James R. Fair Process Science & Technology Center

TEXAS
The University of Texas at Austin

Winter 2020 Newsletter

In This Issue:

Note from the Program Head

https://sites.utexas.edu/pstc/

I will admit to being old and grumpy and the fact I am concerned about the current generation of chemical engineering students may be a consequence of those two factors but:

I did an informal survey of my senior design class last semester and the results indicated that technical positions in the oil and chemical sector were no longer the preferred employment option. Positions in data analytics appear to be where most of our students want to work. This might be a little concerning. While data science can make significant contributions to what we do as chemical engineers, I am concerned correlating my shopping trends or determining how best to supply me with groceries is not going to solve a SIGNIFICANT technical challenges facing the world. Students migrate to money and novelty and entities like Amazon, Facebook, and Google are currently the shiny new things. We all need to do a better job articulating the need for bright people in technical positions that address energy generation, CO_2 management, and plastics recycling to name only a few large-scale problems. This means having a more effective industrial interaction with undergraduate students than simply buying pizza on a Friday afternoon and doing the standard corporate sales pitch. If we are to recapture the narrative, students need to understand how working for a traditional technology company can make a real difference. Developing this is going to take effort on everybody's part.

So suggestions from my horseback view of the problem (in all cases we need to articulate how industry is uniquely positioned to address BIG societal problems – just showing the corporate flag is no longer adequate):

- Expanded summer internships and COOP programs – satisfied student employees talking to other students is the best possible sales force.
- Get engaged in the curriculum – guest lecture in classes, sponsor a challenging senior design problem, host class / student organization tours of your facility.
- Bring your checkbook – back in the day, the traditional energy and chemical sector easily won bidding wars – that is no longer the case.

I understand that a financial commitment will be required for this list, but I do not believe there is an alternative. On a year when we failed to get a space capsule in the correct low earth orbit, something we did routinely in the 1960's, I believe the challenge is real and demands attention for the good of all.

Best wishes for a happy and safe start to 2020,
Bruce

SRP Update: Frank Seibert

Enhancements to the SRP pilot facilities will continue in 2020. The distillation system has been modified to allow for hydrocarbon hydraulic characterization similar to those obtained with the Air/Water column. The modifications include a new high capacity pump, new stainless piping, and new electricals. We are seeking projects. In addition, the entire distillation column, bottoms, and overhead piping and condenser have been re-insulated.

Our original cooling water piping (installed in 1986) was experiencing corrosion. As a result, the original cooling water piping has just been replaced with 304 stainless piping. In addition, the new cooling water piping will be insulated. The project is co-funded by the College of Engineering and SRP.

High performance random and structured packings studies are planned for 2020. The studies will include blended random packings which offer the potential of improved efficiency with similar capacity or improved capacity with similar separation efficiency. A study is currently underway to determine the capacity comparison of a 1986 vintage random support relative to a modern random packing support providing additional open area.

The capacity of a liquid-liquid extractor can be limited by poor drop coalescence at the main operating interface. This is especially true for many "wash" type extractors. In the 1990s, an SRP study was conducted to investigate the performance of Teflon and stainless structured packings in enhancing coalescence and increasing extractor capacity. In some cases, the coalescer addition increased the capacity by 60%. In recent years, new questions regarding coalescer designs have emerged which suggest that a larger study is needed. Such questions include:

- Can Teflon random packing provide a cost-efficient alternative to Teflon structured packing?
- Are less expensive polypropylene packings as efficient as Teflon packings?
- What coalescer height is recommended?
- What capacity increase should be expected with a coalescer addition?
- What coalescer material of construction should be specified?

Other related questions have arisen in the last ten years. Several PSTC sponsors have recently proposed that we explore the possibility of forming a group of PSTC sponsors which provide technical guidance and leveraging of their Tier II funds to support this study.

Interest in oil/water membrane separations continues to increase with multiple projects planned in 2020. The studies involve a collaboration with Professors Lynn Katz and Kerry Kinney. Carolyn Cooper will focus her doctorate studies in this area.

cont.

SRP Update cont.

A field test was successfully completed in early December in treating produced water from an Eagle Ford site. In addition, The Kuwait Foundation of Science recently awarded funding for a three-year study which started January 1, 2020. The effects of differing surfactant types and methods for handling micron and submicron clays will be included in the study. A number of field-related oily water treated are being planned for 2020.

