ABSTRAK

Pada penelitian ini dilakukan modifikasi membran nanokomposit kitosan/PEG/MWCNT dengan penambahan agen antibakteri benzalkonium klorida (BZK) untuk mengatasi fenomena *biofouling*. Metode penelitian yang dilakukan meliputi tahap sintesis dengan metode *solution mixing*, uji aktivitas antibakteri, dan karakterisasi. Uji aktivitas antibakteri dilakukan terhadap bakteri *Staphylococcus aureus* (ATCC 12022) dan bakteri *Escherichia coli* (ATCC 25922) melalui metode cincin inhibisi dan metode TPC, sedangkan karakterisasi membran meliputi analisa spektroskopi FTIR, XRD, SEM, AFM, hidrofilisitas, porositas, kekuatan mekanik (*stress*) dan elongasi (%*strain*) serta stabilitas termal. Hasil uji aktivitas antibakteri menunjukkan bahwa MIC pada membran nanokomposit BZK terhadap *S.aureus* dan *E.coli* adalah 80 ppm dan 100 ppm, secara berturut-turut. Peningkatan aktivitas antibakteri berbanding lurus dengan konsentrasi BZK dimana nilai %BKR membran komposit BZK meningkat dari 2,6% (tanpa BZK) sampai 98.7% terhadap bakteri *S.aureus* dan dari 16% (tanpa BZK) sampai 63,2% terhadap bakteri *E.coli*. Hasil karakterisasi membran menunjukan bahwa BZK berhasil disisipkan ke dalam matriks membran nanokomposit. Penambahan BZK pada membran nanokomposit menyebabkan penurunan intensitas dan pergeseran puncak difraksi sinar-X membran pada 2 teta 9,97^{o} dan 19,99^{o}. Observasi gambar SEM menunjukan membran yang telah dimodifikasi memiliki diameter pori membran yang lebih besar. Modifikasi juga meningkatkan porositas membran (64,28% menjadi 68,03%), kekasaran permukaan membran (Ra = 0,048 nm mencapai 145,348 nm; Rq = 0,06 nm mencapai 167,442 nm), elastisitas dari 45,3% mencapai 147,7% dan kekuatan mekanik membran dari 31,2 MPa mencapai 45,8 MPa. Disisi lain, modifikasi membran nanokomposit menyebabkan penurunan hidrofilisitas membran (*contact angle* θ = 57,81° menjadi 83,29°) dan penurunan stabilitas termal (Td_{max} = 290,8^{o}C menjadi 287,47 ^{o}C). Maka dari itu penambahan BZK dapat meningkatkan aktivitas antibakteri pada membran nanokomposit berbasis kitosan/ PEG/ MWCNT.

***Kata kunci**: membran filtrasi nanokomposit, biofouling, antibakteri, kitosan, PEG, MWCNT, benzalkonium klorida*

ABSTRACT

This research aims to evaluate the characteristic and antibacterial activity of benzalkonium chlorida (BZK) on chitosan/ PEG/ MWCNT nanocomposite based filtration membrane. The research methods included preparation, antibacterial activity assay and characterization. BZK nanocomposite membrane was prepared by solution mixing method. The antibacterial activity assay was conducted using disc diffusion test and TPC test against Staphilococcus aureus (ATCC 12022) and Escherichia coli (ATCC 25922). Characterization of composite membrane was carried out by FTIR spectroscopy, XRD, SEM, AFM, contact angle, porosity, mechanical strength (stress), elongation (%strain) and thermal stability measurement. The antibacterial activity of the BZK nanocomposite membrane was appeared at 80 ppm and 100 ppm against S. aureus and E. coli, respectively. Antibacterial activity linearly increased with addition of BZK concentration. % BKR of the composite membrane without BZK was 2.6% and 16% for S. aureus and E. Coli, respectively. Meanwhile, %BKR BZK nanocomposite membrane was up to 98.7% and 63,2% against S. aureus and E. Coli, respectively. The characterization showed that BZK interact with membrane precursors through alkyl, hydroxyl and amine groups of chitosan as shown on FTIR spectra. BZK addition in membrane decreased the intensity and caused the shifting of the diffractogram peaks at 2 theta 9,97^o and 19,99^o. Based on SEM image observation, BZK nanocomposite membrane has larger surface pore structure. BZK addition also improved physical-chemical properties of the membrane, such as increased porosity (64,28% to 68,03%), membranes surface roughness (Ra = 0,048 nm to 145,348 nm and Rq = 0,06 nm to 167,442 nm), elasticity from 45,3% to 147,7% and also mechanical strength from 31,2 MPa to 45,8 MPa. On the other hand, BZK modification in the nanocomposite membrane decreased the membranes hydrophilicity (contact angle θ = 57,81° to 83,29°) dan thermal stability (Td_{max} 290,8^{o}C to 287,47 ^{o}C). Therefore, BZK nanocomposites membrane is potential to be applied as an alternative antibacterial membrane for filtration.

***Keywords**: nanocomposites filtration zmembrane, biofouling, antibacteria, chitosan, PEG, MWCNT, benzalkonium klorida*