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FAKULTI SAINS DAN TEKNOLOGI
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Lihat sebelah

A STUDY ON MEMBRANES PROPERTIES AND EFFICACY OF POLYMERIC MEMBRANES FOR BACTERIAL REMOVAL

By

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PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK PENYELIDIKAN I DAN II

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:
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LIST OF ABBBREVIATIONS

Symbol

CA	-	Cellulose Acetate
C_p	-	Concentration of permeate solution
C_f	-	Concentration of feed solution
C_r	-	Concentration of retentate solution
C_b	-	Bulk concentration
CFU	-	Colony-forming units
HUS	-	Hemolytic uremic syndrome
K	-	Mass transfer coefficient
MF	-	Microfiltration
MW	-	Molecular weight
NaCl	-	Sodium chloride
NF	-	Nanofiltration
NMP	-	N-methyl-2-pyrrolidone
NMWCOs	-	Molecular weight cut-offs
PES	-	Polyethersulfone
PVP	-	Polyethersulfone
P_m	-	Permeability coefficients
P_s	-	Solute permeability
PSf	-	Polysulfone

RO	-	Reverse Osmosis
R	-	Rejection
r_p	-	Pore radius
r_s	-	Solute radius
S_F, S_D	-	Distribution coefficient of solute by steric hindrance effect under diffusion and convection condition, respectively
SEM	-	Scanning Electron Microscopy
UF	-	Ultrafiltration
Uf 1	-	Polymer concentration PSf 13 %
Uf 2	-	Polymer concentration PSf 15 %
Uf 3	-	Polymer concentration PSf 17 %
Δx	-	Effective membrane thickness
η	-	Ratio of solute radius
σ	-	Reflection coefficient

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ABSTRACT

Water contains a certain number of viruses, bacteria and other microorganisms, which can cause several diseases. Production of disinfected water with constant high quality by use of membrane technology is a good alternative for the conventional treatment techniques. Ultrafiltration (UF) is a pressure-driven membrane process that separates on the basis of size and can remove bacteria. Therefore, UF can be applied for disinfecting water to avoid illnesses. The objectives of this study are to investigate the effect of polymer concentration towards the membrane structure and performance and to characterize membrane morphology and the structure parameters by using theoretical model. The membrane is fabricated from a ternary composition consisting of polysulfone (PSF) as polymer, N-metil-2-pyrolidone (NMP) as solvent and polyvinylpyrolidone (PVP) as additive from different formulation (13%, 15% and 17%) by a simple dry/wet phase inversion process using an electrically controlled Flat sheet membrane casting machine. The membrane permeability and performance were determined based on the pure water flux, sodium chloride solution permeation test and application to bacteria (*E.coli*) removals. The morphology of each membrane will be characterized using Scanning Electron Microscope (SEM) and the measurement of membrane parameters was conducted using steric-hindrance pore (SHP) model. The result of rejection ability towards Cl^- ions was shown in the following manners: PSf 13% > PSf 17% > PSf 15%. While, the removal of *E.coli* achieved 100% of rejection with no bacteria content in water for all membrane produced and for the flux of rejection shows that the lowest polymer concentration (PSf 13%) had the highest flux. From the modeling result, it was found that the polymer concentration can influence the membrane performance by varying the structural details. Through the observation using scanning electron microscopy (SEM), it was shown that the produced membrane exhibited a finger like structure. These findings suggested that the best polymer concentration is lying on PSf 13% with PVP as additive. Beside, the high percentage of *E.coli* rejection obtained shown a great potential of applying ultrafiltration membrane in rejection of microorganism.

ABSTRAK

Air mengandungi jumlah virus, bakteria dan mikroorganisma tertentu yang boleh menyumbang kepada beberapa jenis penyakit. Penghasilan air yang berkualiti yang bebas dari bakteria menggunakan membran teknologi adalah pilihan yang tepat bagi teknik rawatan air. Membran penuras ultra adalah proses pemisahan bertekanan mengunakan dasar saiz bagi pemisahan bacteria. Oleh itu, membran ultra boleh digunakan sebagai pemisahan bakteria tanpa menyebabkan sebarang penyakit. Objektif bagi kajian ini adalah untuk mengkaji kesan kepekatan polimer ke atas struktur dan prestasi membran dan menganalisa struktur serta parameter membran dengan menggunakan model. Membran dihasilkan menggunakan komposisi campuran tiga bahan iaitu Polisulfon (PSf), N-metil-pyrrolidon (NMP) dan polivinilvirrolidon (PVP) dengan kandungan peratusan komposisi yang berbeza menerusi kaedah pembalikan fasa kering/basah dengan menggunakan mesin penghasilan kepingan rata elektrik. Ketelapan dan prestasi membran ditentukan berdasarkan fluk air tulen, ujian ketelapan larutan natrium dan aplikasi ke atas penyingkiran bakteria. Morfologi setiap membran dikaji menggunakan pengimbas elektron mikroskopik (SEM) dan pengukuran parameter membran dilakukan menggunakan model steric-hindrance pore (SHP). Keputusan bagi kebolehan penyingkiran terhadap ion Cl^- ditunjukkan dalam keadaan berikut: PSf 13% > PSf 17% > PSf 15%. Manakala, penyingkiran *E.coli* telah mencapai 100% tersingkir dengan tiada bakteria terkandung dalam air bagi kesemua membran yang dihasilkan tetapi bagi flux penyingkiran menunjukkan kepekatan polimer terendah (PSf 13%) mempunyai flux yang tertinggi.Daripada keputusan permodelan, didapati kepekatan polimer mempengaruhi prestasi membran menerusi perbezaan struktur secara terperinci. Penemuan ini turut mengesyorkan kepekatan polimer yang terbaik adalah pada kepekatan PSf 13% dengan PVP sebagai campuran. Selain itu, peratus penyingkiran bakteria yang tinggi menunjukkan peluang yang besar dalam mengaplikasikan teknologi membran penuras ultra bagi penyingkiran bakteria.