

EFFECT OF SHEAR RATE ON THE PERFORMANCE OF
ASYMMETRIC NANOFILTRATION MEMBRANE

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EFFECT OF SHEAR RATE ON THE PERFORMANCE OF ASYMMETRIC
NANOFILTRATION MEMBRANE

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Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:
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LIST OF SYMBOLS

AFM	-	Atomic Force Microscope
CA	-	Cellulose Acetate
C_p	-	Concentration of permeate solution
C_f	-	Concentration of feed solution
C_r	-	Concentration of retentate solution
C_b	-	Bulk concentration
k	-	Mass transfer coefficient
MF	-	Microfiltration
MW	-	Molecular Weight
NF	-	Nanofiltration
NaCl	-	Sodium chloride
NMP	-	N-methyl-2-pyrrolidone
PES	-	Polyethersulfone
RO	-	Reverse Osmosis
PVP	-	Polyvinylpyrrolidone
SEM	-	Scanning Electron Microscopy
UF	-	Ultrafiltration

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ABSTRACT

The objective of this study is to investigate the effect of shear rate on the performance and structure of asymmetric Polyethersulfone (PES) nanofiltration (NF) membrane for aquaculture wastewater treatment. The membrane is fabricated from a ternary composition consisting of Polyethersulfone (PES)/N-methyl-2-pyrrolidone (NMP)/polyvinylpyrrolidone (PVP) - (18%/77%/5%) by a simple dry/wet phase inversion process using an electrically controlled flat sheet membrane casting machine. Varying the casting speed (10, 15, 20 and 25) seconds will vary shear rate (160, 106.7, 80 and 64) s^{-1} . The membrane permeability and salt rejection performance were determined based on the pure water flux and sodium chloride solution permeation test. Subsequently, permeation tests of aquaculture waste, taken at a discharged point after sand filtration treatment, from fish pond of Institute Aquaculture & Tropical, KUSTEM were employed. The rejection ability towards Cl^{-} ions was shown in the following manners: $R_{SR}=160s^{-1} > R_{SR}=106.7s^{-1} > R_{SR}=80s^{-1} > R_{SR}=64s^{-1}$. The same trend was observed for the removal of total phosphorus case. It could be postulated that, the higher the shear rate the better orientation of polymer molecules in the membrane structure. These findings suggested that the best shear rate casting condition is lying on $160s^{-1}$. Besides, the high percentage of total phosphorus (>96%) obtained shown a great potential of applying nano-membrane technology in aquaculture water and wastewater management.

ABSTRAK

Objektif kajian ini adalah untuk mengkaji kesan kadar ricih ke atas prestasi dan struktur membran penuras nano asimetrik PES untuk rawatan air sisa akuakultur. Membran dibuat menggunakan komposisi campuran tiga bahan iaitu Polietersulfon (PES)/N-metil-2-pyrrolidon (NMP)/polivinilvirrolidon (PVP) - (18%/77%/5%) menerusi kaedah pembalikan fasa kering/basah dengan menggunakan mesin penghasilan kepingan rata elektrik.. Perbezaan laju (10, 15, 20 and 25) saat akan membezakan kadar ricih (160, 106.7, 80 and 64) s^{-1} . Ketelapan membran dan prestasi penyingkiran garam ditentukan berdasarkan fluks air tulen dan ujian ketelapan larutan natrium klorida. Berikutnya, ujian ketelapan air akuakultur yang diambil dititik keluar selepas rawatan penapisan di kolam ikan Institut Akuakultur dan Tropika KUSTEM dijalankan. Kebolehan penyingkiran terhadap ion Cl^{-} ditunjukkan dalam keadaan berikut: $R_{SR}=160s^{-1} > R_{SR}=106.7s^{-1} > R_{SR}=80s^{-1} > R_{SR}=64s^{-1}$. Paten yang sama turut ditunjuk oleh kes penyingkiran jumlah fosforus. Dapat di andaikan, lebih tinggi kadar ricih, orientasi molekul polimer dalam struktur membran adalah lebih baik. Penemuan ini turut mengesyorkan kadar ricih yang terbaik adalah pada $160s^{-1}$. Selain itu, peratus penyingkiran jumlah fosforus (>96%) yang tinggi menunjukkan peluang yang besar dalam mengaplikasikan teknologi membran penuras nano dalam pengurusan air dan air sisa akuakultur.