Clean Fractionation of Biomass

Alternative Feedstocks Program

The U.S. Department of Energy (DOE) Alternative Feedstocks (AF) program is forging new links between the agricultural community and the chemicals industry through support of research and development (R&D) that uses "green" feedstocks to produce chemicals. The program promotes cost-effective industrial use of renewable biomass as feedstocks to manufacture high-volume chemical building blocks. Industrial commercialization of such processes would stimulate the agricultural sector by increasing the demand of agricultural and forestry commodities. New alternatives for American industry may lie in the nation's forests and fields.

A Fresh Approach

The AF program provides new approaches to research partnerships. A unique consortium of five DOE national laboratories has been formed that can provide industry with easy access to the national laboratory system and can offer new approaches for collaborative research. The objective of the consortium is not to commercialize technology directly, but rather to provide industry with a broad range of expertise and to help lower the risk of new process development through federal cost sharing. Successful partnerships have been formed and are focusing on developing economic, environmentally friendly technologies for producing chemicals and materials from renewable resources.

Clean Fractionation of Biomass

The AF program is conducting ongoing research on a clean fractionation process. This project is designed to convert biomass into materials that can be used for chemical processes and products. Like the petroleum-cracking process, which separates a chemically complex crude oil mixture into predictable starting materials for industry, clean fractionation separates a *single* feedstock into individual components cellulose, hemicellulose, and lignin.

The focus of the clean fractionation research is to demonstrate to industry that one technology can successfully separate all types of feedstocks into predictable types of chemical intermediates.

The following criteria are being used to define a successful process:

- Selective separation of each component of a renewable feedstock, in which selectivity is defined as the ability to obtain these fractions with little or no cross-contamination between one component and another
- Easy access to and isolation of the components after separation
- High-yield recovery of each component
- Conversion of components to chemicals with little or no additional purification needed
- Economic viability of the process itself.

R&D for this project is currently under way at the National Renewable Energy Laboratory.

The first step in the clean fractionation process is to treat biomass with a proprietary solvent mixture that dissolves the lignin and hemicellulose components. This can be considered under

the broad category of organosolv pulping. The cellulose fraction is produced as an undissolved solid. Clean cellulose is obtained by a wash/dry step. A second separation is then performed on the soluble material to isolate the lignin from the hemicellulose. The lignin fraction is isolated as a solid; the hemicellulose remains in solution.

DOE Laboratory Consortium

Argonne National Laboratory
Idaho National Engineering Laboratory
National Renewable Energy Laboratory
Oak Ridge National Laboratory
Pacific Northwest Laboratory

Selected Examples of Collaborators

Alternative Agriculture Research Center
Environmental Protection Agency
Risk Reduction Laboratory
National Corn Growers Association
National Institute of Standards and Technology
U.S. Department of Agriculture
Economic Research Service

Research Partnerships within Alternative Feedstocks

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Clean fractionation is a very simple process that yields products with less than 3% cross-contamination between fractions. The lignin fraction is 94% pure, and the cellulose fraction is 97% pure. Hemicellulose is less pure, and work is continuing to improve its purity. Lignin and cellulose recovery rates from biomass are both 95%. This process, which meets the research goals, is simple, is selective, and produces high yields of predictable starting materials.

Researchers and businesses are excited about preliminary results; now the challenge is to develop new markets. These markets may include the pulp and paper industry for peroxide-bleached cellulose and new lignin-derived products, and the cellulose-ester industry.

Opportunities for small businesses also exist because the process is suitable for small-market applications.

For more information on this technology or the DOE Alternative Feedstocks program, contact:

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This document was produced for the U.S. Department of Energy (DOE) by the National Renewable Energy Laboratory, a DOE national laboratory.
DOE/GO-10095-207
DE95013106
Revised September 1995

Printed with a renewable source ink on paper containing at least 50% wastepaper

12-23-95 J51

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