April 2014
Volume 67, Issue 4

American Institute of Chemical Engineers
Knoxville-Oak Ridge Section

For additional information see our Web site at: http://www.ornl.gov/sci/aiche/
Or contact: Paula George, georgepm@ornl.gov, (865)576-0603 or
Rita Gray, rgray22@utk.edu, (865)974-5356

April 2014 Meeting

Date: Thursday, April 17, 2014
Cost: $20
Location: Rothchild Catering and Conference Center, 8807 Kingston Pike, Knoxville TN
Menu: Menu items

5:30 pm Executive Committee Meeting (All members welcome)
6:00 pm Dinner
7:00 pm Program – Kevin Jackson, Regulatory Specialist with Chicago Bridge & Iron Company, ***Control Strategies to Reduce Mercury Emissions from Coal-Fired Power Plants***

Abstract – Recent regulatory initiatives have focused on reducing mercury (Hg) emissions from coal fired power plants. An example is the Environmental Protection Agency's (EPA's) Mercury and Air Toxics (MAT) standard that applies to the electric power generating industry. Under this regulation, existing power plants firing bituminous coal must meet an Hg emission limit of 1.2 lb/TBtu, which is very low. When complying with limits this low, chemical interactions often occur within the air pollution control system that necessitate facility-specific solutions. One such example is Hg re-emission from flue gas desulfurization (FGD) units, which is a chemical phenomenon that can occur once Hg is initially scrubbed into the FGD scrubber liquor. This presentation focuses on Hg re-emissions, and includes an overview of current technologies used to control Hg emissions in the power industry, Hg monitoring methodologies, and some of the problems the industry has experienced in achieving compliance. CB&I's (Chicago Bridge & Iron Company) Power Group routinely designs and installs a variety of Hg control technologies for the power industry, and CB&I's Integrated Emissions Solutions Development (IESD) Group offers two such technologies. These include the patented EMO® process for the oxidation of Hg; and Mercury Re-emission Prevention Chemical (HgRPC), a proprietary chemical used to prevent Hg re-emissions. These same technologies, including HgRPC, can be applied in similar industrial applications.

Bio – Kevin Jackson is a regulatory specialist with CB&I, Knoxville, TN. He received a Chemical Engineering degree from Oklahoma State University, and is a registered professional engineer in Tennessee and Louisiana. (Continued on page 2)

Please make your reservations no later than noon on April15th by contacting

Paula George, georgepm@ornl.gov, (865)576-0603 or
Rita Gray, rgray22@utk.edu, (865)974-5356

The Section will subsidize up to 15 students, including graduate students

April 2014 Meeting (continued from page 1)

Bio – (Continued) Mr. Jackson routinely works with both internal and external clients to assess air pollution control technology alternatives and to provide permitting, compliance, and litigation support. He has also coordinated numerous regulatory and engineering emission performance tests (e.g., East Tennessee Technology Park K-25 TSCA (Toxic Substances Control Act) Incinerator Trial Burn). He currently works with the IESD Group of CB&I in Knoxville, TN, developing CB&I's EMO® and HgRPC technologies. Since 1990 he has worked in Knoxville with the CB&I legacy companies Shaw Environmental, Inc., and IT Corporation. Prior to moving to Knoxville, Mr. Jackson was a process engineer for the Jacobs Engineering Group, Baton Rouge, La (1984-1990).

Recap of March Meeting - How Practical is the Ground as an Energy Resource?

During the March 2014 meeting of the Knoxville-Oak Ridge Section of AIChE, Dr. Moonis Ally presented the pros and cons of ground based heating and cooling systems for residential and commercial use. Various performance factors and costs were discussed and comparisons drawn with gas and electrical heating and cooling systems. Energy consumption data collected from energy efficient homes were presented on ground based heating and air conditioning and hot water heating systems.

(ORNL Hot Water Test Facility - Courtesy of DOE ORNL Photo Archive: http://www.ornl.gov/ornlhome/photos.shtml)

"The science of today is the technology of tomorrow."

Edward Teller
Physicist
1908-2003

Volunteer Opportunity

Structural Engineer Needed

Camp Wesley Woods needs a structural engineer who is willing to donate his/her time to examine some of the structures at the camp and render an opinion as to their structural integrity. If you or someone you know is able to help, please contact Scott Gillenwaters at 813-0905.

