REFERENCES

Adler, E. (1997). Lignin chemistry-past, present and future. Wood Science and Technology, 11, 169–218.

Almeida, J., Bertilsson, M., Gorwa-Grauslund, M., Gorsich, S., Gunnar, L., (2009). Metabolic effects of furfuraldehydes and impacts on biotechnological processes. Applied Microbiology Biotechnology, 82, 625–638.

Ando, S., Arai, I., Kiyoto, K., and Hanai, S. (1986). Identification of aromatic monomers in steam-exploded poplar and their influence on ethanol fermentation. Journal of Fermentation Technology, 64, 567–570.

Axe, D.D., and Bailey, J.E. (1995). Transport of lactate and acetate through the energized cytoplasmic membrane of *Escherchia coil*. Biotechnology and Bioengineering, 47, 8–19.

Azuma, J., Tananka, F., Koshijima, T. (1984). Enhancement of enzymatic susceptibility of lignocellulosic waste by microwave radiation. Journal of Fermentation Technology, 62(4), 377–84.

Balaban, M., and Ucar, G. (1999). The effect of the duration of alkali treatment on the solubility of polyoses. Agricultural and Forest Meteorology, 23, 667–671.

Bardet, M., Robert, D.R., Lundqvist, K., 1985. On the reactions and degradation of the lignin during steam hydrolysis of aspen wood. Sven. Papperstidn, 6, 61–67.

Beguin, P., Aubert, J.P. (1994). The biological degradation of cellulose. FEMS Microbiology Reviews, 13, 25–28.

Buchert, J., Puls, J., and Poutanen, K. (1989). The use of steamed hemicellulose as substrate in microbial conversion. Applied Biochemistry and Biotechnology, 20/21, 309–318.

Caulfield, D., Moore, W.E. (1974). Effect of varying crystallinity of cellulose on enzymatic hydrolysis. Wood Science and Technology, 6, 375–379.

Chang, S., Holtzapple, M.T., (2000). Fundamental factors affecting enzymatic reactivity. Applied Biochemistry and Biotechnology, 5–37.

Cheng, G., Varanasi, P., Li, C., Liu, C.L., Melnichenko, Y.B., Simmons, B.A., Kent, M.C.S., Singh, S.M. (2011). Transition of cellulose crystallinity structure and surface morphology of biomass as a function of ionic liquid pretreatment and its relation to enzymatic hydrolysis. Biomarcomolecules, A–I.

Clark, T., and Mackie, K.L. (1984). Fermentation inhibitors in wood hydrolysates derived from the softwood Pinus radiata. Biotechnology, 34, 101–110.

Coughlan, M.P., Ljungdahl, L.G., (1988). Comparatives biochemistry of fungal and bacterial cellulolytic enzyme system. Biochemistry and Genetics of Cellulose Degradation, 11–30.

Delgenes, J.P., Moletta, R., Navarro, J.M., (1996). Effect of lignocelluloses degradation products on ethanol fermentations of glucose and xylose by *saccharomyces cereisiae, Zymomonas mobilis, Pichia stipitis,* and *Candida shehatae.* Enzyme and Microbiological Technology, 19, 220–225

Duff, S.J.B., Murray, W.D. (1996). Bioconversion of forest products industry waster cellulosics to fuel ethanol: a reiew. Bioresource Technology, 55, 1–33.

Esteghlalian, A., Hashimoto, A.G., Fenske, J.J., and Penner, M.H. (1997). Modeling and optimization of the dilute-sulfuric-acid pretreatment of corn stover, poplar and switchhgrass. Bioresource Technology, 59, 129–136.

Ezeji, T., Qureshi, N., and Blaschek, H.P. (2007). Butanol Production From Agricultural Residues: Impact of Degradation Products on Clostridium beijerinckii Growth and Butanol Fermentation. Biotechnology and Bioengineering, 97, 1460–1469.

Fan, L.T., Lee, Y.H., Gharpuray, M.M. (1982). The nature of lignocellulosics and their pretreatments for enzymatic hydrolysis. Advances in Biochemical and Engineering, 23, 158–187.

Fengel, D., and Wegener, G. (1984). Wood: Chemistry, Ultrastructure, Reactions. De Gruyter, Berlin.

Gabhane, J.D., William Prince, S.P.M., Vaidya, A.N., Mahapatra, C.T. (2011). Influence of heating source on the efficacy of lignocellulosic pretreatment-A cellulosic ethanol perspective. Biomass and Bioenergy, 35, 96–102.