Future 2020 SRP pilot plant and lab scale operations will include:

- Gas Film Controlled Spray Mass Transfer
- Dividing Wall Distillation
- Oldershaw Distillation Studies
- Distillation Random Packing Characterization
- Application of NIR to Obtain Fast Distillation Compositional Measurements
- Air/Water Packing Characterization
- Effects of Temperature, Submicron Clays (Hydrophobic Solids), Surfactants, and Oil Viscosity on the Oil/Water Membrane Separation

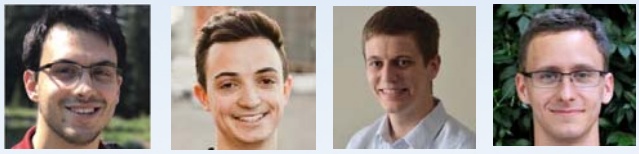
In the News

New PhD Graduates

Three students from the **Freeman** Group have completed their PhDs and will be heading on to bright futures. **Jaesung Park** will be working as a postdoctoral fellow in the Freeman group and **Eui Soung Jang** will move on to work at Intel. **Alon Kirschner** is already employed as a Research Engineering at Southwest Research Institute in San Antonio, TX.

DOE-EFRC Leadership

Graduate students **Marshall Allen**, **Freddy Rivers**, **Michael Howard**, and **Joshua Moon** have been named to the DOE-EFRC Student Leadership Council for UT Austin's M-WET, the Center for Materials for Water and Energy Systems. The EFRC is working on filling gaps in the understanding of fluids and materials to catalyze design of novel surfaces, highly selective solute/fluid interactions, mesoscopic structures, and membranes for energy applications.



From L to R: Marshall Allen, Freddy Rivers, Michael Howard, & Joshua Moon

PI Michael Baldea Wins Accolades

Professor **Michael Baldea** has earned several awards in this last year. He received the AIChE Institute's 2019 Award for Excellence in Industrial Gases Technology, *Computers and Chemical Engineering*'s Best Paper of 2018, and the 2019 Model-Based Innovation Prize from Process Systems Enterprise.

Frontiers in Energy Research

Rahul Sujanani of the **Freeman** Group has authored an article features on the Department of Energy's Frontiers in Energy Research website. In Sujanani's article, "The World of Water Science: Cleaning Contaminated Water for a Wetter Future," he notes that water and energy are interconnected: it takes much energy to purify water on a large scale and that much fresh water is needed to produce energy. Read the full article here: www.energyfrontier.us/content/world-water-science

Publications

Baldea Group

- Otashu, J. I.; Baldea, M. "Scheduling Chemical Processes for Frequency Regulation," *Applied Energy* **2020**, *260*, 114125: 1-13.
- Lee, J. T.; Sung, S. W.; Lee, F. Y.; Baldea, M.; Edgar, T. F. "Full Closed-loop Tests for the Relay Feedback Autotuning of Stable, Integrating and Unstable Processes," *ACS Omega* **2019**, *4*, 18760-18770.
- Santander, O. S.; Betts, C. L.; Archer, E. E.; Baldea, M. "On the Interaction and Integration of Production Planning and (Advanced) Process Control," *Computers & Chemical Engineering* **2020**, *133*, 106627: 1-17.
- Tsay, C.; Baldea, M.; "Integrating Production Scheduling and Process Control using Latent Variable Dynamic Models," *Control Engineering Practice* **2020**, *94*, 104201: 1-16.
- Lejarza, F.; Baldea, M. "Closed-loop Optimal Operational Planning of Supply Chains with Product Quality Dynamics," *Computers & Chemical Engineering* **2020**, *134*, 106594: 1-16.

Baldea/Eldridge Group

- Donahue, M. M.; Baldea, M.; Eldridge, R. B. "Steady State Considerations for Designing Minimum Energy Control Strategies for a Dividing Wall Distillation Column with Trace Components," *Chemical Engineering and Processing—Process Intensification* **2019**, *145*, 107641: 1-12.

Freeman Group

- Lu, J.; Zheng, H.; Hou, J.; Li, X.; Hu, X.; Hu, Y.; Easton, C. D.; Li, Q.; Sun, C.; Thornton, A. W.; Hill, M. R.; Zhang, X.; Jiang, G.; Liu, J. Z.; Hill, A. J.; Freeman, B. D.; Jiang, L.; Wang, H. "Ultrafast Metal Ion Sieving in Rectifying and Highly Selective Metal Organic Framework Based Subnanochannels," *Nature Materials*, **in press**.
- Pérez-Francisco, J. M.; Santiago-García, J. L.; Loría-Bastarrachea, M. I.; Paul, D. R.; Freeman, B. D.; Aguilar-Vega, M. "CMS membranes from PBI/PI blends: Temperature Effect on Gas Transport and Separation Performance," *Journal of Membrane Science* **2020**, *597*, 117703: 1-11.
- Miguel Sanchez, C.; Song, T.; Brennecke, J. F.; Freeman, B. D. "Hydrogen Stable Supported Ionic Liquid Membranes with Silver Carriers: Propylene and Propane Permeability and Solubility ," *Industrial & Engineering Chemistry Research* **2019**, **in press.**
- Freeman, B. D. "Reflecting on 12 Years as an I&EC Research Associate Editor," *Industrial & Engineering Chemistry Research* **2019**, *58*, 21171-21172.
- Stevens, K. A.; Moon, J. D.; Borjigin, H.; Liu, R.; Joseph, R. M.; Riffle, J. S.; Freeman, B. D. "Influence of Temperature on Gas Transport Properties of Tetraaminodiphenylsulfone (TADPS) based Polybenzimidazoles," *Journal of Membrane Science* **2020**, *593*, 117427: 1-10.
- Jang, E.-S.; Kamcev, J.; Kobayashi, K.; Yan, N.; Sujanani, R.; Dilenschneider, T. J.; Park, H. B.; Paul, D. R.; Freeman, B. D. "Influence of Water Content on Alkali Metal Chloride Transport in Cross-Linked Poly (ethylene glycol) Diacrylate.1. Ion Sorption," *Polymer* **2019**, *178*, 121554: 1-10.

