TWO STAGE CATALYTIC CRACKING OF HDPE IN THE PRESENCE OF HZSM-5 AND γ-ALUMINA

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Plastic waste utilization is a worldwide problem. There are several possibilities how to treat the plastic waste: landfilling, incineration, mechanical or feedstock recycling. The feedstock recycling seems to be a very promising method. Thermal or catalytic cracking of polyolefins produces valuable petrochemicals (e.g. ethene, propene, butenes from catalytic cracking) or fuels (gasoline or diesel) depending on the reaction conditions.

The work was focused on thermal and catalytic cracking of HDPE in a two-stage reaction system. This system consists of semi-batch reactor (dosed with HDPE, 25 g) and flow reactor (the catalyst was placed on the bed of the reactor). We have studied the formation and composition of produced gas and liquid. In all experiments the same reaction conditions were used: nitrogen flow of 60 mg/min and catalytic bed temperature of 450°C. In order to compare how the catalyst influences the composition of gaseous and liquid fraction, thermal cracking was carried out. Different types of catalysts were used: modified HZSM-5M (extruded γ- alumina and HZSM-5 in ratio 1:1), original HZSM-5 (used for preparation of HZSM-5M) and γ-alumina (used for preparation of HZSM-5M).

We came to the conclusion that the presence of zeolite catalysts favourably influenced the gas production. The presence of catalyst influences the breaking of high-molecular weight fragments to low-molecular weight fragments, resulting in a higher amount of gas. The yield of gas was the highest for the original zeolite HZSM-5 (67%). Very similar results are obtained with the presence of modified catalyst HZSM-5M (63%). These gas yields are 3.4% and 3.2% times higher as with thermal cracking. The slight catalytic activity of γ-alumina was also observed. The changes in the composition of gas and liquid fractions in comparison with thermal cracking are evident.

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