CHAPTER I
INTRODUCTION

Nowadays, the number of population around the world has been increasing significantly. As a result, the amount of waste also increases dramatically. Among them, cellulose waste is accounted for 69.6 wt% of total solid waste from an average composition of municipal solid waste (Wyk and Mohulatsi, 2003). Cellulose is one of the most abundant renewable biomass, which can be further hydrolyzed to glucose. Glucose is useful not only biologically but also chemically. Glucose can be used to produce more valuable raw materials, such as alcohols and carboxylic acids, which are important substrates for other chemicals.

Cellulose is a polymerized form of glucose molecules with β-1,4-linkage. Cellulose is formed by both intra- and inter-molecular hydrogen bonds, and it consists of composite forms of highly crystallized microfibrils among amorphous matrices (Li *et al.,* 2006). A way that can hydrolyze cellulose to simple sugar is using cellulases. Cellulases consist mainly of three enzymes: *exogluconase* (1,4-β-D-glucan cellobiohydrolase, E.C. 3.2.1.91), *endogluconase* (EG, endo-1,4-β-glucanase, EC 3.2.1.4) and *β-glucosidase* (E.C. 3.2.1.21). These cellulases can be produced by bacteria in higher termite's gut. Taechapoempol (2008) obtained strains with high specific activity for the cellulases.

Typically, the hydrolysis rate of cellulose to glucose eventually slows down after the first few hours, resulting in a lower glucose yield, longer processing time, and some accumulated recalcitrant residue due to incomplete hydrolysis. In addition, the hydrolysis rate is faster for amorphous cellulose than crystalline cellulose. As a consequence, a pretreatment step is required in order to improve the hydrolysis rate. A pretreatment method is applied to open the structure of cellulose to increase the surface area so that it is accessible to the cellulases (Dadi *et al*., 2007). There are several pretreatment methods, such as steam explosion, carbon dioxide explosion, hot water treatment, dilute-acid treatment, alkali treatment, and ozonolysis. However, all these pretreatment methods have several drawbacks. Some pretreatment methods require severe conditions, such as high temperature and pressure, and some require strong acids or bases, resulting in the need of special equipment. Moreover, most of them release toxic and hazardous pollutants (Zavrel *et al.*, 2009). As a result, ionic liquids (ILs) are promising alternative solvents for the pretreatment of cellulose because cellulose can be dissolved in ILs at mild conditions, and ILs can be recovered nearly 100%. Furthermore, several imidazolium-based ILs can dissolve large amounts of cellulose. Recently, cellulose solubilities of up to 25 wt% have been achieved with 1-*n*-butyl-3-methylimidazolium chloride [BMIM]Cl (Swatloski *et al.*, 2002). [BMIM]Cl is one of ILs that has a low melting point (65°C) and low vapor pressure, thus it can be used appropriately to enhance the hydrolysis rate (Novoselov *et al.*, 2007).

In this research, conversion of cellulose to glucose by cellulases, derived from bacteria isolated from higher termites, has been investigated with the aid of [BMIM]Cl ionic liquid in the pretreatment step.