Freeman/El-Halwagi Group

- Sengupta, D.; Kwon, J. S.-I.; Carlberg, P.; Camacho, L. M.; Brennecke, J. F.; Stadtherr, M.; Freeman, B. D.; Khanna, V.; Vidic, R.; El-Halwagi, M. "Deploying Intensified, Automated, Mobile, Operable, and Novel Designs 'Diamond' for Treating Shale Gas Wastewater," *AIChE Annual Meeting* **2019**, 290e, 12 November 2019.

Ritter Group

- Amalraj, P. B. C. A.; Ebner, A. D.; Ritter, J. A. "On the Effective Radial Thermal Conductivity of a Parallel Channel Corrugated Metal Structured Adsorbent," *Industrial & Engineering Chemistry Research* **2019**, *58*, 16922-16933.
- Hossain, M. I.; Holland, C. E.; Ebner, A. D.; Ritter, J. A. "*110th Anniversary*: New Volumetric Frequency Response System for Determining Mass Transfer Mechanisms in Microporous Adsorbents," *Industrial & Engineering Chemistry Research* **2019**, *58*, 17462-17474.

Publications cont.

Ritter Group cont.

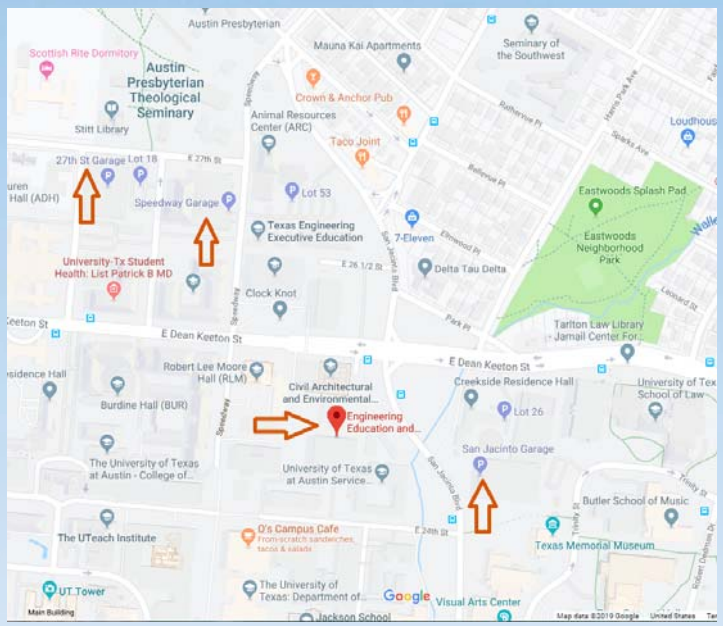
- Ritter, J. A.; Bullmiller, K. C.; Tynan, K. J.; Ebner, A. D. "On the Use of the Dual Process Langmuir Model for Binary Gas Mixture Components that Exhibit Single Process or Linear Isotherms," *Adsorption* **2019**, *25*, 1511-1523.
- Hossain, M. I.; Holland, C. E.; Ebner, A. D.; Ritter, J. A. "Mass Transfer Mechanisms and Rates of CO_2 and N_2 in 13X Zeolite from Volumetric Frequency Response," *Industrial & Engineering Chemistry Research* **2019**, *58*, 21679-21690.
- Jiang, H.; Ebner, A. D.; Ritter, J. A. "Importance of Incorporating a Vacuum Pump Performance Curve in Dynamic Adsorption Process Simulation," *Industrial & Engineering Chemistry Research* **2020**, *59*, 856-873.

Rochelle Group

- Gao, T.; Rochelle, G. T. "CO_2 Absorption from Gas Turbine Flue Gas by Aqueous Piperazine with Intercooling," *Industrial & Engineering Chemistry Research* **2019**, **in press**.

Spring 2020 Meeting

Please join us for our annual PSTC Spring Meeting, scheduled for Tuesday, April 7, 2020, here at the University of Texas at Austin. **Once again, we will be at the new Engineering Education and Research Center (EER) located on the main UT Austin campus downtown.**



Registration and accommodation information is now 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.

The electronic meeting will be available for those unable to attend in person.

Questions? Please feel free to contact us:

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