ABSTRACT

COPPER REMOVAL BY CELLULOSE XANTHOGENATE DERIVED FROM *IMPERATA CYLINDRICA* L. LEAF POWDER

The efficiency of cellulose xanthogenate derived from *Imperata cylindrica* L. leaf powder (CXIC) for removing Cu(II) from aqueous solutions has been investigated. The effects of physicochemical parameters on biosorption capacities such as biosorbent dosage, pH, initial concentration of Cu(II) and contact time were studied. The biosorption capacities of CXIC increased with the rise in pH and Cu(II) concentration but decreased with the increase in biosorbent dose. Biosorption of Cu(II) was considered fast as the time to reach equilibrium was 60 min. Two kinetic models; pseudo-first order and pseudo-second order were applied to analyse the Cu(II) biosorption process, and it was found that the pseudo-second order fitted well with the biosorption data with correlation coefficients (R^2) greater than 0.99. In order to understand the mechanism of biosorption, spectroscopic analyses involving Fourier Transform Infrared (FTIR) and Scanning Electron Microscope (SEM) coupled with Energy Dispersive Spectroscopy (EDS) were carried out on the CXIC. FTIR analyses revealed that -OH, -NH, C=C, COO-, $-CS_2$ and C-O-C as the major functional groups involved in the binding of Cu(II) and complexation was one of the main mechanisms for the removal of Cu(II) as indicated by FTIR spectra. Ion exchange was another possible mechanism involved as indicated by EDS spectra since there was a release of light metal ions during the biosorption of Cu(II). The isotherm study indicated that the CXIC fitted well with the Langmuir model compared to the Freundlich model. Based on the Langmuir model, the maximum biosorption capacity was 18.59 $mg.g^{-1}$.

ABSTRAK

PENYINGKIRAN KUPRUM OLEH XANTHOGENATE SELULOSA DARI SERBUK DAUN *IMPERATA CYLINDRICA* L.

Keberkesanan selulosa xanthogenate terhasil daripada serbuk daun lalang (*Imperata cylindrica* L.) untuk menyingkirkan Cu(II) daripada larutan akueus telah dikaji. Kesan-kesan beberapa parameter fizikokimia ke atas biopenjerapan seperti dos biopenjerap, pH, kepekatan Cu(II) dan masa sentuhan turut dikaji. Kapasiti biopenjerapanan oleh CXIC meningkat dengan peningkatan pH dan kepekatan Cu(II) tetapi menurun dengan peningkatan dos biopenjerap. Tempoh biopenjerapan oleh CXIC dianggap singkat iaitu hanya mengambil 60 min untuk mencapai keseimbangan. Dua model kinetik; tertib pseudo pertama dan tertib pseudo kedua telah digunakan untuk menganalisis proses biopenjerapan bagi Cu(II) dan didapati bahawa tertib pseudo kedua adalah sepadan dengan data biopenjerapan di mana R^2 adalah melebihi 0.99. Bagi memahami mekanisma biopenjerapan, analisis spektroskopi melibatkan 'Fourier Transform Infrared' (FTIR) dan 'Scanning Electron Microscope' (SEM) digabung bersama 'Energy Dispersive Spectra' (EDS) telah dijalankan ke atas CXIC. Analisis FTIR menunjukkan bahawa -OH, -NH, C=C, COO-, $-CS_2$ and C-O-C adalah kumpulan berfungsi utama yang terlibat di dalam pengikatan Cu (II) dan pengkompleksan adalah salah satu mekanisma utama terhadap penyingkiran Cu (II) seperti yang ditunjukkan oleh spektra FTIR. Pertukaran ion merupakan satu lagi mekanisma yang mungkin terlibat seperti yang ditunjukkan oleh spektra EDS kerana terdapat penyingkiran ion-ion logam ringan sepanjang biopenjerapan Cu (II). Kajian isoterma menunjukkan CXIC menepati model Langmuir berbanding model Freundlich. Berdasarkan model Langmuir, kapasiti maksimum biopenjerapan adalah 18.59 $mg.g^{-1}$.

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Zubir bin Othman

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

SEM	: Scanning Electron Microscope
EDS	: Energy Dispersive Spectroscopy
FTIR	: Fourier Transform Infra-red
CXIC	: Cellulose Xanthogenate of *Imperata cylindrica* L.
ICP-OES	: Inductively Coupled Plasma – Optical Emission Spectroscopy
$mg.L^{-1}$	: Milligram per litre
$mg.g^{-1}$	: Miligram per gram
COD	: Chemical Oxygen Demand
BOD	: Biological Oxygen Demand
TOC	: Total Organic Carbon
M	: Molar
UIC	: Untreated *Imperata cylindrica* L.
KBr	: Potassium bromide
HCl	: Hydrochloric acid
NaOH	: Sodium hydroxide
Cu	: Copper
Cd	: Cadmium
Cr	: Chromium
Mn	: Manganese
U	: Uranium
V	: Vanadium
Zn	: Zinc
Ni	: Nickel

Pb	: Lead
Hg	: Mercury
As	: Arsenic
Ti	:Titanium
Ba	: Barium
Mg	: Magnesium
Na	: Sodium
Cu(II)	: Copper (II) ion
g	: gram
%	: percentage
k	: kilo
eV	: electron volt
H^+	: hydrogen ion
min	: minute
sec	: second
Neb	: nebulizer
Aux	: auxillary
ml	: mililitre
rpm	: rotation per minute
min^{-1}	: per minute
R^2	: regression coefficient
$q_{e,cal}$	: calculated value of biosorption capacity
$q_{e,exp}$	: experimental value of biosorption capacity
q_{max}	: maximum value of biosorption capacity
nm	: nanometre

LIST OF APPENDICES