University of Nairobi

School of physical sciences

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M.Sc. Thesis

BIOSORPTION OF ORGANIC DYES FROM AQUEOUS SOLUTION USING WATER HYACINTH (*EICHHORNIA CRASSIPES*) FROM LAKE VICTORIA

BY

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DECLARATION

This work is my original work and has not been submitted for examination for a degree in any other university

Signature .....**date**.....20/11/2011

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ABSTRACT

This study addresses removal of methylene blue dye, and Congo red dye from aqueous solutions using dried *Eichhornia crassipes* (water hyacinth) biomass as a low-cost natural adsorbent. Batch experiments were conducted to study the biosorption characteristics of these two dyes. Effects of dye concentration, contact time, adsorbent dose, pH, temperature and ionic strength on the removal of the methylene blue dye, and Congo red dye from aqueous solutions by *Eichhornia crassipes* were evaluated.

The experimental results revealed that removal efficiency increased with increase of *Eichhornia crassipes* dosage, initial dye concentration and reduction of particle size, but decreased with increase in temperature. Ionic strength and pH of the solution was found not to have effect in the adsorption of the dyes. It was found that 10 min was sufficient to reach adsorption equilibrium for methylene blue dye and 100 minutes for Congo red dye. The possibility of regenerating *Eichhornia crassipes* using nitric acid, hydrochloric acid and hydrogen peroxide was also intensively investigated. An attempt to setup Column biosorption indicated that it was not possible to use the free biomass of *Eichhornia crassipes* in a packed column under the influence of gravity, as it was not possible to maintain the initial flow rate.

The experimental equilibrium data were analyzed using the linearized forms of Langmuir and Freundlich isotherms. Both Langmuir and Freundlich isotherm models were found to provide the best theoretical correlation of the experimental data for the biosorption of both methylene blue dye and Congo red dye. The Maximum adsorption capacities of *Eichhornia crassipes* (roots) based on the Langmuir model for methylene blue dye and Congo red dye

were (mg/g) 33.33 and 35.37, respectively, whereas those based on the Freundlich model were (mg/g) 4.46 and 1.44, respectively.

It was found out that the roots of *Eichhornia crassipes* had the highest adsorption capacity followed by stems and leaves. The study shows that 1.0g *Eichhornia crassipes* (roots) has a potential to adsorb 100% of the dye in 100ml of $2.5x10^{-5}$M methylene blue dye solutions within five minutes and 95% of the dye in 50ml of $1.0x10^{-4}$M Congo red dye solutions within 100 minutes.