The University of Iowa

EDITOR: Nathan Jarvey

AIChE Spring 2019

Advisor's Corner

By: Prof. David Murhammer, Professor and AIChE Student Chapter Advisor

Greetings to Hawkeye Chemical Engineers!! This Spring 2019 issue of our AIChE Student Chapter Newsletter contains four articles that can best be characterized as personal testimonials about unique experiences of students during their time in the Chemical Engineering program at the University of Iowa. First, Tom Hodur, who graduated with a BSE in Chemical Engineering in May 2019 and is currently employed at Pepsico (Quaker) in Cedar Rapids, authored an article about his three-year experience working with the ChemE Car. Second, Jackson Solsma, who will be a Chemical Engineering senior at the University of Iowa during the upcoming 2019-2020 academic year, wrote an article about his participation in a plant trip to the OCI Fertilizer facility in Wever, Iowa. Third, Kyle Wersinger (with assistance from co-author Nathan Jarvey), who will also be a Chemical Engineering senior during the 2019-2020 academic year, discusses his participation in Tinker Process Safety Prize competition. Fourth, Nathan Jarvey, another member of the 2019-2020 academic year Chemical Engineering senior class at the University of Iowa and the current editor of this newsletter, contributed an article about his unique custom elective focus area in creative writing.

In addition to these four personal testimonials, this newsletter issue also contains an article about the participation of our student chapter in the Regional AIChE Student Conference held at the Missouri University of Science and Technology in Rolla, MO. Our student chapter participated in the ChemE Jeopardy Competition, ChemE Car Competition, and the Research Paper Contest and had second place finishes in the ChemE Jeopardy Competition and the Research Paper Contest. Finally, there is an article about the new student mentoring program in which our juniors and seniors serve as mentors for our sophomores and first-year students.

Any comments about the newsletter content can be sent to me at david-murhammer@uiowa.edu.

University of Iowa American Institute of Chemical Engineers

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AIChE

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Mid-American Regional AIChE Student Conference — Michael Leyden

Over 20 University of Iowa chemical engineering students attended the 2019 Mid-America Student Regional Conference from April 12th to 14th hosted by the Missouri University of Science and Technology in Rolla, Missouri. Upon arriving, students were invited to go bowling and enjoy pizza, a great opportunity to socialize with students from the various universities. Although some of us may need to improve on our bowling techniques, it was still a very entertaining evening and a nice way to end the day after a long journey.

All of the conference attendees at the closing dinner

On Saturday, various competitions were held. Student competitions are an invaluable experience, allowing students to make connections with peers from across the region, share their research and compete in friendly competition. We had two students, Ojas Pradhan and Austin Doak, compete in the paper competition; this competition allowed students to give a 15 minute presentation regarding their research to judges and all those who wished to attend. Ojas was awarded 2nd place in the competition. In addition, our AIChE chapter assembled a functioning vehicle to compete at the regional ChemE car competition for the first time in years. This competition requires teams to construct a vehicle that will carry a set amount of water over 10-30 meters, and the car must be powered by a chemical reaction. The name of our car was LDR (Lead Dead Redemption). It was powered by a lead acid battery and used an iodine clock reaction as the stopping mechanism. Each team gathered at the competition site at 7:00 am to receive chemicals and prepare for the competition to start at 9:00 am. It was a long but rewarding morning. The group received 8th place, which was a huge improvement from years past.

In addition, two teams represented the University of Iowa in the regional ChemE Jeopardy competition. Teams were quizzed on categories such as separations, mathematics, biology and many more. The two ChemE Jeopardy teams finished 2nd and 3rd place. Following the competitions, everyone gathered for a delicious buffet and to engage in conversation. Following the dinner, many of us went to a local ice cream parlor, Soda and Scoops, to enjoy dessert. Students were then allowed to enjoy the rest of the evening in Rolla as they saw fit.

