

Biorefining: Making Paper and Fermentable Sugars from Wood

New methods are required to break apart the structural components of wood for conversion to valuable products such as paper, chemicals, and fuels. A new pretreatment process releases the sugars from wood chips prior to thermomechanical pulping. Pulp can be made more efficiently (saving electrical refiner energy) and produce stronger paper products. The sugars support yeast growth and can be fermented into products such as ethanol.

Background

Biomass utilization has emerged as an important resource for obtaining useful forms of energy and reducing dependence on fossil fuels. Since the 1970s, researchers have worked to hydrolyze wood to component sugars (by either chemical or enzymatic methods) and convert these sugars to chemicals and fuels such as ethanol. Available enzymatic methods require some loosening of the wood cell wall, usually by a combination of physical, thermal, and chemical means. The Forest Products Laboratory (FPL) originated some of the methods presently used for wood chip pretreatment, including dilute acid hydrolysis, which is incorporated into several schemes to make sugars from wood. A new FPL development is a method that more gently treats the wood so that multiple products—paper products or chemicals—can be made from the resulting fibers.



Woody biomass is a plentiful by-product of forest restoration and hazardous fuels reduction activities.

Objectives

The objectives of this project are to establish conditions under which various types of biorefining can be used to make paper products and fermentable sugars from wood chips. Initial work concentrated on pretreatments for thermomechanical pulping, with the objective of making paper that is as strong as or stronger than paper from untreated pulp while generating a fermentation resource and conserving energy. Ongoing work will investigate the progressive conversion of more of the wood biomass to sugars by testing treatment prior to chemical pulping and prior to total conversion of wood to chemicals and fuels.

Approach

In this new process, wood chips are pretreated with diethyl oxalate in a heated digester, after which the solubilized sugars are extracted and improved wood chips are converted to pulp. Hydrolyzing the chips in a separate step from extracting the sugars saves on chemical addition because the water of extraction dilutes the reactants. Heating only the chips saves on energy otherwise required to heat the water and the chips to reaction temperature.

Expected Outcomes

Research has already demonstrated the potential of this new pretreatment process for energy savings, stronger

paper products, and a viable fermentation (sugar) resource. Further work will test its utility in obtaining sugars prior to making chemical (kraft and sulfate) pulps and in the total conversion of lignocellulose into useful chemicals. Comparing this method with other available methods will provide information on optimizing the process for a variety of wood species and possible products.

Timeline

During the course of this 2- to 3-year study, various wood species will be tested and evaluated for their potential products.

Cooperators

Biopulping International, Inc., Madison, Wisconsin, is a cooperator on pulping technology and improvements in pulping that are a part of the developing technology. A PCT patent application on this technology has been filed.

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