

CHAIR'S MESSAGE



Hello alumni and friends of UND ChE! We are excited to share with you another edition of *Kinetics* and hope you enjoy reading about everything that has happened with the department this past year.

Other than a global pandemic affecting how we did almost everything [see pg 5] this was a fairly normal year. While there is plenty of sarcasm in that statement, I believe it is also essentially true. Yes, we changed and adjusted how we did many things, but what we were doing – providing a high quality educational experience for our students – was the same as it has always been. I am so proud of our faculty and staff for all their hard work, and inspired by our students' resiliency and patience through this extra challenging year. And as we look to the coming year I'm excited that our too quiet hallways, classrooms, and offices will once again be full of students and the energy that their physical presence brings.

Throughout this year we've also had tremendous support from our alumni. I think the wide

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Join UND ChE On LinkedIn

We have a UND Chemical Engineering group on LinkedIn! This allows our alumni to connect with one another and to get the latest updates from the department. We also use this site to post job announcements for alumni and students. Join now and find out what over 460 of your fellow ChE alumni are up to!

To join, go to www.linkedin.com and search for "UND Chemical Engineering" under groups.

KINETICS

THE UNIVERSITY OF NORTH DAKOTA
CHEMICAL ENGINEERING NEWSLETTER

THE CHE RESEARCH ENGINE IS HUMMING!



Jalynn Janorschke, UND ChE Class of 2022 enrolled in Chemical Engineering so that she could contribute to a more sustainable world.

Despite COVID-19 limitations, she worked this past year with *Wayne Seames* in developing technology to produce fuels and chemicals from microalgae grown in wastewater.

As you read through this edition of *Kinetics*, you may notice that there are a number of articles highlighting significant research grants awarded to ChE faculty [pp. 3, 7-9, 11-13]. This despite the extra teaching workload imposed on the faculty due to COVID-19 and the reduction in our teaching faculty from 8.5 to 7 equivalent faculty over the past couple of years (which increases the teaching load for the remaining instructors).

This recent increase in both research productivity and in external funding is the result of many different ChE faculty members developing fundable research programs, building collaborations with others both within and outside of UND, and the willingness of ChE faculty to submit many requests for funding proposals to a wide variety of funding sources. Another characteristic of ChE research is our emphasis on student-centered research projects. We view research as an opportunity to train the next generation of engineering scholars (graduate students and post-doctoral associates) as well as a mechanism to provide undergraduate students with the chance to "give

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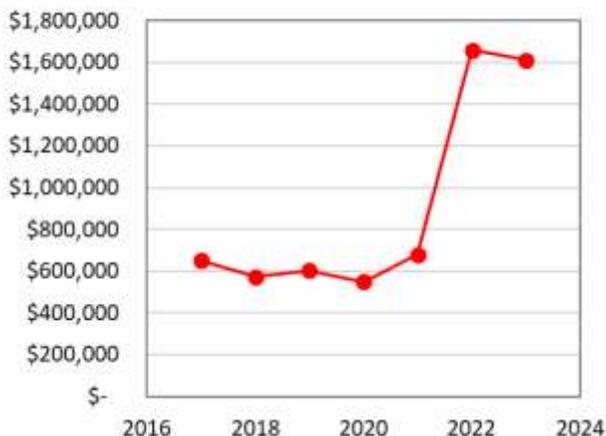
CHE RESEARCH (CONTINUED FROM PG. 1)



Max McCann and Brittany Rew, two recent MS students worked at the IES for Advisor Mike Mann

(Continued from page 1)

Annual ChE research expenditures with projections for 2022 and 2023 based on awarded grants. Our recent expenditures of over \$75k per faculty member will jump to over \$175k per faculty beginning in 2022.



research a try". Undergraduates can: 1) work on funded research projects, when available, 2) do a research project for course credit, or 3) participate in special research programs such as our Research Experience for Undergraduates (REU) site [p. 12]. A collaboration with chemistry and atmospheric sciences, this NSF-sponsored site has been continuously funded for over 15 years. As a consequence of these and other programs, many of our recent BSChE students have enrolled in graduate programs either at UND or other universities.

