ABSTRACT

Removal of heavy metals from sewage effluent is necessary to avoid environmental contamination. Lead and cadmium ions have been found to be the main heavy metal contaminants in waste water mainly from municipal sources. Previously, activated sludge, ion adsorption among others have been utilized in heavy metal removal. However, most of these methods are costly to set up, unsustainable and their byproducts are challenging to dispose. There is need for affordable and sustainable methods of waste water remediation. The adsorption of lead (II) and cadmium (II) ions from simulated aqueous solutions by novel water hyacinth-based cellulose clay nanocomposite were studied and their adsorption performance established using the Langmuir, Dubinim-Radushkevich, Temkin and Freundlich isotherm models. Water hyacinth *(Eichhornia crassipes*) was collected from Lake Naivasha (0°48'44.9"S 36°17'40.7"E), Kenya and pre-treated with 0.1M HNO3. Non-fiber content was removed with 2:1 toluene: ethanol solution. Hemicellulose was removed with 1% NaOH. Lignin was removed with 1% NaOCl. Isolated cellulose was acid hydrolyzed using 5% HC1. The clay was dug 50cm below the surface of earth in Meru (0°07'54.0″N 37°42'45.3"E), Kenya and pretreated by washing and adding 0.1M NaCl to convert to sodic form. The water hyacinth-based cellulose clay nanocomposite (CCNC) was synthesized by solution blending method, with poly vinyl alcohol solution as the dispersion medium. The CCNC was characterized using Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM). FTIR peaks indicated possible intercalation with introduction of cellulosic peaks in the nanocomposite at 1636.9 cm1 (C=O and C=C groups) and enhancement of characteristic peaks in clay at 3700-3300 cm1 and 1100 - 500 cm31 regions. SEM analysis showed increase in surface porosity on incorporation of cellulose to the clay structure. The adsorption studies showed that the adsorption process of Pb (II) ions by the CCNC material underwent heterogeneous adsorption, while Cd (II) underwent both monolayer and heterogeneous adsorption. The adsorption of Cd (II) was best described by Langmuir, Temkin, and Freundlich isotherm models, while Pb (II) adsorption was best described by Freundlich and D-R isotherms. Thermodynamic studies showed that the adsorption process was exothermic in nature. Out of the study, it was clear that the CCNC was efficient in removal of Pb (II) and Cd (II) ions achieving over 99 % ion removal.