(Source: First United Methodist Church- Oak Ridge TN Newsletter - April 3, 2014, page 3 - Forwarded by Harold Hartman)

CBE Department Student Poster Presentations at April Meeting

Beini Chen, Yi Ying Chin, and Jonathan Jones, members of Dr. Steve Abel's undergraduate research group in the Chemical and Biomolecular Engineering Department at the University of Tennessee, will be presenting posters on their research as part of the April 2014 meeting of the Knoxville-Oak Ridge Section of AIChE. You are invited to view the posters and meet with the students before and after the regular meeting. Student bios and summaries of their research follow.

Beini Chen is a sophomore in Chemical Engineering with Biomolecular Concentration at the University of Tennessee, Knoxville (UTK). She is also an international student from Chengdu, China. In fall, 2013, she joined Dr. Steve Abel's research group and has been conducting computational research on cell signaling. Her work primarily focuses on studying bistable behaviors of certain cellular signaling networks using computational methods.

Poster – ***Effects of system size and network topology on the bistability of cell signaling networks***

Abstract – Cells have the ability to detect and respond to diverse environmental stimuli by means of biochemical signaling pathways that propagate information from the cell membrane into the cell. In this work, we use computational methods to study a common signaling pathway that exhibits bistability and observe how it's dynamical and steady state behavior is affected by various cellularly relevant factors. Bistable networks have two distinct stable steady states and are commonly used in cellular decision-making. In the network studied, a substrate protein can be phosphorylated and dephosphorylated at two residues by kinase and phosphatase proteins. The reaction network is simulated using computational methods based on ordinary differential equations, and the transition from bistable to monostable behavior is characterized by observing the time dependence of the system starting from different initial conditions. We find that confining the system, which leads to increased concentration, promotes bistability while decreasing the rate at which enzymes become activated suppresses bistability. In addition, we consider effects of network topology by including additional reactions with reaction rates proportional to an independent control parameter. The reactions, which mimic the ability of proteins to rapidly rebind when in close spatial proximity, are found to greatly influence the signaling dynamics.

Eva Chin is an international student from Malaysia majoring in Chemical Engineering. She came to UTK as a transfer student in 2012. She has been working as an undergraduate research assistant under Dr. Steve Abel in the Chemical and Biomolecular Engineering (CBE) Department since spring 2013. Her research focuses on stochastic modeling of protein rebinding in cells.

Poster – ***Rebinding and Spatiotemporal Correlations in Cell Signaling Networks***

Abstract – Cell signaling networks directly influence cellular behavior and often involve cascades of events in which substrate proteins are phosphorylated by enzymes. The goal of this study is to investigate the likelihood that a recently phosphorylated substrate protein rebinds the catalyzing enzyme before the enzyme binds another substrate protein. Protein rebinding has been shown to influence the behavior of signaling networks, yet it is difficult to measure experimentally. To gain quantitative insight into protein rebinding, we use Monte Carlo computer simulations to study the diffusion and reaction of molecules in space and time, focusing on the effects of both substrate density and system dimensionality. Various substrate densities are considered in one, two, and three dimensions as each dimension has application in the cell's physical environment. At short times, substrate density does not affect the probability of protein rebinding, and the probability density is higher for smaller dimensions due to confinement increasing the encounter frequency. At longer times, the reaction probability density decays exponentially, with higher substrate density requiring longer time to observe this decay; the probability density for high substrate density in 1D decays faster than in higher dimensions (2D and 3D) as most reactions occur at shorter times.

Jonathan Jones is student in the Chemical and Biomolecular Engineering Department at the University of Tennessee, conducting research with Dr. Steven M Abel.

