Conversion of dimethyl ether on zeolite catalysts

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The natural gas is alternative source oil to obtain of synfuel and other valuable products of the petrochemical synthesis. One of the most rational ways of converting natural gas is its conversion to syngas with the following conversion to the hydrocarbons. The process of obtaining of olefins and liquid hydrocarbons from the dimethyl ether and methanol seems to be more efficient in comparison with method of Fisher-Tropsch. The technology of obtaining olefins in industrial scale is not realized in Russia.

The purpose of this work was to research the study of the influence the type of zeolites, molar ratio SiO_2/Al_2O_3, the nature of the active metals in the composition of zeolite catalysts on their activity and selectivity in conversion of dimethyl ether diluted by nitrogen, and also influence of reaction conditions, for obtaining mainly light olefins.

Catalytic qualities of synthetic laboratorial sample of metal-containing zeolite catalysts were studied on the pilot setup of high pressure with twenty-four-hour running, providing uninterrupted supply of dimethyl ether. The catalyst testing was carried out at pressure 3 MPa, temperatures from 300°C to 450°C, gas mix (% vol.): 24 DME, 76 N_2, WHSV=1300 $l/l_{kat.}h$. A sampling of products of the reaction was carried out after 5 and 23 hours of catalyst run at each temperature. All the catalytic materials were characterised by XRD, IRS, TPD NH_3.

It was found that the activity and selectivity of studied catalysts depend on the nature of metals in the composition of catalysts, molar ratio SiO_2/Al_2O_3 and conditions of a reaction**.** On ZSM-5 zeolite catalysts wide range of hydrocarbons is observed. There is a wide specter of C_1-C_8 hydrocarbons both paraffins and olefins n- and iso-structure contents in gas product. Composition of liquid products characterizes by a wide range of hydrocarbons to C_{12} n- and iso-paraffins, olefins, aromatics and naphthenes. Both metal nature and temperature of experiment influences on distribution of hydrocarbons in gas product. Liquid hydrocarbon product is characterized by high octane number (RON) 90-98.

Conversion of DME reaches maximum values at 350°C, however, a further increasing of temperature results in gradual decreasing of conversion, which, probably, conditioned by partial deactivation of a catalyst. The selectivity of catalysts during of the first 5 hours of catalyst run at 350°C made up ~ 40% by hydrocarbon gas and by liquid hydrocarbons up to ~ 29-34%. Containing of CH_4 in hydrocarbon gas was about 5-10%, of ethylene about 14-16% and of propylene about 10-12% on the best samples of catalysts. Study of stable catalyst run showed for all catalysts after 23 hours it observed decrease in catalyst activity, which, probably, caused by forming of high-weight molecular products, blocking the access of reactants to the active sites of catalysts.

Increasing of zeolite molar ratio conducts to enlargement of stable catalyst run and decreasing of coke-formation probably due to decreasing of weak acid sites share and increasing strong acid sites share in zeolite.

The explanation of a different behavior of catalysts in process requires to making further researches.