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Bioenergy Production from Co-Pyrolysis of Coconut Shell and Polyethylene Terephthalate

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Structured Abstract

Background: The increment in the population of Malaysia has not only increased the energy demand and consumption, but also increased the amount of waste that harms the environment. Currently, the fossil fuels that affects the environment negatively is the primary energy source in Malaysia. Hence, this study aimed to provide a shift toward a cleaner and sustainable renewable energy through the utilization of bioenergy that are produced through the co-pyrolysis of coconut shell and polyethylene terephthalate (PET).

Methods: Each feedstock was cleaned, dried and grinded to powder size at 250μm. The evolved gas analysis reactor was used to conduct the co-pyrolysis process. Various loading mass ratio of coconut shell and PET was tested under 600°C and 900°C pyrolysis temperature to obtain the optimum condition. The feedstock and the bioenergy product obtained was characterized using elemental analyser, Gas Chromatography-Mass Spectrometry (GCMS), Fourier-Transform Infrared Spectroscopy (FTIR), and X-Ray Diffraction (XRD).

Results: The percentage of carbon content in biochar produced increased from its feedstock from 47-62% to 70-93% and no nitrogen and sulphur detected. The biogas produced consisted of methane or carbon dioxide. The FTIR spectrum of coconut shells shows the O-H bond, C-H stretch, C-C bond of aromatic and C-O carboxyl bond, while PET shows C=O ester, C-C phenyl ring, C-O and C-H stretch at fingerprint region. The intensity of these functional group decreased as the temperature increased. The percentage of loading mass ratio in the sample has no significant results on the functional group. The XRD of biochar with increased pyrolysis temperature and the composition of coconut shell in the sample shows broader peaks indicating that it mostly consists of amorphous structure.

Conclusion: In conclusion, the co-pyrolysis of coconut shell with PET under various loading mass ratio at 600 °C and 900 °C were successfully produced biochar and biogas.

Keywords: Coconut Shell, Polyethylene Terephthalate, Co-pyrolysis

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