The department's success has not gone unnoticed by UND and College Leadership. The department received the UND-wide departmental award for excellence in research in 2020 and four faculty members (Frank Bowman, Gautham Krishnamoorthy, Michael Mann, and Wayne Seames) have received individual UND-wide research related awards for excellence.

ChE faculty are always looking for new opportunities and collaborations. If you have a potential research project you might want to pursue with one of us, please let us know.

Here are the current faculty research areas of interest:

Ali Alshami: Polymeric Membranes, Biomimetic Membranes, Gas Separation, Water Purification, Biochemical Processing, Biomaterials

Frank Bowman: Atmospheric aerosols - Organic aerosol partitioning; Mathematical modeling of multicomponent aerosols; Air quality modeling; Engineering Education - Educational technology; Assessment of student learning; K12 engineering

Yun Ji: Biochemical processes, pulp and paper technologies, wastewater treating, and wastewater solids characterization and utilization .

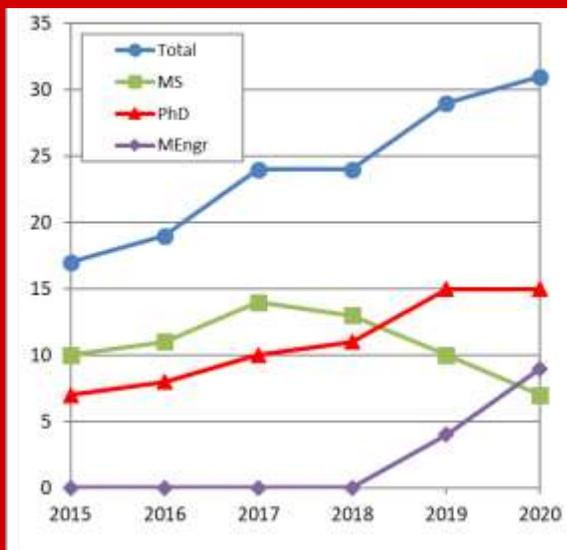
Beth Klemetsrud: Renewable Energy, Thermochemical Conversion, Life Cycle Assessment

Ed Kolodka: Polymer reaction engineering, synthesis, rheological and mechanical properties of polymers, development of polymers from agricultural products, synthesis and characterization of conducting polymers

Gautham Krishnamoorthy: Radiative heat transfer, combustion modeling, computational fluid dynamics, high performance solvers

Mike Mann: Advanced energy systems firing coal and biomass; emission control; renewable and sustainable energy systems; coupling of thermodynamics with political, social, and economic factors

Wayne Seames: Sustainable energy technologies including the invention and development of fuels and chemicals from crop oils and biomass; The environmental impact and remediation technologies of both organic and inorganic chemicals; Project management, design engineering, technical & commercial feasibility analyses. «



ChE Graduate Student Enrollment. Our steady increase in PhD students will resume in 2022 as VISAs for International students begin to be awarded and borders open again. Our target is 2-4 MS/PhD students per faculty member. A range met every year since 2015.



ChE Faculty and Staff at the 2020 Founder's Day Banquet receiving the UND Award for Departmental Excellence in Research

FRANK BOWMAN, CHAIR AND TOM OWENS ASSOCIATE PROFESSOR

(continued from pg. 1)



spread use of Zoom helped us recognize how easy it is to connect even **when you don't all live in Grand Forks. We've enjoyed virtual in-class** visits with alumni from across the country [p. 6], AIChE workshops, and advisory board meetings p, 13]. And it was so gratifying to sign the dozens and dozens of year end thank you cards to all who made a financial donation to the department [see pg 20]. Much of this was towards the Thomas C. Owens Endowed Chair of Chemical Engineering [see pg. 19]. There is still time to take advantage of a generous dollar for dollar match to this endowment and I encourage you to consider contributing.

This past year I continued to teach ChE 201, Chemical Engineering Fundamentals, with the on campus students coming to the classroom once a week and joining over zoom on the other days. I was fortunate to have spent some time **pre-pandemic preparing a full set of online course materials, which made the transition to this year's new mix of in-** person and online teaching much less stressful. After being cancelled for a year, we were able to start up our summer REU program once again and ran the program virtually with 6 students located across the country from New York to California. And together with **Beth Klemetsrud**, the College of Education, and teaching specialists at the **Northeast Education Services Cooperative**, **I'm excited to be leading a new NSF grant to help elementary and middle school** teachers design and implement culturally relevant engineering design tasks in their classrooms [see below].

