# PENGARUH INKORPORASI CuO-*NPs* TERHADAP KARAKTERISTIK DAN KINERJA MEMBRAN NANOFILTRASI PVDF/PVP UNTUK PEMISAHAN ION GARAM

**SKRIPSI**

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*Program Studi Kimia*


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**PROGRAM STUDI KIMIA**
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Skripsi ini diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Program Studi Kimia Departemen Pendidikan Kimia Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

**LEMBAR PENGESAHAN**

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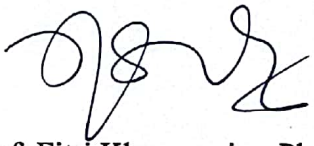

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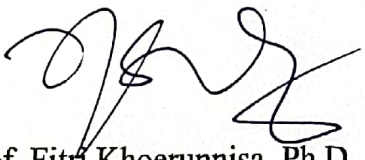

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# ABSTRAK

Kelangkaan air tawar dan pencemaran air menjadikan air laut sebagai salah satu sumber alternatif air bersih yang digunakan. Teknologi membran nanofiltrasi dapat digunakan sebagai teknik pengolahan air laut untuk *pretreatment* desalinasi. Penelitian ini bertujuan untuk mengetahui pengaruh inkorporasi CuO-*Nanoparticles* (*NPs*) terhadap karakteristik dan kinerja membran komposit berbasis *Poly* (*vinylidene fluoride*)*/Poly* (*vinylpyrrolidone*) (PVDF/PVP). Sintesis membran dilakukan melalui metode *casting* dan inversi fasa dengan komposisi optimum 18%:1%:0,1% (PVDF:PVP:CuO-*NPs*). Membran komposit dikarakterisasi dengan spektroskopi *Fourier Transform Infra-red* (*FTIR*), pengukuran sudut kontak, sifat mekanik, dan porositas. Kinerja membran komposit ditentukan melalui pengukuran permeabilitas, permselektivitas, *antifouling* (ion garam NaCl, $CaCl_2$, dan $FeCl_3$, serta *Bovine Serum Albumine* (*BSA*)), dan *release* ion $Cu^{2+}$ melalui sistem filtrasi *cross-flow*. Inkorporasi CuO-*NPs* pada membran PVDF/PVP memodifikasi struktur membran ditunjukkan dengan munculnya puncak serapan baru pada spektra *FTIR* untuk regangan ikatan Cu-O dan transformasi struktur PVDF dari fase α ke fase β yang ditunjukkan pada regangan ikatan C-F, menurunkan nilai sudut kontak menjadi 57,07°, serta meningkatkan porositas dan kekuatan mekanik membran berturut-turut menjadi 65,56% dan 4233 kPa. Inkorporasi CuO-*NPs* juga meningkatkan kinerja membran PVDF/PVP dalam nanofiltrasi ditunjukkan dengan terjadinya peningkatan nilai permeabilitas (27,89 $L \cdot m^{-2} \cdot h^{-1} \cdot bar^{-1}$), permselektivitas terhadap *BSA* (79,46%) serta penurunan rejeksi ion garam berturut-turut menjadi 20,30%; 46,73%; 84,79% ($Na^+$; $Ca^{2+}$; $Fe^{3+}$), dan peningkatan resistensi *fouling* didemonstrasikan dengan nilai rasio pengotoran ($R_t$, $R_r$, dan $R_{ir}$) yang lebih rendah daripada PVDF murni serta peningkatan nilai *Flux Recovery Ratio* (*FRR*) terhadap *BSA* dan ion garam, sebesar 71,80% dan 79,53%; 78,08%; 74,65% ($Na^+$; $Ca^{2+}$; $Fe^{3+}$) secara berturut-turut. Membran PVDF/PVP/CuO-*NPs* pada komposisi optimum menunjukkan *durability* dan stabilitas yang baik setelah pemakaian sebanyak 6 siklus ditunjukkan dengan jumlah *release* ion $Cu^{2+}$ hanya sebesar 0,005 mg/L.

**Kata kunci**: ion garam, karakteristik, kinerja, nanofiltrasi, PVDF/PVP/CuO-NPs

## ABSTRACT

*Seawater is used as an alternate source of clean water due to freshwater scarcity and polluted water. Nanofiltration membrane technology can be used as a water treatment technique for desalination pretreatment. This study aims to determine the influence of CuO-Nanoparticle (NPs) incorporation on the characteristics and performance of Poly (vinylidene fluoride)/Poly (vinylpyrrolidone) (PVDF/PVP)-based composite membranes. Membrane synthesis was performed by casting and phase inversion with an optimal composition of 18%:1%:0.1% (PVDF:PVP:CuO-NPs). Composite membranes are characterized by FTIR spectroscopy, contact angle measurement, mechanical properties, and porosity. The performance of composite membranes is based on permeability, permselectivity, antifouling (NaCl, $CaCl_2$, and $FeCl_3$ salt ions, and Bovine Serum Albumine (BSA)), and $Cu^{2+}$ ion release through a cross-flow filtration system. The incorporation of CuO-NPs on PVDF/PVP membranes can alter the structure of the membrane with the emergence of new absorption peaks for Cu-O stretching bonds and the transformation of PVDF structures from α phase to β phase that showed on C-F stretching bonds, decreasing the contact angle to 57.07°, also increasing porosity and mechanical strength of the membrane to 65.56% and 4233 kPa, respectively. The incorporation of CuO-NPs also improves the performance of PVDF/PVP membranes in nanofiltration as shown by the increase in permeability value (27.89 $L \cdot m^{-2} \cdot h^{-1} \cdot bar^{-1}$), permselectivity for BSA (79.46%) and decreased value for salt ions to 20.30%; 46.73%; 84.79% ($Na^+$; $Ca^{2+}$; $Fe^{3+}$), respectively, also increased fouling resistance was demonstrated by fouling ratios ($R_t$, $R_r$, and $R_{ir}$) lower than pure PVDF and increased Flux Recovery Ratio (FRR) values in BSA and salt ions, which are 71.80% and 79.53%; 78.08%; 74.65% ($Na^+$; $Ca^{2+}$; $Fe^{3+}$), respectively. PVDF/PVP/CuO-NPs membranes showed good durability and stability throughout the 6 cycles as shown by the $Cu^{2+}$ ion release value, which was only 0.005 mg/L.*



***Keywords**: salt ions, characterization, performance, nanofiltration, PVDF/PVP/CuO-NPs*

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