

# Treatment of Lignocellulosic Biomass to alter lignin Content

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## Abstract

The research on biomass conversion technology has attracted great attention of the world along with the shortage of fossil energy resources. Using new steam explosion technique as a treatment process for the lignocellulosic materials has been reported rarely. The mechanism of steam explosion effect in biomass conversion and the modification of lignocellulosic materials were analyzed in this paper. The result showed the effect of steam explosion on dry sugarcane leaves was successfully investigated with treatment conditions of 121<sup>0</sup>C/ 15 PSI for 15 min, 121<sup>0</sup>C/ 15 PSI for 30 min, 132<sup>0</sup>C/ 15 PSI for 15 minutes, 132<sup>0</sup>C/ 15 PSI for 30 min. According to the result of experimentation, the steam explosion technique should be a good treatment method for altering the lignin Content.

**Keywords:** Lignocellulosic Materials, Biomass, Fossil Fuel, treatment, Steam explosion, Lignin Content.

## Introduction

Biomass is a clean and renewable energy resource. The energy stored by plants every year was about 10 times of the world's main fuel consumption, but there was less than 1% of

it was used by us till now. Sugarcane is an important commercial crop worldwide, and one of the principal sources of sugar, ethanol, and jiggery globally. It is an important crop for World economy. Sugarcane leaves are large agricultural Straw resources of the tropic. The total annual waste leaves are upto 20 million tons. The traditional approach is to cleanup after the sugarcane leaves situ burning. Burning cane leaves not only cause the loss of nutrients but also cause a lot of air pollution. Since the beginning of the 1970s, with the impact of the global oil crisis and the improving of people's environmental awareness, the world began to pay more attention to developing and highly efficient conversion techniques of biomass.

## Structure of Lignocellulosic Biomass

Lignocellulose is the primary building block of plant cellwalls. Plant biomass is mainly composed of cellulose, hemicellulose, and lignin, along with smaller amounts of pectin, protein, extractives and ash. The composition of these constituents can vary from one plant species to another. For example, hardwood has greater amounts of cellulose, whereas wheat straw and leaves have more hemicelluloses. In addition, the ratios between various constituents within a single plant



### **Biomass treatment**

The collected dried dry sugarcane leaves were cut into pieces by using knife to nearly about 2 to 3cm long particle size. Steam explosion treatment of dry sugarcane leaves were conducted in a 5litre autoclave equipped with temperature and pressure control systems. The weight of the sample used for each treatment was 10 grams. Only sample is kept inside the crucible surrounded by water in an autoclave. The treatment temperature and pressure were 121 °C / 15 PSI for treatment time of 15 minutes, 121 °C / 15 PSI for treatment time of 30 minutes, 132°C/ 30 PSI for treatment time of 15 minutes, 132°C/ 30 PSI for treatment time of 30 minutes. At the end of each treatment, one exhaust valve of the autoclave was opened to release the steam. Afterwards, the treated dry sugarcane leaves samples were oven dried at 105 °C for 24 hours. Changes in lignin composition and the colour of the treated samples were examined.



(B)

## **Results and Discussions**

### **Effect of Steam Explosion treatment**

#### **Morphological Changes:**

The main difficulties of biomass conversion lie in its low energy density, the lower saccharification of cellulose and hemicellulose rate. Enhancing the saccharification rate effectively in its transformation process is the key to solve the bio-energy utilization problems. The color of steam exploded corn stalks changes with the steam pressure and time, the higher the pressure is the deeper the color. The color change is largely caused by the chromophores of lignin, which indicated that the severe steam explosion conditions caused the changes of lignin. Figure 4 to Figure 7 shows the colour changes in the Sample after treating at different steam pressure and time conditions.



