FEBRUARY MEETING: WHAT DOES "WELL-MIXED" MEAN & WHAT IF A CSTR IS NOT PERFECTLY MIXED?

Suzanne Kresta, PhD

WEBEX MEETING NUMBER 635 888 409 (further directions on page 12)

THURSDAY, 23 FEBRUARY 2017

9:00 pm EST, 8:00 pm CST, 7:00 pm MST, 6:00 pm PST;

UTC/GMT 0200 24 February 2017

Mixed up about mixing? Suspect your CSTR might not really be well-mixed? Or that the processes are not always at steady-state? Wonder how much this all matters and what to do about it anyway? Mixing guru Suzanne Kresta's lively webinar will explore some of these common non-idealities, from on-beyond-the-basics understanding to how she has improved real-life processes with these advanced concepts.

Kresta is an award winning Professor of Chemical and Materials Engineering and Associate Dean of Graduate Studies and Research Faculty at the University of Alberta, and has published extensively on mixing, including 2 recent CEP articles.

IN THIS ISSUE

This is Engineers Week in most of the US. Laura Gimpelson reflects on E-Week past and future, with plenty of links for anyone wanting to get involved here or internationally.

Our intrepid past chair, Amanda Scalza, is on the move again; no longer a Texan, she settling in to The Land of Lincoln. She gives us some insights into how AIChE has helped her in her transitions around the country and up the career ladder.

Neil Yeoman presents the first installment of his discussion of the international crises in 1973 which affected the professional and personal activities of many Americans, including chemical engineers.

Thanks to Michael Mackaplow and David Greene for their letter in response Neil's columns on scientific illiteracy and engineering education, respectively.

Please note you can attend the March VLS Meeting in person at the San Antonio Spring AIChE meeting. The event will also be broadcast live as a webinar.

---- Jennifer I. Brand

VLS ELECTION RESULTS

Congratulations to the newly-elected officers! Vice-Chair is Sabine Brueske, and the new Directors are Dan Miller and Paul Adamson.

Sabine (pronounced "Sabina") is currently Program Director - Industrial Analysis Program at Energetics Incorporated in Bellingham, Washington. Dan, a BASF Corporation retiree, is a long-standing member of the AIChE safety community. Paul is with the U.S. Air Force, currently in the Washington metro area. His educational path shows the versatility of an undergraduate degree in chemical engineering, as his masters is in environmental engineering, and his doctorate is in nuclear engineering.

Contact information for all the officers can be found on the AIChE VLS Website.

MARCH MEETING IN SAN ANTOINO

at the Spring AIChE Meeting

David Dickey

So You Want To Be A Private Engineering Consultant?

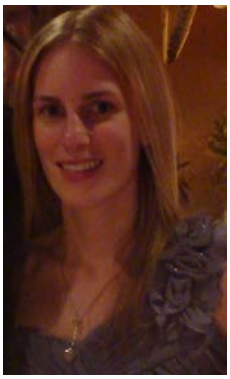
Tuesday, March 28, 2017

6:30 - 7:30 PM

Nueces (Hill Country Level) - accessible by elevator only (Hyatt Regency San Antonio Riverwalk)

FROM THE PAST CHAIR: WHAT'S IN IT FOR ME?

Amanda Scalza



"What's in it for me?" It's a question we all think, but never want to utter. Whether a career option, choosing how you spend your time, or even what products to buy, it's a thought that always pops into our heads. It can be embarrassing, but the question doesn't need to be negative, and its outcomes are often quite useful. Having a personal stake drives us to empathize, make careful decisions, and be our most productive. For myself, this is no truer than with AIChE.

When I helped start my student chapter of AIChE, I was in it for pretty selfish reasons. The civil engineers were busy building a concrete canoe, and the mechanical engineers were making a super mileage vehicle. I wanted a "cool" project too! Voila! My classmates and I started a chapter of AIChE and a Chem-E-Car team! While we followed all the rules, our team never inquired about what other teams were doing, so our car designs were unique. We didn't win, but had fun and learned a ton! Later, we applied the same brazen attitude towards securing an AIChE regional conference. Our campus was so small we had to do it during Spring Break, and with such small class sizes, we had to go beyond chemical engineering: our volunteers came from every facet of engineering. As students, we only worried about what we wanted to do. As a result, we created a network used by scores of future students.