Poster – ***Predicting Polymer Configurations in Confined Cellular Geometries Using Computer Simulations***

Abstract – Actin is a biopolymer that gives eukaryotic cells

CBE Department Student Poster Presentations at April Meeting (continued from page 3)

mechanical stability and the ability to move in a directed manner. Recent experimental results have demonstrated a variety of cell protrusions in which actin plays an important role in stabilizing the protrusion against collapse. Actin filaments, at long length scales, behave like semi-flexible polymers in which bending of the polymer incurs an energetic cost. This research seeks insight into actin behavior by using computer simulations to investigate equilibrium properties of actin-like polymer models. The computer simulations are based on random walks in which the polymer is divided into equal length segments and Monte Carlo simulations that investigate equilibrium configurations of semi-flexible polymers. Both of these approaches were applied in spatial regions with and without boundaries to study the effects of confining actin within cellular structures. When performing the random walk simulations, the mean square displacement (MSD) was computed from the start of the polymer to the end of the polymer. With unbiased random walks, the MSD increases linearly in an unbounded environment; however, in a bounded environment, the MSD exhibits a transition to a regime with smaller slope in a domain-dependent manner. With biased random walks, results are similar but have larger slopes. In the Monte Carlo simulations of semi-flexible polymers, the radius of gyration (Rg) of many configurations was computed at equilibrium. Results investigate the interplay between the flexibility of the polymer and the size of the confining domain and provide insight into the effects of confining actin within cellular protrusions.

THE UNIVERSITY of TENNESSEE KNOXVILLE

Idealistic Engineers

The following is a reprint of an article courtesy of *Inside Higher Ed* by Dr. Scott Hummel that was originally published on March 4, 2014.

Inside Higher Ed recently took note of research by Erin Cech, an assistant professor of sociology at Rice University, who found that engineering students leave college less concerned about public welfare than when they started. According to the article, her research was based on surveys of students at four engineering colleges.

Instead of trying to counter the survey data that led Professor Cech to conclude engineering education makes students cynical, I would instead like to highlight some of the motivations and actions of engineers and engineering students and then consider whether these indicate a desire to improve the human condition.

Lafayette College hosts a Science, Technology, Engineering, and Math (STEM) summer camp for elementary school students. At the camp last summer, I was asked by a camper to explain what engineers do. Engineering covers such as vast array of applications and technologies that summarizing the whole of engineering to a group of 10-year-olds in a sentence or two was a challenge. I've heard it said that engineers are "problem solvers" but that description seems a bit vacuous. Medical doctors are problem solvers, but they're not engineers. The description of an engineer as a "problem solver" is, at the very least, incomplete. I needed to think of something better for the camper, but I'll get back to that later.

Let's dig a bit deeper and look at the motivation for engineering problem solving. Why do engineers develop things like smartphones, medical devices, and (my favorite on this frigid winter day) central heating? The cynical answer here would be the money. Engineers do have relatively high compensation rates compared to many liberal arts degree recipients and they have excellent job prospects. However, it is not money that motivates students to become engineers. The high salary may initially attract students to the programs, in a similar way that high salaries attract people to become medical doctors, but the hope of future earnings does not drag students into a lab at 2 a.m. to complete an analysis. Passion does.

Data support the premise that engineering students want to have a positive impact and improve the

Idealistic Engineers (continued from page 4)

human condition. Over the past decade, enrollment in undergraduate engineering programs across the United States has increased by nearly 25 percent. Over this same period, environmental engineering enrollment has grown nationally by over 75 percent and biomedical engineering has grown by an astonishing 170 percent. The very nature of these degree programs is to help people and the environment. This provides direct evidence that engineering students are deeply committed to using their talents to improve people's lives. More traditional engineering disciplines have also grown in numbers partly due to employment prospects, but also because prospective students see engineering as a way to simultaneously have a financially rewarding career while bettering the world.

Students who pursue engineering careers want to combine their math and science skills with their creative abilities in what is called engineering design. Although the engineering design process is taught at every engineering school, there is no single agreed upon "best" design process. Just like different companies have different design principles and practices, faculty and engineering programs have different variations of the design process as well. That said, engineering design always starts off with the same first step; recognizing a need. Engineers, at their core, are trying to make things more efficient, easier to use, and more effective.

One of the most progressive engineering design processes, made popular by Stanford University's Design Institute, is called Design Thinking. An early step in Design Thinking is to empathize with the client. Whether an engineer is developing a prosthetic leg to enable an amputee to walk, a process to produce a drug to lower cholesterol, or a bridge to better connect people's lives, engineers are empathizing with the condition of those impacted by their design.