The second place ChemE Jeopardy team (left to right: Michael Lake, Esmeralda Orozco, Jeremy Wallace, Kyle McCarthy)

Attending AIChE conferences are an invaluable experience. It allows students to get to know some of the upperclassmen and meet students from across the region. The 2019 national student conference will be held this fall in Orlando, Florida in November and the 2020 regional conference will be held in Lincoln, Nebraska next spring. All students are encouraged to attend. If you have any questions regarding the conferences, feel free to ask fellow classmates or Dr. Murhammer.

ChemE Car: Past, Present, and Future — Thomas Hodor

My journey with ChemE car began almost 3 years ago when I was a sophomore. At the time I had just wanted to get involved so I decided to run for a position on the AIChE student council. I remember wanting to be a part of ChemE car when I heard about it as a freshman so I decided to run for the coordinator position. To be honest I didn't really know what I was getting myself into. I had jokingly said in my election speech that I would "Make ChemE Car Great Again" and didn't take the election very seriously. Despite my efforts I won the nomination and was set to begin my tenure in the fall. When I actually started to begin my term as coordinator in the fall of my junior year. I realized I was somewhat in over my head. I barely knew the rules to the competition, had no sort of experience in mechanics or robotics, and now found myself responsible to build a small car that starts and stops with only chemical reactions. The club itself was not in great shape either. All that was left of the club was a box of scraps leftover from a car that was built almost 5 years ago with no documentation on how the car actually worked.

I decided to take a step back to think about why it had been this way for so long. Every year a coordinator gets elected, but why doesn't a car ever get built? I realized it's because of a lack of continuity between new coordinators. Every year the old coordinator would graduate and a new one would enter with the same lack of experience that I had. Because of this I knew that my time spent as coordinator would be best spent creating a foundation that retains membership and passes on knowledge learned from previous years. So, I spent a majority of my time as coordinator getting supplies, recruiting new members that I knew would stay with the club for multiple years, and finding a dedicated space to build the car. After all those hurdles were finally crossed, we started working on a design for the car in the spring semester.

Working into the fall of my Junior year Jenny Stevenson then became the coordinator, and we had been moved into the same space that was used by the Robotics club. They had helped immensely by allowing us to borrow the tools they had around the lab. They had also given us a lot of advice on how to handle the design of the chassis and circuitry of the car as well. We had gotten into the routine of meeting every Sunday at the same time as the robotics club so that we could borrow their tools and get their input on the design of the car. Eventually we managed to build a car that was powered by an aluminum air battery and stopped with an iodine clock reaction hooked up to Arduino circuit. We were finally ready to go to our first competition at the AIChE regional conference. Little did we realize we were in for quite a rude awakening.

We had been given the set distance the car needed to travel and the weight of water that it had to carry one hour before we had to place our car on the start line. We were expecting to have two hours to get ready, so we were put under a bit of a time crunch. Because of this we had several technical difficulties getting the car ready to be put on the start line, including completely forgetting to attach the container which held the water the car was supposed to carry. This didn't matter however as the car ended up not moving a single inch and we ended up placing dead last in the competition. It was like a car crash in slow motion from the get go. We were all pretty disappointed in the performance, but none of us wanted to quit.

Immediately after the conference we had a meeting and discussed everything that went wrong and what we could have done beforehand to prevent it from happening. So with Mike Leyden as the new coordinator we decided to go back to basics with the car, completely rebuilding the chassis, using a lead acid battery for a power source, and using a simpler version of the iodine clock reaction. The new chassis was able to carry more weight than its predecessor and needed less power to move. The lead acid battery was simpler and cheaper than the aluminum air battery used previously, with the added benefit of it being rechargeable. Finally, the new iodine clock setup used less reactants, making it cheaper and easier to test. (continued on next page)

ChemE Car: Past, Present, and Future (continued) — Thomas Hodor

The only things that hadn't changed were the circuit and Arduino which Ryan Bingen had perfected the year before, and the bottle used to hold the water that we forgotten the year before. Due to these changes we saw better results at the regional conference at Missouri S&T. The car had finally moved, and we took 8th place out of 13 cars. From an outside perspective it may not seem like much, but everyone on the team was ecstatic! We had finally met the ultimate goal that we had set almost 3 years prior, "Just get the car the move".