My first job was in very small town, and I didn't know a soul. Wanting to stay connected, I reached out to one of the sponsors of that student conference, who was extremely involved with AIChE. He informed me that he was a director of this new venture, the Virtual Local Section, and helped me get involved. Though I was inexperienced and a bit shy, the group took me under their wing and invited me to an in-person meeting during an AIChE conference. As you can see, I have been hooked ever since. It is especially powerful and heartwarming to see these now familiar faces among the crowds in conferences now. Though I reached out to the VLS to help myself, I hope some of you have benefited now, and in the future. We will once again be meeting in-person at the AIChE Spring meeting, where I look forward to seeing old friends and meeting new ones.

At one AIChE conference, I met a new friend and fellow young professional, with an equal passion for AIChE. Over the years we have seen each other at conferences and kept in touch. Last month, I moved 1000 miles to a new state, started a new job, and bought my first house. Each of these things by itself could be overwhelming but thanks to this young man, I am not completely alone. Though we don't know each other well, he went out of his way to provide advice about my new

state, and introduce me to the AIChE leaders of the Chicago local section. With their help, Illinois already feels a bit more like home.

On the face of it, AIChE is a great place to develop both technical and leadership skills. What I have received from volunteering for this organization, is much more powerful. It's a network of chemical engineers that are generous and kind, and absolutely invaluable. In the end, I hope my contributions make a small benefit to the community, as the community has made a large one in my own life. Most of all, I hope you consider volunteering as well. It hardly feels like work when you're doing it with friends.

LETTER: SCIENTIFC ILLITERACY

In Neil Yeoman's "The World Out There: Education" (November 2016 VLS section newsletter) he mentions the "scientific illiteracy" he often encountered during his 15 years of auditing courses at a local liberal arts community college. He invited comments. In brief, I concur. In detail, I have frequently noticed two things in many (most?) people that are not consistent with my definition of good scientific reasoning:

1) Valuing individual data points – or simple qualitative statements like "most" - nearly as much as statistical distributions: I believe is that a few data points that support one side of an argument not as strong evidence as a statistical distribution – composed of many data points – that support the other side. But, many people believe that "Statistics can be made to say whatever anyone wants" – and hence dismiss the robustness of the value of conclusions drawn from rigorous statistics.

2) A "feeling" is an acceptable counterargument to a counterargument based on data and logic and proven-theory-based extrapolations from that data. I once had someone say to me "Data is just one element and if it doesn't align with your perceptions... it's not valid!".

My want for society is for people to make decision based on reasoning based on data, statistics, and logical reasoning – with a healthy dose of empathy added in. Perhaps we should consider including courses in both statistics and logic & argumentation, at the high school level?

Michael Mackaplow, PhD

LETTER: ENGINEERING EDUCATION

I was fascinated by Neil Yeoman's explanation of coffee decaffeinating but am even more intrigued by his recent columns on chemical engineering education.

I graduated with 157 credits including 20 for ROTC. In my junior year, I was so overloaded that I had a lab scheduled at the same time as ROTC and had to alternate attendance. After seeing Neil's column, I checked and found my alma mater now requires 121 credits to graduate and there are more electives than in my day.

After serving three years on active duty, my entire career was spent in process design; the first 15 years in petrochemicals and the last 30 in biotechnology (fermentation, cell culture, vaccines). Maybe 10 years after graduation, I became concerned that new graduates did not seem to have the same grasp of science and engineering fundamentals that I recalled but I generally tried to hire only the top graduates from good schools and, by that time, process simulation was replacing manual calculations.

I generally find Neil's columns quite interesting and his August column is no exception as it opens up a discussion that many academics and AIChE leadership will probably oppose. I agree with virtually all of what was written but I would take it even further and suggest that while we consider ourselves to be professionals, I don't believe we have done an adequate job of establishing the criteria or enforcing the requirements to be considered professional. Perhaps a third to half the chemical engineering graduates go on to other careers but, for those that want to practice chemical engineering, I would suggest its time that the program be expanded to the equivalent of an MD or JD, with an additional 2-3 years of post-BS specialization and include a rigorous examination equivalent to the boards required by other professional societies.

Expanding the duration of the undergraduate educational program would allow a more orderly progression where the first two years would address math, science and an introduction to chemical engineering. The next two years would provide the core chemical engineering courses while additional years would allow for specialization (biochemical, nuclear, materials, safety, environmental, etc.) and the soft skills discussed. Programs would be rigorously accredited and the number of accredited programs minimized to ensure quality. The national examination would be required to ensure that the desired results were achieved.

1) Soft Skills

I would separate soft skills into two categories; some skills need to be learned on the job but others could be, and probably should be, taught in the undergraduate curriculum. My education was almost completely theoretical and I would have benefited by having some background with real pumps, heat exchangers, separation equipment, etc. Similarly, instrumentation would be a useful addition to control theory and there is no reason why topics such as maintenance, safety and environmental regulations could not be part of the formal curriculum.

