UNIVERSITI TEKNOLOGI MARA

EFFECT OF PEBAX COATING ON GAS SEPARATION PROPERTIES OF RGO-ZIF-8 PES MIXED MATRIX MEMBRANES

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ABSTRACT

Mixed matrix membranes (MMMs) attract great attention due to their outstanding gas separation performance. The compatibility between the fillers and the polymer matrix is one of the key points for the preparation of high-performance MMM. In this study, MMMs consisting of 10 wt% in-situ synthesized rGO/ZIF-8 hybrid nanofillers were fabricated for gas separation. Pebax-1657 at 2, 3 and 4 wt% concentration was added as coating layer to study the effect of different concentration pebax on the permeability and selectivity of rGO-ZIF-8 PES MMMs. The pebax solution was prepared by dissolving it in a dilute ethyl alcohol in ratio of 70:30. The operating pressure of gas permeation varied from 1 bar to 5 bar. It was found that the permeation rate increase with higher pressure and decrease with increase coating time and concentration of pebax. Based on the result of 3%PEBAX/rGO-ZIF-8 PES MMMs, permeability of CO_2, CH_4, N_2, and O_2 gas shows 19%, 93% 86% and 79% decrease, in permeation rate for each gas respectively and the selectivity increase from 1.76 to 10.19 when compare to 3%PEBAX/PES. The XRD, FTIR TGA and BET analysis was done for the synthesized nanofillers and fabricated PES MMMs membrane of coated and uncoated. The 3%PEBAX/rGO-ZIF-8 PES gave the highest selectivity of 10.19, 3 bar with CO_2 and N_2 permeance of 79.68 and 7.82 barrer respectively whereas for CO_2 no gas flow was recorded during the test.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Gas constitute a part of the three fundamental states of matter with solid, and liquid. Pure gas may constitute of singular atoms like noble gas class, while elemental molecules constitute of one type of molecule such as CO_2, O_2 or NO_2. Gas mixture would contain a mixture of pure gases like the air that made up of mainly of NO_2, O_2 CO_2 with small traces of other gases. The distinguishable part of gases form compare to its other two fundamental states which are solid and liquids are the vast separation of the individual gas particles (Daivid E. Goldberg, 2007; Tickle, 1950).

The most prominent and significant gas are the air, while some gas such as natural gas, oxygen needs to be purified to be use safely in industries or activity. Methane, a key component in natural gas composition contributing to 75% of natural gas, these energy resources comes primarily from natural gas and associated gas in oil reservoir. These natural gas reservoirs and associated gas derived from oil reservoir naturally contain numerous impurities in which needed gas separation process to produce a purified natural gas. The impurities include CO_2, H_2S, and N_2 gas and burning of natural gas containing these impurities will also release the gas to the environment. In order to protect the air from numerous dangerous gases, filtration or gas separation are needed in order to prevent our air from being polluted to a degree which are harmful to our health. It is impossible to prevent the air from being completely unpolluted due to higher degree or filtration require higher cost and also reduced performance and production. Hence a guideline and law are implemented by the government to restrict pollution of the air to maintain the safety and quality of our nation air from pollution (Paper, 2015; Scholes, Stevens, & Kentish, 2012).

In order to achieve this, gas separation process is needed in which a material enable the separation of gases must be fabricated to achieve intended result. Swing Adsorption Technique, Cryogenic Distillation, and also Membrane Gas Separation are the gas separation technique being implemented in the industry. Swing adsorption technique include the Temperature Swing Adsorption, Pressure Swing Adsorption, and Vacuum Swing Adsorption. Both Vacuum Swing and Pressure Swing Adsorption relies on