



James R. Fair

Process Science and Technology Center

Summer 2017 Newsletter

<http://dept.ceer.utexas.edu/ceer/pstc/>



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Note from the Program Head

To our colleagues and friends who have been impacted by Hurricane Harvey, please know our thoughts are with you. Several members of the PSTC / SRP organization have family members significantly affected by the disaster so we are very aware of the stress the storm has caused.

On a lighter note, the summer has been a busy time for the SRP pilot plant. We conducted a significant process control campaign on the dividing wall distillation column. For the chemical system studied, the results indicated that a DWC can be controlled effectively with a very basic control structure. The SRP staff also conducted an investigation of a novel distributor design which showed statistically significant mass transfer efficiency improvement for a structured packing. Complete results from these efforts will be presented at the Fall PSTC sponsors' meeting.

In addition to the experimental program, the SRP staff is working with Professor Rochelle's team to prepare the pilot plant for two significant CO₂ capture campaigns. These investigations will seek to optimize both the separations process approach and the solvent system for CO₂ recovery and will significantly advance the technology.

We are also in the middle of upgrading the control room computer system. Emerson Process Management coordinated the donation of equipment by multiple parties which will maintain our state-of-the-art process control capability.

I would be remiss if I did not acknowledge Robert Montgomery's retirement. Robert has been the SRP's instrument technician since the program began in 1984. Robert's involvement with the pilot plant actually began as an employee of the contractor who built the unit and we are indebted to Jimmy Humphrey and Jose Bravo for having the foresight to hire Robert. *cont.* →



Robert Montgomery works with a colleague in the PSTC-SRP control room.

During his thirty plus years with us, Robert has kept the unit running smoothly through a multitude of process configuration and instrumentation changes. His quiet professionalism will be missed.

As part of the Fall sponsors' gathering we will have a organizational meeting to gather feedback from our sponsors and to review the PSTC's cash flow. Sponsor renewal rates have been excellent but increasing costs are reducing our ability to fund research activities. The Tier I and Tier II fee structures have not been changed since the program's formation ten years ago and it is time we consider an increase. I will ask for input on a proposed Tier I level increase from the current \$ 15,000 to \$ 25,000 (which represents a yearly increase of five percent). I look forward to discussing this plus any other topics of interest to the sponsors.

As a continuation of our on-going effort to make our research results readily available to our membership, the PSTC's Executive Assistant Lauren Murray is conducting a review of social media approaches and our web presence. Her goal is to develop a cost-effective plan for linking our sponsors with our researchers. Your suggestions and input will be appreciated.

We look forward to seeing you at the PSTC sponsors' meeting in October.

Best wishes,

Bruce

SRP Update: Frank Seibert



The pilot plant activity continued during the summer with the successful completion of a dividing wall distillation study which utilized new and enhanced instrumentation, pumps, and control capabilities. We just received news that a \$150K donation of new and more powerful process control computers has been officially approved by the Emerson Process Management. Installation of the new computer system is anticipated in the



first quarter of 2018.

An interesting distributor performance study was performed during the summer. A Fractal distributor, provided by Amalgamated Research Inc (ARI), was compared with a standard

trough drip distributor using the cyclohexane/n-heptane system and a metal structured packing with 500 m²/m³ of surface area. The Fractal distributor provided improved performance and obtained an SRP record low HETP of 4.8 inches. Future studies of the Fractal distributor in distillation service are planned in 2018. *cont.* →





Robert Montgomery, our instrument technician, recently retired after 30 years of service. However, Robert will continue working part time to assist in training his replacement and to continue working with the installation and implementation of new Emerson products' role in enhancing our experimental

capabilities.

Future SRP pilot plant and lab scale operations will include:

- ◆ Pilot Plant Demonstration of the Advanced Flash

Stripper for Carbon Dioxide Capture

- ◆ Effect of a Fractal Distributor on Distillation Packing Performance
- ◆ Distillation Packing Characterization
- ◆ Gas Film Mass Transfer in Co-Current Spray Contactor
- ◆ Pilot Scale Dividing Wall Distillation and Advanced Control
- ◆ Effect of Interfacial Tension on the Oil/Water Separation using a Novel Membrane Process
- ◆ Effect of Plastic Random Packing as a Coalescer in Liquid Extraction
- ◆ Application of Air/Water Derived Mass Transfer Models to Distillation Packing Performance

In the News



Alon Kirschner, a member of the Freeman Group, was awarded a Paige H. and J. Jeff Weidner Endowed Presidential Fellowship in Chemical Engineering for Fall 2017. "This fellowship is paired with the Chemical Engineering TA of the Year award,

for your outstanding work as Teaching Assistants for the department in 2016!" Alon was one of two who received the award.