Gamez, S.R., Gonzalez-Cabriales, J.J., Ramirez, J.A.B.T., Garrote, G., Vazquez, M.N. (2006). Study of the hydrolysis of sugar cane bagasses using phosphoric acid. Journal of Food Engineering, 74, 78–88.

Gaspar, M.L.D., Kalman, G.G.L, Reczey, K.T. (2007). Corn fiber as a raw material for hemicelluloses and ethanol production. Process Biochemistry, 42, 1135-1139.

Grabber, J.H. (2005). How do lignin composition, structure, and cross-linking affect degradability? A review of cell wall model studies. Crop Science, 45, 820–831.

Gray, M.C., Converse, A.O., and Wyman, C.E. (2003). Sugar monomer and oligomer solubility. Data and predictions for application to biomass hydrolysis. Applied Biochemistry and Biotechnology, 179–193.

Grethlein, H.E. (1985). The effect of pore size distribution on the rate of enzymatic hydrolysis if cellulose substrates. Biotechnology, 3, 155–160.

Grethlein, H.E. (1992). Comparison of Pretreatment methods on the basis of available surface area. Biotechnology, 39, 155–163.

Grous, W.R., Converse, A.O., Grethlein, H.E. (1986). Effect of steam explosion pretreatment on pore size and enzymatic hydrolysis of poplar. Enzyme Microbiology and Biotechnology, 8, 274–280.

Hendriks, A.T.W.M., and Zeeman, G. (2009). Pretreatments to enhance the digestibility of lignocellulosic biomass. Bioresource Technology, 100, 10–18.

Icoz, E., Tugrul, K.M.M., Saral, A.M., and Icoz, E. (2009). Research on ethanol production and use from sugar beet in Tukey. Biomass and Bioenergy, 33, 1–7.

Jonsson, L.J., Palmqvist, E., Nilvebrant, N.O., and Hahn-Hagerdal, B. (1998). Detoxification of wood hydrolysates with laccase and peroxidase from the white-rot fungus Trametes versicolor. Applied Microbiology and Biotechnology, 49, 691–697.

Koullas, D.P., Christakopou;os, P., Kekos, D., Macris, B.J., Koukios, E.G. (1992). Correlating the effect of pretreatment on enzymatic hydrolysis of straw. Biotechnology and Bioengineering, 39, 113–119.

Kumar, P.V., Barrett, D.M., Delwiche, M.C., Stroeve, P.T. (2009). Methods for pretreatment of lignocellulosic biomass for efficient hydrolysis and biofuels production. Industrial and Engineering Chemistry Research, 48, 3713–3729.

Lapierre, C., Rolando, C., Monties, B., (1983). Characterization of popular lignins acidolysis products: capillary gas-liquid and liquid-liquid chromatograohy of monomeric compounds. Holzforschung, 37, 189–198.

Larsson, S., Palmqvist, E., Hahn-Hagerdal, B., Tengborg, C., Stenberg, K., Zacchi, G., and Nilvebrant, N.O. (1998). The generation of fermentation inhibitors during dilute acid hydrolysis of softwood. Enzyme and Microbial Technology, 24, 151–159.

Laureano-Perez, L., Teymouri, F., Alizadeh, H., and Dale, B.E. (2005). Understanding factors that limit enzymatic hydrolysis of biomass. Applied Biochemistry and Biotechnology, 124, 1081–1099.

Levan, S.L., Ross, R.J., and Winandy, J.E. (1990). Effects of fire retardant chemicals on bending properties of wood at elevated temperatures. Research Paper FPL- RP-498. Madison, WI: U.S. Department of agriculture, Forest service, Forest Products Laboratory, p. 24.

Mauron, J. (1981). The Maillard reaction in food: A critical review from the nutritional standpoint. Progress in Food and Nutrition Sciences, 5, 5–35.

McMillan, J.D. (1994). Pretreatment of lignocellulosic biomass. In:Himmel, M.E., Baker, J.O., Overend, R.P. (Eds.), Enzymatic Conversion of Biomass for Fuels Production. American Chemical Society, Washington, DC, 292–324.

Mosier, N.T., Wyman, C.L., Dale, B., Elander, R.C., Lee, Y.Y., Holtzapple, M., and Ladisch, M.C. (2005). Features of promising technologies for pretreatment of lignocellulosic biomass. Bioresource Technology, 96, 673–686.

