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Microwave-Assisted Torrefaction of Teakwood Biomass Residues: The Effect of Power Level and Fluid Flows

Authors : Lukas Kano Mangalla, Raden Rinova Sisworo, Luther Pagiling

Abstract : Torrefaction is an emerging thermo-chemical treatment process that aims to improve the quality of biomass fuels. This study focused on upgrading the waste teakwood through microwave torrefaction processes and investigating the key operating parameters to improve energy density for the quality of biochar production. The experiments were carried out in a 250 mL reactor placed in a microwave cavity on two different media, inert and non-inert. The microwave was operated at a frequency of 2.45GHz with power level variations of 540W, 720W, and 900W, respectively. During torrefaction processes, the nitrogen gas flows into the reactor at a rate of 0.125 mL/min, and the air flows naturally. The temperature inside the reactor was observed every 0.5 minutes for 20 minutes using a K-Type thermocouple. Changes in the mass and the properties of the torrefied products were analyzed to predict the correlation between calorific value, mass yield, and level power of the microwave. The results showed that with the increase in the operating power of microwave torrefaction, the calorific value and energy density of the product increased significantly, while mass and energy yield tended to decrease. Air can be a great potential media for substituting the expensive nitrogen to perform the microwave torrefaction for teakwood biomass.

Keywords : torrefaction, microwave heating, energy enhancement, mass and energy yield
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