The 2019 ChemE Car in motion, along with members of the team (in the blue lab coats).

While my journey with ChemE car has finally come to an end, I really hope the club continues to grow and improve in the Future. Joining ChemE car was one of the best decisions I've ever made at the University of Iowa. Being involved with it has taught me countless lessons on leadership, group dynamics, and problem solving. I even got to learn a little 3D modeling along the way as well. My biggest hope is that ChemE car doesn't fall out of favor like it has in previous years. Back when I was coordinator and would ask students if they were interested in joining, they would usually say no saying they don't know anything about batteries or circuits. My answer to anyone who says that is always "neither did any of us when we joined", and it's true. None of us knew how an Arduino worked, or knew about sizing a motor and gearing we needed to move the car. But we figured it out by putting in our best effort to learn and keep trying until we got it right. The truth is all ChemE car needs to be successful are people who are motivated and willing learn new things. A majority of the current members are in their last year at the University so the biggest challenge for the future will be finding the next generation of students willing to put in the time to learn. If that happens, I'm confident that ChemE car will thrive and place first at the next regional conference.

Student Mentoring Program — Anthony Kluch

With increasing class sizes and changes in curriculum, there felt a need to establish a chemical engineering mentor/mentee program. In the Fall of 2018, the idea was first put into practice. Seniors and juniors were encouraged to sign up as mentors and be paired with a sophomore or freshman within the chemical engineering program. These pairs continue until either the mentor graduates or the mentee became a junior, where they would then be paired with a new mentee. Pairings are tailored to connect students with similar elective focus areas and interests to maximize the ability of the mentor to help the mentee. This program is designed to work in conjunction with the current mentor/mentee program that pairs students with alumni currently in the work force. The student mentor program is more focused on bridging the gap between years, and helps younger students navigate class choices and workloads. Along with helping with academic questions, another goal of the program is to help upper classmen get to know the younger classes.

Student Mentoring Program (continued) — Anthony Kluch

The end goal is to have the chemical engineering department improve the sense of community. To achieve this, during the school year events are held to help mentors and mentees interact and get to better know each other. The overall hope of the program is to help eliminate confusion and answer many common questions within the chemical engineering department.

Along with the student mentor program, a student advisor program was devised to help incoming freshman transition from high school to chemical engineering. Five seniors were selected for this program, representing surrounding states, elective focus areas, and groups involved on campus. A spotlight was created for each of these students to illustrate their interests as well as contact information. These spotlights will be displayed on the chemical engineering website.

Common bios include: hometown, elective focus area, involvement on campus, research, internships, co-ops, studies abroad, and jobs within the college of engineering. The idea is to allow any incoming students to see which student best aligns with their goals in college and be able to reach out and ask any general questions they have pertaining to chemical engineering or the University of Iowa. The goal of this program is to help more prospective students consider chemical engineering as a major. There are many misconceptions that surround the major like, difficulty and focus on chemistry. The spotlights will hopefully allow students who are considering chemical engineering learn what it is actually like to earn the degree rather than base their decision on information they heard from people that are not currently in the major.

OCI Fertilizer Plant Tour — Jackson Solsma

This year we had the opportunity to visit the OCI Fertilizer Plant in Wever, Iowa for my Green Chemistry and Technology class taught by Dr. Stanier. This was the first plant tour that I had ever been on and was more impressive than I could have imagined. The facility was built with a capital investment of approximately three billion dollars and produces around three million pounds of nitrogen fertilizers and diesel exhaust fluids per year. During the tour, they spoke at length about how the facility is considered, "top notch," and succeeds in matching or beating many environmental regulations. This was crucial to me, as my elective focus area (EFA) is energy and environment, which for me means that I want my future career to be focused on helping businesses use more renewable materials, cut down on greenhouse gas emissions, and plan in advance of future environmental regulations. During the tour, I was very impressed at the overall layout of the plant, which incorporated many inherently safer design strategies. Something they always mention in our chemical engineering classes is that you should be safer at the plant than sitting at home, and now I can see why! The scale (and thus, the safety requirements) of the operation was massive. Seeing the true size of many of the process units we talk about during class blew me away. Overall, the tour showed me that the old ways of engineering and design are changing in favor of more sustainable, but still very profitable practices.

