

Note from the Program Head

Fall greetings from Austin. At the request of multiple sponsors, Lauren has added two new sections to the Newsletter: a list of publications from the last six months authored by PSTC research groups and a list of Fall AIChE meeting presentations being given by PSTC researchers. Our intent will be to make these sections “evergreen” thus allowing our sponsors to be kept up to date with our latest results. In this newsletter we profile one of our PhD graduates. As I continue to say, our students are our greatest product and highlighting their career progress provides an excellent opportunity to emphasize the unique training opportunity your support gives our students. Frank outlines our thoughts on collaboration with FRI in his SRP activity summary. We are hopeful we can finally navigate the organizational and legal challenges of forming a partnership between the two efforts. There are significant advantages to linking the data generation efforts of FRI with the modeling and computational capabilities of PSTC researchers.

As you probably know, my other job is teaching in the Chemical Engineering Department. I will be contacting you for input and assistance constructing a new course to be offered to incoming freshmen. Greg Fenves, our Civil Engineer University President, has begun an initiative he calls “College to Career.” The goal is to

ensure our students are both first job ready and equipped for a career that will change and evolve in unexpected ways. Toward this goal, I will be developing a “signature course” targeted at addressing skill-set gaps industry has identified in college graduates. We have an existing list but I am curious what our PSTC sponsors view as problem areas, hence the appeal for help. I will also be asking for ideas and assistance in structuring course content to address the identified areas. My current thinking is to attack the lack of training we give students in team-based projects. While we certainly have team projects, my senior design class being an example, I do not believe we equip students with the tools required to promote smooth project execution or effectively manage a group activity. The class will be open to all majors. It is clear, regardless of degree path: the future will be based on multifunctional, cross-disciplinary, team activities. Thanks in advance for the help.

I look forward to visiting with you.

Best wishes,

Bruce



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SRP Update: Frank Seibert



The SRP pilot plant activity remains high with distillation and air/water characterization studies involving new high performance random packings. In addition, a new pilot scale carbon dioxide capture study with Gary Rochelle and Eric Chen was just completed. The US DOE-funded study involved using a hybrid process consisting of conventional absorption/stripping with a membrane contactor to remove carbon dioxide. The objective of the study was to use a hybrid process to reduce overall capital costs. Studies using the oil/water membrane separation process continue to gain interest among our PSTC sponsors and abroad. A three-month study of continuous operation separating oil and water has just concluded with new oil/water separation projects in the planning stages. UT Environmental Engineering Professors Lynn Katz and Kerry Kinney will be teaming up with the SRP in this work. Several Oldershaw distillation projects are also underway.

The Appleton Group, a subsidiary of Emerson Process Management, recently donated LED lighting for the pilot plant and two of our indoor labs. The scope of work involved replacing 28 outside lights and 21 indoor lights. The new lighting is expected to result in improved energy efficiency along with providing substantially better lighting in the plant and labs.

The large-scale distillation system is being modified to allow for packing pressure drop and flooding characterization using n-heptane and cyclohexane. The modifications will allow for independent adjustments of the liquid and vapor rates similar to the air/water hydraulic characterization procedure. ARI has donated a high turndown, high capacity Fractal liquid distributor for this activity. A new, much higher capacity pump has been installed. Some minor piping modifications and insulation remain before testing.

Future 2018/2019 SRP pilot plant and lab scale operations will include:

- ◆ Lab Scale Distillation Studies
- ◆ Effect of a Fractal Distributor on Distillation Packing Performance
- ◆ Distillation and Air/Water Related Packing Characterization

- ◆ Effect of Interfacial Tension on the Oil/Water Separation using a Novel Membrane Process
- ◆ Effect of Plastic Random and Structured Packing as Coalescers in Liquid Extraction

In the past 18 months, questions involving sieve tray and packed extractor design have become more numerous. This is a result of new engineers joining our companies and being assigned an extraction-related task. As a result of this increased interest, future PSTC review meetings will include an extraction design-related presentation.