(C)



(A)



(D)



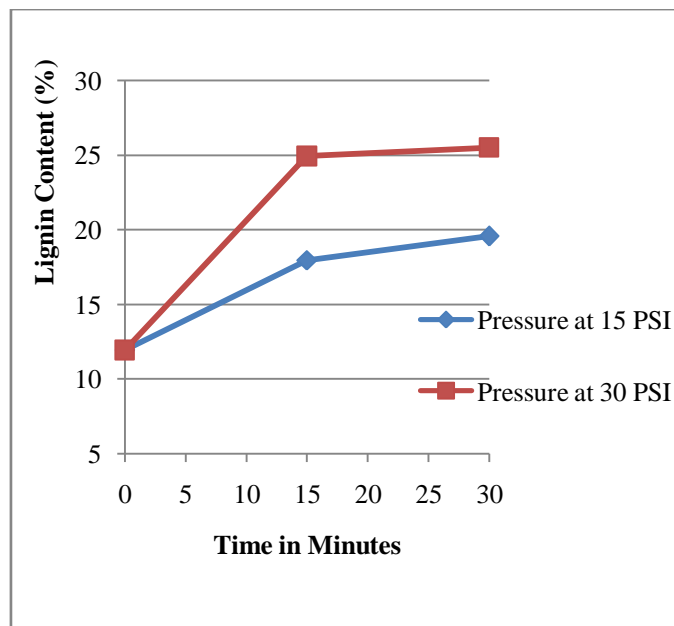
(E)

**Figure 4 :** Photograph of raw material (A), treated with various conditions of pressure and time 15psi / 15 min for (B), 15psi / 30 min for (C), 30psi / 15 min for (D), 30 psi / 30 min for (E).

**Effect of Pressure, Temperature and time on Lignin Content**

**Table 1:** Effect of Pressure, Temperature and Time on Lignin Content

Pressure in psi	Temperature in °C	Time in Minutes	Lignin Content (%)
Untreated Biomass	Initial Condition	Initial Condition	11.95
15	121	15	17.96
15	121	30	19.58
30	132	15	24.94
30	132	30	25.51



**Figure 5:** Graphical representation of the effect of pressure and time on lignin content.

**Conclusion**

The goal of the treatment process is to break down the lignin structure and disrupt the crystalline structure of cellulose, so that the acids or enzymes can easily access and hydrolyze the cellulose. Treatment can be the most expensive process in biomass-to-fuels conversion but it has great potential for improvements in efficiency and lowering of costs through further research and development. Treatment is an important tool for biomass-to-biofuels conversion processes. In our opinion, Steam explosion is a very promising new pre-treatment technology thanks for its advantages of short processing time, non-polluting and low energy consumption. Experimental results show that the effect is fairly obvious using the steam explosion as treatment technique in the biomass conversion process. As time of treatment and pressure increases the lignin content in steam exploded lignocellulosic biomass increases.

**References**

[1] Cassie Marie Welker, Vimal Kumar Balasubramanian, Carloalberto Petti ,Krishan Mohan Rai, Seth DeBoltand VenugopalMendu, "Engineering Plant Biomass Lignin Content and Composition forBiofuels and Bioproducts", energies-review,ISSN 1996-1073,(27 .07. 2015).

[2] Parveen Kumar, Diane M. Barrett, Michael j. Delwiche, and Pieter Stroeve, "Methods for Pretreatment of Lignocellulosic Biomass for Efficient Hydrolysis and Biofuel Production" *Ind. Eng. Chem. Res.*Publication date (web): 20 march 2009. Downloaded from <http://pubs.acs.org>

- [3] Sun, Y.; Cheng, J. “Hydrolysis of lignocellulosic materials for ethanolproduction: A review”. *Bioresour. Technol.* 2002, 83, 1–11.
- [4] P.F.H. Harmsen, W.J.J. Huijgen, L.M. BermúdezLópez, R.R.C. Bakker, “Literature Review of Physical and Chemical Pretreatment Processes for Lignocellulosic Biomass”, Page No. 21 to 27, 2010.
- [5] Anna Maria Raspolli Galletti, Claudia Antonetti, “Biomass pre-treatment: separation of cellulose, hemicellulose and lignin. Existing technologies and perspectives”, eurobioref,2011.
- [6] PhaniAdapa, Lope Tabil, Greg Schoenau, Anthony Opoku, “Pelleting characteristics of selected biomass with and without steam explosion pretreatment”, *Int J Agric & Biol Eng* Vol. No.3,Page no. 1-18, 2010.
- [7] Wolfgang Stelte, “Steam explosion for biomass pretreatment”, Page 1-15.
- [8] PAK SUI LAM, “Steam explosion of biomass to produce durable Wood Pellets” a Thesis submitted the university of British Columbia, May2016.