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Research Article

Individual and Catalytic Co-Pyrolysis of Agricultural Outcomes and Polymeric Materials over Nano-HZSM-5 Zeolite: Synergistic Effects and Yield Analysis for Heating Applications

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The catalytic effect of nano-HZSM-5 zeolite on co-pyrolysis of cotton shell (CS) and municipal plastic wastes (MPW) was studied. The influence of reaction temperature during individual pyrolysis, blending ratio, and catalytic effects was studied by applying constant heating rate. The experiments were conducted in a fixed bed batch type reactor. The hindering effect during catalytic decomposition of MPW was carried out and its positive synergistic effect on liquid oil yield was analysed. The reaction temperature for all the experiments are fixed based on the decomposition rate obtained from thermogravimetric study. The experimental outcomes revealed that during co-pyrolysis, the formation of char was reduced to 7.2 wt% with increased liquid oil yield of 66.5 wt%. Furthermore, adding catalyst for co-pyrolysis process improved the reaction by decreasing char formation. During catalytic process, the maximum liquid oil output was 69.3 wt% at 500°C temperature, CS/MPW ratio of 1 : 2. When compared to co-pyrolysis process, the catalytic co-pyrolysis showed 4.21 wt% higher liquid oil yield. The physical analysis of the oil shows maximum hating value of 34.6 MJ/kg. The FTIR study on catalytic co-pyrolysis oil shows the presence of aliphatic and aromatic hydrocarbons.

1. Introduction

The increased energy demand and rapid industrialisation due to the population and modern lifestyle force researchers to find alternative sources for conventional fuels. According to the survey conducted in the middle of 2020, the need for global energy is expected to increase by 30% over the next two decades in order to sustain rapid urbanisation [1]. Every living being requires a healthy atmosphere in order to thrive and develop. One of the biggest issues is the degradation of ecosystems caused by the discharge of inorganic and organic pollutants from various industries and automotive engines [2, 3]. There has been considerable demand around the world to investigate the production and use of biofuels for heat and power applications [4]. Fossil fuels have played a major part in satisfying current energy demands, but their