A new collaboration involving FRI and the PSTC is being discussed and championed by FRI President, Jose Bravo. As some of our colleagues remember, Jose was our SRP Program Manager in the late 80s and early 90s. Jose was also one of Dr. Fair's first graduate students who returned to UT to supervise the design and construction of the various SRP pilot plants. Jose also initiated the SRP contract research program. FRI membership has expressed an interest in the PSTC process engineering areas of distillation, dividing wall distillation, absorption/stripping, liquid extraction, and process control. Details of the collaboration are still being worked out. One possibility is FRI including a PSTC members-only session during their review meeting.



New LED lighting courtesy of the Appleton Group

In the News

2018 AIChE Annual Meeting Presentations

<https://www.aiche.org/conferences/aiche-annual-meeting/2018>

Monday, October 29th

- ◆ Demand Response-oriented Modeling and Production Scheduling Optimization for Chlor-alkali Processes—**Joannah Otashu, Michael Baldea**
- ◆ Optimal Demand Response Operation of an Industrial Air Separation Unit Using Data-driven Scheduling-relevant Dynamic Models—**Calvin Tsay, Michael Baldea**
- ◆ Structured Adsorbent Pressure Temperature Swing Adsorption Cycles for Metabolic CO₂ Removal from Spacecraft Cabins—**Armin Ebner, James A. Ritter**
- ◆ Gas Separation Properties of Novel Poly (benzimidazole)s—**Joshua D. Moon, Benny D. Freeman**

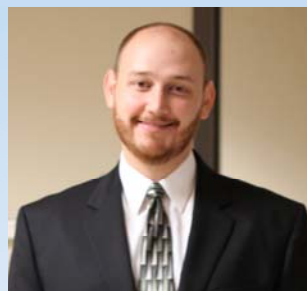
Tuesday, October 30th

- ◆ On the Use of the Dual Process Langmuir Model for Gas Mixture Components That Exhibit Single Process or Linear Isotherms—**James A. Ritter**
- ◆ Multi-scale Modeling and Design Optimization of an Industrial Hydrogen Production Plant with High-resolution PSA and Steam-methane Reformer Models—**Calvin Tsay, Michael Baldea**

Wednesday, October 31st

- ◆ Role of Bed Design Characteristics on the Effective Thermal Conductivity of a Structured Adsorbent—**James A. Ritter**
- ◆ Green Operation of an Air Separation Unit Using an Efficient MILP Optimal Scheduling Framework—**Morgan Kelley, Michael Baldea**

Alumni Spotlight: Scott Owens



For a change of pace, we have begun reaching out to our alumni community and seeing what they've been up to after graduating from the PSTC program. For this issue of our newsletter, we check in with Scott Owens, a 2010 UT Austin graduate who earned his PhD in chemical engineering.

Scott grew up in Oakdale, Tennessee, a tiny town with a population of only 212. Like many future engineers, he was fascinated by figuring out how things worked. Taking things apart only exasperated his parents until he could successfully put everything back together again. Moving to Knoxville to attend high school, Scott was fortunate in receiving guidance from some of his favorite teachers—Mrs. Kornrumpf in AP Calculus, Mrs. Brown in AP Chemistry, and Mrs. Thompson in Business all

encouraged him to pursue engineering as a profession.

Scott attended the University of Tennessee where he studied chemical engineering (ChE)—it appealed to him the most out of all the engineering fields because he could understand things from the molecular scale in thermodynamics and chemistry all the way up to integrated production units making billions of pounds of product. After earning a BS in ChE, *summa cum laude*, and with three semesters of co-op work with Dow Chemical (in Freeport, TX, and Midland, MI), he was ready for the next step in his education.

Based on his undergraduate co-op experience, Scott knew he wanted to work in an applied research capacity. UT Austin was the only graduate school with a dedicated pilot plant; with the ability to conduct contract pilot research for major petrochemical companies, he knew that UT was the one and only place to go for his education.

