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Solid fuel upgrading and nutrient recovery from banana residues by hydrothermal treatment

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Background: There is a growing global concern not only on energy security but on sustainable and cleaner sources of energy as an alternative to fossil fuels. Biomass is an attractive fuel because it is carbon neutral, renewable and considered as a major energy source next to coal, oil and natural gas. Banana residues from plantations are a potential reliable supply of biomass for its abundance and composition. These are lignocellulosic biomass that remains to be untapped for substantial energy conversion especially in developing countries. However, the inherent properties of banana residues such as high moisture content, low bulk and energy density, and irregular morphology necessitate pretreatment prior to solid fuel application. Hydrothermal treatment (HT) can upgrade the fuel features of biomass to make it more suitable for solid fuel applications like combustion and gasification. During HT, a liquid by-product is simultaneously produced that contain essential nutrients that may be applied as fertilizer. The aim of this study is to upgrade the fuel properties of banana residues by HT and investigate its application as solid fuel for combustion and gasification. The liquid by-product is characterized to evaluate its potential as fertilizer.

Methodology: Experiment on HT of banana residues was conducted at 180-220oC to investigate the fuel properties suitable for combustion and gasification application. Thermogravimetric analysis (TGA) was employed to investigate the combustion and gasification performance of the hydrothermally treated biomass.

Findings: The obtained higher heating value (20.4-22.7 MJ/kg) is within the range of sub-bituminous coal that shows the efficacy of the upgrading. The ignition and burnout combustion temperatures were higher than the raw biomass. The retained alkali metals in the biomass after HT influenced the gasification reactivity by catalytic effect. The liquid by-product contains macro and micro nutrients that are essential for plant growth.

Conclusion & Significance: The HT of biomass afforded a solid fuel for combustion and gasification, and multi-nutrient liquid product.

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