickel, ruthenium, and iron, exhibit catalytic activity. Group VI metals Cr, Mo, W, Group VII metals Mb, Te, Re, and Group IV metals Cu, Ag, and Au somewhat increase the activity level of the catalyst for the production of high molecular weight synthetic hydrocarbons from pentane to nonadecane from synthesis gas [6,7]. In practice, a mixture of carbon monoxide and hydrogen is used in industry Two main synthesis options are used to obtain hydrocarbons from high molecular weight synthetic pentane to nonadecane: low-temperature and high-temperature [8]. Low-temperature synthesis is carried out at temperatures below 300°C on cobalt- or iron-containing catalysts to obtain hydrocarbons from high molecular weight synthetic pentane to nonadecane from synthesis gas. This mainly produces high



molecular weight n-saturated hydrocarbons, n-olefins and oxygen-containing compounds. High-temperature synthesis is carried out at temperatures above 300°C in a catalyst to produce high molecular weight synthetic hydrocarbons from pentane to nonadecane from iron-containing synthesis gas. The product consists mainly of a mixture of hydrocarbons with a high olefin content, which are used as basic raw materials for many chemical processes.

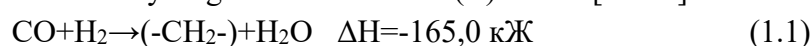
The mixture of carbon monoxide and hydrogen is characterized by a relatively low content of isosaturated hydrocarbons for the synthesis of hydrocarbons from high molecular weight synthetic pentane to nonadecane, and therefore the synthesized hydrocarbons have a low octane number. Due to the low cloud point and filtration temperature of the diesel fraction, it is difficult to use these components as fuel. Therefore, in both cases, it is necessary to change the composition of the raw material obtained in the production of motor fuel, which is hydrotreated using cracking, isomerization and other processes according to a technological scheme, combining processes [9].

In order to demonstrate the competitiveness of gas-to-liquid technology over conventional motor fuel production, it is desirable to intensify each stage of the process. One solution to this problem is to combine the hydrocarbon synthesis and hydrotreating stages in a single reactor. To do this, it is necessary to develop new effective catalysts for the production of high-molecular-weight synthetic hydrocarbons from pentane to nonadecane from mixed synthesis gas.

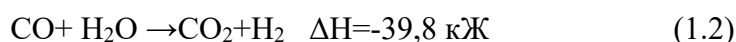
The mobile technology of the gas-to-liquid technological process, implemented in a block-modular manner, allows the use of simple equipment for processing oil-associated gases and low-pressure gases from spent gas fields in field conditions. [10-13].

The synthesis of hydrocarbons from high molecular weight synthetic pentane to nonadecane by a mixture of carbon monoxide and hydrogen is a complex system of chemical reactions that proceed sequentially and in parallel in the presence of a catalyst to obtain hydrocarbons from high molecular weight synthetic pentane to nonadecane from synthesis gas. [2, 55].

The main reaction of the synthesis is the hydrogenation of carbon (II) oxide. [14-15]:

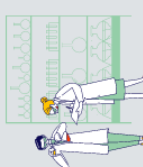


(1.1) Equation (1.1) characterizes the successful reaction of hydrocarbon production from cobalt-containing synthesis gas to produce hydrocarbons ranging from high molecular weight synthetic pentane to nonadecane in the presence of a catalyst. The formation of water in the reaction is also an indication that the reaction proceeds in the presence of water vapor (1.2). This reaction is characterized by the fact that it proceeds mainly in the presence of a catalyst to produce hydrocarbons ranging from high molecular weight synthetic pentane to nonadecane from iron-containing synthesis gas:



Along with the main reactions of the synthesis, the following intermediate processes may also occur:

- Hydrogenation of carbon monoxide to methane is activated at temperatures above 200°C on cobalt and nickel catalysts to produce high molecular weight synthetic hydrocarbons from pentane to nonadecane from synthesis gas [8,16]:

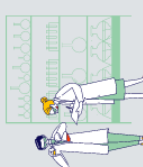


Summary

Equation (1.1) characterizes the successful reaction of hydrocarbon production from cobalt-containing synthesis gas to produce hydrocarbons ranging from high molecular weight synthetic pentane to nonadecane in the presence of a catalyst. The formation of water in the reaction is also an indication that the reaction proceeds in the presence of water vapor (1.2). This reaction is characterized by the fact that it proceeds mainly in the presence of a catalyst to produce hydrocarbons ranging from high molecular weight synthetic pentane to nonadecane from iron-containing synthesis gas.

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