Simultaneous adsorption of ammonium and phosphate from contaminated water solutions by a nut residue biochar

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Excessive amounts of phosphorous and ammonium discharged in wastewaters threaten the biodiversity of aqueous ecosystem and safety for living organisms. Adsorption is an efficient, environmentally friendly and economically feasible process for the removal of these pollutants. Present study aimed to investigate the potential of a nut residue biochar, physically activated by steam, for simultaneous adsorption of phosphate and ammonium from contaminated water solutions. The performance of biochar was tested as a function of initial ion concentrations, adsorbent dose, contact time and pH. The mechanism of adsorption was examined by carrying out structural and chemical analyses of the material before and after ions adsorption, as well as by applying two isotherm models, simulating the experimental data.

The results showed that the specific surface area of the adsorbent increased about 260 fold after activation by steam. Adsorption was fast within 30 min, while reached equilibrium after 12 h. The maximum uptake of phosphate was 70% at phosphate concentration 10 mg/L and adsorbent dose 4 g/L, whereas the maximum uptake of ammonium was 74.4% at ammonium concentration 300 mg/L and adsorbent dose 4 g/L. The maximum adsorption capacity of the material increased with a decrease in adsorbent dose to 2 g/L and reached a value of 94.5 mg/g for phosphate and 108 mg/g for ammonium. The experimental data were best fitted by the Freundlich model. Potential mechanisms of adsorption were surface complexation, electron coordination, or electrostatic attraction.