Navarro, A. (1994). Effects of furfural on ethanol fermentation by Saccharomyces cerevisiae: mathematical models. Current Microbiology, 19, 87–90.

Nilvebrant, N.O., Reimann, A., Sousa, F., Kleen, M., and Palmqvist, E. (1997). Identification of fermentation inhibiting compounds from acid hydrolysis of wood. In: Proceedings of the Nineth International Symposium on Wood and Pulping Chem., Montreal. 79, 1–4.

Olsson, L., and Hahn-Hagerdal, B. (1996). Fermentation of lignocellulosic hydrolysates for ethanol production. Enzyme and Microbial Technology, 18, 312–331.

Palmqvist, E. and Hahn-Hagerdal, B. (2000). Fermentation of lignocellulosic hydrolysates. ∏: inhibitors and mechanisms of inhibition. Bioresource Technology, 74(1), 25–33.

Palmqvist, E., Meinander, Q., Grage, and H., Hahn-Hagerdal, B. (1999). Main and interaction effects of acetic acid, furfural and phydroxybenzoicacid on growth and ethanol productivity of yeasts. Biotechnology and Bioengineering, 63, 46–55.

Popoff, T. and Theander, O. (1976). Formation of aromatic compounds from carbohydrates part III. Reaction of D-glucose and D-fructose in slightly acidic, aqueous solution. Acta Chemica Scandinavica B, 30, 397–402.

Puri, V.P. (1984). Effect of crystallinity and degree of polymerization on enzymatic saccharification. Biotechnology and Bioengineering, 26, 1219–1222.

Redding, A.T., Wang, Z.Y., Keshwani, D.P., Cheng, J. (2011). High temperature dilute acid pretreatment of coastal Bermuda grass for enzymatic hydrolysis. Bioresource Technology, 102, 1415–1424.

Saha, B.D.C, Iten, L.O.B., Cotta, M.C.A., Wu, Y.V.T. (2005). Dilute acid pretreatment, enzymatic saccharfication and fermentation of wheat traw to ethanol. Process Biochemistry, 40, 3693-3700.

Saka, S. (1991). Chemical composition and Distribution. Dekker, New York, 3–58.

Sears, K.D., Beelik, A., Casebier, R.L., Engen, R.J., Hamilton, J.K., Hergert, H.L., (1971). Southern pine prehydrolyzates: characterization of polysaccharides and lignin fragments. Journal of Polymer Science, 36, 425–443.

Sivers, M.V., and Zacchi, G. (1995). A techno-economical comparison of three processes for the production of ethanol from pine. Bioresource Technology, 51, 43–52.

Stouthamer, A.H. (1979). The search for a correlation between theoretical and experimental growth yields. International Review of Biochemistry Microbiology and Biochemistry, 21, 28–35.

Sun, Y., and Cheng J.Y. (2002). Hydrolysis of lignocellulosic materials for ethanol production; A review. Bioresource Technology, 83, 1–11.

Suortti, T. (1983). Identification of antimicrobial compounds in heated neutral glucose and fructose solutions. Lebensm Unters Forsch, 177, 94–96.

Sweet, M.S., and Winandy, J.E. (1999). Influence of degree of polymerization of cellulose and hemicellulose on strength loss in fire-retardant-treated southern pine. Holzforschun, 53 (3), 311–317.

Taherzadeh, M., Eklund, R., Gustafasson, L., Niklasson, C., Liden, G., (1997). Characterization and fermentation of dilute-acid hydrolyzates from wood. Industrial and Engineering Chemistry Research, 36, 4659–4665.

Thompson, D.N., Chen, H.C., Grethlein, H.E. (1992). Comparison of pretreatment methods on the basis of available surface area. Bioresource Technology, 39, 155–163.

Vazquez, M., Oliva, M., Tellez-Luis, S.J. and Ramirez, J.A. (2007). Hydrolysis of sorghum straw using phosphoric acid:Evaluation of furfural production. Bioresource Technology, 98, 3053–3060.

Verduyn, C., Postma, E., Scheffers, W.A., and van Dijken, J.P. (1990). Energetics of Saccha romyces cerevisiae in anaerobic glucose-limited chemostat cultures. Microbiology, 136, 405–412.

Verduyn, C., Postma, E., Scheffers, W.A., and Dijken, J.P. (1992). Effect of benzoic acid on metabolic fuxes in yeasts: a continous-culture study on the regulation of respiration and alcoholic fermentation. Yeast Chichester England, 8, 501–517.

