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Rocky Mountain AIChE News

November 2022 Volume 32 Number 3

November Section Meeting: Reaction engineering *in planta*? Tales of mass transfer limitations and their kinetic consequences at the mesoscale for next-generation biorefining

Between the molecular and reactor scales—familiar favorites to the chemical engineering community—lies an intermediate regime termed the "mesoscale" where chemical reaction kinetics and transport phenomena compete along similar time and length scales. However, little is known about the coupled chemistry and physics of biomass conversion at the mesoscale, which govern effective rates of organic component extraction from plant cell walls during biorefinery feed fractionation processes. First, I will introduce an experimentally validated simulation framework that determines transport-independent kinetic rate constants upon incorporating realistic feedstock characteristics for an exemplary hardwood solvolysis process. This generalizable mesoscale reaction–diffusion modeling approach will then be extended to validate and predict the alkaline deacetylation of corn stover, an emerging biorefinery pretreatment method that removes acetyl from hemicellulose prior to mechanical refining to improve downstream enzymatic sugar yields.

November Section Meeting

Topic: Reaction engineering *in planta?* Tales of mass transfer limitations and their kinetic consequences at the mesoscale for next-generation biorefining

Speaker: Nicholas E. Thornburg, PhD
Center for Integrated Mobility Sciences, National Renewable Energy Laboratory

Date: Tuesday, November 29th

Time: 6:00 – Introduction
6:05 - Career Discussion
6:15 - Technical Presentation
7:15 – Q & A

Cost: Free

REGISTRATION REQUIRED. More information can be found on our website.

Register

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Reaction–diffusion models are developed and validated for three major anatomical fractions (cobs, husks and stalks), and model findings categorize experimental feedstock performance into kinetic-controlled vs. diffusion-controlled regimes based on the particle size and microstructural attributes of each tissue type. Critically, the model predicts that typical corn stover particles as small as ~2.3 mm in length are entirely diffusion-limited for acetate extraction, with experimental effectiveness factors calculated to be 0.50 for such processes. Overall, this presentation highlights opportunities to improve biomass fractionation and conversion via reaction engineering and provides actionable kinetic information to guide the design and scale-up of emerging biorefinery strategies.

Speaker Biography: Dr. Nicholas (Nick) Thornburg is a chemical reaction engineer in the Fuels and Combustion Science group within the Center for Integrated Mobility Sciences (CIMS) at the National Renewable Energy Laboratory (NREL). Nick joined CIMS in April 2020 and began his current role as a staff research engineer in October of the same year. He originally joined NREL's National Bioenergy Center (NBC) as a postdoctoral researcher in April 2017, where he studied particle-scale reaction engineering and multiphase chemical reactor design and optimization for biomass deconstruction. Nick's current research interests lie in multiphase reaction engineering for onboard fuel reforming and emissions management applications and for the renewable synthesis of small-molecule chemicals and fuels, such as ammonia. Nick has a Bachelor of Science in Chemical Engineering from Washington University St. Louis and a Doctorate in Chemical Engineering from Northwestern University. His doctoral research at Northwestern focused on understanding heterogeneous transition metal oxide catalysts for applications in sustainable chemical manufacturing. Before joining NREL, Nick gained industrial research and development experience with The Dow Chemical Company and 3M.

VOLUNTEER AS A YOUNG PROFESSIONAL LIAISON (YPL)

We are looking for Young Professional Liaisons for each state – CO, NM, WY, SD & MT. Please send nominations to any section officer listed below.

DECEMBER AIChE MEETING

Our next AIChE meeting is scheduled for December 13th at 6:00pm. The topic will be Algae Biofuels presented by Bruno Klein.

AIChE Meetings

2022

Nov 13-18	2022 AIChE Annual Meeting Phoenix, AZ
Dec 5-6	5th Food Innovation and Engineering (FOODIE) Conference Davis, CA
Dec 6-8	3rd Competitive Energy Systems Symposium Honolulu, HI
Dec 9-11	5th International Conference on Microbiome Engineering Boston, MA
Dec 9-11	6th Int'l Conference on Plant Synthetic Biology, Bioengineering, and Biotechnology Ft. Lauderdale, FL
Dec 14-16	7th Bioengineering and Translational Medicine Conference Boston, MA

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The objectives of AIChE are to advance chemical engineering in theory and practice, to maintain a high professional standard among its members, and to serve society, particularly where chemical, engineering can contribute to the public interest.

MEETING SCHEDULE

The Rocky Mountain Local Section (RMLS) of AIChE generally meets the second or third Tuesday of every month, September through May.