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Integrated biorefinery approach for sequential pre-treatment of lignocellulosic biomass

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Pre-treatment process contributes towards overall cost of biomass conversion and thereof the design of lignocellulosic pre-treatment stage with a biorefinery/bioproducts approach could be highly feasible. We had developed a sequential chemical and enzymatic delignification process for lignocellulosic biomass, and the biorefinery prospects are highlighted through this work. Hydrogen peroxide pre-treatment could solubilize more than 50 % of lignin into process effluent 'Black liquor', from which lignin could be recovered by acid precipitation and further purified. Lignin itself is a significant bio-product with several industrial applications. Industrial products such as vanillin, nanocomposites, etc could be further developed from the recovered lignin. Besides, the photocatalytic treatment of 'Black liquor' generates intermediates which could be developed into valuable products with industrial applications. For enzymatic delignification, instead of depending on commercial enzymes, solid state fermentation techniques could be applied on lignocellulosic residues for ligninases production. Bulk level production of ligninases along with other enzymes could also meet the industrial and nanobiotech applications or demands. Biomass process residues could be finally converted into biochar with significant environmental and agricultural applications. Integration of comprehensive biorefinery concept in the lignocellulosic pre-treatment stage could thus yield multiple lignin based bio-products along with sustainable energy generation. Biorefineries across the nations could strengthen the global bioeconomy as well as meet the bioenergy goals.

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Studies on performance and emissions characteristics of small utility compression ignition engine using castor (*Ricinus communis* L.) oil based biodiesel

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Experimental investigation have been carried out to analyze the effects of castor oil based biodiesel fuel on performance and emissions characteristics in a constant speed (1500 rpm), direct injection commercially used small utility diesel engine. Biodiesel fuel was produced from non-edible grade castor oil. All the measured parameters were compared with the base diesel fuel by using different biodiesel/diesel blends (B20, B40 and B60). The performance parameters evaluated were brake power (BP), brake specific fuel consumption (BSFC) and brake thermal efficiency (BTE). Tests were conducted at different load conditions to evaluate the emission characteristics such as oxides of nitrogen (NOx), un-burnt hydrocarbon (UHC) and carbon monoxide (CO). At full load condition, results showed that B40 and B60 produced lesser brake power when compared to B0 by 17.4 and 25.6% respectively. While BSFC increased by 15.6 and 20.4% for B40 and B60 blends. In addition, CO and UHC emission were reduced by 26.21 and 42.30%, while NOx increased by 28.22% for B20. It is evident from the study that the Castor oil based biodiesel significantly affects the performance and emission characteristics of the conventional diesel engine without any major hardware modification.

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