

Biochar ageing causes an opposite effect on ammonium and phosphate sorption

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Fertilizer use efficiency is often low due to low retention capacity of nutrient ions in the soil. Biochar, a form of pyrogenic carbon, can be applied to soil as it can potentially reduce nutrient losses by adsorbing cations and anions on its surfaces. The sorption of ions is primarily governed by surface characteristics of biochars. When biochar ages in soils, the surface properties change and therefore, biochar ageing may have an effect on ion sorption. Here, we chemically aged a eucalyptus wood derived biochar to different levels using three H₂O₂ concentrations, i.e., 5%, 10% and 15%, at 80°C for 6 hours. Surface properties of fresh and aged biochar were determined using chemical and spectroscopic techniques, which include- (a) specific surface area using CO₂ as adsorbate, (b) surface charge using potentiometric titration and (c) functional groups using DR-FTIR and XPS. Biochar ageing increased NH₄⁺ sorption while it reduced PO₄³⁻ sorption. The increase in NH₄⁺ sorption with biochar ageing can be explained by a greater proportion of acidic functional groups in aged biochar while the decrease in PO₄³⁻ sorption may be related to a decrease in net positive surface charge density. Both cation and anion desorption increased with increased level of ageing, suggesting that NH₄⁺ and PO₄³⁻ were less strongly bound to aged than to fresh biochar. Our study showed that artificially aged biochar might be used for low cation exchange capacity soils to gain an increased retention of cations, however, the application may be less effective for the retention of anions.