One can gain insight into the values embraced by the field of engineering by looking at its professional organizations. In addition to the traditional ones founded to improve safety and reliability of engineered systems, organizations such as Engineers Without Borders, Engineering World Health, and the National Academy of Engineering's Grand Challenges were formed in the last 25 years to make a positive impact on the human condition. Recently a new type of organization was created called Engineering for Change. This community brings together the combined talents of engineers, social scientists, NGOs, local governments, and community advocates to improve the quality of life in communities around the world by promoting the development of affordable and sustainable solutions to the most pressing humanitarian challenges. These types of service organizations are thriving at engineering schools across the country with broad participation from students who are doing impactful work to help people live happier and healthier lives.

Engineers are optimists who believe that they can design and create solutions to help solve the problems facing society. This brings me back to the response I gave the camper who wanted to know what engineers do. "Engineers make people's lives better through the use of technology," I told her.

There is nothing cynical about that.

Bio – Scott R. Hummel is the William Jeffers Director of the Engineering Division at Lafayette College, Easton PA.

Source: Inside Higher Ed, March 4, 2014
http://www.insidehighered.com/views/2014/03/04/essay-questions-idea-engineering-students-are-cynical

Scott Hummel information:
http://www.lafayette.edu/about/news/2014/02/20/hummel-appointed-director-of-the-engineering-division/

(Articled forwarded by Harold Hartman)

UT Student Awards Dinner Reminder

Please join us for

The 2014 Chemical and Biomolecular Engineering Awards Dinner

Thursday, April 10, 2014

6:00 pm- Cash Bar in CBE Banquet Area

6:30 pm Program

Calhoun's on the River
400 Neyland Drive
Knoxville, Tennessee

AIChE Members: $20 at the Door

Menu
Grilled Chicken Teriyaki Served over Rice
Hickory Smoked Pulled Pork with BBQ Sauce
Sautéed Mixed Vegetables
Spinach Maria
Stuffed Baked Potatoes
Double Chocolate Cake
Italian Cream Cake

RSVP to Rita Gray (rgray22@utk.edu)
by
Thursday, April 3, 2014

Knoxville-Oak Ridge Section of AIChE Presents Awards to Outstanding UTK-CBE Students

The Knoxville-Oak Ridge Section of AIChE will present monetary awards of $200 each to the AIChE Outstanding Student and AIChE Outstanding Baccalaureate at the Chemical and Biomolecular Engineering Department's Awards banquet on April 10, 2014. Amanda Jones (Fig. 1) received the AIChE Outstanding Baccalaureate Award and David Dickenson (Fig. 2) received the AIChE Outstanding Student Award.

(Article courtesy of Paul Taylor)

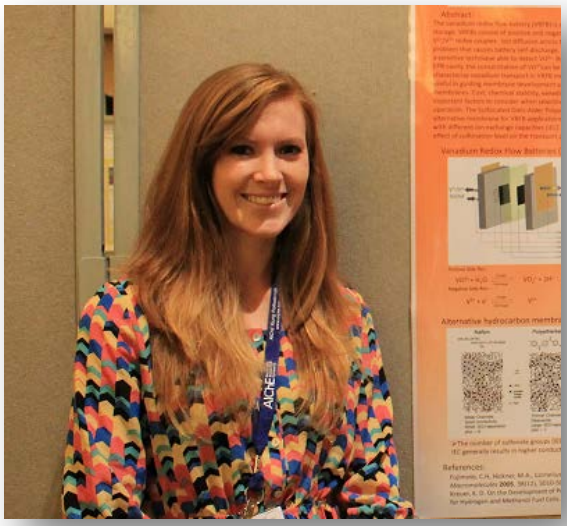

Fig. 1. Amanda Jones is a senior in Chemical and Biomolecular Engineering at the University of Tennessee, Knoxville (UTK). She is involved in undergraduate research with the Zawodzinski Group, which focuses on electrochemical energy storage. This year, Amanda served as Vice President of the student chapter of AIChE at UTK, and was previously involved with the Chem-E-Car Team, serving as Co-Captain. She had the honor of representing both the Zawodzinski Group and the Chem-E-Car Team at the National AIChE Conference in San Francisco. Her research poster won first place in the Fuels, Petrochemicals, and Energy category, and UTK's Chem-E-Car team won an award for inherent safety in design.

