UNIVERSITI TEKNOLOGI MARA

PREPARATION AND CHARACTERIZATION OF COMPOSITE REVERSE OSMOSIS MEMBRANE IN TREATING OILY WASTEWATER FROM OIL REFINERY

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Thesis submitted in fulfilment of the requirements for the degree of
Masters of Science

Faculty of Chemical Engineering

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Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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Abstract

Oily wastewater management became a critical consideration in recent years particularly in the oil and gas industry. This is due to the fact that oily wastewater contains harmful compounds such as oil and grease, and heavy metals that may harm the environment. Therefore, the aim of this study is to develop the composite reverse osmosis membrane in treating the oily wastewater from the specific oil refinery. The membrane consists of Polysulfone (PSF) as the main polymer, while Polyvinyl pyrrolidone (PVP) and bentonite acted as an additive and inorganic material. The solvent and non-solvent used are N-methyl pyrrolidone (NMP) and water. The reverse osmosis membrane was casted manually via phase inversion method. The oily wastewater sample was characterized in terms of conductivity, total dissolved solid (TDS), salinity, pH and temperature. Meanwhile, membrane performance studies were carried out in terms of permeate flux and solute rejection at the operating pressure of 1.5 to 4.0 bar. The effect of the operating pressure and composition of PVP and bentonite towards membrane performances has been observed. The findings were supported by the membrane characterizations which consist of Fourier Transform Infrared (FTIR) analysis, contact angle measurement, Thermogravimetric (TGA) analysis, X-ray Diffraction (XRD) analysis and Field Emission Scanning Electron Microscopy (FESEM) analysis to investigate the change of the membrane properties with the presence of those two materials. Then, modeling was computed using Design Expert 6.0.10 software. From the experiments, it can be concluded that the addition of PVP and bentonite enhanced the membrane performance in terms of membrane permeate flux and solute rejection, and also membrane properties such as hydrophilicity, thermal behaviour, crystallinity and membrane structure thereby suggested that the PSF-PVP-bentonite membrane is viable to treat the oily wastewater from the specific oil refinery. The best membrane candidate is M23 membrane sample (10 wt% of PVP and 5 wt% of bentonite) that recorded excellent value of permeate flux and solute rejection at 0.00183 $m^3/m^2.s$ and 99.05%. Meanwhile, at the optimum value of 4 bar (operating pressure) and, 9.86 wt% and 4.56 wt% for the composition of PVP and bentonite, the membrane was able to achieve the permeate flux value of 0.00171 $m^3/m^2.s$ and the solute rejection of 97.01%.

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