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Preparation, characterization and performance of polyvinidene fluoride (PVDF)/Tetraoctyl phosphonium bromide (TOPBr) nanocomposite ultrafiltration membrane towards protein separation and fouling quantication / Connie Leng Mee Yu.

PERPUSTAKAAN SULTANAH NUR ZAHIRAH UNIVERSITI MALAYSIA TERENGGANU (UMT) 21030 KUALA TERENGGANU		
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PERPUSTAKAAN SULTANAH NUR ZAHIRAH UMT

PREPARATION, CHARACTERIZATION AND PERFORMANCE OF  
POLYVINYLIDENE FLUORIDE (PVDF)/TETRAOCTYL PHOSPHONIUM  
BROMIDE (TOPBr) NANOCOMPOSITE ULTRAFILTRATION MEMBRANE  
TOWARDS PROTEIN SEPARATION AND FOULING QUANTIFICATION

By  
CONNIE LING MEE YU

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

SCHOOL OF OCEAN ENGINEERING  
UNIVERSITI MALAYSIA TERENGGANU  
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SCHOOL OF OCEAN ENGINEERING  
UNIVERSITI MALAYSIA TERENGGANU

VERIFICATION AND APPROVAL FORM

This PITA research report entitled *Preparation, Characterization and Performance of Polyvinylidene fluoride (PVDF)/Tetraoctyl Phosphonium Bromide (TOPBr) Nanocomposite Ultrafiltration Membrane Towards Protein Separation and Fouling Quantification* prepared and submitted by Connie Ling Mee Yu Matric No. UK29502 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 *Preparation, Characterization and Performance of Polyvinylidene Fluoride (PVDF)/Tetraoctyl Phosphonium Bromide (TOPBr) Nanocomposite Ultrafiltration Membrane Towards Protein Separation and Fouling Quantification* is the result of my own research except as cited in the references.

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# **PREPARATION, CHARACTERIZATION AND PERFORMANCE OF POLYVINYLIDENE FLUORIDE (PVDF)/TETRAOCTYL PHOSPHONIUM BROMIDE (TOPBr) NANOCOMPOSITE ULTRAFILTRATION MEMBRANE TOWARDS PROTEIN SEPARATION AND FOULING QUANTIFICATION**

## **ABSTRACT**

Ultrafiltration (UF) membrane is widely used in much industrial area and applications. Polyvinylidene fluoride (PVDF) is one of the commonly used materials for membrane due to its excellent properties. However, its hydrophobic nature cause decreasing of the demand and limited applications. Hence, PVDF membrane was selected to study and to synthesis a higher performance membrane. Tetraoctyl phosphonium bromide (TOPBr) was used and acted as a nano-filler material added into PVDF matrix in order to obtain hydrophilic surface with antifouling properties of PVDF/TOPBr nanocomposite membrane. Phase inversion process was used for membrane fabrication. The objectives were to characterize PVDF/TOPBr nanocomposite UF membrane in terms of physiochemical (water content, porosity, thermogravimetric analysis (TGA), x-ray diffraction (XRD), fourier transform infrared spectroscopy (FTIR), mechanical properties, and morphology structure by scanning electron microscopy (SEM). Performance of membrane towards water permeation and protein separation as well as fouling quantification were studied in this research. The membrane with best composition was chose in terms of its properties and performances. When clay dosage increased, pore size of nanocomposite membrane increased and so this increased its water content and porosity. While mechanical strength and thermal stability of nanocomposite membrane decreased with increased dosage of clay content. This is due to thickness of nanocomposite membrane decreased and fast degradation of organic content in TOPBr. TOPBr was dispersed well and exfoliated in PVDF matrix as it can be proved by results of basal spacing decreased as increased in clay dosage. Membrane flux increased but rejection decreased when increased dosage of clay content where it might due to the increasing of porosity and pore size of nanocomposite membrane. Anti-fouling had be enhanced by increased dosage of clay in nanocomposite membrane where it reduced protein absorb on membrane surface and easy to be cleaned. PVDF/TOPBr with 1.0 wt% of TOPBr exhibits the best results.

**PENYEDIAAN, PENCIRIAN DAN PENILAIAN PRESTASI POLYVINYLIDE FLUORIDA (PVDF)/TETRAOCTYL PHOSPHONIUM BROMIDA (TOPBr) NANO-KOMPOSIT MEMBRAN ULTRATURASAN TERHADAP PEMISAHAN PROTEIN DAN PENGKUANTITIAN KOTORAN**

**ABSTRAK**

Ultraturasan (UF) membran telah digunakan di kebanyakan sektor-sektor perindustrian dan aplikasi. Polyvinylide fluorida (PVDF) adalah salah satu bahan yang biasa digunakan dalam membran kerana ciri-cirinya yang baik. Walau bagaimanapun, sifat hidrofobik PVDF membran telah menyebabkan kekurangan daripada permintaan dan terhad dalam aplikasi. Oleh itu, membran PVDF telah dipilih untuk menjalankan kajian dan menghasilkan membran berprestasi yang lebih baik. Tetraoctyl phosphonium bromida (TOPBr) digunakan sebagai bahan nano-komposit untuk mendapatkan permukaan hidrofili yang berfungsi melawan kotoran. Proses fasa balikan telah digunakan untuk fabrikasi membran. Objektif adalah untuk mencirikan PVDF / TOPBr nano-komposit UF membran dari segi fisiokimia (kandungan air, keliangan, analisis termogravimetri (TGA), lenturan sinar-x (XRD), *fourier transform infrared spectroscopy* (FTIR), sifat mekanik, dan struktur morfologi dengan mikroskopi elektron pensakanan (SEM). Prestasi membran terhadap penyerapan air dan pemisahan protein serta pengkuantitian kotoran dikaji dalam kajian ini. Membran dengan komposisi terbaik telah memilih dari segi sifat dan penilai prestasinya. Apabila dos tanah liat meningkat, taburan saiz liang membran nano-komposit juga meningkat dan ini telah meningkatkan kandungan air dan keliangan membran. Manakala kekuatan mekanikal dan kestabilan haba membran nano-komposit menurun dengan peningkatan dos tanah liat. Ini adalah disebabkan oleh ketebalan membran nano-komposit menurun dan degradasi cepat oleh kandungan organik dalam TOPBr. TOPBr telah tersebar dengan baik dan terlupas dalam matriks PVDF dan ini dibuktikan dengan keputusan jarak basal membran telah menurun dengan peningkatan dalam dos tanah liat. Flux membran meningkat tetapi penolakan menurun apabila meningkat dos tanah liat di mana ia mungkin disebabkan oleh peningkatan keliangan dan taburan saiz liang membran nano-komposit. Komposisi melawan kotoran telah dipertingkatkan dengan peningkatan dos tanah liat dalam membran nano-komposit di mana ia mengurangkan protein menyerap pada permukaan membran dan memudahkan pembersihan. Membran PVDF / TOPBr dengan 1.0% nisbah jisim TOPBr telah mempamerkan prestasi yang terbaik.