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The removal of iron and manganese in groundwater by asymmetric nanofiltration membrane / Bazlin Hasbullah.

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Perpustakaan
Universiti Malaysia Terengganu (UMT)

THE REMOVAL OF IRON AND MANGANESE IN GROUNDWATER BY ASYMMETRIC NANOFILTRATION MEMBRANE

By

Bazlin Hasbullah

Research Report submitted in partial fulfillment
of the requirements for the degree of
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Department of Engineering Science
Faculty of Science and Technology
UNIVERSITI MALAYSIA TERENGGANU

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PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK PENYELIDIKAN I DAN II

Adalah ini diakui dan disahkan bahawa laporan bertajuk:

The Removal of Iron and Manganese in Groundwater by Asymmetric Nanofiltration Membrane.

Oleh Bazlin bt Hasbullah No. Matrik UK 8046 telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Kejuruteraan sebagai mematuhi sebahagian daripada keperluan memperolehi Ijazah Sarjana Muda Teknologi (Alam Sekitar), Fakulti Sains dan Teknologi, Universiti Malaysia Terengganu.

Disahkan oleh:

.....

Penyelia Utama

Nama: Dr. Nora'aini bt Ali

Cop Rasmi: DR. NORA'AINI BINTI ALI
Ketua
Jabatan Sains Kejuruteraan
Fakulti Sains dan Teknologi
Universiti Malaysia Terengganu
21030 Kuala Terengganu

Tarikh: 24/5/07

.....

Penyelia Kedua (jika ada)

Nama: En. Asmadi b. Ali

Cop Rasmi:

Tarikh: 24/5/07

.....

Penyelia Ketiga (jika ada)

Nama: Dr. Edlic Sathiamurthy

Cop Rasmi:

DR. EDLIC SATHIAMURTHY
Penyarah
Jabatan Sains Kejuruteraan
Fakulti Sains dan Teknologi
Universiti Malaysia Terengganu
21030 Kuala Terengganu.

Tarikh: 31/7/07

.....

Ketua Jabatan Sains Kejuruteraan

Nama: Dr. Nora'aini Bt. Ali

Cop Rasmi: DR. NORA'AINI BINTI ALI
Ketua
Jabatan Sains Kejuruteraan
Fakulti Sains dan Teknologi
Universiti Malaysia Terengganu
21030 Kuala Terengganu

Tarikh:.....

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LIST OF ABBREVIATION / SYMBOLS

H_3PO_4	-	Phosphoric acid
INOS	-	Institute of Oceanography
$KMnO_4$	-	Potassium permanganate
MF	-	Microfiltration
MW	-	Molecular Weight
MWCO	-	Molecular weight cut off
NaCl	-	Sodium chloride
NF	-	Nanofiltration
NMP	-	N-methyl-2-pyrrolidone
PA	-	Polyamide
PES	-	Polyethersulfone
PSF	-	Polysulfone
PWD	-	Public Works Department
PWP	-	Pure water permeation
RO	-	Reverse osmosis
SEM	-	Scanning Electron Microscope
SHP	-	Steric Hindrance Pore
THM	-	Trihalomethane
TMS	-	Teorell-Meyer-Sievers
UF	-	Ultrafiltration

WHO	-	World Health Organization
WSB	-	Water Supply Board
WSC	-	Water Supply Company
WSD	-	Water Supply Department
$ZnCl_2$	-	zinc chloride
r_p	-	pore radius
$A_k/\Delta x$	-	ratio of membrane porosity to membrane thickness
σ	-	reflection coefficient
P_s	-	solute permeability
J_v	-	flux
P_m	-	water permeability
C_p	-	concentration in permeate (mol/liter)
C_b	-	concentration in bulk (for dead end filtration) (mol/liter)
C_w	-	concentration in wall (mol/liter)
r	-	radius of stirred cell
υ	-	kinematic viscosity
$D_{i\infty}$	-	bulk diffusivity
k_B	-	Boltzmann's constant
H_F, H_D, S_F, S_D	-	steric and hindrance factors
η	-	ratio of solute radius to pore radius

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ABSTRACT

Iron and manganese are common elements in groundwater. Excessive content of both metals in the groundwater will cause aesthetical and operational problems to human. Oxidation, ion exchange and adsorption are some of the conventional methods used to remove the iron and manganese in groundwater. However, these methods have their own merits and limitations and could not remove this metal effectively. The efficiency of iron and manganese removal from groundwater was investigated in this research by means of asymmetric nanofiltration (NF) membrane separation technology. DR/2500 Laboratory Spectrophotometer was used to analyze the concentrations of samples obtained. The effects of evaporation time in the formation of asymmetric nanofiltration membrane using a simple dry/wet phase inversion technique were also determined. Employing the combination of solution-diffusion model (Spiegler–Kedem equation) and steric-hindrance pore (SHP) model, the membrane structural properties were determined and have been characterized for different cases of the formation parameter. The experimental and modeling showed very promising results in terms of membrane performance with interesting structural details. The best evaporation time for the removal of iron and manganese was determined to be in the range of 5 seconds to 7.5 seconds. The iron was found to be 90% successfully removed while the manganese was 75% removed in which these removals were observed to comply with the WHO standard guidelines for drinking water.

ABSTRAK

Ferum dan mangan merupakan unsur yang biasa ditemui dalam air bawah tanah. Kandungan kedua-dua elemen ini yang berebihan di dalam air akan menimbulkan banyak masalah sehingga menyebabkan nilai estetika air berubah. Terdapat beberapa kaedah rawatan untuk menyingkirkan ferum dan mangan ini. Contohnya pengoksidaan, pertukaran ion dan penjerapan. Walaubagaimanapun, terdapat beberapa kekurangan pada kaedah-kaedah ini dan ianya didapati tidak begitu berkesan. Kajian ini dijalankan untuk mengkaji keberkesanan membran penuras nano dalam menyingkirkan logam-logam berat ini. Alat *DR/2500 Spectrophotometer* digunakan untuk menganalisis sample-sampel yg diperolehi. Kesan jangkamasa evaporasi ketika formasi membran penuras nano ini turut dikaji. *Spiegler–Kedem Equation and Steric-Hindrance Pore (SHP) Model* telah digunakan dalam mengkaji struktur membran yang digunakan dan ciri-ciri membran untuk setiap parameter juga dikenalpasti. Sebanyak 90 peratus ferum dan 75 peratus mangan yang berjaya disingkirkan yang mana masa evaporasi yang terbaik ialah pada julat antara 5 saat hingga 7.5 saat. Penyingkiran ferum dan mangan ini didapati telah memenuhi garis panduan yang ditetapkan oleh *WHO*.