

Biosorption of copper from aqueous solutions by raw and activated spines of *Bombax buonopozense*: Equilibrium, kinetics and thermodynamic studies

ABSTRACT: Biosorption of copper on raw and activated (AC) spines of *Bombax buonopozense* in a batch system was studied. The percentage removal of copper was found to be a function of pH, contact time, dosage, initial metal concentration and temperature. The experimental results were analyzed with Langmuir, Freundlich, and Dubinin-Radushkevich isotherm models and in each case the Langmuir model appears to have better regression coefficients, R^2 , 0.998 and 0.987 for raw and activated adsorbents respectively. From the kinetic studies the rate constant values for the adsorption process were calculated. Also, various thermodynamic parameters such as ΔG° , ΔH° , ΔS° and E_a were calculated and the result showed that the sorption process was endothermic in nature and that higher solution temperatures favoured metal ion removal by the adsorbents. These results indicated that spines of *Bombax buonopozense* have potential for the uptake of the toxic element (copper) from industrial effluents.

Keywords: Biosorption, Langmuir isotherm, endothermic, kinetic, thermodynamic

INTRODUCTION

Wastewater treatment processes in terms of removal of toxic metals is of great importance in determining the quantity of heavy metals discharged into municipal waters. Discharge of industrial wastewater containing hazardous metals into the environment causes serious environmental problems to human and ecosystems [1, 2]. This is because untreated wastewater from industries and homes end up in rivers and aquatic systems that are sources of livelihood for humans [3]. Most of these rivers are used as sources of drinking water by rural dwellers without any form of treatment and thus increase the chances of several health problems such as cancer, kidney failure, oral ulcer, renal failure and metabolic acidosis [4].

Several techniques are available for the removal of inorganic pollutants (potential toxic metals) from industrial wastewater. The removal of these inorganic pollutants from domestic or drinking water can be achieved through precipitation, flocculation, solvent extraction, ion exchange, reverse osmosis [5], but the process of adsorption has become a preferred method for the removal of toxic contaminants from water because of its effectiveness, economical value, versatility and simplicity [6].

Adsorption is a mass transfer process by which a substance is transferred from the liquid phase to the surface of a solid and becomes bound by physical or chemical interactions [7]. Adsorption processes mostly involve the use of various low cost agricultural by-products for the elimination of heavy metals from wastewater and these include *Moringa oleifera* pod [8], papaya wood [9], neem bark [10]. Most of these are used in form of granular or powdered activated carbon which have been employed as adsorbents for the removal of both heavy metals and organic pollutants from contaminated water.

The goal of this work was to investigate the sorption capacity, thermodynamics and kinetics of raw and activated adsorbents prepared from spines of *Bombax buonopozense* for copper removal.