2) Industry and Academic Viewpoints

Law schools, medical schools and accounting programs are not designed to produce academics; their mission is to produce lawyers, doctors and accountants. Their faculties are very much influenced by the respective professional societies and practicing professionals. Engineering should be the same and AIChE should be more involved in the curriculums and accreditation.

My experience is that there are many brilliant researchers and many wonderful teachers but the chance of the same person being both is unusual. Teaching chemical engineering is not easy and it is further complicated by the need to put so much of the core program into two years. I say that because, the freshman year is a transition from high school and is only an introduction. Before the senior year brings the curriculum together and allows for some specialization, the basics of heat and mass transfer, kinetics and thermodynamics must be crammed into two years along with the necessary math and science courses that would ideally be done before attempting the chemical engineering lessons.

I would guess that the number of new United States, BS graduates is about 4000 per year. Although there have been ups and downs, I think the current number is similar to what it was 50 years ago. However, there are several differences. When I was in school, only 1/3-1/2 the chemical engineering sophomores actually graduated as chemical engineers while today the retention rate is probably close to 100%. Then, there were probably l00 accredited programs while today, there are about 200. I believe that accreditation was by AIChE when I was in school but is now by ABET, While ABET may be easier I wonder if it can do as good a job as AIChE?. There are probably twice as many chemical engineering programs which means that there are twice as many faculty positions. I would ask if there are sufficient good teachers for the number of programs?

3) Fundamental Criteria

There should be a minimum criteria for chemical engineering that includes math and science, ideally taught before the core chemical engineering courses. I would think that we can agree on two semesters of thermodynamics, one of kinetics, two of heat and mass transfer and one of controls, preceded by an introduction and followed by a design course of 1-2 semesters. Probably some other engineering such as environmental, mechanical/structural and electrical should be included. I would also do something for safety and possibly utility systems.

4) Practical Experience

I would make an oversight committee part of the accreditation requirement. This committee would be mainly non-academics and they would have an input on curriculum and faculty appointments. I would also recommend the use of adjunct faculty to teach certain of the courses such as design and safety.

When I was in school, we spent countless hours on trial and error solutions. Although this effort does not appear to be particularly useful, we certainly understood phase equilibrium and had a good appreciation of whether a computer-derived solution made sense. In my early years at Badger, we were all masters of Fortran and everyone was busy developing programs particularly for distillation and heat transfer. As HTRI and FRI developed, we kept modifying the results to match our

empirical experience and only reluctantly gave up our proprietary process simulation package for Aspen. I believe that we were able to properly implement the use of computer systems because we had so much experience with hand calculations. One particular example that I recalled involved a multiphase (2 liquid phases) distillation where I was fortunate to work with a former thermodynamics professor who developed a method of using Gibbs Free Energy to model the separation. At that time, Aspen did not do three phase equilibria but we were able to resolve the problem by doing a computer trial and error and matching the Free Energy of the phases. Again, the underlying knowledge of thermodynamics is what enabled a solution.

I will never forget a new engineer trying to explain why a mass balance didn't balance and her remark that it need not because of accumulation and miscellaneous losses. While this may be interesting academically, it is a disaster in the real world. I remember a project from the mid-1960s that was a failure because of the inability to remove trace byproducts that kept building up to the point that the process failed. And, another case where a distillation column had to keep water from the bottoms while producing a high purity overhead product. After a few months of operation, trace quantities of water built up in the column and corroded the trays. My point is that somehow a new engineer did not have an adequate understanding of fundamental mass and energy balances having been taught by someone with no practical experience.

My very first task as a new process engineer was to design a scrubber for a plant being commissioned that was venting excess chlorine. I got out all my school books, calculated the size I needed, drew up a sketch and presented it to the vessel department. A few months later, I got a memo that didn't seem to relate to me but described a welding process to add man-ways to a vessel already in the field. Later, I found out that it was my scrubber that had been built exactly from my design. I wonder if there are any current texts that discuss mechanical design of chemical engineering equipment and the need for access via man ways or flanges?

5) Academic Focus

At the undergraduate level, attention should be focused on teaching and not on research. As smaller universities won't have enough students and faculty to emphasize both teaching and research, they should focus on teaching and not research. These smaller universities would not be accredited to award post-graduate degrees. Obviously this suggestion will be unacceptable to professors who don't want to limit their future career opportunities but it will be a boon to those who really want to teach.

