Biomass Program

Sugars R&D

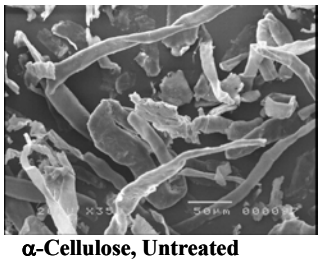
Fundamental Study on Kinetics and Transport Phenomena in Low-Water, Dilute-Acid Total Hydrolysis of Cellulosic Biomass

The process of dilute acid hydrolysis employs low-concentration acids and elevated temperatures to process lignocellulosic biomass. This project is investigating the reaction mechanism and kinetic pattern in dilute acid hydrolysis of the cellulosic component of pretreated biomass using batch and bed-shrinking flow-through reactors; and the effect of intra-particle acid diffusion within the biomass matrix. Researchers will study untreated and prehydrolyzed agricultural residues such as corn stover, sugarcane bagasse, and rice straw.

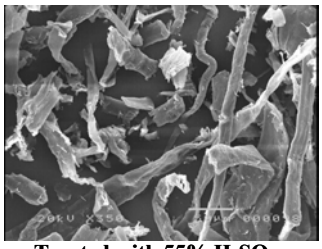
R&D Pathway

Researchers will carry out 7 different tasks: 1) identify the reaction pattern in the acid catalyzed hydrolysis of the glucan content of agricultural residues under low acid conditions; 2) gain a better understanding of the heterogeneity of the reaction and proper adjustment of the reaction conditions with the addition of a third catalytic component; 3) define unconventional reaction conditions to improve yield of sugars in the hydrolysis of pretreated biomass; 4) seek an efficient way to improve the sugar yield in the continuous prehydrolysis process; 5) optimize reactor design and operation for reduced water input to reduce reactor energy consumption; 6) determine the optimum residence time in the reactor and the precise injection points of the steam and acid in the reactor; and 7) determine the optimal biomass feedstock size.

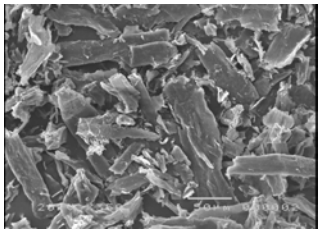
The photos show how dilute acid hydrolyzes, or breaks down, the cellulose polymer chains which are composed of glucose (350x magnification). The sugars released can subsequently be converted to value-added fuels and chemicals.



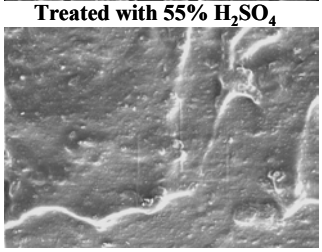
α-Cellulose, Untreated



Treated with 55% H_2SO_4



Treated with 60% H_2SO_4



Treated with 65% H_2SO_4

Benefits

- Encourages development of technology needed to support a new bioindustry
- Encourages productive use of agricultural residues and forestry wastes

Applications

This research addresses pretreatment issues that can help advance the use of lignocellulosic biomass for bioproducts.

Project Participants

Auburn University

Project Period

FY 2002 – FY 2004

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Visit the Web site for the Office of the Biomass Program (OBP) at www.eere.energy.gov/biomass.html

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