NREL NATIONAL RENEWABLE ENERGY LABORATORY
Quarterly Update
National Bioenergy Center | Biochemical Platform Integration Project

Spring 2011

BIOMASS

The Biochemical Process Integration Task focuses on integrating the processing steps 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 ethanol or other fuels, as well as commodity sugars and a variety of other chemical products, from renewable lignocellulosic biomass.

The National Renewable Energy Laboratory manages this project for DOE's Office of the 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, e-mail dan.schell@nrel.gov.

33rd Symposium on Biotechnology for Fuels and Chemicals

The symposium will be held at the Sheraton Seattle in Seattle, Washington, on May 2–5, 2011. Meeting information can be found at the following website: http://www.simhq.org/meetings/sbfc2011/index.asp. Eighteen different sessions are offered this year, as shown below, along with three special topic sessions on Wednesday night.

Session 1: Microbial Science and Technology I: Systems/Synthetic Biology Approaches and Genetic
Session 2: Biomass Pretreatment and Fractionation I
Session 3: Biomass Supply and Logistics
Session 4: Bioprocessing and Separations Technology
Session 5: Enzyme Science and Technology I
Session 6: Biomass Physicochemical Analysis
Session 7: Microbial Science and Technology II
Session 8: Biomass Pretreatment and Fractionation II
Session 9: Biofuels and Biorefinery Economics and Sustainability
Session 10: Biomass Recalcitrance
Session 11: Emerging Biofuels and Chemicals
Session 12: Cellular & Molecular Fungal Biology for Biomass Conversion
Session 13: Enzyme Science and Technology II
Session 14: Biomass Pretreatment and Fractionation III
Session 15: Plant Science and Technology
Session 16: Enzyme Science and Technology III: Advances in the Molecular Level Understanding of Enzyme Mechanisms
Session 17: Microbial Science and Technology III
Session 18: Biorefinery Commercialization and Deployment

Special Topic 1: Analytical Methods for Biomass Conversion
Special Topic 2: International Advanced Biofuels Updates
Special Topic 3: Algal Platform

R&D Progress

Assessing Waste Water Treatment Needs

In 2010, we placed a subcontract with Harris Group and Brown & Caldwell (a waste water treatment technology vendor) to design a treatment system using data collected from an actual waste water sample (fermentation broth). The major finding of this work was that the concentrations of inorganic compounds in the sample (from the feedstock and from chemicals used in pretreatment/conditioning) were probably too high for standard treatment by anaerobic and aerobic digestion. This may necessitate special upstream cleanup steps at additional cost and complexity. According to the study, upstream removal of sulfur was not required, but nitrification was required in aerobic digestion to handle ammonia. This design, including the required unit operations and the cost estimates, has been integrated into our newest Aspen model. The report on this model will be published in May 2011.

Update on New Arabinose-to-Ethanol Fermenting *Zymomonas mobilis* Strains

Arabinose is the third most abundant sugar in corn stover following glucose and xylose and typically comprises about 5% of the available sugars in dilute-acid pretreated, enzymatically hydrolyzed biomass. Six months ago, we reported that on pure sugars a new plasmid-bearing *Z. mobilis* strain, 8b/pZB206, used arabinose at a much faster rate than a genomically integrated strain. In the last six months, we constructed a new plasmid-bearing *Z. mobilis* strain, 8b-6C/pZB207, and a new genomically integrated strain that achieved even better utilization of arabinose in pure mixed-sugar solutions containing glucose, xylose, and arabinose. We also evaluated the two new strains on 10% (w/w) total solids (TS), on enzymatically hydrolyzed pretreated corn stover, and on the associated solids-free liquor fraction. The plasmid-bearing and genomically integrated strains consumed 70% and 63% of the available arabinose, respectively, in a 10% TS whole-slurry hydrolysate after 4 days, while also consuming all of the glucose and xylose. In the hydrolysate liquor fraction, arabinose consumption was 49% and 31%, respectively. This result is likely caused by the lower glucose concentration in the liquor hydrolysate (15 g/L) compared to the whole-slurry hydrolysate (40 g/L). We believe that the lower glucose concentration reduced cell mass production, which subsequently lowered sugar conversion rates and led to earlier cell death and incomplete sugar utilization. Our future goal is to achieve 85% conversion of xylose and arabinose to ethanol in 20% TS whole-slurry hydrolysates.

Biochemical Process Integration Task Information

Web-based information on the biochemical process integration project, including presentations made at past review meetings, is available at the following links: http://www.obpreview07.govtools.us/biochem/ and http://www.obpreview2009.govtools.us/biochem. The latest project review meeting was held February 14–17, 2011, in Denver, Colorado. Information is available at the following website: http://obpreview2011.govtools.us/.

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NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

NREL/NS-5100-51440 • April 2011

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