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par

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Valorization of sugarcane bagasse via slow pyrolysis and its by-product for the protection of wood

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Title : Valorization of sugarcane bagasse via slow pyrolysis and its by-product for the protection of wood

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Abstract :

Biomass residue—such as sugarcane bagasse—has great potential in providing renewable energy sources. However, its natural properties such as low density, low calorific value, and biodegradation susceptibility can limit its utilization. To improve its energy efficiency, slow pyrolysis—the process of thermal decomposition in an oxygen-deficient environment—can be applied by transforming the biomass into carbon-rich char. In a typical slow pyrolysis scenario, biomass is slowly heated to produce mainly char, where the organic vapors are often considered secondary products. However, there is an interest to recover this by-product by condensing the organic vapor generated during pyrolysis for various purposes. Moreover, this product has a long history due to its benefits as a bio-pesticide used by traditional farmers, notably in Asian countries. In this study, bagasse was slow-pyrolyzed to co-produce char and pyrolysis liquid using a laboratory fixed bed reactor. Different parameters were tested, such as temperatures (400 °C and 500 °C), heating rate (1 °C/min and 10 °C/min), and holding time (30 min and 60 min). This study aims to evaluate the valorization potential of bagasse with the purpose of energy densification (conversion of biomass into char) and valorizing the utilization of its by-product (pyrolysis liquid) for wood protection.

Results showed that the yield of char decrease with the increase of pyrolysis temperature but results in the favorable calorific value improvement; while at the same time generating a high mass of liquid yield. The optimum pyrolysis condition to co-produce char and pyrolysis liquid was at 500 °C temperature and 10 °C/min of heating rate, yielding 28.97% char and 55.46% liquid. The principal compounds of pyrolysis liquid were water, acetic acid, glycolaldehyde, 1-hydroxy-2-propanone, methanol, formic acid, levoglucosan, furfural, followed by some phenol compounds and guaiacol derivatives. Pyrolysis liquid also exhibits anti-fungal and anti-termite activity at relatively low concentrations in the Petri-dishes bioassays. When treated to beech and pine wood, pyrolysis liquid indicates good protection towards termites (*Reticulitermes flavipes*) and Basidiomycete fungi (*Coniophora puteana* and *Rhodonia placenta*, cubic rot and *Trametes versicolor*, a fibrous rot) at concentration 50% and 100%. However, it remains leachable when exposed to water or high humidity, which indicates that future studies should be conducted to find out how to decrease its leachability.