SYNTHESIS AND INTERACTION MECHANISM OF ZWITTERIONIC ADSORBENT COATING FOR CATIONIC AND ANIONIC DYES REMOVAL

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by

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LIST OF SYMBOLS

λ_{max}	maximum wavelength
V	volume
W	weight
C_0	highest initial adsorbate concentration
C_e	equilibrium concentration of adsorbate
C_t	liquid-phase concentrations
q_e	amount at equilibrium
Q_m	maximum adsorption amount
K_L	Langmuir constant
R^2	correlation coefficient
R	Universal gas constant

LIST OF ABBREVIATIONS

ATR-FTIR	Attenuated Total Reflectance Fourier Transform Infrared
AAS	Atomic Absorption Spectrometry
APE	Acrylic Polymer Emulsion
AR 1	Acid Red 1
AB 75	Acid Brown 75
AO	Acid Orange
ASTM	American Society for Testing and Materials
BG	Brilliant Green
BY 28	Basic Yellow 28
CEC	Cationic Exchange Capacity
CMC	Carboxy Methyl Cellulose
CV	Crystal Violet
CS	Chitosan
DO	Dissolved Oxygen
EDX	Energy-dispersive X-ray spectroscopy
ENR	Epoxidized Natural Rubber
EPIDMA	Epichlorohydrin Dimethyl Amine
HDTMA-Br	Hexadecyltrimethylammonium bromide
ICP-OES	Inductively Couple Plasma Atomic Emission Spectroscopy
LDH	Layered Double Hydroxide
MB	Methylene Blue
MCM	Microfibriller Cellulose Mat
MG	Malachite Green

MMT	Montmorillonite
MR	Methyl Red
MIDA	Malaysian Investment Development Authority
PAA	Polyacrylate
PEG	Polyethylene glycol
pHpzc	pH potential zeta charge
PVA	Polyvinyl alcohol
PVC	Polyvinyl Chloride
PVDF	Vinylidene difluoride
RBBR	Remazol Brilliant Blue R
RO 16	Reactive Orange 16
SEM	Scanning Electron Microscope
SMX	Sulfamethoxazole
UV-Vis	Ultra- Violet Spectrophotometer
VOC	Volatile Organic Compound
XRF	X-ray Fluorescence
ZwitAd	Zwitterionic Adsorbent Coating

SINTESIS DAN MEKANISME INTERAKSI LAPISAN PENJERAP ZWITERION UNTUK PENYINGKIRAN BAHAN PEWARNA KATION DAN ANION

ABSTRAK

Penjerapan adalah satu teknik yang digunakan secara meluas dalam rawatan air sisa berwarna kerana proses ini pratikal, murah, cekap dalam pengoperasian dan fleksibel dalam reka bentuk bahan penjerapnya. Walaubagaimana pun, penjerap yang berbentuk serbuk halus dan berkepingan yang mempunyai nano-saiz, bentuk tidak sekata dan ketumpatan yang tidak stabil akan mengakibatkan kesukaran terutamanya dalam system aliran berterusan. Oleh yang demikian, kajian ini telah memberi tumpuan kepada penghasilan lapisan penjerap yang mempunyai fungsi zwitterion untuk penyingkiran bahan pewarna kation dan anion dari larutan akueus. Lapisan penjerap disediakan melalui kaedah yang mudah dengan menggunakan kombinasi bahan seperti aditif (tanah liat bentonit), surfaktan (polielektrolit kation, EPIDMA), pelarut (air suling) and pengikat (emulsi polimer akrilik, APE), yang kemudiannya di salut ke atas kain kapas sebagai substrak. Nisbah formula yang optimum telah disahkan sebagai 1: 2: 4, yang bersamaan dengan bentonit (g): APE (g): EPIDMA (wt.%). Lapisan penjerap zwiterion yang selepas ini dirujuk sebagai ZwitAd telah di cirikan dan di analisis untuk memastikan sifat kimia dan fizikalnya. ZwitAd mempamerkan prestasi yang baik dalam kecekapan penyingkiran dan keupayaan penjerapan untuk kedua-dua jenis pewarna sama ada secara penjerapan tunggal atau serentak, bersama-sama dengan kekuatan salutan yang baik, dan stabil dari sudut kimia dan haba. Mekanisma penjerapan pewarna boleh digambarkan melalui tarikan elektrostatik antara permukaan penjerap amphoterik (caj positif dan negatif) dengan anionik sulfonat

$-SO_3^-$ dari pewarna Acid Red 1 (AR1) dan $(=NH)^+$ dari pewarna Brilliant Green (BG). Tarikan lain juga melibatkan ikatan hidrofobik dan hidrogen. Kesan kepekatan awal pewarna (10 ppm-250 ppm), dos penjerap (0.1 g- 0.5 g), pH awal (2-12), kekuatan ionik (1 g / L - 5 g / L) dan kesan suhu (30-70 ° C), kesan pewarna binari dan tertiari, penjerapan pada jenis pencemar lain dan kajian kitaran juga dikaji secara mendalam. Di samping itu, keseimbangan isoterma, kinetik, termodinamik dan kajian mekanisme juga dinilai. Keputusan menunjukkan dengan bertambahnya masa dan kepekatan pewarna, membawa kepada pertambahan keupayaan penjerap ZwitAd terutama untuk penyingkiran pewarna AR 1. Variasi dalam kepekatan awal pewarna dari 50 mg/L hingga 250 mg/L memberikan peningkatan keupayaan penjerap dari 33.33 mg/g kepada 74.50 mg/g untuk pewarna AR 1 dan 34.83 mg/g kepada 183.01 mg/g untuk pewarna BG. Selain itu, ZwitAd sangat baik menjerap dalam jangkauan pH dari 2 hingga 12. Maksimum 10 kali kitaran penjerapan-penyahjerapan pewarna BG dicapai dengan menggunakan kebolehsanaan pemulihan secara terma. Data penjerapan yang diperolehi dinilai berdasarkan keseimbangan isoterma dan kedua-dua pewarna mengikut isotherm Freundlish. Model tersebut menunjukkan penjerapan terdiri daripada pelbagai lapisan heterogen. Kajian kinetik menunjukkan pewarna AR 1 mengikuti pseudo-tertib pertama dan pewarna BG mengikuti pseudo-tertib kedua. Kajian termodinamik juga mendedahkan bahawa penjerapan berlaku proses spontan dan endotermik. Kajian semasa mendapati ZwitAd berpotensi sebagai lapisan penjerap yang boleh dilaksanakan dan praktikal untuk teknologi rawatan air sisa di masa hadapan.