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Performance Evaluation of asymmetric nanofiltration membran
: Effect of dye concentration on dye removal treatment /
Farhanah Sulaiman.

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Universiti Malaysia Terengganu (UMT)

PERFORMANCE EVALUATION OF ASYMMETRIC NANOFILTRATION MEMBRANE: EFFECT OF DYE CONCENTRATION ON DYE REMOVAL TREATMENT

By

Farhanah Sulaiman

Research Report submitted in partial fulfillment
of the requirements for the degree of
Bachelor of Science (Environmental Technology)

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Faculty of Science and Technology
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JABATAN SAINS KEJURUTERAAN
FAKULTI SAINS DAN TEKNOLOGI
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Performance Evaluation of Asymmetric Nanofiltration Membrane: Effect of Dye Concentration on Dye Removal Treatment oleh FARHANAH BINTI SULAIMAN, No. Matrik UK8033 telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Kejuruteraan sebagai memenuhi sebahagian daripada keperluan memperolehi Ijazah SARJANA MUDA TEKNOLOGI (ALAM SEKITAR), Fakulti Sains dan Teknologi, Universiti Malaysia Terengganu.

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LIST OF ABBREVIATION AND SYMBOLS

Abbreviations/ Symbol

DD	Diffusion Dialysis
ED	Electrodialysis
EKA	Electokinetic Analyzer
GS	Gas Separation
INOS	Institute Oceonography
MC	Membrane Contactors
MD	Membrane Distillation
ME	Membrane Electrolysis
MF	Microfiltration
NaCl	Sodium Chloride
NF	Nanofiltration
NMP	N-methyl-2-pyrrolidone
PES	Polyethersulfone
PSf	Polysulfone
PV	Pervaporation
RB5	Reactive Black 5
RO	Reverse Osmosis
SEM	Scanning Electron Microscopy
SR	Shear Rate

TFC	Thin Layer Film
UF	Ultrafiltration
UMT	University Malaysia Terengganu
VP	Vapor Permeation
A	Effective area of membrane (m^2),
C_p	Salt concentration in permeate (mol/liter)
C_b	Salt concentration in bulk (for dead end filtration) (mol/liter)
C_w	Salt concentration in wall (mol/liter)
d	Diameter
D_S	Solute diffusivity (m^2/s)
J_v	Flux (m^3/m^2 s)
K	Coefficient value, J/ K
r_p	Pore radius
r_s	Radius solute
R_{obs}	Observed rejection
$R_{real.}$	Real rejection
t	Permeation time (s)
T	Temperature
ΔP	Applied Pressure (Pa)
μ	Absolute viscocity (Pa.S)
V	Volume of permeate solution collected, (m^3)
Xd	Effective charges density

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ABSTRACT

Membranes has been received a great deal of attention as an alternative that can be used for the purification of dye complex wastewater streams. Asymmetric NF membrane meets the necessary standards caused by the capability to retain ions as well as relatively small organic molecules from an aqueous solution. Asymmetric NF membrane was developed to evaluate the efficiency of asymmetric NF membrane for dye removal application. Asymmetric NF membranes were developed by the dry/wet phase inversion method from casting solutions containing 23% Polysulfone (PSf) as polymer and N-methyl-2 pyrrolidone (NMP) as solvent using a semi automated electrically controlled casting machine. Membrane had been fabricated at the three different of shear rate (353.9 s^{-1}, 232.6 s^{-1} and 161.8 s^{-1}). Pure water flux was measured before the membranes were characterized in term of salt rejection and theoretical approach. The morphology of the membranes were observed by using Scanning Electron Microscopy (SEM) for identifying of the membrane structure Membrane performance have been measured by employing five aqueous solution of Reactive Black 5 with concentration of 100 mg/l to 500 mg/l. Operating pressure in the range 2 bars to 10 bars were applied. According to the experimental result of pure water flux and applied Steric Hindrance Pore model, the highest shear rate gives the best performance of membrane. In the investigation on effect of dyes concentration, flux was decreased when increasing RB5 concentration. Flux decline was happen during the time caused by fouling. RB 5 rejection proportionally increased with the RB5 concentration. Donnan effect became a dominant in this separation process. Application of dye removal exceeding 90% of dyes will promise advanced treatment option for pollution control in dye complex wastewater streams.

ABSTRAK

Membran merupakan altenatif yang terbaik yang boleh digunakan untuk menyingkirkan pewarna komplek dalam airsisa. Proses membran yang mencapai keperluan piawai adalah membran penuras nano asimetrik disebabkan keupayaan menahan ion dan molekul organik yang kecil daripada larutan akues. Tujuan kajian ini dilaksanakan adalah untuk pencirian membran penuras nano asimetrik terbaik dan mengkaji kesan kepekatan pewarna terhadap membran tersebut. Membran penuras nano asimetrik di sediakan melalui kaedah balikan fasa kering / basah menggunakan larutan polysulfone (PSf) berkepekatan 23% sabagai polimer dan N-methyl-2 pyrrolidone (NMP) sabagai pelarut menggunakan mesin pengacuan elektrik separa automatik. Membran di sediakan mengikut tiga perbezaan kadar ricih (353.9 s^{-1}, 232.6 s^{-1} and 161.8 s^{-1}). Membran di nilai berdasarkan ketelapan air dan penciriannya berdasarkan peratus penyingkiran garam dan penggunaan teori model. Morfologi membran dikaji menggunakan pengimbas mikron elektroskopik untuk mengenalpastian struktur membran terbaik. Prestasi membran di nilai dengan menggunakan lima larutan Reactive Black 5 dengan kepekatan 100 mg/l sehingga 500 mg/l. Tekanan yang digunakan adalah berjulat di antara 2 bar hingga 10 bar. Berdasarkan keputusan eksperimen ujian ketelapan air dan penggunaan model, didapati kadar ricih tertinggi menghasilkan membran berprestasi tinggi. Fluk semakin berkurang dengan pertambahan kepekatan RB5. Penurunan fluk berlaku mengikut masa disebabkan sekatan molekul pada liang membran. Penyingkiran RB5 adalah berkadar langsung dengan kepekatan. Kesan Donnan adalah dominan dalam proses ini. Aplikasi penyingkiran pewarna yang melebihi 90% akan menjanjikan pilihan rawatan terbaik untuk kawalan pencemaran di dalam airsisa berpewarna.