

A Feasibility Study on Producing Bio-Coal from Orange Peel Residue by Using Torrefaction

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Abstract : Nowadays people use massive fossil fuels which not only cause environmental impacts and global climate change, but also cause the depletion of non-renewable energy such as coal and oil. Bioenergy is currently the most widely used renewable energy, and agricultural waste is one of the main raw materials for bioenergy. In this study, we use orange peel residue, which is easier to collect from agricultural waste to produce bio-coal by torrefaction. The orange peel residue (with 25 to 30% moisture) was treated by torrefaction, and the experiments were conducted with initial temperature at room temperature (approximately at 25° C), with heating rates of 10, 30, and 50°C / min, with terminal temperatures at 150, 200, 250, 300, 350°C, and with residence time of 10, 20, and 30 minutes. The results revealed that the heating value, ash content and energy densification ratio of the solid products after torrefaction are in direct proportion to terminal temperatures and residence time, and are inversely proportional to heating rates. The moisture content, solid mass yield, energy yield, and volumetric energy density of the solid products after torrefaction are inversely proportional to terminal temperatures and residence time, and are in direct proportion to heating rates. In conclusion, we found that the heating values of the solid products were 1.3 times higher than those of the raw orange peels before torrefaction, and the volumetric energy densities were increased by 1.45 times under operating parameters with terminal temperature at 250°C, residence time of 10 minutes, and heating rate of 10°C / min of torrefaction. The results indicated that the residue of orange peel treated by torrefaction improved its energy density and fuel properties, and became more suitable for bio-fuel applications.

Keywords : biomass energy, orange, torrefaction

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