Catalytic conversion of ethanol into valuable alkenes

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At present, emphasis is placed on the production of chemicals from renewable sources. This is due to ever-increasing global environmental pollution and the depletion of the reserves of fossil fuels. Bioethanol is a liquid biofuel derived from biomass by biochemical transformation. Ethanol ranks among hydroxyderivates (alcohols) that are characterized by high reactivity [1,2]. The aim of this work was to extend the theoretical knowledge of the process of transformation of ethanol to alkenes (ethylene, propylene, 1,3-butadiene) and oxygenates (especially acetaldehyde) in the presence of heterogeneous catalysts. Subsequently, the catalytic activity of hydrotalcites, sepiolites and zeolites was studied. Reactions were carried out at atmospheric pressure, temperature ranging from 300 °C to 550 °C in the fixed bed reactor. The gaseous products were analysed by gas chromatography and the liquid products were analysed by GC/MS technique. Selected catalysts were characterized by X-ray diffraction analysis and SEM. The catalytic activity of the individual catalysts, the impact of promoters, preparation methods and reaction conditions on the conversion of ethanol to simple alkenes were compared. The highest yield of ethylene, namely 44,5 % at 500 °C, was obtained by using hydrotalcite prepared by the urea hydrolysis method. The highest production of propylene was observed over Zn-promoted hydrotalcite, in which a part of Mg-cations was substituted by Zn during the preparation step. The propylene yield of 11,8 % was achieved at 500 °C. Zeolite MCM-22 had positive effect on C4 fractions (except butadiene) production, which were obtained in yield of 15,8 % at 550°C. The highest yield of 1,3-butadiene, 40,3 % at 400 °C, was obtained in the presence of zeolite Y13 catalyst, which contained zinc and copper as promoters. Sepiolites doped with manganese, provided the yield of acetaldehyde of 56,5 % at 550 °C.

References

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