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

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SCHOOL OF OCEAN ENGINEERING
UNIVERSITI MALAYSIA TERENGGANU
2016

Lihat Sebelah

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By
KUAN SHI YUN

A PITA report summited in partial fulfillment of
the requirements for the award of the degree of
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SCHOOL OF OCEAN ENGINEERING
UNIVERSITI MALAYSIA TERENGGANU
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VERIFICATION AND APPROVAL FORM

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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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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 crititcal 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. Objektik 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 menunjukan lebih banyak leliang dan rongga dalam kestrukturan membrane 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.