A look into Iowa Fertilizer Company's Weber, Iowa plant from the outside

Tinker Process Safety Prize — Nathan Jarvey and Kyle Wersinger

Near the close of the fall 2019 semester, students in the Dr. Murhammer's Chemical Process Safety class were given an opportunity to compete in the first Tinker Safety Prize competition. The award is named after Sharon Tinker, an alumnus who spent much of her 30+ year career working in process safety at ExxonMobil and continues to value process safety in chemical engineering after retirement. Awards were given to all of the participants, with the 1st place student receiving $1000, the two runners-up each receiving $500, and all other participants receiving an honorable mention as well as a smaller monetary prize. The competition itself was based upon three main aspects: the participant's final grade in the Chemical Process Safety course, a written report of approximately 2500 words summarizing a Chemical Safety and Hazard Investigation Board investigation of an incident, and a poster presentation of their findings. 50% of the award weighting was given to the student's grade in the class, while the rest was split between the written report and the poster presentation. Students were given until just after the close of winter break to complete the written report (roughly a month and a half in total), with the reports due on January 18th and the poster presentation session occurring on February 22nd.

Based upon the final tally from the panel of industry-member judges (including Sharon Tinker herself) and final class grades, Kyle Wersinger received 1st prize for the completion for his project focusing on a dust explosion/fire at Imperial Sugar Company. The incident that he discussed occurred on February 7th, 2008 at their sugar refinery in Port Wentworth, Georgia, causing 14 fatalities and 36 major injuries in the process. The incident was judged to have occurred largely due to poor routine maintenance work regarding the sugar dust itself, which was rarely done in the first place and when actually done used compressed air to move the dust elsewhere and suspend it into the surrounding air (which is a major safety hazard in the first place). The lack of real maintenance work made all of the areas in which sugar dust was allowed to compile the perfect place for the dust explosion pentagon- made up of a fuel source (the dust), oxygen from the air, an ignition source, dust confinement, and dust suspension- to come together and create a major accident. All that was really needed was an ignition source and just enough dust to become suspended in the air and the result is a massive accident that kills or injures 50 people and causes millions of dollars of damage to the plant.

Another major issue Kyle discussed in his project was that of a lack of a proper explosion relief and/or ventilation system with recently installed conveyor ducts. This created a situation where no outlet was available for an incident to be mitigated (at least to some extent) if an accident did occur. What ventilation did exist throughout the plant was extremely undersized and poorly maintained, meaning it was basically useless in preventing the buildup of significant dust layers throughout the plant, some several inches in depth. Furthermore, not only did management know about this, company leaders were aware that employees were neglecting maintenance or doing so improperly and of previous smaller dust explosions that had occurred elsewhere within the company and were still entirely complacent. Something as simple as management taking action against these massive safety hazards to everyone inside the plant could have saved time, money, and (most importantly) lives, but instead nothing was done.

