UNIVERSITI MALAYA

ORIGINAL LITERARY WORK DECLARATION

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Name of Degree: MASTER OF TECHNOLOGY (ENVIRONMENTAL MANAGEMENT)

Title of Project Paper/Research Report/Dissertation/Thesis ("this Work"):

Adsorption Studies of Methylene Blue using Selected agro-wastes as Low Cost Adsorbents

Field of Study:

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ABSTRACT

Today, there are a lot of dyes available commercially. Effluent discharge from textile industries to neighbouring water bodies is currently causing significant health problem. Synthetic dyes used in textile industries, if not treated prior to its disposal can enter our water systems and cause pollution. The study was performed using different agro-wastes namely kenaf (FH 990), banana stem, and sugarcane bagasse to produce low cost industrial adsorbents. Adsorption method was applied in removing methylene blue (MB) dye from aqueous solution. The aims of this study are to investigate the adsorption capacity under optimal parameters and compare the cost effectiveness together with the calorific value of adsorbents before and after the treatment. The characteristics of wastewater effluent was examined and the characteristics of adsorbents were determined by using FTIR, FESEM and BET analysis. The experiments were conducted in single adsorbate system by batch technique to determine the optimum condition for higher adsorbency. The determination of optimum conditions was carried out in different pH (2 - 10), agitation time (5- 300 minutes), initial concentration (10 – 70 mg/L) and temperature (20 - 100 ºC). The adsorption isotherms of Langmuir and Freundlich were employed to examine the equilibrium adsorption data. Thermodynamic parameters such as $\Delta H°$, $\Delta S°$ and $\Delta G°$ were also calculated. The optimal adsorption was achieved by banana stem with the adsorption capacity of 68.47 mg/L and maximum removal percentage of 97.82 % for initial methylene blue concentration of 70 mg/L. The adsorption of methylene blue can be well describes by Freundlich isotherm and the adsorption process was found to be exothermic and spontaneous for all the adsorbents. Thus, all results indicated that the selected agro-wastes could be employed as an effective new low cost adsorbent for the removal of textile dyes from aqueous solutions.

ABSTRAK

Kini, terdapat banyak pewarna yang boleh didapati secara komersial. Pembuangan efluen dari industri tekstil ke dalam sistem pengairan telah menyebabkan masalah kesihatan yang ketara. Pewarna sintetik yang digunakan dalam industri tekstil boleh menyebabkan pencemaran jika tidak dirawat sebelum dilepaskan ke dalam sistem air. Kajian ini dilakukan dengan menggunakan sisa pertanian terpilih iaitu kenaf (FH 990), batang pisang dan hampas tebu untuk menghasilkan penjerap perindustrian kos rendah. Kaedah penjerapan telah digunakan untuk menyingkirkan pewarna metilena biru (MB) daripada larutan cecair. Tujuan kajian ini adalah untuk mengkaji kapasiti penjerapan di bawah parameter optimum dan membandingkan keberkesanan kos bersama dengan nilai kalori adsorben sebelum dan selepas rawatan. Ciri-ciri air sisa efluen telah dikaji dan ciri-ciri penjerap ditentukan dengan menggunakan analisis FTIR, FESEM dan BET. Kajian ini telah dijalankan dengan menggunakan sistem penjerapan berkala untuk menentukan keadaan yang optimum untuk penyerapan yang lebih tinggi. Rawatan ini termasuk penentuan keadaan optimum pada pH yang berbeza (2 - 10), masa pergolakan (5-300 minit), kepekatan awal (10 - 70 mg / L) dan suhu (20 - 100 ºC). Sesuhu penjerapan Langmuir dan Freundlich telah digunakan untuk mengkaji data penjerapan pada keseimbangan. Parameter termodinamik seperti $\Delta H°$, $°\Delta S$ dan $\Delta G°$ juga telah dikira. Penjerapan optimum telah diperolehi dengan menggunakan batang pokok pisang dengan kapasiti penjerapan 68.47 mg/L dan kadar penjerapan maksimum 97.82% bagi kepekatan metilena biru sebanyak 70 mg/L. Penjerapan metilena biru dapat diterangkan dengan isoterma Freundlich di mana penjerapan didapati adalah proses eksotermik dan spontan untuk semua bahan penjerap. Keputusan menunjukkan bahawa sisa pertanian boleh digunakan sebagai bahan penjerap baru yang berkesan untuk penyingkiran pewarna tekstil dari larutan cecair dengan kos yang rendah.

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LIST OF SYMBOLS AND ABBREVIATIONS

mL	Millilitre
cm^{-1}	unit used for wavenumber
%	Percentage
mg/L	Milligram per litre
L/mg	Litre per milligram
$J\ K^{-1}\ mol^{-1}$	Gas constant
ΔG°	Gibbs free energy change
ΔS°	Entropy change
ΔH°	Enthalpy change
nm	Nanometre
μm	Micrometre
Kj/mol	Kilojoule per mole
K	Kelvin
°C	Degree Celsius
g	Gram
L	Litre
mm	millilitre
min	minute
g/L	Gram per litre
mg/g	Milligram per gram
R^2	Linear correlation
mV	Megavolt

m^3/mol	Metre square per mole
cm	Centimetre
atm	Atmospheric pressure
FAU	Formazin Attenuation Unit
cm^3	Centimetre square
Å	Angstrom
m^2/g	Metre square per gram
cm^2/g	Centimetre square per gram
K_F	Freundlich constant
n	Freundlich exponent related to adsorption intensity
Q_m	Maximum amount of adsorption
b	Adsorption equilibrium constant
MIDA	Malaysia Industrial Development Authority
Matrade	Malaysia External Trade Development Corporation
NaOH	Sodium hydroxide
H_2O_2	Hydrogen peroxide
AOX	Adsorbable organic halides
IUPAC	International Union of Pure and Applied Chemistry
MB	Methylene Blue
LMB	Leukomethylene blue
COD	Chemical oxygen demand

BOD	Biological oxygen demand
RO	Reverse osmosis
DO	Dissolved oxygen
rpm	Rate per minute
FTIR	Fourier transform infrared spectroscopy
UV-VIS	Visible and Ultraviolet Spectroscopy
TDS	Total dissolved solids
TSS	Total suspended solids
FESEM	Field Emission Scanning Electron Microscopy