ABSTRACT

THE IMPACT OF BIOCHAR ON SOIL PROCESSES AND ITS POTENTIAL IN SOIL REMEDIATION

By

AMELIA MD SOM

Biochar is charcoal made for environmental purposes and is produced by burning up biomass in the absence or limited amount of oxygen. Incorporation of biochar into the soil has been proposed as a mode for carbon sequestration in efforts to reverse climate change. Discovery of Terra Preta in the Amazon had shown biochar is able to improve soil fertility. Large-scale biochar incorporation into the soil would undoubtedly cause changes in soil processes but so far, it has not been widely reported. Although biochar is able to increase soil water-holding capacity, its hydrophobicity can significantly affect this ability. The biochar's porous and low density was found to change the degree of soil compaction upon heavy loading as determined by using the Proctor test. Biochar with a high pH value would cause a significant rise in soil pH with neutral to basic properties but only a slight increase in soil with acidic pH. The effect of biochar on the Exchangeable Cation Capacity value of soil repeatedly displays correlation with the fluctuation of Ca^{2+} present and the rise in pH value. The rise in pH may also induce ammonia volatilisation that increases the leaching of ammonium into the percolating water and influence the proliferation and inhibition of soil microflora. Acidic soils such as peat benefited from increase in the pH but rise of pH in neutral soil, as those soils in a temperate climate, inhibit the growth of pH sensitive microbes. Biochar may become a good source of phosphate as the anions become concentrated in the biochar during biochar production. Palm frond biochar was shown to have the highest adsorption capacity towards Cu^{2+}, Pb^{2+}, Zn^{2+}, Ni^{2+} and Cd^{2+} based on the Langmuir model. A pseudo second order kinetic model was found to have a better fit based on linear regression correlation coefficient, R^2 and similarity between the calculated and experimental adsorption capacities. The kinetics of the metal competition in binary solutions was described by using the intraparticle diffusion model. The parameters for scaling up Palm frond biochar to full-scale and/or pilot columns was determined by using a Rapid Small Scale Column Test. A field trial was conducted to evaluate biochar potential in assisting natural remediation of multi-contaminated site and concluded that with sufficient quantities, biochar was able to prevent leaching of heavy metals and will continue to revegetate the contaminated site. Biochar has the potential to remediate infertile soil through improving water holding capacity, pH value, phosphate availability and soil densification and it has great potential to treat large areas of contaminated land, in remote location or with limited funds.