

**Development and application of rice-straw biochar for removal of selected heavy metals (Pb, Cd and Cr) in contaminated paddy soil**

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Biochar which is derived from carbon rich biomass such as wood, manure and leaves, is increasingly recognized as multifunctional material for various applications like contaminant management in soil and water, soil amendment in agriculture etc.

In this study, rice-straw derived biochar was produced at a temperature of 400 °C in the presence of concentrated H<sub>3</sub>PO<sub>4</sub>. The resulted biochar was subjected to oxidation by different agents including KOH, HNO<sub>3</sub> and H<sub>2</sub>O<sub>2</sub> to enhance its adsorption properties. The pore size distribution of modified, non-modified and commercial biochar types was studied using scanning electron microscope (SEM) technique and functional group analysis was carried out using the Fourier transform infrared spectroscopic (FTIR) technique. The FTIR spectroscopic analysis revealed significant increase in concentrations (based on peak area with constant amount of samples) of the functional groups such as carboxylic, alcoholic hydroxyl, phenolic hydroxyl and carbonyl groups available on the surface of the KOH treated sample. The SEM analysis revealed about 40% increment in pore diameter of the rice straw biochar that was modified with KOH.

The paddy soil sample analyzed was amended with known amounts of heavy metal (Pb, Cd, and Cr) containing salts prior to analysis. To study the heavy metal adsorption capacity of modified, non-modified rice straw biochar and commercial biochar types, biochar (5 g x 7) which were packed and sealed in cellulose bags (5 x 5 cm<sup>2</sup>) were introduced to the soil samples (3 kg in a side sealed rain-gutter). All the experiments were performed in triplicate.

The amounts of heavy metals in amended soil, after treating with biochar, and adsorbed by biochar were measured using Atomic absorption spectroscopic (AAS) technique. The AAS study revealed that all modified rice straw biochar types adsorbed heavy metal ions more efficiently than its non-modified counterpart. Further, this analysis revealed that H<sub>2</sub>O<sub>2</sub> treated biochar is more likely to adsorb Pb and Cd, while the KOH treated biochar is more suitable for Cd and Cr adsorption.

**Keywords:** Biochar, Heavy metals, Modifier, Rice straw