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EVALUATION OF PHOSPHATE AND AMMONIUM ADSORPTION-DESORPTION OF SLOW PYROLYZED WOOD BIOCHAR

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Abstract

Biochar is attracting attention as a soil amendment and organic/inorganic adsorbent for water purification. Proper use of biochar in such cases requires understanding of the mechanisms of nutrient adsorption and desorption on biochar. In this study, slow pyrolyzed wood biochar's were prepared at temperatures 400 and 600°C with retention time of 60 and 120 minutes to investigate their phosphate and ammonium adsorption capacities. The effects of pyrolysis process conditions and biochar physicochemical properties on potential adsorption capacity were evaluated. Results of adsorption kinetics showed that both pseudo-first-order and pseudo-second-order models could well predict the adsorption kinetics of phosphate and ammonium indicating that the chemical adsorption was one of the main mechanisms of phosphate and ammonium absorption. Langmuir-Freundlich isotherm was the best-fit model for ammonium adsorption which means the occurrence of chemical adsorption on heterogeneous surface whilst Langmuir isotherm agreed well with the phosphate adsorption. For different biochar's, ammonium adsorption capacity ranged from about 0.34 to 5.3 mg/g and phosphate adsorption capacity ranged from about 0.6 to 42.2 mg/g. Phosphate adsorption capacity improved with increasing temperature and retention time of pyrolysis process. However, higher ammonium adsorption which was observed in lower pyrolysis temperature and residence time can be attributed to more oxygen-containing functional groups. Both phosphate and ammonium adsorptions-desorption by biochar are more strongly related to solution pH, and maximum adsorption capacities were observed at pH of 7 and 3 for ammonium and phosphate, respectively.

Key words: adsorption, ammonium, biochar, isotherm, phosphate

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