Biochar derived from non-customized matamba fruit shell as an adsorbent for wastewater treatment

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Abstract

This study of Matamba shell reviled them as material with outstanding surface morphology, elemental and kinetic mechanism characteristics. Mutamba biochar revealed irregular honeycomb morphological transformation from the field emission scanning electron microscope after pyrolysis at 600 °C for 2 h. Energy dispersive X-ray spectroscopy revealed high content of carbon (72.68wt%), nitrogen (14.14wt%) and oxygen (10.35wt%) on the biochar surface. The available oxygen composition provides enough polarization ability for high iodine adsorption (43.65 mmol/g) from the experimental data which were significantly induced by weak van der Waals forces and π-π and π-stacking interaction on the biochar surface and its micropores. The carbon content above 50% in ash rich biochar with an increase in pyrolysis can be ascribed to elements incorporated into aromatic or heterocyclic ring system established through preferential loss of oxygen at 600 °C pyrolysis. The adsorption kinetics were conducted to evaluate the equilibrium adsorption of the novel material and Elovich and Intra particle diffusion better described well the kinetic adsorption through Iodine adsorption than pseudo first order and pseudo second order models. Elovich was the best model to fit the adsorption kinetics with 45.41 mmol/(g•min) adsorption rate. The second order Akaike Information Criterion (38.26), adjusted correlation coefficient R^2 (0.9898) and sum of squares error (1.442) were used to fit the data. Consequently, the biochar in this study can serve as a promising green material for efficiently removing organic and inorganic contaminants from the environmental water ecosystem. The environmental significance of biochar will be of fundamental meaning to rural areas in developing countries in aquatic contaminants immobilization for water reuse. These results indicate that the Matamba fruit shells has the possibility to be used as an eco-friendly and low-cost effective adsorbent for anionic dye removal from the water environment. They also demonstrate the immense potential of the fruit shell waste to produce high performance biochar as an alternative green carbonaceous material that can be applied to adsorb organic and inorganic unwanted constituencies from wastewater as well as improvement of waste management in developing countries at a low cost. Its application as a pathway mitigation for diminishing greenhouse gasses and reducing the global warming potential could not be underestimated.