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PC2) Mg/Al Impregnated Biochar for the Removal and Recovery of Phosphates and Nitrate

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Abstract

Utilization of organic waste as a renewable energy source is promising for sustainability and mitigation of climate change. Pyrolysis converts organic waste to gas, oil, and biochar by incomplete biomass combustion. Biochar is widely used as a soil conditioner and adsorbent. Biochar adsorbs/desorbs metals and ions depending on the soil environment and condition to act as a nutrient buffer in soils. Biochar is also regarded as a carbon storage by fixation of organic carbon.

Phosphorus (P) and nitrogen (N) are strictly controlled in many wastewater treatment plants because it causes eutrophication in water bodies. P and N is removed by biological and chemical methods in wastewater treatment plants and transferred to sludge for disposal. On the other hand, P is an irreplaceable essential element for all living organisms and its resource (phosphate rock) is estimated about 100 years of economical mining. Therefore, P and N recovery from waste and wastewater is a critical issue for sustainable human society. For the purpose, intensive researches have been carried out to remove and recover P and N from waste and wastewater. Previous studies have shown that biochars can adsorb and desorbed phosphates implying that biochars could be a complementary fertilizer. However, most of the conventional biochar have limited capacity to adsorb phosphates and nitrate. Recent studies have focused on biochar impregnated with metal salts to improve phosphates and nitrate adsorption by synthesizing biochars with novel structures and surface properties. Metal salts and metal oxides have been used for the surface modification of biochars. If P removal is the only concern, P adsorption kinetics and capacity are the only important factors. If both of P and N removal and the application of recovery are concerned, however, P and N desorption characteristics and bioavailability are also critical factors to be considered. Most of the researches on impregnated biochars have focused on P removal efficiency and kinetics.

In this study, coffee waste is thermally treated to produce biochar and it was impregnated with Mg/Al to enhance phosphates and nitrate adsorption/desorption and P bioavailability to increase its value as a fertilizer. Kinetics of phosphates and nitrate adsorption/desorption and bioavailability analysis were carried out to estimate its potential as a P and N removal adsorbent in wasewater and a fertilizer in soil.

Key words : Biochar, Coffee waste, Metal impregnation, Phosphate adsorption, Phosphorus recovery