Fig. 2. David Dickenson is a Chemical Engineering student at the University of Tennessee, Knoxville (UTK). He will receive his BS this spring. During his years at UTK, David pursued a cooperative education assignment with DuPont Co. and an internship with Eastman Chemical Co. Although he enjoys working with chemicals, his preference is in energy production. To that end, David will be working at Shell Oil in New Orleans, where he hopes to gain experience in the petroleum industry. Ultimately, he hopes to start his own business related to energy usage and production.

Preview of May Meeting

May 2014

Dr. C. Stuart Daw, Oak Ridge National Laboratory, ***How Caves Played a Key Role in One of the First Biochemical Industries in the U.S.***

Ever since its development in the early 20th century, the Haber-Bosch process has been the primary source of chemically stabilized nitrogen compounds. This is especially true for propellants and explosives, almost all of which are based on oxides of nitrogen, which supply the oxidizing component of their chemical energy. In earlier centuries however, nitrogen oxides, in the form of nitrates, were derived primarily from natural biological sources, including bird guano and cave soils. The latter source in fact played a strategic role in U.S. history during both the War of 1812 and the Civil War. In this presentation, Stuart Daw will give an overview of the biochemical processes that produce nitrates in cave soils and how these resources were heavily exploited for commercial and military purposes in the U.S. during the 18th and 19th centuries. Stuart will also describe the physical and chemical processes used to extract the raw nitrates from caves and convert them to refined saltpeter for gunpowder. The production of gunpowder from cave soils reached its zenith during the U.S. Civil War, when the Confederacy launched its own version of the Manhattan Project to construct a massive powder works near Augusta, Georgia. Although cave nitrates are no longer commercially exploited for producing explosives and propellants, the story of the strategic role they played in American history provides an interesting perspective on the emergence of the U.S. chemical industry.

Student Poster planned for May meeting – Tyler Cosby, ***Characterizing Proton Conductivity in a Deep Eutectic Solvent***

Bio: Tyler Cosby, originally from Pulaski, TN, graduated from Tennessee Technological University with a B.S. in Chemical Engineering in May 2013. He was active in the undergraduate AIChE and Omega Chi Epsilon (OXE) chapters. In the summer of 2012 and 2013 he was a part of the Technology Internship Program (TIP) at SABIC Innovative Plastics in Mount Vernon, IN where he worked in the bisphenol A technology lab. He joined Dr. Joshua Sangoro's Soft Materials Research Group as a PhD student in the fall of 2013.

Tyler is a first year graduate student studying eutectic mixtures and ionic liquids as a research assistant under Dr. Joshua Sangoro.

Research Summary: In the past decade eutectic mixtures have received increased attention as potential materials to fill roles in numerous applications such as chemical separation processes, drug solubility, solar cell electrolytes, supercapacitors, chemical sensors, and solvents for chemical synthesis. In order for this potential to be realized, a better understanding of the relationship between chemical structure and mixture properties is needed. In this work, charge transport and structural dynamics in the 1:2 mole ratio mixture of lidocaine and decanoic acid (LID-DA) have been characterized over a wide temperature range using broadband dielectric spectroscopy and depolarized dynamic light scattering. Additionally, Fourier transform infrared spectroscopy (FTIR) measurements were performed to assess the degree of proton transfer between the neutral parent molecules. From analysis of the FTIR spectrum, as well as our detailed analysis of the dielectric data, we have determined that this carboxylic acid based deep eutectic mixture is approximately 25% ionic at ambient conditions. Furthermore, we have found that the rate of proton transport is nearly identical to the rate of structural relaxation at all measured temperatures, indicating that fast proton transport via a Grotthuss-type mechanism does not occur in LID-DA. Our results indicate that while LID-DA exhibits the thermal characteristics of a deep eutectic solvent, its charge transport properties resemble those of a protic ionic liquid.

Employment Opportunity

Environmental Leader (Plant)
CD-21622

Location**:** Rural South Central AL, 90 Miles north of Pensacola FL

Relocation: Competitive Relocation benefits available to qualified candidates

Benefits: Excellent benefits and competitive compensation!

Opportunity to manage the environmental compliance programs at an Alabama production facility. Will be part of the plant leadership team and work directly with site leaders to ensure that environmental requirements are integrated into the site's day to day operations. Will also work with other environmental experts at the regional and business level.