Warth, A.D. (1988). Effect of benzoic acid on growth yield of yeasts differing in their resistance to preservatives. Applied and Environmental Microbiology, 54 (8), 2091–2095.

Weil, J R., Dien, B., Bothast, R., Hendrickson, R., Mosier, N.T. S., and Ladisch M.M. R. (2002). Removal of Fermentation Inhibitors Formed during Pretreatment of Biomass by Polymeric Adsorbents. Industrial and Engineering Chemistry Research, 41, 6132–6138.

Wyman, C.E. (1994). Ethanol from lignocellulosic biomass technology, economics, and opportunities. Bioresource Technology, 50, 3–16.

Wyman, C.E., Dale, B.E., Elander, R.T., Holtzapple, M., Ladisch, M.R., and Lee, Y.Y. (2005). Coordinated development of leading biomass pretreatment technologies. Bioresource Technology, 96, 1959–1966.

Yoshida, M., Liu, Y., Uchida, S., Kawarada, K., Ukagami, Y., Ivhinose, H., Kaneko, S., Fukuda, K. (2008). Effect of cellulose crystallinity, hemicelluloses, and lignin on the enzymatic hydrolysis of miscanthus sinensis to monosaccharides. Bioscience, Biotechnology, and Biochemistry, 72, 805-810.

Zhang, J.H., Zhang, B.X., Zhang, J.Q., Lin, L., Liu, S.J., Ouyang, P.K. (2010). Effect of phosphoric acid pretreatment on enzymatic hydrolysis of microcrystalline cellulse. Biotechnology Advances, 28, 613–619.

Zhao, J and Xia, L.M. (2010). Bioconversion of corn stover hydrolysate to ethanol by a recombinant yeast strain. Fuel Processing Technology, 91, 1807-1811.

Zheng, Y., Pan, Z.L., and Zhang, R.H. (2009). Overview of biomass pretreatment for cellulosic ethanol production. Agricultural and Biological Engineering, 2, 51–68.

Zhu, S.D., Wu, Y.X., and Ziniu, Y., Zhang, X., Wang, C.W., Yu, F.Q., Jin, S.W. (2006). Production of ethanol from microwave-assisted alkali pretreated wheat straw. Process Biochemistry, 41, 869–873.

APPENDICES

Appendix A Stainless Steel Reactor

The reactor is an acid resistant stainless steel which can resist the acid corrosion. Moreover, this reactor has performance to operate under high temperature and pressure. The total volume of reactor 1 L. The reactor system was combined with a temperature control, coil heater with ceramic plate, pressure gauge, pressure release valve and, mechanic agitation to create homogeneous system. The figure of stainless steel reactor and its system is shown in Figure A1.

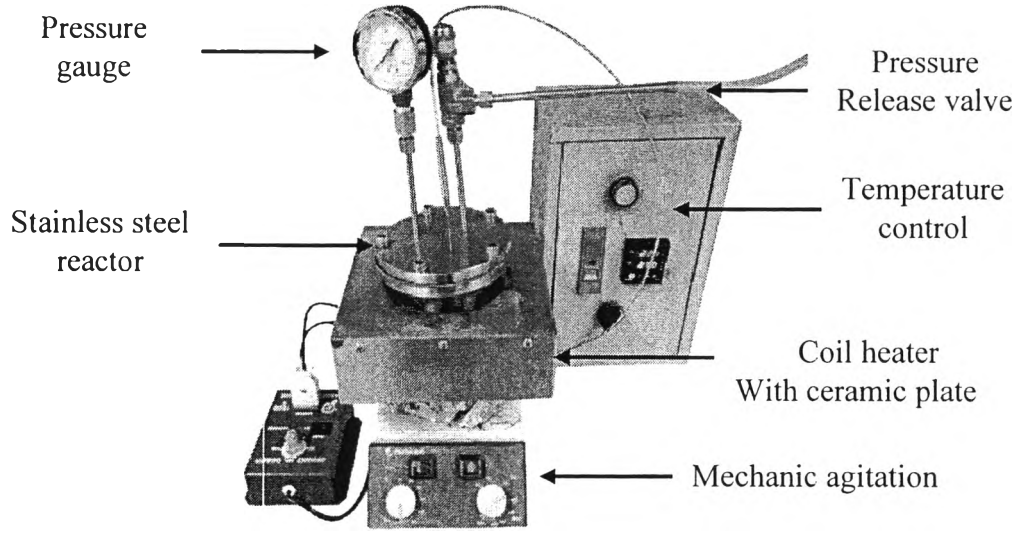

Figure A1 Stainless steel reactor.

