

PREPARATION, CHARACTERIZATION AND  
PERFORMANCE OF POLYSULFONE/ALKYL  
PHOSPHONIUM MONTMORILLONITE NANOFILTRATION  
MEMBRANE FOR DYE REMOVAL

NURUL HAFIZAH BINTI MOHD AFINDI

SCHOOL OF OCEAN ENGINEERING  
UNIVERSITI MALAYSIA TERENGGANU

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POLYSULFONE/ALKYL PHOSPHONIUM MONTMORILLONITE  
NANOFILTRATION MEMBRANE FOR DYE REMOVAL

By

NURUL HAFIZAH BINTI MOHD AFINDI

A PITA report submitted in partial fulfilment of  
the requirements for the award of the degree of  
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UNIVERSITI MALAYSIA TERENGGANU

VERIFICATION AND APPROVAL FORM

This PITA research report entitled *Preparation, Characterization, and Performance of Polysulfone/Alkyl Phosphonium Montmorillonite Nanofiltration Membrane for Dye Removal* prepared and submitted by Nurul Hafizah Binti Mohd Afindi, Matric No. UK29547 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.

Approved by:

Supervisor

Name: Dr. Asmadi Bin Ali @ Mahmud

Official Stamp:

Date: 1/6/2016

DR. ASMADI BIN ALI @ MAHMUD  
Pensyarah  
Pusat Pengajian Kejuruteraan Kelautan  
Universiti Malaysia Terengganu

Supervisor

Name:

Official Stamp:

Date: .....

Head of Environmental Technology Program

Name: Prof. Dr. Ir. Ahmad bin Jusoh

Official Stamp:


PROF. DR. AHMAD BIN JUSOH  
Dean

School Of Ocean Engineering  
Universiti Malaysia Terengganu

Date: 6/6/16

## DECLARATION

I hereby declare that this PITA research report entitled *Preparation, Characterization, and Performance of Polysulfone/Alkyl Phosphonium Montmorillonite Nanofiltration Membrane for Dye Removal* is the result of my own research except as cited in the references.

Signature :  .....

Name : NURUL HAFIZAH BINTI MOHD  
AFINDI

Matric No. : UK29547

Date : 12/6/2016 .....

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# **PREPARATION, CHARACTERIZATION, AND PERFORMANCE OF POLYSULFONE/ALKYL PHOSPHONIUM MONTMORILLONITE NANOFILTRATION MEMBRANE FOR DYE REMOVAL**

## **ABSTRACT**

Recently, dye has been broadly used in many applications especially in industries. Discharged of dyes wastewater generates large volumes of effluents on a daily basis, which contains substantial loads of organic compounds, inorganic salts, and suspended impurities. Polysulfone nanofiltration membrane had been applied for dye-containing wastewater treatment. However, one of the disadvantage of polysulfone is it easy to cause fouling onto the membrane surface. So, to overcome this problem, nanoclay, alkyl phosphonium montmorillonite (APM) was used to decrease the fouling and to increase hydrophilicity. In this study, the effects of polysulfone/alkyl phosphonium montmorillonite nanofiltration membrane on efficiency of dyes removal from wastewater and able to improve the overall performance were determined. Polysulfone (PSf) of 19 wt% and 21 wt% were used as the polymer backbone for nanofiltration (NF) membrane and alkyl phosphonium montmorillonite (APM) consist of range of 0.0 wt%, 0.1 wt%, 0.5 wt% and 1.0 wt% were used as nano-composite material in order to improve hydrophilicity of the native membrane property. The Nanofiltration membranes were fabricated using dry/wet phase inversion technique with an electrical casting machine. Based on the performance, the water content, porosity and flux increase with an increase in APM addition compare to native membrane. The flux of 19 wt% PSf was higher compare to the flux 21 wt% PSf due to larger pore size and less porosity. The rejection of sodium chloride (NaCl) and Malachite Green dye were increase with the increase of concentration PSf and APM. The best removal of Malachite Green dye was 87% from 19 wt% PSf membrane with addition of 0.5 wt% APM and 90% from 21 wt% PSf membrane with addition of 1.0 wt% APM at pressure 8 bar. This research indicated that the higher concentration of APM (0.5 wt% - 1.0 wt%) which added to the PSf polymer contribute to the higher flux rate and better dye removal.

# **PENYEDIAAN, PENCIRIAN, DAN PRESTASI MEMBRAN PENURASAN NANO POLISULFONA/ALKIL FOSFONIUM MONTMORILONIT UNTUK PENYINGKIRAN PEWARNA.**

## **ABSTRAK**

Pada masa kini, pewarna telah digunakan secara meluas di dalam pelbagai aplikasi terutamanya di dalam industri. Airsisa pewarna yang dilepaskan menghasilkan isipadu efluen yang banyak untuk asas harian yang mengandungi muatan kukuh campuran organik, garam bukan organik dan kotoran mendap. Membran penurasan nano polisulfona telah diaplikasikan untuk rawatan air sisa yang mengandungi pewarna. Walaubagaimanapun, satu daripada kekurangan polisulfona ialah ianya mudah meyebabkan kotoran pada permukaan membrane. Jadi, untuk menyelesaikan masalah ini, tanah liat nano, polisulfona/alkil fosfonium montmorilonit (APM) telah digunakan untuk mengurangkan kotoran dan meningkatkan hidrofilik. Di dalam kajian ini, kesan membran penurasan nano polisulfona/alkil fosfonium montmorilonit terhadap kecekapan penyingkiran pewarna daripada airsisa dan kemampuan peningkatan terhadap prestasi secara keseluruhannya telah ditentukan. Polisulfona (PSf) yang mengandungi peratusan berat di antara 19 wt% dan 21 wt % akan digunakan sebagai polimer utama untuk membran penurasan nano dan alkil fosfonium montmorilonit (APM) yang mengandungi peratusan berat di antara 0.0 wt%, 0.1 wt%, 0.5 wt% dan 1.0 wt% telah digunakan sebagai bahan campuran polimer dalam usaha untuk meningkatkan hidrofilik yang merupakan ciri asas membran. Membran penurasan nano telah dibuat menggunakan teknik fasa balikan kering/basah dengan mesin acuan elektrik. Daripada penilaian prestasi, kandungan air, keporosan dan fluks meningkat dengan peningkatan pertambahan APM berbanding membrane asal. Fluks 19 wt% PSf lebih tinggi berbanding fluks 21 wt% PSf berdasarkan saiz liang yang lebih besar dan kurang poros. Penyingkiran NaCl dan pewarna malasit hijau meningkat dengan peningkatan kepekatan PSf dan APM. Penyingkiran terbaik bagi pewarna malasit hijau ialah 87% daripada membran 19 wt% PSf dengan pertambahan 0.5 wt% APM dan 90% daripada membran 21 wt% PSf dengan pertambahan 1.0 wt% APM pada tekanan 8 bar. Kajian ini menunjukkan bahawa peningkatan konsentrasi APM (0.5 wt% - 1.0 wt%) yang ditambah pada polimer PSf menyumbang kepada peningkatan kadar fluks dan penyingkiran pewarna yang lebih baik.