Responsibilities for this position include:

Managing all environmental compliance programs at this manufacturing facility, this includes developing and maintaining required plans, permits and reports, as well as, environmental risk management systems and training site employees,

Requirements:

Minimum requirements include: BS, preferably in Environmental Science, Engineering, or similar field and at least (5) years or hands-on experience managing air, various water programs, SPCC, SARA, and hazardous and non-hazardous waste.

For additional information on this opportunity, contact:

Colleen R. Doerr-Fisher, Senior Recruiter
Professional Outlook, Inc.
Professional Recruitment Since 1991
Email: cdoerr@professionaloutlook.com
Direct: **616.796.2282**
Office: 616.738.9600

Southern Appalachian Science and Engineering Fair - 2014

The Southern Appalachian Science and Engineering Fair (SASEF) is the premier science competition for students in middle and high school in the 23 counties of central East Tennessee. SASEF has promoted teaching the scientific method in science, engineering, and math since 1952. This year there were more than 220 projects presented. The Knoxville – Oak Ridge Section of AIChE awarded two $75 prizes for the top chemistry or engineering related projects in the senior and junior divisions. Paul Taylor and Mark Swientoniewski determined the winners of these special awards. The winner in the junior division was Andrea Wilkerson (Fig. 3) for her project, *The Truth About Vinegar*. Andrea measured the acetic acid concentration of seven different vinegars by titrating them with a standard sodium hydroxide solution to a phenolphthalein endpoint. The winner in the senior division was Sterling Fisher (Fig. 4) for his project, *Invisible Threat! An Analysis of Water Quality and Biota in the Middle Prong of the Little Pigeon River.* Sterling measured dissolved oxygen, pH, E. coli and Coliform bacteria concentrations, and the population of various macro invertebrates at four locations in the river. The impact of increasing human influence at the downstream sites was clearly evident.

(Article courtesy of Paul Taylor)

Fig. 3. Andrea Wilkerson – Junior Division Winner

Fig. 4. Sterling Fisher – Senior Division Winner

Activities Calendar

Date	Time	Topic	Speaker	Location
Apr 10	6:30 PM	UT Department of Chemical & Biomolecular Engineering 2014 Awards Banquet	Welcome by Dr. Khomami Student Presentations	Calhoun's on the River – upstairs banquet room, Knoxville TN
Apr 17	6:00 PM	Control Strategies to Reduce Mercury Emissions from Coal-Fired Power Plants	Kevin Jackson, Chicago Bridge & Iron Company	Rothchild's, Knoxville TN
May 15	6:00 PM	Gunpowder Production and Nitrate Extraction from Caves	Stuart Daw	McClung Museum

Sponsoring Opportunities

We continue to accept advertising in the newsletter in order to provide funds to support student participation in the meetings.

Rates per newsletter are:

$80 full-page advertisement

$45 half-page advertisement

$25 quarter-page advertisement

The section will also continue to accept individual or corporate sponsors to provide student meals at section meetings. The sponsor will be recognized at the meeting and in the Newsletter.

The cost to sponsor one meeting is **$200**. It's a great way to encourage students to attend the local meetings and become future members in the Institute!

(Engine for aircraft nuclear propulsion program in 1955 - Courtesy of DOE Photo Archive: https://www.flickr.com/photos/departmentofenergy/sets/72157630137563548/)

"Don't tell people how to do things, tell them what to do and let them surprise you with their results."

George S. Patton
US Army General
1885-1945

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Editor: B. Lewis

About Our Organization – Careers

Whether you're a student looking for an internship, a young professional looking for your first job or a seasoned engineer looking to breathe new life into your career, AIChE offers a variety of options to help guide you.

Learn about institute networking opportunities, attend a career fair, get profession advice, or simply review the AIChE job board, CareerEngineer.

Find a Job
Search through the AIChE CareerEngineer job board's online jobs to find your new career path.

2013 Salary Survey
Every other year in June, *CEP* Magazine publishes the AIChE Salary Survey, which provides information on the salaries of chemical engineers related to multiple factors and demographics.

Other actions that you can perform on this site include:

Post your resume

Create a job alert

Post a job

(Source: AIChE website http://www.aiche.org/resources/careers)

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