UNIVERSITY OF NAIROBI

DEPARTMENT OF CHEMISTRY

ADSORPTION OF HEAVY METALS FROM AQUEOUS SOLUTIONS USING

MANGROVES FROM KENYAN COAST

BY:

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DECLARATION

I declare that this thesis is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work or my own work has been used, this has properly been acknowledged and referenced in accordance with the University of Nairobi's requirements.

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DEDICATION

To my beloved parents, Dad Salesio, Mom Sabina and My fiancé, Chris.

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ABSTRACT

In this study, adsorption of heavy metals (copper, lead, zinc and cadmium) from aqueous solutions was investigated using mangrove biomass from the Kenyan Coast. The efficacy of mangrove biomass on the removal of divalent metal ions from aqueous solutions was investigated in single state in batch mode. Batch experiments involved the study of the effects of initial pH, temperature, initial concentration of the metal ion, adsorbent dosage and contact time on metal ions adsorption. The roots showed highest ability for the uptake of heavy metals (Cu, Zn, Cd and Pb) from aqueous solutions and were therefore used for all subsequent adsorption studies in this research. The adsorption of the heavy metal ions increased with increase in the ratio of the sample dose of the adsorbent to concentration of the heavy metal ions and decreased with increasing adsorbent particle size. Increase in shaking speed was observed to increase the amount of ions that adsorbed on the adsorbent. However, agitation rate beyond 500 rpm led to a decrease in percentage adsorption. When mangrove roots adsorbent was compared with other adsorbent materials, the results indicate good sorption properties. Langmuir and Freundlich adsorption models were used for mathematical description of adsorption equilibrium. Evaluating the correlation coefficients showed that both Freundlich and Langmuir isotherm described the data appropriately. The adsorption capacities (Q_{max}) from the Langmuir isotherm for Pb (II), Zn (II), Cd (II) and Cu (II) were found to be 13.698 mg/g, 6.211 mg/g, 5.495 mg/g and 11.36mg/g respectively. The effectiveness of mangrove roots in the sorption of the four metals from aqueous system was Pb (II) > Cu (II) > Zn (II) and Cd (II). Kinetic studies showed that a pseudo second order model was more suitable than the pseudo first order model. These results indicated that mangrove roots can be used as low cost adsorbent for the removal of heavy metals from aqueous solutions.

Keywords: *Adsorption, Batch technique, Heavy metal ions, Mangroves and Kinetics.*

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