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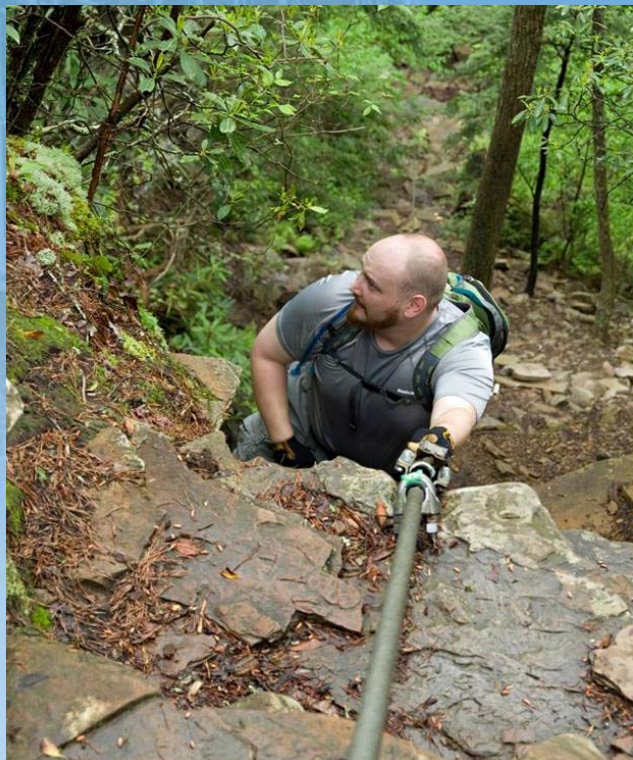
Alumni Spotlight cont.

After joining the Eldridge group, Scott focused his research on the governing phenomena in operating equipment. As development cycles of new products shorten and competition grows fiercer internationally, Scott says the design and operational efficiency that comes from precise knowledge of how best to operate plant equipment will only increase in importance.

Currently a Principal Chemical Engineer in the Scale Up division of the Eastman Chemical Company, Scott spends his time on projects with a heavy dependence on distillation and solid-liquid separations. In fact, he sees in Eastman a great example of what he focused on in graduate school—the company has shaped its research section into a combined “Scale Up and Process Innovation” department. Their unit is now in charge of ensuring success and improving efficiency in new process and plant revamps.

Scott’s work, from undergraduate co-ops on up, has taken him around the world. He has worked at sites in the US, the Netherlands, and Japan. When he’s not being awed by North America’s largest chemical facility (Dow) in Freeport, Texas, or enjoying a beautiful sunset over mainland Japan, he feels blessed to be at home in the foothills of the Appalachians. In addition to doing work that he loves, Scott gets to enjoy time outdoors hiking and kayaking, plus a bit of woodworking or reading indoors when the weather turns.

While all of the time spent indoors, outdoors, and around the globe has provided valuable learning experiences, Scott still values the time spent at the PSTC. Having the opportunity to work with continuous equipment, commercial DCS software and equipment, and world-class research faculty has been critical to his transition from academia to industry—even more so now that he works on scaling up novel processes and new technology. It has all been an integral part of a lifetime journey, one that began with him disassembling things at home to see how they worked, and now drives Scott forward as he designs the parts and pieces to make them work even better than before.



