

Quarterly Update

National Bioenergy Center Biochemical Platform Integration Project



Biomass Program—Sustainable Fuels, Chemicals, Materials, and Power

July-September 2008, #20

The Biochemical Process Integration Task focuses on integrating the processing steps involved in enzyme-based lignocellulose conversion technology. This project supports the U.S. Department of Energy's efforts to foster development, demonstration, and deployment of "biochemical platform" biorefineries that economically produce commodity sugars and fuel ethanol, as well as a variety of other fuel and chemical products, from abundant renewable lignocellulosic biomass.

The National Renewable Energy Laboratory manages this project for DOE's Office of the Biomass Program. Information on the Biomass Program is available at [Biomass Program](#).

To discuss the contents of this update, or for further information on the Biochemical Process Integration Task, contact Dan Schell at NREL, phone (303) 384-6869, email dan_schell@nrel.gov

31st Symposium on Biotechnology for Fuels and Chemicals

The next Symposium will be held at the Intercontinental Hotel in San Francisco, CA, May 3-6, 2009. Meeting information can be found at the following web site: <http://www.simhq.org/meetings/sbfc2009/index.html>. A list of the technical session topics is as follows:

Sunday, May 3

Session 1 – Plant Science and Technology
Session 2 – Microbial Science and Technology I
Poster Session, Part 1

Monday, May 4

Session 3 – Biomass Pretreatment and Fractionation
Session 4 – Translational Genomics for Bioenergy Feedstocks
Session 5 – Enzyme Science and Technology I
Session 6 – Microbial Science and Technology II
Poster Session, Part 2

Tuesday, May 5

Session 7 – Biorefinery Deployment
Session 8 – Biofuels Logistics and Sustainability
Evening Special Topics:
Topic A: International Commercialization of 2nd Generation Biofuels
Topic B: Development and Commercialization of Algal-Based Biofuels

Wednesday, May 6

Session 9 – Bioprocessing and Separations Technology
Session 10 – Enzyme Science and Technology II
Session 11 – Emerging Biofuels and Chemicals
Session 12 – Biomass Recalcitrance

R&D Progress

Rapid Compositional Analysis Method Developed for Dilute Acid Pretreated Corn Stover Slurries

We recently developed a new rapid method for compositional analysis of pretreated corn stover slurries based on near-infrared (NIR) spectroscopy. The method uses projection-to-latent-structures (PLS) analysis to create an equation that relates a sample's NIR spectrum to its composition. The composition of a clarified pretreated liquor sample is determined from its transmission NIR spectrum. The composition of the pretreated solid fraction is determined by measuring the transmittance NIR spectrum of the whole slurry sample and its associated clarified liquor fraction. The difference between the two spectra is then mathematically related to the composition of the solid material. This new technique significantly decreases sample preparation and analysis time, providing compositional information on both the liquor and solid fraction in under an hour. Previous procedures required several hours for sample preparation and chromatographic analysis steps for liquor samples



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and several days for acid digestion and chromatographic analysis steps for pretreated solids. Figure 1 clearly shows good agreement between component concentrations predicted by the NIR method and component concentrations measured using standard wet chemical techniques for liquors (Fig. 1A) and solids (Fig. 1B). The method is currently only applicable for dilute-acid-pretreated corn stover, but could be extended to other feedstocks. This technique may also be adaptable to real-time compositional measurement of pretreated process streams, thus providing a technique for real-time process control and performance optimization.