At home some of the biggest news was the wedding of my daughter Ryon over the summer. It was strange to be **travelling after staying pretty much in town for a year, but it's fun experiencing the other side of being an in-law.** The rest of the family has also been accomplishing great things. Allie is a ChE major at Clarkson and led their ChemECar team to a 3rd place finish at the national AIChE competition. Maia graduated from EGF Senior High and is starting at the University of Minnesota-Twin Cities this fall. Erin is in band, track, and tennis at the high school. Eli is honing his video game skills after we broke down and finally got a game console for the first time in 20+ years of parenting (mainly to prevent me from spending all my time playing games). And Alisa was extra busy as a school social worker dealing with pandemic impacts on kids and families and is looking forward to working at a new school this year.

Best wishes on a healthy, happy, and hopefully more "normal" year to all of you! We always love to hear how you are doing, so please keep in touch and feel free to stop by anytime you are in the area.◀

\$450,000 NSF GRANT TO HELP SCHOOL TEACHERS TEACH ENGINEERING

(extracted from the original UND today article by Jan Orvik, 2/4/21)

Frank Bowman will lead a team of UND researchers in partnership with the Northeast Education Services Cooperative to conduct a three-year, \$450,000 project funded by the National Science Foundation, to help ND elementary and middle school teachers design and implement engineering tasks in the classroom that are culturally relevant for American Indian and rural students.

Project ExCEED (Exploring Culturally relevant Engineering Education Design) will include teachers from the Devils Lake, Mount Pleasant-Rolla and Rolette school districts. They took part in hands-on summer workshops to get experience and understanding of the engineering design process, culturally relevant instruction methods, and learn to incorporate both into their classrooms, whether they are teaching science and math or English and history. Workshops were held in the summer of 2021.

"Engineering design is problem-solving, and an essential part of that is considering the culture and needs of the people involved," said Bowman. **"This project will prepare teachers to**

share the excitement of engineering problem-solving through design tasks that are directly relevant to the students in their classrooms. We are thrilled to be working with our community and school partners to better support Native American and rural students here in North Dakota."

During the school year, and with guidance from the project team, teachers will develop lesson plans for engineering design tasks tailored to their classrooms, curriculum requirements and community culture. Cultural relevancy is a key focus of the project. The classroom engineering tasks, especially those developed to be specifically relevant to Native American and rural student populations, will be promoted and made available to other teachers across the state and nation.

The goal is for teachers to create engineering design tasks and use teaching practices that are relevant to and support students across a breadth of cultural communities and groups, with a special focus on Native American tribes. Throughout the project, the research team will study the effectiveness of the profession-

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CONGRATULATIONS TO THE 2021 FOUNDERS DAY AWARD RECIPIENTS

GAUTHAM KRISHNAMOORTHY
UND Foundation/McDermott Faculty
Award for Excellence in Research
& Creative Activity

FRANK BOWMAN
UND Foundation Award for
Excellence in Teaching, Research
or Creative Activity, and Service



STACY BJORGAARD & FRANK BOWMAN: UND Award for Excellence in
Online Course Development and Innovative Teaching Strategies

The 2021 Founders Day ceremony took place virtually on Thursday, Feb. 25., marking the 138th anniversary of the signing of the Dakota Territory legislation which established UND in 1883, six years before statehood. It is the official birthday of UND. Founders Day, which has been celebrated since 1904, honors members of the campus community including department, faculty, and staff award winners. This year two CHE faculty and one CHE alumnus were honored with four total awards.

[Frank Bowman](#) received the UND Foundation Faculty Scholar Award, recognizing his combined excellence in all three aspects of the faculty position: teaching, research and service.

In his nomination letter, [Mike Mann](#) stated, “Frank is a caring and selfless individual who has a reputation of delivering quality education, has a consistent record of research, and is always willing to serve when asked. Frank is well known around the college for the strength of his teaching. He demonstrates his passion for teaching through the time and effort he puts into his classes and the quality he delivers.