Appendix B Retention Time and Calibration Curve of Monomeric Sugar and Furfural by HPLC

The quantity of monomeric sugars yield and furfural in fermentable sugars which got from pretreatment and enzymatic hydrolysis process were determined by HPLC equipped with a refractive index detector (Series 200 LC/S/N291N5060508, Perkin Elmer) using an Aminex-HPX 87H column (300 mm x78 mm, Bio-Rad Lab, USA) and a guard column (30 mm x 4.6 mm, Bio-Rad Lab, USA) under these following conditions: flow rate 0.30 mL/min, mobile phase 0.005 M of H_2SO_4 and column temperature was fixed at 65°C.The retention times of monomeric sugar in both fermentable sugars are shown in Table B1. It showed that there are 3 monomeric sugars, which are glucose, xylose, arabinose, and one inhibitor compound. In order to determine the quantity of monomeric sugar, calibration curve of each monomeric sugar is necessary. Figure B1 shows the calibration curve of monomeric sugar and furfural.

Table B1 Retention time of monomeric sugar

Monomeric sugar	Retention time (min)
Glucose	17.13
Xylose	18.32
Arabinose	19.83
Mannose	N/A
Galactose	N/A
Cellubiose	N/A
Rhamnose	N/A
Furfural	92.18

N/A; Not Available

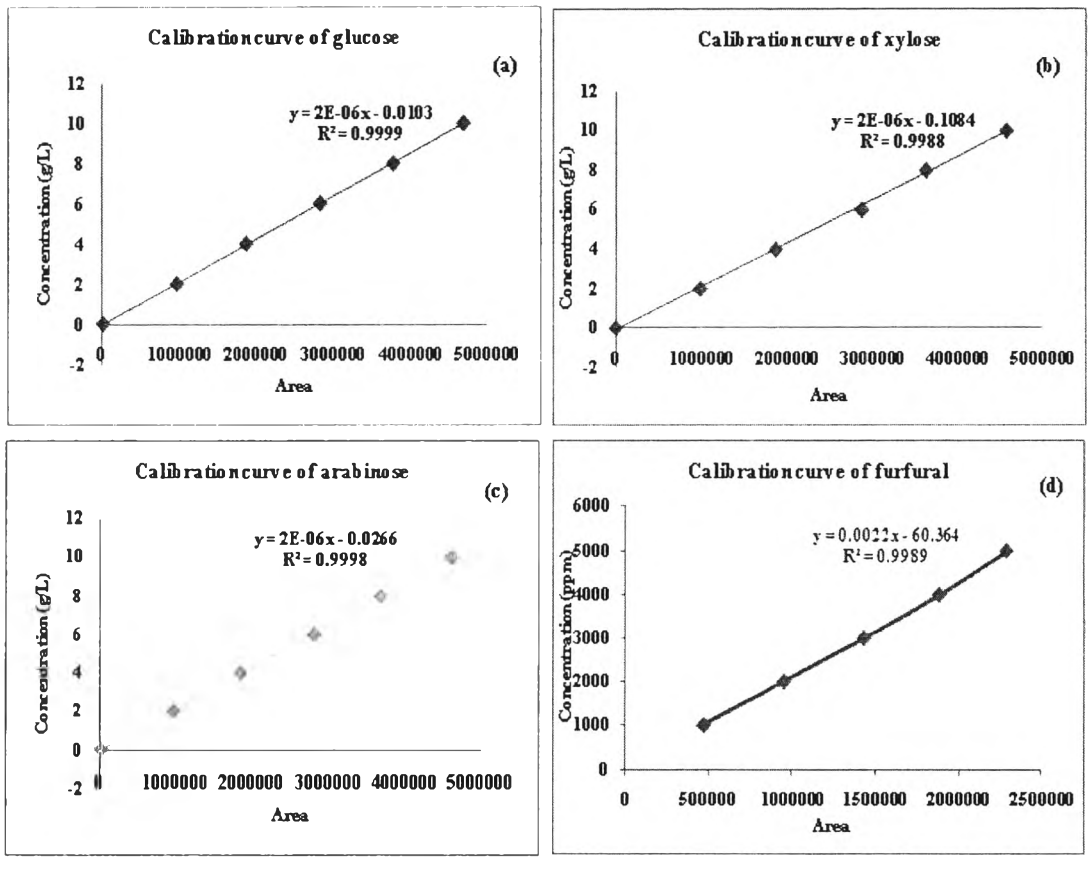

Figure B1 Calibration curve of monomeric sugar and furfural in fermentable sugars. Symbols; (a) calibration curve of glucose, (b) calibration curve of xylose, (c) calibration curve of arabinose, and (d) calibration curve of furfural.