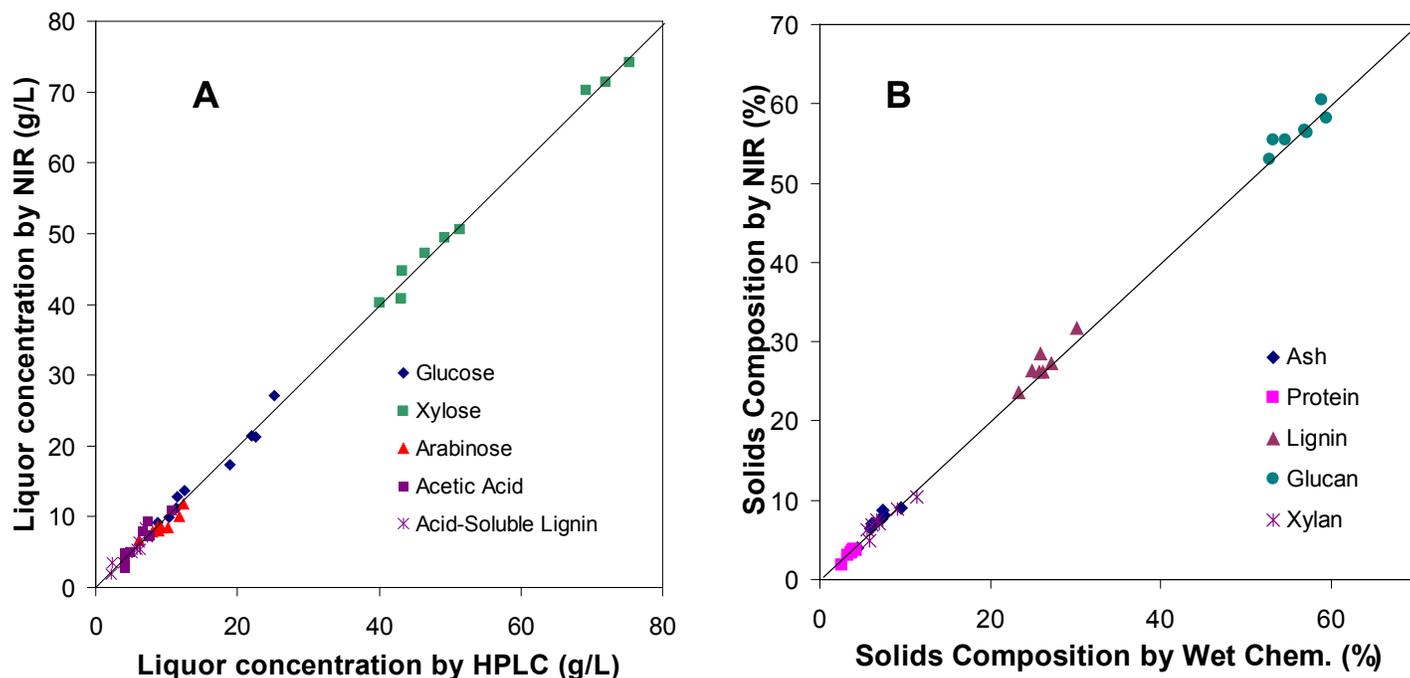


Figure 1. Comparison of component concentrations determined by the standard chemical method and NIR/PLS for liquors (A) and pretreated solids (B)

Understanding Corn Stover Compositional Variability

We recently studied the influence of corn type, environmental conditions, and harvest year on corn stover composition. Five hundred and eight (508) corn stover samples were harvested in 2001, 2002, and 2003 from 47 sites in 8 corn belt states. We measured the composition using a rapid analysis method based on a NIR/PLS technique. As shown in Figure 2, glucan content ranged from about 26% (w/w, dry basis) to 36%, and xylan content increased with increasing glucan content (data not shown). Such a wide variation in carbohydrate content significantly impacts ethanol production, yields and economics. One interesting finding is that glucan and lignin content are positively correlated, as shown in Figure 3. There are both positive and negative

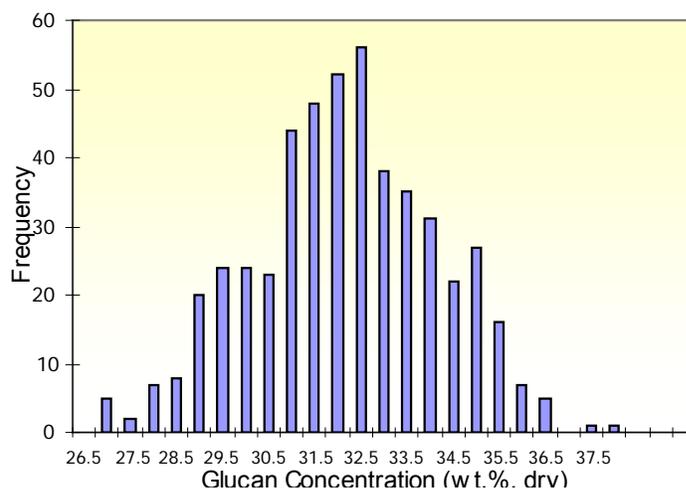


Figure 2. Histogram of Glucan Content

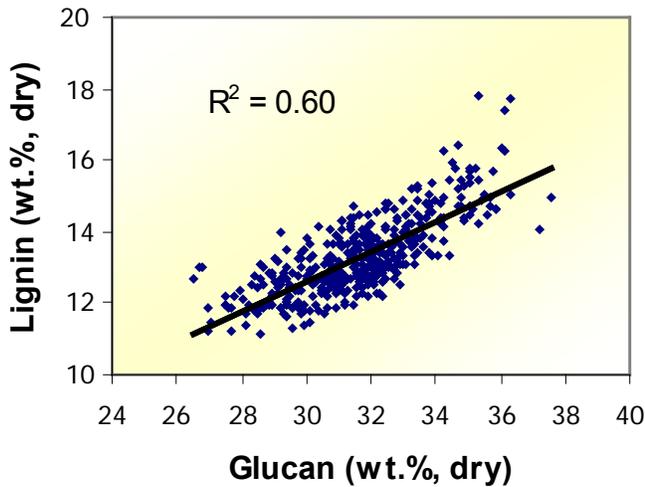


Figure 3. Correlation plot of sample glucan versus lignin content

aspects to this finding: more lignin hinders enzymatic cellulose conversion but also provides more high-energy-content lignin for thermochemical conversion. Results of the analysis of variance indicate high year to year variance in corn stover composition, but little influence of corn variety on corn stover composition. These results will be published in their entirety in a future special edition of the journal *Cellulose*.

Biochemical Process Integration Task Information

Web-based information on the process integration project, including presentations made at past review meetings, are available at the following links ([Process Integration Project Information, http://obpreview07.govtools.us/biochem/](http://obpreview07.govtools.us/biochem/)). A discussion of how Stage Gate management is used in the Biomass Program is also available at this site ([Stage Gate Management](#)).

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U.S. Department of Energy
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DOE/GO-102008-2719 • December 2008



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