On the research side, Frank is best known as a collaborator. While he has developed his own research interests, his best contributions are those larger efforts that build the overall research capacity and reputation of UND. For example, Frank has been an integral part of a team including Atmospheric Sciences and Chemistry studying aerosols and their impact on the environment.

Frank is also willing to serve as needed. He served as an associate chair for many years before taking on the

role as chair of the department. In both roles, he goes beyond the typical chair duties by taking on other responsibilities to help promote a stable/growing enrollment in the department, including the promotion and growth of our online program. He is known for being fair and level-headed, so is often called upon by the college to serve on committees that help set policy and make other college wide decisions. He contributes on the professional level, mainly through active involvement in the national AIChE chapter and as Advisor of **the UND student chapter.**”

Frank is the third active CHE faculty member to be named UND’s “**Professor of the Year**”. [Michael Mann](#) received the award last year (2020) while [Wayne Seames](#) received the award in 2013.

Frank along with UND ChE alumnus [Stacy Bjorgaard, BS ‘10, PhD ‘15](#), who is an instructor for general engineering courses for CEM, were two of eight UND faculty receiving the inaugural UND Award for Excellence in Online Course Development and Innovative Teaching Strategies. Stacy and Frank were honored for their high quality, innovative designs for on-line delivery of engineering courses.

[Gautham Krishnamoorthy](#) received the UND Foundation/McDermott Faculty Award for Individual Excellence in Research. Gautham is a shining example of a faculty member that, despite a heavy teaching load (where he also excels), is successful in all facets of the research process. He aggressively seeks external funding, has a high award percentage and looks for collabo-

(Continued on page 5)

DEALING WITH COVID-19, YEAR 2



We used lots of different configurations during COVID to address limitations on physical contact during teaching. As Ed Kolodka said, “I had 25 students enrolled in the local section of ChE 321, but the classroom had a capacity of 8 people. Since I consider myself a people person, this meant I could fit less than a third of the class into the room at a time. In addition, the instructor was required to stay behind a plexiglass ‘sneeze shield’.

Since I use a lot of interactive problems, this was very problematic. Instead of attempting to teach under these conditions, I made the decision to hold all of my classes virtually.” Here’s a snapshot of some of our approaches:

Ed Kolodka: ChE 102, ChE 321, ChE 411, ChE 416 I made brief, prerecorded lectures which the students were required to watch before each class session which were held over Zoom during the normal class times. I used these lectures to emphasize important points and answer any questions from the recordings. The students also worked on additional individual and group example problems as well as homework assignments and projects. As an added benefit, a number of distance students were able to participate in the classes in real time for the first time! This approach was more successful in Junior and Senior level classes but only partially successful in lower level classes (freshmen tend to be a bit too shy to actively participate in Zoom meetings).

Yun Ji: (1) ChE 435/535 on campus with social distance; (2) ChE 332 on campus; (3) ChE 562 seminars delivered via zoom

Beth Klemetsrud: CHE 103 – on campus students in the classroom every third day, with the others joining over zoom. ChE 206 – Oncampus students signed up to attend class and the other students joined over zoom, along with distance students. ChE 331 – Students had an accelerated lab schedule to make sure all labs could be completed oncampus. In case the University decided to go to full remote learning, at home lab kits were ready to put together for students. ENGR 340 – Course was completely online to better facilitate case study discussions.

Frank Bowman: CHE 201 – on campus students in the classroom every third day, with the others joining over zoom, along with a distance student or two.

Ali Alshami: CHE 305, 315, and 505 were taught with a blended teaching mode. I complemented the recorded lectures, made mainly for DEDP students and available for on-campus students, with regular live video class meetings. We also continued with all the assessment tools used in traditional instructional methods, albeit virtually. Tests, quizzes, and other assessments were conducted live via video conferencing. Given the success realized and the relatively high satisfaction reported by the students, I anticipate the blended approach will emerge as the most accepted method in higher education.

Wayne Seames: CHE 408 & CHE412/413/414 were all taught virtually using Zoom with each session recorded for DEDP students. All students also had access to 2019 recordings of in-class sessions. In 408, students were randomly placed into breakout rooms to work on example problems. On-campus students took exams in person in the evening using three classrooms to insure social distancing. In PD2, all review meetings were handled over Zoom.

