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Light alkanes (C4-C5) are very good raw materials for ethylene and propylene production by steam cracking. Mixtures of saturated and unsaturated hydrocarbons of said range are produced in large amounts as steam cracking and fluid catalytic cracking (FCC) byproducts. However, presence of unsaturated hydrocarbons in C4 and C5 fractions reduces the yield of ethylene and propylene as well as effective production time of pyrolysis reactors due to formation of carbonized products. Therefore the total hydrogenation of said fractions can increase their value as steam cracking feedstock very substantially.

This study focuses on hydrogenation of C4 fraction, more specifically on development of the methodology of kinetic data collection and evaluation. The hydrogenation of 2-methylpropene on platinum catalyst was investigated as a model reaction.

A high temperature and high pressure cartridge packed-bed microreactor unit with integrated reactant mixer (MCTU-600 from Ehrfeld Mikrotechnik BTS GmbH) was used for experiments with model reaction. The gas phase hydrogenation of 2-methylpropene was carried out on the commercial catalyst Cherox 3902, (0.3 wt. % Platinum on γ-alumina, egg-shell type) under the temperatures up to 110°C and hydrogen pressure 20 barg. Outlet stream composition was analyzed by on-line GC analysis.

The microreactor was slightly modified to be able to measure temperature at the inlet and at the outlet of the catalyst bed. The outlet thermocouple was in close proximity to the catalyst. This thermocouple brought important information about the instantaneous bed temperature which was further used for optimization of reaction conditions suitable for kinetic data collection.

Time development of the 2-methylpropene conversion within several hours on stream was also studied under constant reaction conditions. Very high catalyst activity and fast deactivation in the initial phase (10 days) of the catalyst usage was observed. Also, the relatively long time on stream to reach steady state performance (8-10 hours) was necessary to obtain steady state conversion after the interruption overnight. The effects of temperature (60 – 110°C) and 2-methylpropene and hydrogen partial pressures on the reaction rate were investigated at weight hourly space velocity (WHSV) in range 2 – 150 grams of 2-methylpropene/gram of catalyst/hour. Collected data are used for kinetic model development and validation.

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