CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Energy is an important aspect of every living organism and one of the requirements necessary to run activities. Nowadays, energy consumption of the world population is being increased significantly due to the continuous development of countries and the increasing growth of human population. Most of the country depending on the non-renewable energy sources such as fossil fuels and petroleum for electricity generation and fuel for transportation. However, the global crisis of conventional fossil fuels and growing energy demands has led to increase dependency upon the renewable energy sources. Furthermore, the environmental concern related to the greenhouse gas emission from the burning of conventional fuels adding to the motivation for the development of clean energy.

Renewable energy is energy developed from natural sources of earth and it can be restored easily in a short time scale and not depleted even after being used continuously. Biomass is one of the renewable resource that can be derived directly or indirectly from plant. In Malaysia, biomass resources are mainly lignocellulose type based on the palm oil, wood and agro industries. Major sources of biomass come from the oil palm residues in the form of empty fruit bunches (EFB), palm oil mill fibers, shells, palm trunks and fronds. Lignocellulosic biomass is the most promising feedstock for bioethanol production and mainly composed of three main polymers, which is cellulose, hemicelluloses and lignin.

Recently, production of biofuels especially bioethanol coming from the abundant renewable resource, biomass has gained a lot of attention to overcome the problems rise due to the depletion of fossil fuels. In order to release sugars from the polymeric matrix, the biomass will undergo hydrolysis process. Hydrolysis of biomass releases not only fermentable sugars but also several compounds that are considered to be toxic to the fermenting organism. These compounds are mainly grouped into three classes of furan, phenolic derivatives and weak acids such as formic and acetic acid (Grzenia et al., 2008). In order to maximize sugar yields, it is essential to remove these toxic compounds and here our focus is on acetic acid removal.

Liquid membrane is a promising technology for the recovery of various carboxylic acids because it applies the principle of double liquid-liquid extraction for the transport through the membrane (Hassoune & Rhlalou, 2008). Supported liquid membrane (SLM) represents one of the feasible types of liquid membrane as it uses a porous membrane support impregnated with complexing carriers to separate the feed and strip phase. In SLM, organic liquid membrane phase is imbedded in small pores of polymer support and hold by capillary forces. Liquid membrane contains a carrier/ extractant that dissolved in an inert organic solvent. Flat sheet supported liquid membrane (FSSLM) are one of the typical SLM configurations used at laboratory scale, in which the flat sheet membrane is placed between of two compartment cell.

The flat sheet membrane support can be produced from the same polymeric material as in symmetric porous membrane or using different material as in composite membrane. During this study, vapour induced phase separation (VIPS) was chosen for fabricating symmetric PES flat sheet membrane incorporated with graphene nanoparticles. The addition of a small amount of graphene in the membrane is expected to improve the membrane hydrophobicity, porosity and mechanical properties of the membrane. The important fabrication parameters involve during VIPS process will undergo screening process toward producing good membrane support for SLM process for extraction of acetic acid.

1.2 Motivation

Acetic acid is formed from the hydrolysis of acetyl groups during lignocelluloses biomass hydrolysis. It inhibits the subsequent bioconversion of the solubilised sugars to the desired product. It is important to remove acetic acid as it can diffuse through the cytoplasmic membrane of cells and undesirably affect cell metabolism during fermentation. In a meanwhile, intracellular pH is reduced when undissociated acetic acid diffuse through cell cytoplasm, thus resulting in impaired transport of various ions and increased energy requirement (Grzenia et al., 2008). The acetic concentrations as low as 0.25 g/L can affect the growth of the microorganism during the fermentation (Grzenia et al., 2008). Therefore, it is important to remove the acetic acid from biomass hydrolysate prior to the fermentation stage in order to increase to bioethanol production yield.

1.3 Problem Statement

Nowadays, energy consumption has increased drastically due to increase in population and exploration by various industries. Oil crisis in 1970s has growing concerns in many countries regarding security of energy supply, higher fossil fuel prices, environmental degradation, climate change and the sustainability of the energy systems. These concerns have led to increase global attention in supporting the development of alternative energy based on renewable sources (Gumartini 2009). Biomass offers potential opportunity with significant role as energy resources to contribute to the global primary energy supply mainly due to its renewability and its carbon neutrality in climate change mitigation. Lignocellulosic biomass consists of three main polymers, which is cellulose, hemicelluloses, and lignin that can release sugars from their polymeric matrix during hydrolysis process. Fermentation of the released sugars yield bioethanol that can be use as the transport fuels or can be used to produce specific chemicals.

Several byproducts are released together with the sugar during hydrolysis, such as acetic acid, formic acid, furfural and phenolic compounds. Acetic acid removal using SLM is the main focus in the current study. SLM uses relatively small