Recent Publications

Freeman Group

- ◆ Kamcev, J.; Paul, D. R.; Freeman, B. D. "[Equilibrium Ion Partitioning between Aqueous Salt Solutions and Inhomogeneous Ion Exchange Membranes](#)," *Desalination* **2018**, *446*, 31-41.
- ◆ Moon, J.; Galizia, M.; Borjigin, H.; Liu, R.; Riffle, J.; Freeman, B. D.; Paul, D. R. "[Water Vapor Sorption, Diffusion, and Dilution in Polybenzimidazoles](#)," *Macromolecules* (in press).
- ◆ Kamcev, J.; Doherty, C. M.; Lopez, K.; Hill, A. J.; Paul, D. R.; Freeman, B. D. "[Effect of Fixed Charge Group Concentration on Salt Permeability and Diffusion Coefficients in Ion Exchange Membranes](#)," *Journal of Membrane Science* **2018**, *556*, 307-316.
- ◆ Scholes, C. A.; Freeman, B. D. "[Thermal Rearranged Poly\(imide-co-ethylene glycol\) Membranes for Gas Separation](#)," *Journal of Membrane Science* **2018**, *563*, 676-683.
- ◆ Joseph, R. M.; Merrick, M. M.; Liu, R.; Fraser, A. C.; Moon, J. D.; Choudhury, S. R.; Lesko, J.; Freeman, B. D.; Riffle, J. S. "[Synthesis and Characterization of Polybenzimidazole Membranes for Gas Separation with Improved Gas Permeability: A Grafting and Blending Approach](#)," *Journal of Membrane Science* **2018**, *564*, 587-597.
- ◆ Yan, N.; Paul, D. R.; Freeman, B. D. "[Water and Ion Sorption in a Series of Cross-linked AMPS/PEGDA Hydrogel Membranes](#)," *Polymer* **2018**, *146*, 196-208.
- ◆ Kamcev, J.; Paul, D. R.; Manning, G. S.; Freeman, B. D. "[Ion Diffusion Coefficients in Ion Exchange Membranes: Significance of Counterion Condensation](#)," *Macromolecules* **2018**, *51*, 5519-5529.
- ◆ Abdellah, M. H.; Scholes, C. A.; Freeman, B. D.; Liu, L.; Kentish, S. E. "[Transport of Terpenes through Composite PDMS/PAN Solvent Resistant Nanofiltration Membranes](#)," *Separation and Purification Technology* **2018**, *2017*, 470-476.

Ritter Group

- ◆ Eghbal, P.; Fatemi, S.; Vatani, A.; Ritter, J. A.; Ebner, A. D. "[Purification of Helium from Nitrogen Rejection Unit in Cryogenic Natural Gas Process by Pressure Swing Adsorption](#)," *Separation and Purification Technology* **2018**, *193*, 91-102.
- ◆ Ebner, A. D.; Ho, J. G. S.; Ritter, J. A. "[Graphical Approach for Formulating Pressure Swing Adsorption Cycle Schedules with Unlimited Equalization Steps](#)," *Adsorption* **2018**, *24*, 221-232.
- ◆ Erden, L.; Ebner, A. D.; Ritter, J. A. "[Separation of Landfill Gas CH₄ from N₂ using Pressure Vacuum Swing Adsorption Cycles with Heavy Reflux](#)," *Energy & Fuels* **2018**, *32*, 3488-3498.
- ◆ Erden, H.; Ebner, A. D.; Ritter, J. A. "[Development of a PSA Cycle for Producing High Purity CO₂ from Dilute Feed Streams. Part I: Feasibility Study](#)," *Industrial & Engineering Chemistry Research* **2018**, *57*, 8011-8022.
- ◆ Nguyen, H. G. T.; Espinal, L.; van Zee, R. D.; Thommes, M.; Toman, B.; Hudson, S. L.; Mangano, E.; Brandani, S.; Broom, D.; Cychosz, K.; Bertier, P.; Yang, F.; Krooss, B. M.; Siegelman, R.; Long, J. R.; Nakada, Y.; Nakai, K.; Ebner, A. D.; Erden, L.; Ritter, J. A.; Moran, A.; Talu, O.; Huang, Y.; Walton, K. S.; Billefont, P.; de Weireld, G. "[Reference High-Pressure CO₂ Adsorption Isotherm for Ammonium ZSM-5 Zeolite: Results of an Interlaboratory Study](#)," *Adsorption* **2018**, *24*, 531-539.

Fall 2018 Meeting

Please join us for our annual PSTC Fall Meeting October 16-17, 2018, here at the University of Texas at Austin. Once again, we will be at the [Commons Learning Center](#) located on the Pickle Research Campus. [Registration](#) and [accommodation](#) information are available on our website. Handouts of the presentations will be available for attendees; pdf copies will be posted on our website closer to meeting time.

Questions? Please feel free to contact us:

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