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1100103669
Preparation, characterization and performance of
polyethersulfone/teraoctylphosphonium bromide (PES/TOPB)
nanocomposite ultrafiltration membrane in protein separation /
Kuan Shi Yun.

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RECEIVED 18 OCT 2018		

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PREPARATION, CHARACTERIZATION AND PERFORMANCE OF
POLYETHERSULFONE/TETRAOCTYLPHOSPHONIUM BROMIDE
(PES/TOPBr) NANOCOMPOSITE ULTRAFILTRATION MEMBRANE
IN PROTEIN SEPARATION

By
KUAN SHI YUN

A PITA report submitted in partial fulfillment of
the requirements for the award of the degree of
Bachelor of Technology (Environment)

SCHOOL OF OCEAN ENGINEERING
UNIVERSITI MALAYSIA TERENGGANU
2016



SCHOOL OF OCEAN ENGINEERING
UNIVERSITI MALAYSIA TERENGGANU

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This PITA research report entitled *Preparation, Characterization and Performance of Polyethersulfone/Tetraoctylphosphonium Bromide (PES/TOPBr) Nanocomposite Ultrafiltration Membrane in Protein Separation* is prepared and submitted by Kuan Shi Yun, Matric No. UK 29559 in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (Environment) has been examined and is recommended for approval of acceptance.

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DECLARATION

I hereby declare that this PITA research report entitled entitled *Preparation, Characterization and Performance of Polyethersulfone/Tetraoctylphosphonium Bromide (PES/TOPBr) Nanocomposite Ultrafiltration Membrane in Protein Separation* is the result of my own research except as cited in the references.

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ACKNOWLEDGEMENT

First and foremost, I am grateful to God for the good health and wellbeing that were necessary to complete this thesis.

I wish to express my sincere thanks and gratitude to my supervisor, Dr. Asmadi bin Ali@Mahmud for the continuous guidance and encouragement. I am extremely grateful and indebted to him for sharing expertise, and sincere and valuable knowledge extended to me.

I would like to take this opportunity to convey my appreciation to all the science officers, laboratory assistants. Without their help and guidance in regards to my research, I would not have completed my laboratory analysis smoothly.

My fellow labmates in Universiti Malaysia Terengganu, thank you for the times we were working together before deadlines and all the fun we have had in the past year. I would also like to convey my profound gratitude to my family for their constant support, encouragement and understanding throughout my research.

Last but not least, I also place on record, my sense of gratitude to one and all, who directly and indirectly have lent their hands in this venture.

PREPARATION, CHARACTERIZATION AND PERFORMANCE OF POLYETHERSULFONE/TETRAOCTYLPHOSPHONIUM BROMIDE (PES/TOPBr) NANOCOMPOSITE ULTRAFILTRATION MEMBRANE IN PROTEIN SEPARATION

ABSTRACT

Ultrafiltration is a process which has been employed in many different industries to separate micro-solutes from macromolecules and to polish waste water. The hydrophilicity, porosity and mechanical strength of UF membrane are significant in membrane separation process. Polyethersulfone is a hydrophobic polymer that is prone to membrane fouling especially in protein separations. It is well known that increasing the hydrophilicity of membrane will decrease the hydrophobicity of membranes. Thus, the hybrid membrane between polyethersulfone (PES) and tetraoctylphosphonium bromide (TOPBr) is selected as a way to improve the hydrophilicity as well as thermal and mechanical properties of the native membrane. The objectives of this study are to prepare and characterize PES/TOPBr nanocomposite membrane at different modified nanoclay content by means of functional groups, morphology, thermal, mechanical, water content, porosity, pure water flux and protein separation test which best loading content of TOPBr is identified. The membrane with the best loading content is then analyzed based on protein separation affected by pH and ionic strength. FTIR and XRD results revealed the formation of exfoliated clay mineral layers in PES matrix. SEM results revealed more pores and finger-like cavities on the asymmetric membranes. Thermal stability, mechanical strength, water content, porosity, pure water flux and protein separation were improved with addition of nanoclay. PES membrane with 0.8 wt % of TOPBr was selected as best loading content based on its characterization and performance study. The membrane then underwent protein separation in different pH and ionic strength. The highest BSA flux was obtained at pH 6 while highest rejection at pH 3. The highest flux and saline rejection was obtained at 0.1 M. All in all, the findings from this study are very essential which may inaugurate towards the critical knowledge of separation performance of nanocomposite membranes.

**PENYEDIAAN, PENCIRIAN DAN PRESTASI
POLYETHERSULFONE/TETRAOCTYLPHOSPHONIUM BROMIDE
(PES/TOPBr) NANOKOMPOSIT ULTRATURASAN MEMBRAN
DALAM PEMISAHAN PROTEIN**

ABSTRAK

Ultraturasan adalah satu proses yang telah digunakan dalam pelbagai industri berbeza untuk memisahkan bahan larut mikro dari makromolekul dan pembersihan air sisa. Kehidrofilikan, keliangan dan kekasaran permukaan membran serta kekuatan mekanikal membrane UF memainkan peranan yang penting dalam proses pemisahan membran. Walau bagaimanapun, factor pengotoran membran adalah satu masalah yang serius terutamanya bagi pemisahan protein kerana kehidrofobikan membran. Ia adalah umum bahawa peningkatan kehidrofilikan membran akan mengurangkan kehidrofobikan membran. Oleh itu, membran hibrid antara polyethersulfone (PES) dan tetraoctylphosphonium bromide (TOPBr) dipilih sebagai satu cara untuk meningkatkan kehidrofilikan dan juga kestabilan haba dan mekanikal membran asli. Objektif kajian ini adalah untuk menyediakan dan mencirikan PES/TOPBr membrane nanokomposit pada kandungan TOPBr yang berbeza melalui kumpulan berfungsi, morfologi, haba, mekanikal, kandungan air, keliangan, fluks air tulen dan ujian pengasingan protein di mana kandungan TOPBr yang terbaik dikenalpasti. Membran dengan kandungan TOPBr terbaik kemudiannya dianalisis berdasarkan pemisahan protein yang dipengaruhi oleh pH dan kekuatan ionik. Keputusan Fourier Transform Infrared (FTIR) Spektroskopi dan X-ray Powder Diffraction (XRD) mendedahkan pembentukan lapisan mineral terlupas dalam matriks PES. SEM menunjukkan lebih banyak leliang dan rongga dalam kestrukturannya tak simetri. Kestabilan haba, kekuatan mekanikal, kandungan air, keliangan, fluks air tulen dan pemisahan protein telah bertambah baik dengan penambahan TOPBr. Membran PES dengan 0.8 berat % telah dipilih sebagai kandungan terbaik berdasarkan kajian pencirian dan prestasinya. Membran itu kemudiannya menjalani pengasingan protein dalam kandungan pH dan kekuatan ionik berbeza. Fluks BSA adalah paling tinggi pada pH 6 manakala penolakan BSA paling tinggi adalah pH 3. Dalam kandungan ionik pula, fluks dan penolakan BSA adalah paling tinggi pada 0.1 M. Secara keseluruhannya, hasil dapatan kajian ini adalah amat penting untuk menuju kearah pengetahuan kritikal prestasi pemisahan membrane nanokomposit.