EFFECT OF TEMPERATURE AND HEATING RATE ON PRODUCTS YIELD IN PYROLYSIS OF SHAMPOO BOTTLE AND BOTTLE CAP

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ABSTRACT

EFFECT OF TEMPERATURE AND HEATING RATE ON PRODUCTS YIELD IN PYROLYSIS OF SHAMPOO BOTTLE AND BOTTLE CAP

The global demand for renewable energy and the requirement for sustainable waste management have revealed the importance of alternative energy sources. Pyrolysis is a thermochemical recycling method that promises a way to convert plastic waste into valuable energy sources. However, the efficiency and yield of pyrolysis products depend on several factors such as temperature and heating rate. Despite previous studies on pyrolysis, limited research has focused on how these parameters influence the yield and characteristics of pyrolysis oil and char derived from different types of high-density polyethylene (HDPE) waste. This study aimed to investigate the effects of temperature and heating rate on the products yield from different types of HDPE waste which are shampoo bottle and bottle cap. Shampoo bottle and bottle cap waste were subjected to pyrolysis under 450 – 600 °C with heating rate of 5 – 20 °C/min in a fixed bed reactor, and the resulting oil and char were analyzed for their properties. The results showed that the highest oil yield obtained is 68 wt. % at 600 °C with heating rate of 5 °C/min for shampoo bottles while the bottle cap obtained the highest oil yield of 69.23 wt. % at 550 °C with the same heating rate. The study also revealed that increasing temperature and heating rate led to an increase in gas yield while reducing oil and char yield. This is due to higher temperatures, increases thermal cracking, causing char yield to decrease while increased gas production and a slight decrease in oil yield beyond the optimal temperature. In contrast, lower temperatures and slower heating rates resulted in higher char formation due to incomplete degradation of the polymer structure. From the FT-IR spectrum, the intensity of hydroxyl and alkanes group in oil decreased as the temperature and heating rate increased while char reveals intensity of alkanes and aldehydes in char decreased. Based on oil yield and processing conditions, bottle caps waste appears to be the better feedstock due to its ability to achieve a higher oil yield at a lower temperature, which can improve energy efficiency.

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