ABSTRACT

Zeolite ZSM-5 is a porous material with a regular microporous structure, high surface area, good thermal stability, and has Bronsted and Lewis acid sites so that it is widely used as a catalyst in various hydrocarbon conversion reactions. One effort to increase the catalytic activity of ZSM-5 is through metal modification to produce a catalyst that has a higher potential in the catalytic pyrolysis process of plastic waste. In this study, the synthesis of CuO/ZSM-5 catalysts was carried out through the Cu2+ ion exchange method using $CuSO_4 \cdot 5H_2O$ precursors with Na+ ions from ZSM-5, at variations in Cu content of 3 wt%, 6 wt%, and 9 wt%. The resulting catalysts were characterized using XRD to identify the crystal structure and phases formed, BET analysis to determine the specific surface area and pore characteristics, and FTIR to identify the presence of Bronsted and Lewis acid sites on the catalyst. The synthesized catalyst was then applied to the catalytic pyrolysis process of polypropylene (PP) plastic waste, considering the increasing amount of plastic waste that is difficult to degrade naturally. The pyrolysis process was carried out using a fixed bed reactor at temperatures of 400°C, 450°C, and 500°C without the presence of oxygen to convert plastic waste into useful products. The catalyst performance was evaluated based on plastic conversion and the distribution and yield of pyrolysis products including liquid oil, gas, and solid residue (char). The composition of the oil product was analyzed using GC-MS, it was found that the CuO/ZSM-5 catalyst with an optimum CuO content at a temperature of 450˚C of 6 wt% provided the best performance compared to other catalysts, namely the gasoline fraction of 56.19%, the diesel fraction of 33.60% and the heavy hydrocarbon fraction of 10.21%.

Keywords: Zeolite ZSM-5; CuO/ZSM-5; ion exchange; polypropylene waste; catalytic pyrolysis.