CHAPTER I
INTRODUCTION

Presently, fossil fuels become one of the most essential sources of energy in the world. As they begin to deplete, scientists look for another way to replace them. Bioethanol is one of the candidates to replace fossil fuels. Currently, one way to reduce the use of fossil fuel is to utilize gasohol. Gasohol, the mixture of gasoline and ethanol, has a number of advantages over conventional petroleum-based fuels, such as lower price, higher octane number, better anti-knocking properties, higher heat vaporization, and complete combustion, resulting in much less pollutants from emission.

Bioethanol from the fermentation broth is typically 8 to 12%, thus several stages of distillation are needed. Anhydrous ethanol for chemical and fuel use is obtained typically by azeotropic distillation with cyclohexane or by adsorption on molecular sieves. Azeotropic distillation is a relatively expensive method. In addition, some concerns about environment and health occur over the use of the dehydrating agents. Pervaporation or vapor permeation is considered to be an appropriate and competitive replacement for azeotropic distillation and adsorption on molecular sieves. Pervaporation using ceramic membranes is generally economic with water contents of approximately 10 wt.% and less, with final product water content of hundreds of ppm to 10 ppm attainable. To go much below these water contents require significantly greater installed membrane area and possibly a greater reduced pressure on the permeate side (Scott 1998).

Polybenzoxazine (PBZ) is a polymer derived from phenolic resin, having properties of high thermal stability, easy processability, very high char yield, fast development of mechanical properties as a function of conversion, glass transitions much higher than curing temperatures, good flame retardant, and electronic properties. In addition, PBZ provides other special properties, such as low water absorption despite having many hydrophilic groups, and excellent dimensional stability due to the near zero shrinkage after processing, maintaining excellent mechanical properties. The preparation method to obtain PBZ with the desired properties comprises a phenolic compound, a primary amine, and formaldehyde.

PBZ has been synthesized from inexpensive raw materials and polymerized by a ring-opening polymerization reaction. The benefit of ring-opening polymerization is that no by-product exists in the reaction (Ishida and Allen 1996, Ishida 2011).

In 2011, Pakkethati *et al.* synthesized PBZ membranes and studied their performance on ethanol-water separation via pervaporation process. The PBZ studied were synthesized from bisphenol-A, formaldehyde, and three different types of multifunctional amines: hexamethylenediamine (hda), tetraethylenepentamine (tepa), and diethylenetriamine (deta), which are denoted as poly (BA-hda), poly(BA-tepa) and poly(BA-deta), respectively. They found that the poly (BA-had) membrane gave the best performance for separating water from ethanol while the others swelled.

Thus, the objective of this work was to use alumina tube to support poly(BA-tepa) and poly(BA-deta) membrane and study whether the alumina support could improve the performance of the poly(BA-tepa) and poly(BA-deta) membrane for ethanol-water separation.