INVESTIGATION OF N-HEPTANE CONVERSION OVER Pt-Al₂O₃ CATALYSTS UNDER GRADIENTLESS REFORMING CONDITIONS

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The rates of the total and individual directions of n-heptane conversion in reforming over platinum-on-alumina catalysts were shown to be independent of dilution with hydrogen. They can be described by simple equations following from kinetic concepts in ideal adsorbed layers.

The present study makes use of the possibility of direct measurement of the reaction rates under gradientless operating conditions to study the conversion of n-heptane in reforming over a Pt-Al₂O₃ catalyst.

The experiments were carried out in a flow-circulation apparatus described in Ref. /1/ without hydrogen recirculation, at 40 atm and temperatures from 470 to 510 °C. The hydrogen/n-heptane mole ratio was varied from 2.5 to 24. The n-heptane dried on freshly calcined alumina contained no more than 1.2% iso-heptanes according to chromatographic data. Electrolytic hydrogen was purified over Ni-Cr and Pt-Al₂O₃ catalysts and dried over active alumina and zeolites.
The catalyst samples contained no acid additives and differed in catalytic activity by a factor of about two. The catalyst particles were crushed to 0.5-1.0 mm grain size in order to ensure the kinetic regime of the experiments. Before the experiments the catalysts were reduced in a hydrogen stream at 500 °C for 10 hrs. The chromatographic analysis of the gaseous and liquid conversion products was made as described in Ref. /1/, using an XL type chromatograph. Peak areas were determined by means of an integrator developed by Alabuzhev /3/. The calculations were performed on a Minsk-32 computer using a special program.* The relative error of the total rate of n-heptane conversion was estimated to be 15-20%, depending on the extent of reaction.

Among the products of n-heptane reforming over various samples of Pt-Al₂O₃ catalysts all the paraffins from C₁ to C₇ (with the exception of 2,2-dimethylpropane and 2,2,3-trimethylbutane), as well as toluene and benzene were isolated and identified. The amount of two unidentified compounds did not exceed 0.1%. No appreciable amounts of unsaturated compounds and cycloparaffins were found among the products. On a more sensitive chromatograph, 13 more unidentified peaks of various hydrocarbons were detected, but their total amount did not exceed 0.3% of the total amount of all hydrocarbons.

Figure 1 gives the yields of hydrocarbons (s) plotted against the total n-heptane conversion Xₜ𝑜𝑡, ranging from 15 to 80% for one of the catalyst samples. As Xₜ𝑜𝑡 increases, the yields of all hydrocarbons increase with the exception of the methylhexane yield, which passes through a maximum.

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