Alon also received the Elias Klein Travel Supplement from the North American Membrane Society (NAMS) for the International Congress on Membranes and Membrane Processes (ICOM) conference.

Student Spotlight: Di Song

This summer we're taking a closer look at Di Song who is closing in on his Ph.D. while working on separations and carbon capture. Di hails from Luoyang, an ancient capital for thirteen dynasties, a cradle of Chinese civilization. He earned bachelors' degrees in chemical engineering and English at Zhejiang University, one of China's top universities.

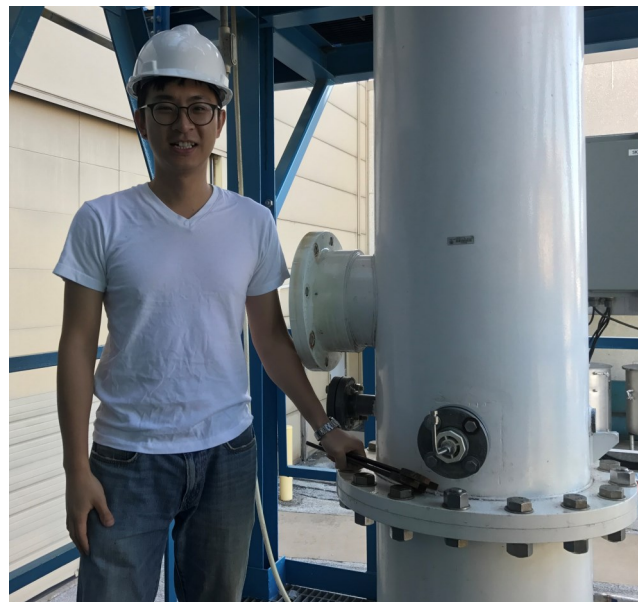
Di was born into a chemical engineering family—his parents and all his grandparents were chemical engineers. "Hydrocracking" and "vacuum distillation" were phrases he was able to spout from a young age, picking them up from family conversations (although he had no idea what the phrases really meant).

Di originally tried to veer away from the family occupation, looking to carve out a separate identity, choosing electrical engineering upon first arriving at Zhejiang University. After two years of study, however, he found himself still fascinated by chemical engineering. He was drawn to the ability to study and control real-world substances and processes. After switching his major to chemical engineering, Di has declared it be the best decision he's ever made!

Selecting University of Texas at Austin for its excellent chemical engineering program, Di felt blessed to be admitted and still considers himself lucky to be a part of the PSTC. *cont.* →

Interested in the area of environmental protection, Di likes getting his hands dirty and working on real process in a pilot plant environment. He specifically chose to be co-advised by Dr. Gary Rochelle and Dr. Frank Seibert, experts in carbon capture and separations process, respectively.

The focus of Di's research is the fundamental study of mass transfer properties for packings with emphasis on the effect of viscosity. This project involves experimental work with a pilot-scale packing tower and modeling work with a large set of packing databases. He is also interested in process design and modeling (such as AspenPlus®), chemical engineering-related programming (like VBA), and statistical data analysis. Di is currently working on a Phillips 66 project that involves the major process modification of the existing tower. It is exciting for him to see the project proceed gradually with his contribution through the steps of design, drawing, purchasing, fabrication, installation, testing, trouble-shooting, and finally steady data generation. While Di says that although his research is pretty fundamental and not as flashy as some novel research topics, he loves it and believes that separations process research will still be important in the chemical engineering field.



When not ensconced in the pilot plant, Di enjoys Austin, Texas for its perpetually sunny days. He fills his free time building real battleship models, reading detective novels, and enjoying time spent with his four-year-old schnauzer-terrier mix, his "little old man." As for the future, we wish Di nothing but the very best as he advances in the world of chemical engineering!

—Lauren Murrah

PI Spotlight: Dr. Gary Rochelle



Dr. Gary Rochelle is the focus of our PI Spotlight this summer. Raised in Odessa, Texas, Rochelle's father worked with control equipment for Foxboro Instrument Sales. His father had studied chemical engineering at Texas Tech—Rochelle has memories of the family garage

being used to store mercury, an element used in pneumatic instruments. His father's work, along with a summer job at El Paso Products working on computer applications, sparked his interest in pursuing science.

Rochelle picked up his B.S. and M.S. degrees at the

Massachusetts Institute of Technology with practice school then spent two and a half years working for the Environmental Protection Agency on flue gas desulfurization. He also enlisted as an officer for the U.S. Public Health Service. In three and a half years of work at the University of California, Berkeley, Rochelle earned a Ph.D. while working with C. Judson King on the process synthesis of flue gas desulfurization.