As for the explosion itself, Kyle discussed the notion that it began in the tunnel between storage silos, where no system for removing blockages existed. It is believed that a sugar buildup started there and built up until a high enough concentration of dust was in the air that a heat source (which was never identified exactly) ignited the sugar. This initial explosion blasted open the tunnel and into another area of the plant, where it caused the ignition of secondary dust collections and spread fireballs throughout much of the plant. These explosions blew through three-inch thick concrete floors, walls, machinery, and other debris, sending large pieces of the plant flying throughout the building plant along with the massive fireballs. In the process, the explosions destroyed a series of buildings and caused severe damage to the refinery itself. (continued on next page)

Tinker Process Safety Prize — Nathan Jarvey and Kyle Wersinger

A showcase of the damage from the explosions, including multiple destroyed buildings.[1]

Emergency communication was only conducted verbally on site and evacuation plans and drills were not made nor conducted, so employees were essentially left to their own devices to escape from the debris and fire that consumed these buildings. That represents another extreme safety hazard, though in this case it was just one of the large number of factors that made this incident not only occur in the first place, but also much worse than it could have been.

Kyle goes on to discuss the CSB's recommendations based upon the incident, which mainly involve fixing the issues mentioned previously and implementing training on the dangers of combustible dusts for all employees. While he saw the CSB's recommended actions as adequate, he also felt that more action should be taken at a management level to address the complacency and ineffective action from previous accidents that had occurred.

As a whole, all of the participants in this year's competition said that they learned a lot from putting together their reports/posters and recommended that any interested students should take on the project next year. As process safety continues to be a massively important topic industrially and academically (especially here at Iowa with the efforts of Dr. Murhammer), this project will monetarily and academically continue to inspire students to further study safety issues and incidents for (hopefully) years to come.

The Ties that Bind – Creative Writing and Chemical Engineering — Nathan Jarvey

One of my favorite parts of being in the Chemical Engineering department at Iowa is the freedom afforded to me as part of the department's Elective Focus Area (EFA) program. Though most students choose to follow a path similar to one or more of many preset EFA's, the most popular of which in the class of 2020 are pharmaceuticals and energy and the environment, others (including myself) are taking drastically different routes. A classmate of mine, for example, has an EFA regarding international relations, while my personal EFA focuses on long-form creative writing. While certain requirements must be met for science/engineering classes, the program has allowed me to take a series of upper-level creative writing workshops with the goal of drafting a full-length science fiction novel by the time I graduate in the spring of 2020. I understand how to some people my project might come across as irrelevant to my actual chemical engineering degree or future either in industry or in graduate school, but in truth I've found that the ties that bind my creative endeavors to engineering work to be far stronger than I ever anticipated.

One of the most common stigmas from my experiences regarding scientists and engineers (especially engineers) is that they have poor communication skills either professionally, personally, or in both areas. Yet, as the scale and scope of the scientific and/or business advancement that so many of us are working toward grows further in this global economy, strong communication skills are vital to actually allowing good ideas to come to fruition. Whether I like it or not, so much of the interpersonal communication that I have has to be persuasive in nature. This means that by gaining a better understanding of linguistics and techniques to more clearly present ideas, I can more effectively get my ideas across regardless of audience, but especially in the cases in which the audience is very general or has little to no background knowledge of a subject.

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The Ties that Bind (continued) - Nathan Jarvey

My time spent in the writing workshop has allowed me to do just that, especially as the other writers that I have met usually do not have the scientific background that being a chemical engineering student has given me.

In many ways, being a chemical engineering student is actually a major advantage to me as a science-fiction writer, as so much of my work is based upon real science. However, in order to properly establish anything beyond the reader's understanding of the modern world in their mind, I am required to not only explain my alien world to them, I am required to do so clearly and without boring them. While that is often a difficult task- as many scientific topics are highly complex by definition- it affords me a lot of practice explaining ideas to people. Usually, after a few iterations I can manage to explain a complex idea to the reader while maintaining the balance between being informative, not patronizing, and at least somewhat intriguing for a reader to get through something as daunting as, for example, chemical reaction mechanisms. This principle is directly applicable in writing lab reports, business communications, explaining my work to family/friends, research presentations, and many more areas. While we do write many 50 and 60 page lab reports as parts of our chemical engineering classes, the amount of opportunities we are given to practice those skills is nowhere near that afforded to me in my creative endeavors.

