CHAPTER I
INTRODUCTION

One of the most commonly found problems about the energy is the depleting of fossil fuels. From this concern, there are many researches about renewable and sustainable energy to replace fossil fuels. Butanol is one of the alternative energies that have a similar octane number to gasoline. Consequently, it can work in vehicles designed for use with gasoline without modification. The low cost and renewable feedstock, has potential for bioconversion into fermentable sugars which can produce biofuel such as butanol, is lignocellulosic biomass.

The main problem of butanol production is the structure of lignocellulosic biomass which consists of cellulose, hemicellulose, and lignin. Lignin is recalcitrant to chemical and biological process due to its covalent bonds to hemicelluloses and cross-linking to cellulose. From its complexity structure, the accessibility of enzymes to hydrolyze cellulose that is utilized for the biofuel production will be decreased.

There are several techniques to break the complex structure of lignocellulosic biomass so as to remove the lignin content, decrease the cellulosic crystallinity and enhance the enzymatic accessibility. However, each pretreatment has some bad points. For instance, biological methods use long time. In physical pretreatments (e.g. milling, chipping, grinding, and gamma ray irradation) require high energy and high cost when they are used at full-scale. In chemical processes (e.g. dilute acid, alkali, using organic solvent) can cause toxic, corrosion, and environmentally unfriendly compounds. To solve these problems, ionic liquids (ILs) are the answer for lignocellulosic pretreatment because of their properties. ILs are non-volatile and non-flammable, require less energy, operate at moderate conditions and use green solvents that can recycle such as water. And the most important reason is ILs have high potential to dissolve cellulose in order to reduce the crystallinity, disrupt the lignin content and improve the hydrolysis step. From previous researches, the 1-ethyl-3-methyl imidazolium acetate [EMIM][Ac] is the most effective solvent for lignocellulosic biomass pretreatment. As a result, in this study, [EMIM][Ac] is the suitable solvent to reduce complex structure of lignocellulosic biomass.

However, there are three major constraints of ILs that prevent it from becoming commercially viable. First, the process requires a large amount of expensive ILs; second, recycling of pure ILs uses high energy; third, the solution has high viscosity during pretreatment making it difficult to handle.

Mixing ILs with water is a possible alternative to solve these problems. However, cellulose is known to precipitate when water is added to an IL solution of cellulose. Consequently, solubilization of cellulose may not be feasible, but the strong interaction between cellulose and ILs may still exist even in aqueous environment. Moreover, low concentration of aqueous ILs can accelerate the enzymatic hydrolysis of cellulose (Fu and Mazza, 2011).

Recently, microwave technology has been recognized as a powerful tool for the organic synthesis and processing of polymers. Microwave heating could increase the solubility of cellulose in 1-butyl-3-methylimidazolium chloride [BMIM][Cl] and 1-ethyl-3-methyl imidazolium acetate [EMIM][Ac], resulting in significant improvement of cellulose hydrolysis. Therefore, microwave technology should be applied in the present work (Ha *et al.*, 2011).

The purpose of this work is to optimize the condition of ionic liquids pretreatment combined with microwave irradiation by varying operating time and temperature. The suitable operating condition that gives the highest yield of sugars is evaluated by response surface methodology (RSM).