

March Section Meeting: Technology Advances in Sugars Platform Biorefining R&D

Current sources for commodity sugars and sugar-based chemicals and fuels production include, primarily, sugar cane, sugar beet, and cereal grains, especially corn and wheat. The potential volumes of commodity liquid transportation fuels (e.g., ethanol) that can be produced from these feedstocks is limited. And food and feed markets also compete for these feedstocks. Expanding the existing sugars platform to include fibrous lignocellulosic biomass feedstocks – cellulosic residues from agricultural processing operations and forest products and management industries – is essential to be able to supply large enough volumes of renewable liquid transportation fuels to substantially lower dependence on imported petroleum.

Over the past several decades, all major processing steps involved in biochemically converting lignocellulosic biomass to fuel ethanol – hemicellulose hydrolysis, cellulose hydrolysis, and biomass sugar fermentation – have been shown to be technically feasible. This has been done repeatedly and at multiple scales (i.e., bench, pilot and demonstration scales) using several different processing approaches. Thus, the remaining – and still significant – technical challenge is to improve the integrated bioconversion technology to the point where it becomes robust and efficient enough to economically compete with existing sugar platform technologies based on using starch (US and Europe) [or sucrose (Brazil)].

Technoeconomic evaluations of existing grain dry mill (corn starch)-to-ethanol conversion technology and would-be biomass (lignocellulose) conversion processes show the potential for substantially lower operating costs using lignocellulose compared to cereal grains. However,

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March Section Meeting

- Topic:** Technology Advances in Sugars Platform Biorefining R&D
- Speaker:** Jim McMillan,
National Renewable Energy Laboratory
- Date:** Tuesday, March 21st
- Time:** 6:00 Social Hour
6:45 Dinner
7:30 Presentation
- Location:** Golden Hotel
800 11th Avenue, Golden
- Menu:** Penne Pasta with Marinara Sauce & Pesto Cream Sauce, Meatballs, Sausage, Caesar Salad, Anti-Pasto Platter & Italian Breadsticks with Tiramisu for Dessert
- Cost:** Members: \$20
Non-Members: \$25
Students & Unemployed: \$10

Please RSVP by **Friday, February 17th** (early RSVPs are greatly appreciated!). Indicate your name, phone number, and number of attendees by emailing Tom Wellborn at rockyaiche@yahoo.com. Alternatively, you leave a voice mail for Tom at 303-933-0533.

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capital costs are projected to be twofold to threefold higher for lignocellulose technology than for current fossil-fuel fired dry mill technology. The use of biomass-fired boilers rather than natural gas-fired boilers is one reason for the higher projected capital cost of lignocellulose conversion processes. Beyond differences in how process utilities are provided, the high capital cost differential between starch and lignocellulose conversion technologies reflects the fact that starch, a storage carbohydrate in grains, is much easier to hydrolyze/liquefy than the structural carbohydrates cellulose and hemicellulose (holocellulose) found in fibrous plant matter. Reflecting this, higher levels of chemical severity and biocatalyst addition are required to saccharify holocellulose than to saccharify starch.

Bridging these differences is the subject of the USDOE's Biomass Program sugar platform core R&D. In the longer term, developing a better understanding of the causative factors underlying the relative "recalcitrance" of biomass compared to starchy grains is essential to be able to identify and/or design more efficient processing strategies. In the shorter term, significant capital cost reduction for lignocellulose processing can be achieved through process intensification, i.e., by learning to operate biomass-based processes at higher biomass (and sugar) concentrations so as to increase the efficiency of use of the processes' capital equipment.

This talk will review recent lignocellulose sugar platform technology advances and outline current strategies. The focus will be on describing the recent major R&D progress achieved by the USDOE through the targeted funding of government-academic and government-industry partnerships formed to tackle the critical processing steps of, respectively, biomass pretreatment (aka hemicellulose hydrolysis and/or cellulose activation) and enzymatic cellulose saccharification. As will be shown, this partnering strategy has been highly effective in advancing our understanding of pretreatment process chemistries and in decreasing the cost and increasing the effectiveness of cellulolytic enzymes for biomass conversion applications.

James D. ("Jim") McMillan is the group manager for Bioprocess R&D and a senior biochemical engineer in the National Renewable Energy Laboratory's Bioenergy Center, where he strives to advance lignocellulose biorefining technology. He is the co-inventor on two patents, co-recipient of two R&D 100 awards, and author or co-author of six book chapters and more than 60 papers, reports and technical presentations. He currently co-chairs the annual Symposium on Biotechnology for Fuels and Chemicals and has co-edited the past five

Symposia proceedings volumes. He is a reviewer for several journals and funding agencies, and was previously on the editorial board of the World Journal of Microbiology and Biotechnology. Jim is also an elected director in the American Institute of Chemical Engineers' Food, Pharmaceutical, and Bioengineering Division, and chairs an AIChE annual topical conference entitled, "Envisioning Biorefineries: Chemicals and Materials from Renewable Resources." Serving on several doctoral students' theses committees, Jim is or has been an adjunct faculty member in the Colorado State University, University of Colorado, and University of Puerto Rico chemical engineering departments. He obtained his B.S. in chemical engineering with high distinction from Colorado State University, and his M.S. in chemical engineering practice and Ph.D. in biochemical engineering from the Massachusetts Institute of Technology.

Get Involved in Your Rocky Mountain AIChE Section

As we near the end of the 2005-2006 program year, please consider volunteering for an officer position for the next program year. We are in particular need of a volunteer for the Program Chair position for the next program year. The Program Chair, with assistance from the other officers, arranges the eight monthly section meetings from September through May. Being an officer is a great way to meet people, stay on top of new technology, practice leadership skills, and steer the future of your Rocky Mountain AIChE section. To get involved, contact Kevin Milliman at 303-804-2374.

NEW MEXICO CORNER

New Mexico members are getting active and organized. Kerrie is searching for volunteers to speak/present an engineering topic, so please contact her if you know of anyone available in the Albuquerque area. For more information about the New Mexico meetings, contact Kerrie Pratt at PrattKL@cdm.com

AIChE Meetings

2006

Apr 23-27	2006 Spring Nat'l Orlando, FL
Apr 23-27	World Congress on Particle Technology Orlando, FL
June 11-14	Process Develop. Symposium Palm Springs, CA
Sept 5-7	2nd Int'l Conf. on Bioengineering & Nanotechnology Santa Barbara, CA
Sept 10-14	Safety in Ammonia Plants Vancouver
Nov 12-17	2006 Annual Mtg. San Francisco, CA

For further information, contact
National AIChE.

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MEETING SCHEDULE

The Rocky Mountain District of AIChE meets the third Tuesday of every month. Please join us for our upcoming meetings.

April 18: Suncor's Mike Morgan - Syncrude for Colorado Fuels

May 16: CSU's Dr. Patrick Byrne - Status of Transgenic Crops

Rocky Mountain AIChE News
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On the Web at:

<http://www.aiche-rm.org>

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DIRECTIONS
FROM I-70: Take
Route 58 (exit 265)
west towards
Golden. Take the
Washington Street
exit and turn left at
the stoplight. The
Golden Hotel is on
the right side at the
corner of 11th and
Washington Ave.

DIRECTIONS FROM I-25: Take US 6 west towards Golden. Turn
right onto 19th Street. Drive through one stop light, then turn left
onto Washington Avenue. The Golden Hotel is on the left side at the
corner of 11th and Washington Avenue.