FABRICATION OF ASYMMETRIC NANOFILTRATION MEMBRANE USING BINARY, TERNARY, AND QUATERNARY COMPONENT

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2005

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

Department of Engineering Science
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KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA
2005

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PROJEK PENYELIDIKAN I DAN II

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oleh Norlisa Bt Ahmad Subki No. Matrik UK 6583 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, Kolej Universiti Sains dan Teknologi Malaysia.

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ACKNOWLEDGEMENT

Syukur alhamdulillah in the name of ALLAH S.W.T, the most Gracious and Merciful I finally finished my thesis. After all hard work and hard task that I have been through, by hook or by cook, I finally managed to finish it in time. First of all, I would like to express my appreciation and thanks to my supervisor, Dr Nora'aini Ali for her courage and guidance, to En Asmadi Ali as my co-supervisor who always supported me and also to En Zul Hassan in completing this task. Million of thanks I dedicated specially to the head department Faculty of Science and Technology(FST), Prof Madya Ir Md Jusoh. Besides that, to all KUSTEM lecturers and staffs for their cooperation and understands my needs in finishing this project.

My deepest love and gratitude for my dearest parents, Ahmad Subki Haji Ahmad and Nor Sulaiman for their warmest love and attention they gave to me. To all my classmates and close friends, a bunch of thanks I give to you all. Last but not least, to all the people I have mentioned above and for those I did not, my deepest love and appreciation I specially dedicated for them. Thank you.

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LIST OF SYMBOLS

Cb	concentration of bulk solution ($molm^{-3}$)
Cp	concentration of permeate solution ($molm^{-3}$)
Cw	wall concentration
Deff,∞	effective bulk diffusivity (m^2s^{-1})
H_2O	Water
Jv	flux (m^3/s)
k	mass transfer coefficient
MWCO	molecular weight cut off
NMP	N-Methyl-2-Pyrrolidone
PEG	polyethylene glycol
PES	Polyethersulfone
P_m	permeability coefficient
PSf	Polysulfone
PVP	Polyvinylpyrrolidone
r	radius of influence (cm)
TEG	tetra ethylene glycol
υ	kinematic viscosity (m^2s^{-1})
ω	stirring speed ($rads^{-1}$)

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ABSTRACT

Membranes can be built from binary (polymer and solvent), ternary (polymer, solvent and non-solvent) and quaternary component (polymer, solvent, non-solvent and additive). This study is to investigate the asymmetric nanofiltration membrane performance in those three components. Two sets of formulation were prepared using polyethersulfone (PES) as the polymer, N-methyl-2-pyrrolidone (NMP) as the solvent, water (H_2O) as the non-solvent and polyvinylpyrrolidone (PVP) as the additive. The first formulation has the same PES percentage (23%) coded as B23, T23 and Q23 while the second formulation has different PES percentage (binary 23%, ternary 21% and quaternary 16%) coded as B23, T21 and Q16. The flat sheet membrane were prepared using dry-wet phase inversion technique and cast on semi-automated electrical casting machine. The liquid separation performance was measured using pure water and sodium chloride (NaCl) permeation test and the membrane structure was analyzed using scanning electron microscopy (SEM). The experimental result gives B23 as the highest pure water permeability (21.24 x 10^{-6} m^3/ m^2sec.MPa) with finger-like structure. Q16 exhibits the best performance among other components, where it gives moderate flux (from 0 to 6.4 m^3/ m^2sec) and high in rejection (from 0 to 26%). From the findings, it can be concluded that the introduction of additives in the casting solution will increase the membrane performance with sponge structure (small voids in the upper layer of the membrane)

ABSTRAK

Membran boleh dibina daripada komponen binari (polimer dan pelarut), ternari (polimer, pelarut dan bukan pelarut) dan kuaternari (polimer, pelarut, bukan pelarut dan aditif). Kajian ini dijalankan untuk membandingkan prestasi membran asimetrik penuras nano dalam ketiga-tiga komponen tersebut. Dua set formulasi disediakan menggunakan polyethersulfone (PES) sebagai polimer, N-methyl-2-pyrrolidone (NMP) sebagai pelarut, air (H_2O) sebagai bukan pelarut dan polyvinylpyrrolidone (PVP) sebagai aditif. Formulasi yang pertama mempunyai peratus polimer yang sama untuk setiap komponen (23%) yang dikodkan sebagai B23, T23 dan Q23. Formulasi yang kedua pula menggunakan peratus polimer yang berbeza bagi setiap komponen (binari 23%, ternari 21% dan kuaternari 16%) yang dikodkan sebagai B23, T21 dan Q16. Membran kepingan rata disediakan menggunakan teknik fasa basah-kering dan diacuankan menggunakan mesin acuan separa automatik. Prestasi pengasingan cecair dijalankan mengggunakan air dan larutan garam (NaCl) dan struktur membran dianalisa menggunakan *scanning electron microscopy* (SEM). Keputusan eksperimen yang didapati ialah B23 menunjukkan pemalar kebolehtelapan air yang tertinggi (21.24×10^{-6} $m^3/ m^2sec.MPa$) dengan struktur membran berbentuk jari. Q16 pula menunjukkan prestasi terbaik jika dibandingkan dengan komponen ternari dan binari, di mana ia memberikan lingkungan fluks yang sederhana (daripada 0 to 6.4 m^3/ m^2sec) dan lingkungan penolakan ion garam yang tinggi(daripada 0 to 26%). Daripada kajian, boleh disimpulkan bahawa penambahan aditif ke dalam larutan dop akan meningkatkan prestasi membran dengan struktur berspan(kelompang kecil pada permukaan atas membran)