UNIVERSITI TEKNOLOGI MARA

FABRICATION OF COMPOSITE MAGNETIC HAP/GO-PES MEMBRANE FOR IRON REMOVAL

LUQMAN BIN ROSLAN

Thesis submitted in fulfillment
of the requirements for the degree of
Bachelor of Engineering (Hons.) Oil and Gas

Faculty of Chemical Engineering

July 2018

ABSTRACT

Abstract—Polymeric based membrane usually having problems with fouling and hydrophilicity. Thus, a new material is introduced which is graphene oxide (GO). GO is the materials that have a unique properties and hydrophilic nature. Besides, GO can help to enhance the permeate flux, improve mechanical strength, increase surface hydrophilicity, and reduce fouling. GO has good hydrophilicity compared to graphite due to presence of oxygenous group carbonyl, epoxide, hydroxyl and carboxyl. GO is synthesise from the modified Hummers method. GO then is further bind to the polymeric membrane surface. The magnetic NPs and hydroxyapatite (HAP) was added into the GO-PES membrane to form GO-MHAP-PES membrane. The membranes are fabricated using the phase inversion technique and embedded with various percentages of GO-MHAP (0.5wt%, 1.0wt%, 1.5wt% and 2.0wt%). Last but not least, morphology and performance test was investigated using X-ray diffraction (XRD), water contact angle, and Fourier Transform infrared (FTIR). Conclusion of the experiment stated that the modified fabricated membrane GO-MHAP-PES membranes have a low water contact angle stated at 60.73º, 58.03º, 57.73º, and 58.2º lower than GO-PES membrane at 68.2º. The results show that, addition of GO will improved it affinity toward water than a typical PES membrane. In addition, GO-MHAP-PES membranes also show a good rejection rate for iron removal. The iron removal is at 96.5% and 97.9% demonstrated by GO-MHAP-PES 1.5wt% and GO-MHAP-PES 2.0wt%.

Keywords—Graphene oxide, Magnetic nanoparticle, Phase inversion technique, Water contact angle

ACKNOWLEDGEMENT

In the name of Allah S.W.T, with all the possibilities that been given to complete this final year project on the fabrication of composite magnetic hydroxyapatite (HAP)-graphene oxide (GO)-polyetersulfone (PES) to produce GO-MHAP-PES membrane. Special thanks to my family and college for the support and inspiration. Besides that, I would like to thank my supervisor Dr. Nur Hidayati Bt. Othman, Oil and Gas Engineering lecturer of Universiti Teknologi MARA (UiTM) for her comments, ideas, guidance and times to help me in this project.

Finally yet importantly, I want to thank my seniors for guiding and assisting me in completing the project. Their willingness to prepare the equipment and guidance has eased my project. Moreover, I also want to thank the management of the Faculty of Chemical Engineering and Universiti Teknologi MARA (UiTM) for the facilities provided.

End of my words, I am Luqman Bin Roslan again want to thank to all parties that participated directly or indirectly to make this final year project success.

TABLE OF CONTENT

CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND

Heavy metals are defined as metallic elements that have a relatively high density compared to water. Besides, heavy metal defined as a highly electronegative metal with a density greater than 5 g/cm^3 (Agarwal, 2009). Heavy metals are a major concern because it able to affect human and ecosystem since it is toxic, persistence and non-degradable (He et al., 2017). Sources of heavy metals include mining industry, foundries, smelters, chemical plant waste, emission gas from vehicle or factories and agriculture activities.

In the past decade, many research and technologies have been done to remove heavy metals such as utilization of adsorbent, membrane filtration, chemical precipitation, centrifuges, and electro- dialysis. Among them, membrane filtration technologies seem to be the most efficient to control and the removed heavy metal efficiently. Besides, it also capable to remove suspended solid, organic and inorganic effluent. There are several types of process available in membrane filtration, which is ultrafiltration (UF), microfiltration (MF), reverse osmosis (RO), and nanofiltration (NF). All of the processes are classified according to their capability to remove particles according to contaminant size.

The evolutions of membrane do not stop there, it continues to improve by introducing additives that useful to increase membrane efficiency and make it a reliable method to remove heavy metal. Organic and inorganic membranes are the type of membrane available in the market. Organic membrane is a membrane made of natural polymer or synthetic polymer such as polyethersulfone (PES), polyvinylidene fluoride (PVDF) and polyacrylonitrile (PAN). Inorganic membrane is a membrane made from metallic and ceramic. Among the two types of membrane, organic membrane is the commonly used because of their properties and availability.