Appendix C Retention Time and Calibration Curve of Ethanol by GC

After we're obtained the fermentable sugars from both pretreatment and enzymatic hydrolysis step, they were fermented to ethanol by *Saccharomyces Cerevisiae* for 24 h and the ethanol yield was detected by Gas Chromatrography at faculty of Pharmacy, Chulalongkorn university. In order to determine the quantity of ethanol in fermentable sugars, the calibrational curve of ethanol is required. Figure C1 shows the calibration curve of standard ethanol under various concentrations in the range 0.5 g/L to 10 g/L.

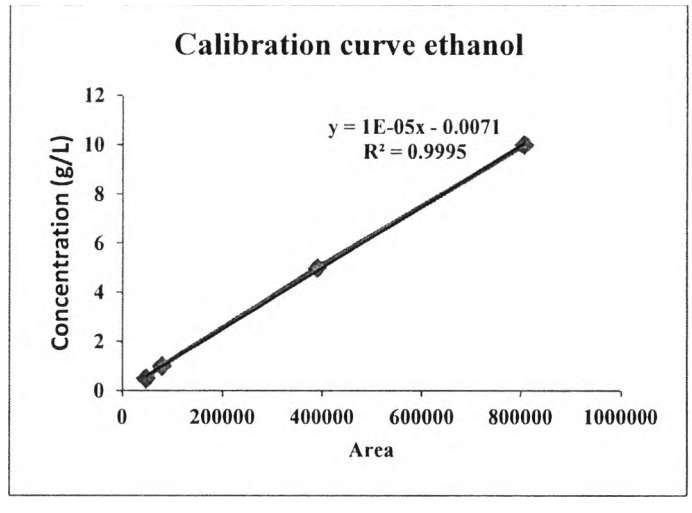

Figure C1 Calibration curve of ethanol.

Appendix D Ethanol Yield

Table D1 Comparison ethanol yield from various pretreatment method and feed stock

Feed Stock	Pretreatment Method	Pretreatment Condition	Yeast	Ethanol yield (g/L)	Ref
Corn stover	Sulfuric acid	108 °C with 1.5% H_2SO_4 for 6 h, with at a LSR of 1:10 (w/v)	Saccharomyces cerevisiae ZU-10	34.3	Jing Zhao and Liming Xia (2010)
Corn stover	Sodium hydroxide	80 °C with 2% NaoH for 75 min with at a LSR of 1:8 (w/v)	Saccharomyces cerevisiae ZU-10	41.2	Jing Zhao and Liming Xia (2010)
Wheat straw	Sulfuric acid	121 °C with 0.75% (v/v) H_2SO_4 for 75 min	Escherichia coli strain FBR5	19	Saha *et al.*, (2005)
Wheat straw	Sodium hydroxide	1% NaOH for 60 min	Trichoderma reesei and Saccharomyces cerevisiae	31.1	Zhu *et al.*, (2006)

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Proceedings

1. Satimanont, S., Luengnaruemitchai, A., and Wongkasemjit, S. (2012, April 24) Dilute Phosphoric Acid Pretreatment of Corncob for Biofuels Production. Proceedings of The 3rd Research Symposium on Petroleum, Petrochemicals, and Advanced Materials and The 18th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.
2. Satimanont, S., Luengnaruemitchai, A., and Wongkasemjit, S. (2012, January 12) Dilute Phosphoric Acid Pretreatment of Corn Cobs for Butanol Production. Pure an Appiled Chemistry International Conference, Chiangmai, Thailand.
3. Satimanont, S., Luengnaruemitchai, A., and Wongkasemjit, S. (2012, April 11-13) Effect of Temperature and Time on Dilute Acid Pretreatment of Corn Cobs. International Conference on Chemical, Biological and Environmental Engineering (ICCBEE 2012), Venice, Italy.