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Evaluation of Sugarcane Straw Derived Biochar for the Remediation of Chromium and Nickel Contaminated Soil

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Abstract : Soil constitutes a crucial component of rural and urban environments. This fact is making role of heavy and trace elements in the soil system an issue of global concern. Heavy metals constitute an ill-defined group of inorganic chemical hazards, whose main source is anthropogenic activities mainly related to fabrications. This accumulation of heavy metals soils can prove toxic to the environment. The application of biochar to soil is one way of immobilizing these contaminants through sorption by exploiting the high surface area of this material among its other essential properties. This research examined the ability of sugar cane straw, an organic waste material from sugar farm, derived biochar and ash to remediate soil contaminated with heavy metals mainly Chromium and Zinc from the effluent of electroplating industry. Biochar was produced by varying the temperature from 300 °C to 500 °C and ash at 700 °C. The highest yield (50%) was obtained at the lowest temperature (300 °C). The proximate analysis showed ash content of 42.8%, ultimate analysis with carbon content of 67.18%, the Hydrogen to Carbon ratio of 0.54 and the results from FTIR analysis disclosed the organic nature of biochar. Methylene blue absorption indicated its fine surface area and pore structure, which increases with severity of temperature. Biochar was mixed with soil with at a ration varying from 4% w/w to 10% w/w of soil, and the response variables were determined at a time interval of 150 days, 180 days, and 210 days. As for ash (10% w/w), the characterization was performed at incubation time of 210 days. The results of pH indicated that biochar (9.24) had a notable liming capacity of acidic soil (4.8) by increasing it to 6.89 whereas ash increased it to 7.5. The immobilization capacity of biochar was found to effected mostly by the highest production temperature (500 °C), which was 75.5% for chromium and 80.5% for nickel. In addition, ash was shown to possess an outstanding immobilization capacity of 95.5% and 90.5% for Chromium and Nickel, respectively. All in all, the results from these methods showed that biochar produced from this specific biomass possesses the typical functional groups that enable it to store carbon, the appropriate pH that could remediate acidic soil, a fine amount of macro and micro nutrients that would aid plant growth.

Keywords : biochar, biomass, heavy metal immobalization, soil remediation
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