A significant portion of what I constantly hear in my lab classes regarding report writing is that a lab report is supposed to be, in essence, a story. A story with differing pieces for different audiences, but a core message and flow that anyone reading it should be able to understand. In many ways, a novel is the same. Different audiences may find themselves attached to different characters or pieces of a world, each chapter might present a different focus than the last, but at its core, a traditional novel should provide the reader a core message hidden somewhere within its pages that any reader can pick out.

While that core message is often considered to be one or more emotional questions rather than a specific result, technical question, or business proposition, the base principle is the same. Having knowledge and practice with semantics and overall linguistics serves as a boon to all of the above and so much more. For me, novel writing is just the best way for me to get that experience while being able to explore my thoughts, ideas, emotions, and personality in a way that I can intrigue others to want to go on a journey with me. I really may not like that it has to be so, but it's inherently persuasive. Still, any creative work that can better inform my scientific, technical, business, and personal communication skills gives me a massive advantage going forward, even if I'm giving up the opportunity to achieve something like a business minor to get it.

Now, I cannot say that my experience in the workshop has been perfect; I have certainly experienced some disdain for writing from those I know in engineering and a lot of disdain for engineering work (or just math in general) from most of the writers I've met. At times, I get the sense that I'm stuck between the two worlds- yet in my mind, at least, that only proves the existence of the very stigmas that I'm trying to overcome. The ties that bind the world of chemical engineering to that of creative writing (especially in science fiction) are far stronger than anyone in either world seems to realize- and for me, understanding those bonds is part of why I continue to write. Being given the opportunity to show that engineers can communicate well and can make art fit for any audience through writing is something I never realized I would have going into my first workshop, but I'm grateful for nonetheless. After all, engineering really is both a science and an art, and just as science can and should inform art, art can and should inform science- I'm just glad to be a part of blurring those lines.

Image Source

1. U.S. Chemical Safety and Hazard Investigation Board. (2009). Sugar Dust Explosion and Fire.

Acknowledgements

Thank you to the AIChE Officers for their hard work and contributing efforts to make our AIChE Student Chapter a successful organization.

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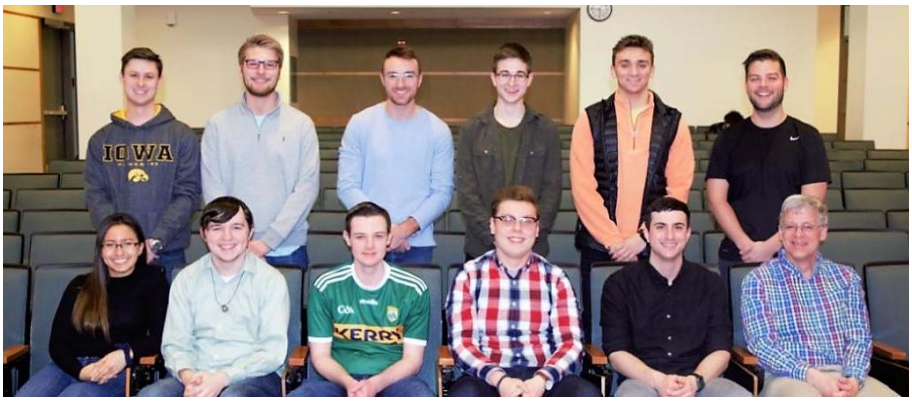

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Editor-In-Chief Nathan Jarvey would also like to thank the following people for their support and contributions to the Spring 2019 AIChE Student Chapter Newsletter:

Faculty Advisor: Professor David Murhammer

Contributors: Thomas Hodor, Michael Leyden, Anthony Kluch, Jackson Solsma, Kyle Wersinger

Your help is much appreciated!

Interested in speaking at professional seminar? If so, then contact our Fall 2019 AIChE Student Chapter Vice President Esmeralda Orozco at esmeralda-orozco@uiowa.edu or Student Chapter Advisor Prof. David Murhammer at david-murhammer@uiowa.edu for details and availability!

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