Acid activation of groundnut husk for copper adsorption: kinetics and equilibrium studies

E.A. Ofudje*, A.O. Awotula, G.V. Hambate, F. Akinwunmi, S.O. Alayande, O.D. Olukanni

*Department of Chemical Sciences, McPherson University, Seriki-Sotayo, Ogun State, Nigeria, emails: ofudje@gmail.com, ofudjeandrew4real@yahoo.com

Department of Biological Sciences, McPherson University, Seriki-Sotayo, Ogun State, Nigeria, email: aoawotula@gmail.com

Higher Institute of the Sahel, University of Maroua, Cameroon, email: valeryhambate@gmail.com

Institute for Human Resources Development, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria, email: akinwunmifatai@gmail.com

Centre for Energy Research and Development, Obafemi Awolowo University, Ile Ife, Nigeria, email: gbengaalayande@googlemail.com

Department of Chemical Sciences, Redeemers University, Ede Osun State, Nigeria, email: oluolukanni@gmail.com

Received 20 January 2017; Accepted 15 August 2017

ABSTRACT

In this study, the use of cheap unmodified and acid-modified agricultural waste primed from groundnut husk as adsorbents for the removal of Cu(II) ions from aqueous solution were examined in a batch process under different experimental conditions. Fourier transform infrared characterization of the adsorbent before and after the adsorption process revealed the likely involvement of various functional groups such as –COOH, –C=O, –NH2 and –OH groups. Structural and morphological changes of the biomass were equally observed by X-ray diffraction and scanning electron microscopy analysis before and after adsorption of copper ions. Optimum experimental conditions were obtained to be the initial metal concentration of 50 mg L–1, contact time of 70 min, biomass dosage of 0.03 g and hydrogen ion concentration of 5.0. The kinetic studies showed that the sorption pattern of both biomasses followed pseudo-second-order model, while the isotherms studies revealed that the adsorption data were well governed by Freundlich adsorption isotherm. The monolayer adsorption capacity for unmodified groundnut husk was found to be 14.525 and 20.146 mg g–1 for acid-modified groundnut husk as computed from the Langmuir model equation. It can thus be concluded that waste groundnut husk can be used as a low cost and environmentally friendly adsorbent for Cu(II) ions removal from aqueous solution.

Keywords: Adsorption; Copper; Equilibrium; Groundnut husk; Kinetics

* Corresponding author.