RECYCLING OF HDPE USING COMBINATION OF NATURAL CLINOPTILOLITE AND HZSM-5

Vasilkovová B., Hájeková E., Vatrt M., Hudec P.

Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, Radlinského 9, 812 37 Bratislava, Slovak Republic, email: bozena.vasilkovova@stuba.sk

The result of indispensability of plastics in common life and industry is creation of excessive amounts of plastic waste. Incineration, landfilling or mechanical recycling are not satisfactory means of plastic waste disposal. The result of incineration is creation of toxic products and CO_2 which is unacceptable from the environmental point of view. Tertiary (feedstock) recycling is a very effective process (thermal or catalytic cracking, hydrogenation, etc.). Thermal or catalytic cracking means cracking of polymers or plastics in the absence of oxygen. The result is the formation of monomers (e.g. ethene and propene) that are used to produce petrochemicals (polyethylene, polypropylene) or the formation of fuel fractions (e. g. gasoline or diesel).

The aim of the work was to study how the simultaneous presence of clinoptilolite and HZSM-5 during cracking influences the formation and composition of gaseous and liquid products. The cracking process comprised of two stages. Clinoptilolite together with HDPE was placed in the first semi-batch reactor. Zeolite (original HZSM-5 or modified HZSM-5M, extrudates of γ- alumina and HZSM-5 in ratio 1:1) was placed on the bed of the flow reactor. In all experiments the same reaction conditions were used: nitrogen flow of 60 mg/min and catalytic bed temperature of 450°C. To compare how the presence of catalysts influence the composition of gaseous and liquid fraction, thermal cracking was carried out.

The combination of two catalysts during cracking is very effective in obtaining higher amount of gas fraction. The combination of clinoptilolite and HZSM-5 in the process gives a higher gas yield (73%) compared to the combination of clinoptilolite and HZSM-5M (67 %). It is an increase of about 53% and 47% respectively in comparison with thermal cracking. In case of catalytic cracking propane and methylpropane are the main components of the gas and the liquid fraction is dominant in the range of gasoline (C5-C11).

Acknowledgment
This work was supported by the Slovak Research and Development Agency under contract APVV-18-0348.