In 1977, Rochelle came to the University of Texas at Austin (UT Austin) and worked on research and development of flue gas desulfurization by limestone slurry scrubbing from 1977 – 1990. This limestone slurry scrubbing process is still a technique in use today.

cont. →

In 1984, he started working on acid gas treatment by amine scrubbing for the Separations Research Program (SRP).

In fact, Rochelle was an initial part of the SRP start-up efforts. He had arrived at UT Austin before Dr. James Fair and had actually been Dr. Fair's new faculty "mentor" as Dr. Fair had come to the university from industry. Rochelle was originally interested in two parallel areas: acid gas and air pollution control of coal-fired power plants. He merged these two areas in 2000 to focus on CO₂ capture.

Rochelle notes that amine scrubbing is the only reasonable technology, and the only significant choice, for air pollution control. The technology has come a long way since he began working in this field and it's now in much better condition. The major competition

is in renewable energy and extensive use of natural gas but Rochelle stresses that CO₂ carbon capture can be used to remove emissions from natural gas.

CO₂ carbon capture is not the only interest that Rochelle has in life. He is an avid backpacker and often takes his students with him, visiting such places as Weminuche Wilderness Area near Durango, Colorado, as well as abroad in Norway, Canada, and Switzerland. He also enjoys taking his four grandchildren hiking and biking in Austin as well as singing with his wife in the Round Rock Community Choir. Gary Rochelle brings so much to his work, his family, and his students, and we are honored to have him as part of the Process Science and Technology Center.

—Lauren Murrah



Articles We've Published

Full citations and abstracts are available on the [PSTC website](http://dept.ceer.utexas.edu/ceer/pstc/).

Freeman Group

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- ◆ Kushwaha, A.; Dose, M.E.; Luo, S.; Freeman, B.D.; Guo, R., "Polybenzoxazole (PBO)-based Gas Separation Membranes Thermally Derived From Blends of Ortho-functional Polyimide and Polyamide Precursors," *Separation and Purification Technology* **2017**, 184, 384-393.
- ◆ Kamcev, J.; Paul, D.R.; Manning, G.S.; Freeman, B.D., "Accounting for Frame of Reference and Thermodynamic Non-idealities When Calculating Salt Diffusion Coefficients in Ion Exchange Membranes," *Journal of Membrane Science* **2017**, 537, 396-406.
- ◆ Baek, Y.; Freeman, B.D.; Zydney, A.L.; Yoon, J., "A Facile Surface Modification for Antifouling Reverse Osmosis Membranes using Polydopamine Under UV Irradiation," *Industrial and Engineering Chemistry Research* **2017**, 56, 5756-5760.
- ◆ Tiwari, R.R.; Jin, J.; Freeman, B.D.; Paul, D.R., "Physical Aging, CO₂ Sorption and Plasticization in Thin Films of Polymer with Intrinsic Microporosity (PIM-1)," *Journal of Membrane Science* **2017**, 537, 362-371.
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- ◆ Kamcev, J.; Paul, D.R.; Freeman, B.D., "Effect of Fixed Charge Group Concentration on Equilibrium Ion Sorption in Ion Exchange Membranes," *Journal of Materials Chemistry A* **2017**, 5, 4638-4650.
- ◆ Kasemset, S.; Wang, L.; He, Z.; Miller, D.J.; Kirschner, A.; Freeman, B.D.; Sharma, M.M., "Influence of Polydopamine Deposition Conditions on Hydraulic Permeability, Sieving Coefficients, Pore Size and Pore Size Distribution for a Polysulfone Ultrafiltration Membrane," *Journal of Membrane Science* **2017**, 522, 100-117.
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- ◆ Galizia, M.; Benedetti, F.M.; Paul, D.R.; Freeman, B.D., "Monovalent and Divalent Ion Sorption in a Cation Exchange Membrane Based on Cross-linked Poly(*p*-styrene sulfonate-co-divinylbenzene)," *Journal of Membrane Science* **2017**, 535, 132-142.
- ◆ He, Z.; Kasemset, S.; Kirschner, A.Y.; Cheng, Y.-H.; Paul, D.R.; Freeman, B.D., "The Effects of Salt Concentration and Foulant Surface Charge on Hydrocarbon Fouling of a Poly(vinylidene fluoride) Microfiltration Membrane," *Water Research* **2017**, 117, 230-241.

Fall 2017 Meeting

Please join us for our annual PSTC Fall Meeting October 17-18, 2017, 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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