Hydrocarbon Synthesis from Ethene-Containing Synthesis Gas over Supported Cobalt Catalysts

A.L. Lapidus, A.Yu. Krylova, O.L. Eliseev, Ya. V. Durandina

N. D. Zelinsky Institute of Organic Chemistry, Russian Academy of Sciences, 47 Leninsky prosp., 119991 Moscow, Russian Federation. Fax: +7 (495) 135 5303. E-mail: oleg@ioc.ac.ru

Currently production of hydrocarbon from CO and H_2 over supported metal catalysts (Fischer-Tropsch synthesis) attracts growing attention as a key part of gas-to-liquid technologies. Olefins are known to be primary FT products. Once formed they can readsorb at the catalyst surface and undergo secondary reaction such as hydrogenation, insertion in growing chain, starting new chains etc. To investigate these reactions co-feeding of olefins during synthesis is straightforward way.

Provided light olefins insert in growing chains they become desirable components of fed gas. Some ways of synthesis gas production give minor amounts of light olefins. Also light olefins could be produced from FT paraffins and admixed to fed gas thus shifting total molecular weight distribution of synthesised hydrocarbons to desirable heavy fractions.

Our contribution is devoted hydrocarbon synthesis from $CO+H_2+C_2H_4$ mixtures in fixed bed reactor over silica-supported cobalt catalysts such as $Co\text{-}M_xO_y/SiO_2$ where M= Zr, Al, Cr. In FT conditions, ethene can be hydrogenated into ethane and incorporated in growing hydrocarbon chains. Ethene converts almost completely if its concentration in fed gas is lower then 20 vol%. By adding ethane to synthesis gas CO conversion somewhat decreases. However, catalyst hourly productivity in respect to liquid hydrocarbons increases due to ethane incorporation and therefore changing molecular weight distribution of formed products. Relative degree of ethane incorporation depends on cobalt percentage in the catalyst and promoter nature (ZrO_2 seems to be the best). Total pressure increasing helps ethene incorporation and increases C_{3+} yield. Some features of CO and C_2H_4 adsorption on the studied catalysts are disclosed by means of TPD method.