On the other hand, the reduced number of graduate programs will improve the education of those that decide to go the research route as the students will have more opportunities to interact and learn in a more focused environment.

David Greene, PE, FAIChE

THE WORLD OUT THERE: SYNFUELS

Neil Yeoman

In the autumn of 1973, Israel was the target of a surprise attack by its enemies whose goal was to destroy the Jewish state. As part of that effort, allies of the attackers, who supplied a major portion of the crude oil the US needed, imposed an oil embargo on the US for its support of Israel's existence. At the same time, the oil exporters took control of oil prices by letting the price rise to whatever the market would bear. Up to that point the price had been set by the customers at $4/bbl. The effect of this move was significant. I cannot remember to what level the price of crude quickly rose but I do remember the rise in the gasoline prices and problems of getting gasoline. Up until that time gasoline cost about 28 cents per gallon. Immediately after the embargo the price rose quickly to 99.9 cents per gallon. It might have gone higher but the gasoline pump meters only had two digits ahead of the decimal point and one digit after it. Earlier in 1973 it would have been inconceivable to expect the price to rise to a dollar a gallon. As quick as they could to it the US gasoline suppliers changed the pump meters and the prices rose further. Because of the impact of oil prices on just about everything else inflation was high. Some fixed income guaranteed investments were yielding 14% per year. Then US President Richard Nixon announced his intention to make the US energy independent, but he didn't stay in office long enough to actually do anything in that direction. He was replaced by Gerald Ford who if he did anything it was invisible to the public. In 1977 Jimmy Carter took office and immediately initiated a massive program for US energy independence.

In 1977, I was working for Scientific Design Company (SD), the engineering and construction arm of a group of companies (The Halcon / SD Group), run by the legendary Ralph Landau, whose primary activity was the development and commercialization of new chemical technologies. Most of these technologies were developed in the laboratories of a sister company, Halcon Research and Development Corporation (HRDC). Because of SD's skill in implementing new processes, companies other than Halcon came to SD to do at least their process engineering. For example, I worked directly on 21 projects that eventually resulted in new process plants or major process plant revamps. Nine of those projects were first-of-kind. Six were Halcon developed technologies and three were from other companies.

The Carter energy independence program had four "pillars." They were 1) Conservation, 2) Nuclear Energy, 3) Synfuels, and 4) Developing Sources, such as wind, solar, waste-to-energy, biofuels, geothermal, ocean thermal, etc. Synfuels was the conversion of coal to oil. The US

has a lot of coal and in 1977 the public and the body politic were unaware of the climate change problem that was developing because the climate science community had no real voice.

Converting coal to oil was a massive undertaking for a country like the US. It was being done successfully in South Africa but because the US has so much bigger a need it was first appropriate to explore the various ways it could be done, and there were many options. In South Africa there were two coal gasification plants using a well established but not very efficient process. That satisfied their needs. For the US something better was desired. A great deal of chemical engineering effort would be required to just help DOE decide what the preferred processes would be. It was expected that about 100 coal conversion plants would be required, each one upstream of an oil refinery. The effort to design and build those plants would be enormous, but that wouldn't start until several years into the future. The Carter program promised to have a huge effect on the chemical engineering profession. It was expected that up to about a third of all chemical engineering activity would be related to the synfuels area for decades to come.

Halcon/SD Group upper management decided that the company would not try to include synfuels as a business area. The initial phase of the Carter program would require very high level talent and was unlikely to be anywhere near as profitable as using that talent in Halcon's usual business area, and the latter E&C phases, which might be quite profitable, would require the resources of companies much larger than SD. However, SD's VP in charge of the company's chemical engineering activities, Manfred (Fred) Gans, decided that SD must get involved at a low level to be able to monitor technological advancements that the Carter program would develop so as to be able to apply them to Halcon's usual business area. When I heard that such would be the case I asked to be one of the people assigned to do that. My request was denied. I was a Senior Process Manager at the time, one of two, and SD felt that it could not afford to assign somebody so senior to such an activity. The synfuels team would be one process manager (Ron Cascone), one senior process engineer (T.Y. Chang), and one process engineer. That team would seek small evaluation projects to develop a relationship with DOE and its subcontractors and to keep abreast of technology advances the energy independence program would develop. This was put in place in mid 1977.