NSF TEACHING GRANT

(continued from page 3)

al development program. As the initial cohort of teachers become more comfortable with the skills they are learning, they will take on a mentorship role, guiding the next years group of teachers through the program.

A key goal of the project is to foster a collaborative network of teachers within and across school districts that can continue to support one another.

UND researchers taking part in the project include [Frank Bowman](#); Julie Robinson, assistant professor of teaching & leadership, and [Bethany Klemetsrud](#), assistant professor of chemical engineering. The project team also includes Erin Lacina, director of professional learning and operations at the Northeast Education Services Co-operative, one of seven regional education associations in North Dakota. «

Founder’s Day Award

(continued from page 4)

rations with others both at UND and around the world. He is an excellent mentor who involves both graduate and undergraduate students in his research, despite the complexity of his areas of research.

In addition, Gautham publishes his work in high quality refereed journals and he and his students present their results at quality technical conferences. Gautham always has time for others, both students and faculty and he is willing to stretch from his core research into other areas in order to collaborate and help others with their areas of research.

Gautham is the third active faculty member to receive a UND award for individual excellence in research. [Michael Mann](#) and [Wayne Seames](#) received the award in 2006 and 2007, respectively. «

Kinetics was produced by Wayne Seames with contributions from the faculty and staff of the UND Department of Chemical Engineering. Additional contributions were provided by UND’s Division of Marketing & Communications

WAYNE SEAMES

CHESTER FRITZ DISTINGUISHED PROFESSOR

Hello! What an unusual year we had, and yet the department's end objectives were still achieved: providing an exceptional undergraduate program, training the next generation of CHE scholars while conducting impactful research, and providing service to others.

Last fall for the first time since 2001 I did not teach CHE 411, Plant Design I. To prepare for the transition I wrote 11 draft chapters of a new design and economics textbook, which served as the primary resource for Dr. Kolodka's class. Based on student performance in CHE 412, which I still taught this year, this resource was a success. I will be using feedback from students taking CHE411 last year and this year to improve the material. I also wrote three of the four chapters needed for the PDII courses, CHE412/413/414.



I was also invited by my Publisher to prepare a second edition of "Designing Controls for the Process Industries" and will be working on this over the next two years. For those of you who have learned from or even just read the book, if you have any suggestions on new content or other improvements, please let me know. As all of this suggests, I will be spending a lot of time writing over the next few years!

I am also the PI on a major research project awarded by the DOE this past year [p. 7]. Through this grant I was able to hire a post-doctoral associate and a lab technician. My doctoral student Ian Foerster graduated last May and accepted the post-doc position starting after his graduation. The department hired a second lab technician David Wetzel [see p. 12] to take over the duties performed by David Hirschmann. David H. is now working full-time on research support. **We've needed a second lab technician for a while due to CHE faculty research activities, so I was thrilled we were able to fund this addition.** In addition to the DOE grant, my research group continues to invent and develop technologies to convert lignocellulosic biomass and algae-derived carbohydrates into value platform chemicals for use in fuels, polymers, and other products.

Once vaccinated, my wife Janet and I ventured out again, with a week-long trip through Northwestern Wisconsin and a two-week trip to Tucson, Az. On the 2nd trip, we took along eight additional family members and all shared a single house (thank you AirBnB!)! With four small grandsons, it made for a noisy, energetic trip! A highlight of the Tucson trip was a delayed celebration of my mother-in-law's 90th birthday (which occurred in May 2020).

Best wishes to you for the upcoming year. If you get back to Grand Forks, please do stop by, all of us love seeing our former students! In the meantime, please stay in touch via email or on our CHE group page on LinkedIn!«

ALUMNI SHARE THEIR EXPERIENCES AND ADVICE VIRTUALLY WITH THE SENIOR CLASS

Due to the pandemic, we were unable to invite alumni into our classes this year to share their experiences with the students. So we recruited three of our alumni who agreed to talk with our senior students via the Zoom video-conference system we used in the course: **Katie (Dearth) Buhler, Site EHS Lead, Pfizer in Brandon, Manitoba, BSCHE '14; Brandon Hastings, Superintendent, Pulp Bleach Division, Sappi North America, BSCHE '06; and Kory Kotrba, Partner, Brooks, Cameron & Huebsch, PPLC, Minneapolis, BSCHE '06.**

Katie's talk focused on an ethical dilemma she had faced during her career and replaced an in-person case study group discussion we previously used in the course. We will be using her videotaped talk in future years. Brandon provided advice about conflicts he has encountered during his career as an engineer and supervisor and the steps he took to resolve them. Kory, who is now a lawyer, talked about negotiations in the workplace.

