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FAKULTI SAINS DAN TEKNOLOGI
UNIVERSITI MALAYSIA TERENGGANU

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EFFECTS OF DIFFERENCE PH AND CONCENTRATION PARAMETERS ON BACTERIAL REMOVAL BY ULTRAFILTRATION

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JABATAN SAINS KEJURUTERAAN
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LIST OF ABBREVIATION

LRV	-	Log Reduction Value
%R	-	Percentage Reduction
CA	-	Cellulose Acetate
C_f	-	Concentration of feed bacterial *E.Coli*
C_p	-	Concentration of permeate bacterial *E.Coli*
MF	-	Microfiltration
NF	-	Nanofiltration
NaCl	-	Sodium chloride
NMP	-	N-metil-2-pyrolidone
PSF	-	polysulfone
PVP	-	polyvinylpyrolidone
SEM	-	Scanning Electron Microscope
UF	-	Ultrafiltration
ZP	-	Zeta Potential

LIST OF SYMBOLS

ΔP	Pressure difference, N/m^2
Δx	Membrane thickness, m
r_p	Pore radius, m
η	Liquid viscosity
ε	Surface porosity of the membrane

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ABSTRACT

Ultrafiltration membranes technologies are finding increasing application in disinfection process to improve water quality for drinking water production as a safety and environmentally process. However the influence of water pH and bacterial *Escherichia Coli (E.coli)* concentration limited the applicability of this technology due to the fouling phenomena. The specific objectives for this study are to investigate the effect and the optimum value of *Escherichia Coli* concentration and pH parameters on the bacterium *Escherichia Coli* removal through the UF membrane. In this study three different water pH6, pH7 and pH8 and bacterial *E.coli* concentration $\log_{10}5.1$ cfu/ml, $\log_{10}5.7$ cfu/ml and $\log_{10}6$ cfu/ml though to be in some extent responsible for membranes fouling are evaluated. Ultrafiltration membrane with difference composition made of polysulfone (PSF), N-metil-2-pyrolidone (NMP) and polyvinylpyrolidone (PVP)-(13wt.%, 15wt.% and 17wt.%) using an electrically-controlled casting machine are prepared. The membranes permeability and performance of removing *E.coli* in different feed concentration and pH were determined based on *E.coli* solution flux and rejection percentage. The ability rejection of different feed concentration for each membrane shown that the lower the bacterial solution concentration the higher the flux and bacterial rejection in the following manners: ($\log_{10}5.1$ cfu/ml > $\log_{10}5.7$ cfu/ml > $\log_{10}6$ cfu/ml). The pH adjustment could be used to control the UF fouling and bacterial rejection. The acid pH will improve the UF performance, where this behavior is explained in term of charge effects on membrane size. These finding suggested that the best membrane composition is 13wt.%, with $\log_{10}5.1$ cfu/ml solution concentration with pH 6. Besides, the higher percentage of bacterial *E.coli* rejection (7 log reduction value) showed a great potential of applying UF membrane in water treatment plant.

ABSTRAK

Aplikasi teknologi penapisan ultra didapati meningkat di dalam proses meningkatkan kualiti air minuman supaya selamat dan mesra alam. Bagaimanapun kesan pH air dan ketumpatan kandungan bakteria *Escherichia Coli (E.coli)* menghadkan kaberkesanan teknologi ini. Oleh yang sedemikian objektif kajian ini adalah untuk menentukan kesan dan mencari nilai optimum ketumpatan bakteria *Escherichia Coli* dan pH air ke atas penyingkiran bakteria ini menerusi penapisan ultra. Melalui kajian ini tiga nilai pH air iaitu pH6, pH7 dan pH8 serta ketumpatan bacterial *E.coli* pada $\log_{10}5.1$ cfu/ml, $\log_{10}5.7$ cfu/ml and $\log_{10}6$ cfu/ml yang menjadi faktor penyekatan dikaji. Penapisan ultra yang mempunyai komposisi polysulfone (PSF), N-metil-2-pyrolidone (NMP) dan polyvinylpyrolidone (PVP) -(13wt.%, 15wt.% dan 17wt.%) dihasilkan dengan menggunakan kaedah pembalikan menggunakan mesin pneumatic. Prestasi penapis dalam penyingkiran *E.coli* yang berdasarkan perbezaan nilai ketumpatan dan pH dapat ditentukan berdasarkan nilai fluk dan peratusan penyingkiran. Penyingkiran ketumpatan larutan yang berbeza bagi setiap penapis menunjukkan bahawa semakin rendah ketumpatan larutan semakin tinggi flux dan penyingkiran bakteria dalam keadaan berikut: ($\log_{10}5.1$cfu/ml > $\log_{10}5.7$ cfu/ml > $\log_{10}6$ cfu/ml). Perubahan nilai pH boleh digunakan untuk mengawal penyumbatan pada penuras ultra dan penyingkiran bakteria. Keadaan berasid boleh digunakan untuk memperbaiki prestasi penuras ultra. Keadaan ini dapat diterangkan daripada kesan cas ke atas saiz penuras. Penemuan ini menyarankan penuras dihasilkan pada komposisi 13g%, dan diaplikasikan pada ketumpatan larutan $\log_{10}5.1$ cfu/ml pada pH 6. Selain itu, kadar penyingkiran bakteria *E.coli* yang tinggi (7 log penyingkiran nilai bakteria) menunjukkan potensi yang tinggi untuk diaplikasikan di dalam sektor pengurusan rawatan air.