A year and a half later I was appointed VP & Chief Chemical Engineer succeeding Fred Gans who was appointed Senior VP & Chief Technology Officer. I was appointed to that position not because I was the best chemical engineer around, which I most certainly wasn't, but because of a perception of organizational, administrative, and other soft skills. In that position I sometimes served as project director on projects where there was a

perceived special need for those soft skills or where other circumstances dictated. In my next column I will describe one of those projects, a study to define how best to produce eastern coal derived hydrogen as fuel for the Space Shuttle. Between now and then I invite readers of this column to "google" Manfred Gans, one of the most impressive people I have had the honor to know.

Please retain this copy of the VLS newsletter and reread this column prior to reading my column in the next newsletter.

NATIONAL E-WEEK FEBRUARY 19-25, 2017

Laura Gimpelson, P.E.

Each year more than 70 United States engineering, education, and cultural societies, and more than 50 corporations and government agencies celebrate being an engineer during week of George Washington's birthday. This year the week of February 19-25 has been declared "National Engineers Week" in the United States. Ireland will celebrate E-Week March 4-10, 2017. A few educational institutions actually celebrate on their own schedules, but the general remarks apply.

The goal of National Engineers Week (Eweek) is to showcase the positive contributions engineers make to our lives and to promote engineering to the public, especially at local schools. Depending on your location, events range from hosting competitions such Mathcounts, Future City, Robotics, and Science and Engineering Fairs to honoring the top engineers, agencies and employers at banquets and dinners.

During my 40 plus years in engineering, I have judged science fair projects, introduced elementary, junior high and high schools students to environmental and chemical engineering projects and organized award banquets to honor outstanding engineers and engineering projects.

My favorite event has been the "Take Your Daughter to Work" day. Using the process of baking cookies, I explain how engineers create the process, equipment and instructions to make millions of cookies each year. As in actual engineering practice, safety is always included, with a safety briefing on how to prevent burns, spills and fires when baking cookies at home. At the end of the day, most of the attendees including the chaperones and teachers understand engineering is more than building roads or power plants.

One of the major sponsors of Eweek activities is the National Society of Professional Engineers (https://www.nspe.org). This year's National program highlights the following events and the website provides links to local sections and their activities.

Date	Program
February 19–25, 2017	Engineers Week
February 18, 2017	Family Day in Washington, DC
February 21, 2017	Future City Competition Finals
February 23, 2017	Introduce a Girl to Engineering Day
March 7–9, 2017	Global Marathon

For information on the events in your location, check some of the websites listed below or contact your local engineering societies, school districts and private schools and governmental agencies for more information.

www.aiche-metrony.org/Engineers/Week.html

https://www.facebook.com/EngineersWeek

futurecity.org

www.discovere.org/our-programs/girl-day

https://msachieves.mdek12.org/2017-national-engineers-week-nasa

www.carnegiesciencecenter.org/calendar/event-details/?eventID=2187

https://www.ashrae.org/government-affairs/grassroots-advocacy/national-engineers-week-eweek

www.engineeringfamilyday.org

www.dvewc.org/about

www.new-sandiego.org/awards/outstandingengineer.html

https://www.army.mil/article/120306

www.wfeo.org/**engineers**days (International Dates and host organizations)

Australia: https://www.facebook.com/EngineersAustralia (August 2017)

Canada: http://www.nem-mng.ca/ March 2017

India: https://www.ieindia.org/en September 15

Ireland: www.**engineersweek**.ie

ATTENDING A VLS MEETING

- **Join by internet:**
  - https://aiche.webex.com/mw3000/mywebex/default.do?siteurl=aiche
  - Search for VLS or by meeting number 635 888 409
- **Join by phone:** Access code: 635 888 305
  - 1-866-469-3239 Call-in toll-free number (US/Canada)

- 1-650-429-3300 Call-in toll number (US/Canada)
- Global Call-in numbers
- Toll-free calling restrictions

Attendance at a Virtual Local Section Meeting is open to AIChE Virtual Local Section Members, AIChE members, and other interested people.

The statements and opinions in this newsletter reflect the views of the contributors, not of the AIChE or the VLS, neither of which assume responsibility for them.

PDH CREDIT FOR VLS MEETINGS

LAURA J. GIMPELSON, P. E.

Attendees of the Virtual Local Section Meetings can receive up to 1 hour of professional development credit that meets the continuing education requirements of most state professional engineering registrations. To receive the certificate documenting your attendance, send an email to the VLS secretary, Laura Gimpelson, at virtualaiche@gmail.com.

Include the following information in your email:

1. Name of the Presentation and Speaker
2. Attendee's name as listed on the registration certificate
2. Attendee's registration number and state/providence of issuance

The certificate, in pdf format, will be issued within 30 days of the receipt of the request.