Converting Washington Lignocellulosic Rich Urban Waste to Ethanol: Part 1, Process Research

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Goal

To develop an optimized process for converting lignocellulosic rich urban waste to ethanol.

Background

- WA State Biomass Inventory concludes 4 million annual tons of municipal solid waste available for production of energy and fuels.
- We investigated bioconversion of three MSW streams into ethanol
  - Objective to find lowest energy conversion for each feedstock
- Results of bioconversion study inform the Life Cycle Assessment – shown on next poster

Methods

Lignocellulosic rich urban waste stream have been divided into three main streams: paper, municipal solid and yard waste.

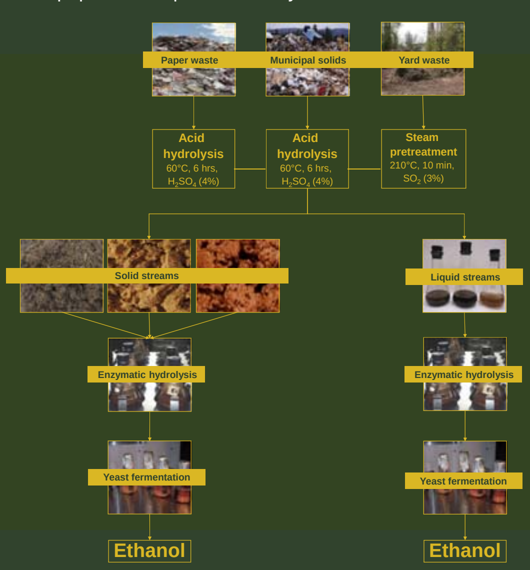

Figure 1. Experimental design describing conversion of lignocellulosic municipal solid waste to ethanol.

Results

	Paper waste (%)	Municipal solid waste (%)	Yard waste (%)
Arabinose	0.9	0.8	3.8
Galactose	0.3	0.5	5.2
Glucose	65.1	72.1	39.6
Xylose	7.9	7.1	6.7
Mannose	4.5	7.7	7.1
Total Lignin	21.4	7.5	39.1

Table 1. Chemical composition of paper, municipal solid and yard waste.

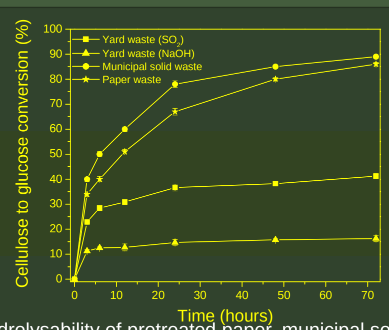

Figure 2. Hydrolysability of pretreated paper, municipal solid and yard waste .

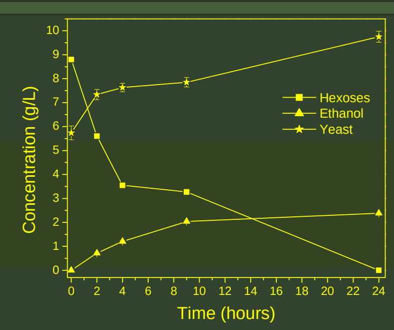

Figure 3. The ethanol production during fermentation of pretreated yard waste by PTD3.

Summary

- The paper, yard and municipal solid waste are sugar rich lignocellulosic feedstocks (Table 1).
- Dilute acid hydrolysis is an effective pretreatment method for paper and municipal solid waste (Figure 2).
- Steam pretreatment (210°C, 10 min and 3% SO_2) is a good pretreatment method for fractionation of yard waste into hemicellulose, cellulose and lignin rich fractions.
- The water insoluble fractions of municipal solid and paper waste are easily hydrolysable by enzymes. Almost theoretical cellulose to glucose conversion were achieved (Figure 2).
- The water insoluble fraction of yard waste is difficult to hydrolyze by enzymes (41% cellulose to glucose conversion). However, the low cellulose to glucose conversion yields were expected since the biomass was composed of mixture of branches, wood chips, bark, and needles (Figure 2).
- Pretreated and hydrolyzed sugars of municipal solid, paper and yard waste are readily fermentable by yeast. High ethanol yields were obtained (100% of theoretical) (Figure 3).