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Influence of Biochar Properties on Maximum Phosphate Adsorption Capacity

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Abstract

The use of biochar as a low-cost adsorbent to remove nutrients from aqueous solutions is getting great attention lately due to its many environmental applications and benefits. Although, biochar has been widely used to remove phosphate from aqueous solutions, inconsistencies still exist with regards to biochar properties responsible for the adsorption process. This research was therefore, carried out to determine the influence of some biochar properties on maximum phosphate adsorption capacity of biochar produced from four different feed-stocks. The biochars used for this study were prepared from two plant materials; (Maize cob and rice husk) and two animal wastes (cow dung and poultry litter) at 600 °C. The different biochars were subjected to a laboratory batch sorption experiment by equilibrating with 15, 30 and 60 mg l⁻¹ phosphate. Data obtained were fitted into the linear forms of the Langmuir, Freundlich, Temkin and Dubinin-Radushkevich (D-R) adsorption isotherms while least square regression analysis was used to test the goodness of fit using the coefficient of determination (R^2). Similarly, stepwise regression analysis was carried out to determine the nature and extent of relationships between the biochar properties and maximum phosphate adsorption capacity using statistical analysis software (SAS 9.4). Results revealed higher R^2 values for the D-R adsorption isotherm (> 0.97) across all the treatments suggest better fit of the D-R adsorption isotherm for phosphate adsorption onto the biochar materials. The maximum phosphate adsorption capacity of the biochar materials is in the order: maize cob biochar $>$ poultry litter biochar $>$ cow dung biochar $>$ rice husk biochar. Stepwise regression analysis revealed that 99 % of the change in maximum phosphate adsorption is influenced by the combined effects of biochar EC, moisture content and specific surface area. Hence, modification of biochar EC, moisture content and specific surface area is essential for improving phosphate adsorption by biochar

Keywords: Adsorption capacity, biochar properties, phosphate adsorption