THE PHOSPHATE RECOVERING CAPACITY OF DIFFERENT TYPES OF BIOCHARS

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Discharging wastewater containing phosphorus into natural water bodies negatively impacts aquatic ecology, such as eutrophication, and the presence of phosphate nutrients creates a significant challenge in wastewater treatment. Adsorption by biochar is recognized as a promising technique for adsorbing phosphates from aqueous solutions. In recent years, biochar made from different raw materials has been used to recover phosphorus present in the aqueous media. This study analyses the phosphate recovery capacity of biochars prepared from rice husks, rice straw, tea waste, bamboo wood, and eggshells. Raw materials for biochar production were collected and rinsed with water to remove any impurities and oven-dried at 60°C for 12 h to remove the moisture. Each biochar was produced through slow pyrolysis at a predefined temperature (300°C, 500°C, 600°C, 700°C and 800°C) for 2.0 h in a large chamber muffle furnace. After the biochar had cooled to room temperature, they were taken out, weighed, and labelled for the adsorption experiment. A mass of 2.0 g of dry biochar of each raw material was added into test tubes filled with 50.00 mL of phosphate stock solution of 100 mg L^{-1}, sealed, and shaken at 120 rpm for 12 h. After 12 h test tubes were removed and the solutions were filtered and the concentrations of the phosphate were determined using the ascorbic acid blue method. The procedure was repeated with all the biochars for five replicates each. Concentrations were calculated and compared using basic statistics in Minitab 17 statistical software and Excel 2013. A small amount of ash was obtained from the biochar prepared using rice husk, rice straw, tea waste, and bamboo wood remain as. In contrast, the eggshell biomass displayed a very low weight loss and remained constant across all five temperatures. Rice husk, rice straw, tea waste, and bamboo wood biochar exhibited removal efficiencies of less than 20 %. Notably, Eggshell char prepared at 800°C (ES800) displayed the highest phosphate removal efficiency of 98.92±0.17% among all the biochar tested, without requiring chemical activation. The eggshells were considerably stable and resistant to decomposition at the tested temperatures due to a high percentage of $CaCO_3$, which has good thermal stability. Calcium ions (Ca^{2+}) present in $CaCO_3$ would form strong electrostatic interactions with phosphate ions. Therefore, in contrast to the other four materials, which contain organic compounds such as cellulose and lignin, Eggshell char demonstrates more effective adsorption of phosphate from aqueous solutions. These findings suggest further research into optimizing the conditions for maximum phosphate adsorption and potential applications of ES800.

Keywords*: Biochar, Phosphorus, Removal efficiency, Wastewater*

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