

CHAPTER 6

Conclusions and Further Works

6.1 Conclusions

The purpose of this research is lignin elimination from lignocellulose. Lignin is eliminated by base solution pretreatment and base solution with ozone pretreatment method. Lignocellulose of this research can be divided into 2 types. There are low of lignin and high of lignin. Bana grass is low of lignin type which is from Hangchat District, Lampang Province, while corn stover is high of lignin type which is from Fang District, Chiang Mai Province. Both bana grass and corn stover have cellulose, hemicellulose and lignin which are the compositions. At first, lignocellulose is chopped to the small size of less than 1 mm. And then, it is dried to remove moisture. After that, it is pretreated by alkaline and ozone.

The chemical compositions are analyzed both before and after the experiment. There are the amount of cellulose, hemicellulose and lignin. TAPPI is the standard which is used for chemical composition.

NaOH, NH₃ and Ca(OH)₂ are the base solution of this research. They are used in the pretreatment process. The concentration of NaOH solution is 0.5 – 10.5%wt., while NH₃ solution is 5.0 – 20.0%wt, and Ca(OH)₂ is 20 - 100%wt.

6.1.1 Effect of Base pretreatment

It can be described that lignin is removed from the sample by using base solution at various concentrations, impregnation time and temperature. The result found that NaOH can eliminate lignin more than NH_3 and $\text{Ca}(\text{OH})_2$. Whereas $\text{Ca}(\text{OH})_2$ can eliminate the least lignin compared to the others. The decreasing of base concentration, impregnation time and reaction temperature lead to increasing lignin elimination. In addition, cellulose quantity increases as well. However, the amount of solidity recovery decreases because base treatment can eliminate lignin from lignocellulose, and it also eliminate other composition.

Desired lignocellulose which use for ethanol production has to be at low amount of lignin and high amount of cellulose and hemicellulose because cellulosic enzyme changes cellulose to sugar which is the reactant of ethanol production. Thus, good lignocellulose should have high cellulose and hemicellulose and it should have low lignin. This research considers ratio of cellulose and lignin. Good lignocellulose should have higher ratio of cellulose than lignin. The result found that ratio of cellulose and lignin for bana grass is 7.3 and corn stover is 2.6 at the initial experiment. After the pretreatment, bana grass has the maximum cellulose and lignin ratio at 12.6 with NaOH concentration of 5.5%wt. The amount of lignin elimination is 5.2%. For corn stover, maximum cellulose and lignin ratio is 8.1 with NaOH concentration of 10.5%wt. The amount of lignin elimination is 7.6%. For NH_3 pretreatment, bana grass has maximum cellulose and lignin ratio at 12.0 with NH_3 concentration of 20%wt. The amount of lignin elimination is 5.4%. The maximum cellulose and lignin ratio of corn stover is 3.8 with NH_3 concentration of 20%wt. The amount of lignin elimination is 12.6%. For $\text{Ca}(\text{OH})_2$ pretreatment, bana grass has maximum cellulose and lignin ratio at 9.0 with $\text{Ca}(\text{OH})_2$ concentration of 100%wt. The amount of lignin elimination is 7.0%. While, the maximum cellulose and lignin ratio of corn stover is 3.5 with $\text{Ca}(\text{OH})_2$ concentration of 100%wt. The amount of lignin elimination is 13.9%.

6.1.2 Effect of ozone pretreatment

Ozone can be used for pretreat lignocellulose. The concentration of ozone in the experiment is 1000 mg/hr. The pretreatment time of ozone is 0 – 30 mins. The result found that ozone pretreatment only cannot eliminate lignin but it can do well if it react with alkaline solution. The result found that, ozone with NaOH solution can eliminate lignin more than use with NH_3 and $\text{Ca}(\text{OH})_2$. The result of ozone pretreatment for bana grass and corn stover are the same. It is found that, the increasing time leads to lignin elimination and ozone do not destroy cellulose. Hence, the ratio of cellulose and lignin is high.

6.1.3 Inhibitor examination

The inhibitor substance for sugar reduction and ethanol production are acetaldehyde and total phenolic. These substances occur during the pretreatment from ozone. They are toxic to yeast which is used in ethanol and sugar reducing production. For corn stover, total phenolic quantity from NaOH with ozone, NH_3 with ozone and $\text{Ca}(\text{OH})_2$ with ozone are 18.87 ± 0.56 , 8.72 ± 0.26 and 2.95 ± 0.14 in order. For the result of bana grass, total phenolic quantity from NaOH with ozone, NH_3 with ozone and $\text{Ca}(\text{OH})_2$ are 25.35 ± 0.79 , 9.83 ± 0.03 and 3.06 ± 0.03 respectively. Total phenolic is found in the product both of bana grass and corn stover but acetaldehyde is not detected in both of bana grass and corn stover. These toxics can be eliminated by water washing.

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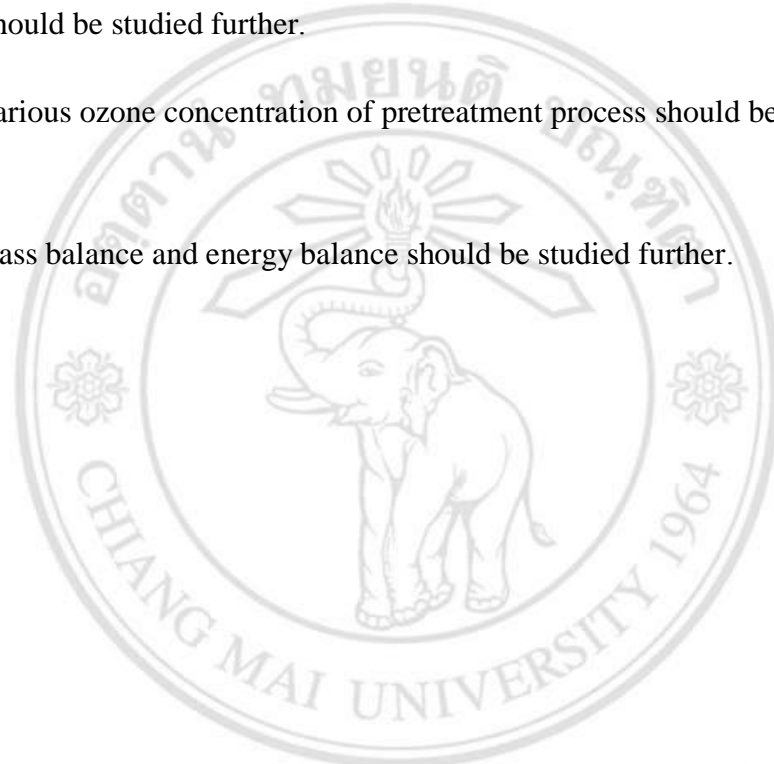
6.2 Further Works

6.2.1 This research is the study for the lignin elimination. It should be tested for sugar reduction and ethanol fermentation after lignin pretreatment.

6.2.2 This research does not have fixed ratio of solution and lignocellulose. Various ratio values should be studied further.

6.2.3 Various ozone concentration of pretreatment process should be studied further.

6.2.4 Mass balance and energy balance should be studied further.



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