Zeolite catalysts for production of synthetic highly-octane gasoline by method of Fischer-Tropsch.

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Natural gas is alternative petroleum raw material for production motor fuels, and also products for petrochemical synthesis. At the first step natural gas is converted to syngas, and at the second step syngas is converted to hydrocarbons by method of Fischer-Tropsch mainly on iron or cobalt catalysts.

Gasoline fraction obtained on cobalt catalyst by FT-synthesis has insufficiently high octane number due to low content of olefins and isoparaffins. It necessary to conduct second stage of hydrotreatment of this gasoline fraction for production of marketable gasoline. Aim of present work consists of investigation of influence of FT-conditions on characteristics of fuel. At the second part of the work influence of type and content of zeolite in composition of Pt-catalysts on isomerization and cracking activity of catalysts in reaction of isomerization of n-hexane and gasoline fraction in conditions of industrial process are investigated.

Zeolites were investigated by XRD, IRS, TPD NH_3. Catalysts based on zeolites (Y, β, ZSM-5, USY, Mordenite) were obtained by formation of zeolite with aluminum hydroxide, then dried up and calcinated at 500°C and then impregnated by solution $Pt(NH_3)_4Cl_2$.

The catalytic properties of samples studied by testing in the F-T synthesis on syngas of the following composition: 18%vol. CO, 32%vol. H_2, 50%vol. N_2, under pressure 3 MPa, at temperatures from 240 to 310°C, at G.H.S.V of initial gas ~2900 hr^{-1}. Nitrogen presence in syngas explained by method of oxidation of methane the oxygen of air, unlike pure O_2.

Hydrocarbon productivity of binary cobalt/zeolite catalyst is 320-340 g/l-hr, including 22-25% CH_4, 6-8% C_2-C_4, 30-34% C_5-C_{10} gasoline fraction, 8-12% diesel fraction C_{11}-C_{20}, 1-2% C_{21+} high-molecular hydrocarbons by CO summary conversion almost 95%.

Presence of zeolite component conducts to decreasing of overheating of catalyst in reactionary zone, hence, decrease collateral reactions and carbon deposit. Binary catalytic system based ZSM-zeolite have high stable activity.

Pt-loaded catalysts studied by modeling reaction of isomerization of n-hexane and C_5-C_{10} gasoline fraction of Fischer-Tropsch synthesis under pressure of flowing hydrogen 3 MPa, G.H.S.V. (gas) 600 l/l – cat. hr., at temperatures from 250 to 400°C, space velocity of liquid raw 1 hr^{-1}. As a result of the regular researches of catalytic properties of Pt-zeolite samples, it was showed, the conversion of n-C_6H_{14} increases with growth of zeolite content and temperature in line ZSM>β>MOR>Y for all samples of catalysts. Selectivity of i-C_6 grew in line Y>MOR>β>ZSM for catalysts with same content of zeolite. Higher isomerization activity of Y, β catalysts in comparison with ZSM catalysts may be explained by various structural and acid properties of these zeolites. Modification of zeolite Y into USY leads to increasing of n-hexane conversion and selectivity of i-C_6.

USY-based Pt-catalyst has most effectively hydroisomerisated olefins and n-paraffins of gasoline faction of FT-synthesis to iso-paraffins with increasing of octane number from 76 to 83, and with saving high stable activity and i-C_6-selectivity.