Effect of the catalyst (HZSM-5 and Ni-Mo-catalysts) grain size to the product yield, composition and contaminants during waste plastic pyrolysis

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Pyrolysis is one prospective way for waste plastic utilization to convert waste streams into valuable hydrocarbons. It is a thermal process in exception of oxygen in the temperature range of 400 and 1000°C. The presence of catalyst had significant effect to the product yield and properties. Acidic catalysts with high Si/Al ratio have the best properties in C-C scission; furthermore the aromatization or saturation reactions could be linked rather to the pore size and the presence of other elements on the catalyst surface; HZSM-5, β-zeolite, Y-zeolite, Co-Mo-catalyst or Ni-Mo-catalyst are the mostly used catalysts for waste plastic pyrolysis.

In this work the thermo-catalytic pyrolysis of waste polymers have been investigated in a batch reactor using HZSM-5 and Ni-Mo-catalysts at 450 and 550°C. Raw materials had S, Cl, P, Zn, Ca, Ti and Br as contaminants. Catalysts have been contacted both with gas phase and liquid phase of pyrolyzed hydrocarbons. Both HZSM-5 and Ni-Mo-catalysts were used with different grain size to increase the volatile products yield, modify the hydrocarbon composition and decrease the concentration of the contaminants. Higher yields of both gases and pyrolysis oils could be observed by the using of catalysts and the molecular weight of products was also lower, especially at 450°C applying liquid phase connection. Catalysts application in gas phase of pyrolysis products had more significant effect to the investigated properties at 550°C. Based on SEM micrographs significant amount of coke deposits on catalyst surface was found in case of liquid phase connection. HZSM-5 catalyst had high activity in isomerization reactions, especially in gas phase treating. The contaminant level of products could be significantly decreased by Ni-Mo-catalyst, while contaminants rather accumulated on the surface of HZSM-5 catalyst.

Keywords: waste plastic, pyrolysis oil, catalyst activity, contaminant