学位論文全文の要約

題　目 BEHAVIOR OF MODEL AND REAL BIOMASS (EUCALYPTUS) IN HYDROTHERMAL PRETREATMENT BY A CONTINUOUS FLOW REACTOR AND AN AUTOCLAVE REACTOR

（連続流通式反応器とオートクレーブ反応器を用いた水熱前処理におけるモデル化合物と実バイオマス(ユーカリ)の挙動）

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Hydrothermal pretreatment processes have a potential to become an important group of technologies for converting wet biomass or organic waste into valuable energy such as bio-ethanol and so forth. This method is non-toxic and does not require any harmful chemicals in the process. Moreover, it mainly utilizes water in the reaction which makes it an environmentally friendly process. The most abundant carbohydrates in biomass are the polysaccharides. Lignocellulosic (biomass) being an excessive waste from agriculture sector makes it an interesting option for hydrothermal pretreatment. Eucalyptus is one of the available raw materials in Thailand. It is a valuable lignocellulosic biomass and can be used as a feedstock. The goal of this study is to convert cellulose in the eucalyptus to sugar product such as glucose, simultaneously avoid the degradation of sugar during hydrothermal pretreatment.

The present study therefore devotes to thoroughly investigate mechanisms of glucose formation and degradation of cellulose mechanisms for a better understanding in hydrothermal pretreatment. It was first time to establish the cellulose dissolution in hydrothermal pretreatment (in subcritical water condition) applying for flow continuous system to describe the dissolution rate with affect from variety of parameters such as particle size of feedstock treatment temperature and so on.

In this study, two types of reactors were used for investigated; a continuous flow reactor and an autoclave reactor. To improve the sugar production from hydrothermal pretreatment, both reactors were studied by means of varying parameters including treatment time, treatment temperature, flow rate, feedstock concentration, and particle size of raw material.

Firstly, to determine the reaction parameters and the reaction pathways of cellulose degradation, enzymatic hydrolysis using cellulase is an essential process. Cellulase was utilized to catalyze hydrolysis reaction and the amount of cellulose degradation after hydrolysis was investigated to determine the reaction rate parameter. The effects of treatment temperature, treatment time, and flow rate of eucalyptus residue on hydrothermal pretreatment with non-catalyst were firstly explored for glucose production by using flow reactor and autoclave reactor. The first-order kinetic model was assumed to describe the mechanism of cellulose degradation in eucalyptus residue. The decomposition rate of glucose was faster than that of cellulose in the

hydrothermal pretreatment.

Secondly, we focused on the effect of the acid towards the reaction. In biomass, it is observed that acetic acid is the one of the degradation product from hemicelluloses in hydrothermal pretreatment, which leads to understanding of the effect of auto-catalyst in hydrothermal pretreatment then the effects of CH_3COOH and K_2CO_3 on the liquid composition were experimentally investigated. The autocatalytic effect of acid production in the hydrothermal pretreatment is therefore not significant. A pseudo-first-order kinetic model regarding to cellulose content was developed to explain the conversion mechanism of cellulose to glucose in the hydrothermal pretreatment process.

Finally, the above studies on hydrothermal pretreatment using real biomass compounds such as eucalyptus and water hyacinth gave different results in terms of cellulose degradation rate. Meanwhile, it is important to use model biomass compound such as pure cellulose to provide a better understanding on its overall degradation under hydrothermal conditions. Cellulose dissolution mechanism in hydrothermal pretreatment was elucidated in this study by using the continuous flow reactor. The dissolution rate of cellulose in the hydrothermal pretreatment was successfully determined. The model equation was used to explain the dissolution phenomena of cellulose in hydrothermal pretreatment, which is a key to improve the yield of hydrolyzed product such as glucose. Hence, the proposed model can explain the phenomena of dissolution of cellulose in hydrothermal pretreatment under subcritical condition in a continuous flow system.