CHAPTER 1

INTRODUCTION

1.1 Motivation

The major fossil fuels product that contributes to the greenhouse effect is carbon dioxide. Among all the industries emitting CO₂, fossil fuel power plants generate the largest amount of CO₂ emission with more than 30 billion tons of carbon dioxide emission in recent years. This has made the greenhouse gas as the main contributor to global warming. The release of CO₂ and N₂ gases from the combustion of fossil fuel is refer as post combustion. (Zhang et al, 2014; Renewables 2012 Global Status Report, REN 21; Brunetti et al, 2010).

By removing this carbon dioxide gas, the flue gas released to the atmosphere will have low CO₂ content and high in N₂. Mostly, in the petrochemical industry, the capability to separate gas will be the most essential. The separation of carbon dioxide is one of the energy intensive process where it has an important role in energy saving and carbon dioxide capture and storage implementation to reduce global warming. The captured CO₂ from membrane separation can be send to storage for the use in the carbonated beverage and food processing production, as the PH control in industrial processes and many others. These have increase the interest in the development of gas separation process by membrane based technology as membrane gas separation also provide a great performance due to the membrane interactions of high form of permeability with a huge selectivity to capture specific gaseous species (Zhang et al, 2014; Luis et al, 2012).
1.2 Statement of problem

The foremost important key for a good performance of a membrane in gas separation process are depend on the permeability and selectivity of the membrane. Polymeric membranes are material that chemically stable in a range of conditions and have the ability to make a stable solution in a suitable solvent (Scott & Hughes, 1996). However, previous study found out that pure polymers are materials with low selectivity (Hu et al, 2013). It has become a great challenge for producing membranes with high permeability and selectivity in gas separation process. Therefore, this study is conducted to overcome the problem by adding additive to the membrane casting solution to achieve high selectivity and permeability of the membrane.

1.3 Objectives

The following are the objectives of this research:

1) To produce PVDF membrane.
2) To characterize the membrane physically and chemically.
3) To investigate the performance of the membrane with additive.

1.4 Scope of this research

This study has focused on several scopes in order to achieve its objective. The scopes are as follows:

1) Phase separation method of phase inversion is used to produce a flat sheet PVDF membrane.
2) The PVDF membrane will be tested for chemical analysis using Fourier transform infrared (FTIR) spectroscopy.
3) Physical analysis will be tested using Scanning electron microscopic (SEM). This analyses will help to determine the characteristic of the PVDF membrane produced.
4) The membrane is then tested for its performance in separating CO₂/N₂ gaseous using Gas Permeation Test.
1.5 Organisation of this Thesis

This thesis is organized and structured into five chapters.
Chapter 1 is an introduction chapter for this thesis where the research objectives and outline of the thesis are presented.

The concept and fundamentals of polymeric membrane and gas separation process are introduced in chapter 2. In this chapter, a brief description on membrane transport process, membrane structure and module, membrane materials selection and the methods commonly used to produce membrane. Besides, this chapter also gives some description on the effect of modification of membrane.

Chapter 3 shows a review on the method of fabrication of membrane used for this research which is by using the dry/wet phase inversion method. The fabricated membrane with the modification is tested for its performance through single gas permeation test with CO2 and N2 gases. The selectivity and permeability of the membrane to separate the gases mixture is studied. Besides, the performance of the membrane also is defined from the physical and chemical properties by using SEM and FTIR instrument. Effect addition of different amount of additive into the membrane casting solution to the performance of the membrane to separate gases is studied.

Chapter 4 demonstrated the analysis of the performance of the produced membrane in comparison with the predicted result obtain from several researchers that have done similar research. The analysis includes the morphology of the membrane and the presence of functional group of the added additives through the FTIR analysis. The permeability and selectivity of the membrane is calculated and discussed according to the different ratio of additive composition in the membrane.

Chapter 5 displayed the conclusion of the research that ties together the physical properties of the membrane and its performance in separating gas by the effect of additive composition. The recommendations for future work also presented in this chapter.