In her email, Katie stated, "I was a student in your 2013-14 Plant Design class. I was reminded of the many valuable take-aways of the course – from the personal finance classes to the "joy is in the journey" reminders – and wanted to provide the feedback that, thus-far, the non-technical aspects of this course have been just as beneficial to my career (and financial security) as the technical aspects. As I revisit my long-term career and education goals, I continue to appreciate the quality education I received at UND in the Department of Chemical Engineering [thanks Katie!]. «



Katie Dearth Buhler, BSCHE '14 (left) and Brandon Hastings, BSCHE '06 talking to the Seniors via Zoom

Modern alchemy: UND aims to turn corn stalks, stems & leaves into jet fuel - CHE's Wayne Seames leads four-year, \$4.69 million Department of Energy research project

(extracted from original by Patrick C. Miller, 10/8/20 UND today)

One of the significant challenges for renewable alternative fuels could be solved if a consortium of research laboratories led by the University of North Dakota can turn corn waste into jet fuel.

Wayne Seames will head the four-year, \$4.69 million project with \$3.75 million in funding by the DOE's Office of Energy Efficiency and Renewable Energy Bioenergy Technologies Office (BETO) and co-funding from the North Dakota Corn Council. Key UND participants include Alena Kubatova, Chemistry and Bethany Klemetsrud, ChE. Post-doc Ian Foerster (photo), laboratory technician Dave Hirschmann, and graduate and undergraduate students from UND's chemical engineering and chemistry programs will work on the project. This team of scientists and engineers will develop a process to convert the lignin contained in corn stover – the stalks, stems and leaves left over after corn is harvested – into jet fuel. Lignin is a polymer that, along with cellulose, forms the structural support of plants.



PI Wayne Seames and Post-Doc Ian Foerster, PhD '21 stand with a similar system they completed in 2020 for a commercial client. Photo by Sidney Mook, GF Herald

Why corn stover?

“About 70 percent of corn stover goes back on to the field to renew the soil,” Seames explained. “That leaves about 30 percent available to use as a biomass raw material. You can imagine that with all the corn we grow in the U.S., that’s millions of tons of product. Making jet fuel from plant material is especially challenging, both for safety reasons and for providing enough energy density to enable a jet aircraft to fly the same distance as an airplane using conventional fuel. Jets fuels are extremely difficult to formulate,” Seames said. “You need a very high energy density, a very low freezing point and a very low volatility.”

The goal of the project is to extract cyclohexane compounds from the lignin for use as a jet fuel feedstock. First, corn stover will be bought from farmers by DOE's Idaho National Laboratory, where it will be dried, chopped and powdered. It will then be shipped to DOE's National Renewable Energy Laboratory (NREL) in Golden, Colo., to undergo a process that removes the sugars from the lignin to form a base reactive solution – similar to pickling liquor. This solution will be shipped to UND for further processing and testing. The catalytic reaction to transform the lignin into cyclohexanes and other compounds is based on a unique bi-functional catalyst developed at Washington State University (WSU) in Pullman, Wash., by a research team led by Bin Yang, associate professor in biological systems engineering.

The reactive lignin solution will be routed through the catalytic reactor with hydrogen at high pressure and high temperature to break the lignin apart and reform it into a solution that is primarily cyclohexanes. These are essentially a non-aromatic version of benzene compounds. The advantage of using cyclohexanes is that they provide the same desirable properties of aromatics for jet fuel, but they aren't as corrosive or as toxic. Once the solution has been optimized, UND researchers will produce a prototype jet fuel that will be sent to the University of Dayton in Ohio for fuel specification testing.

“They'll be running a series of tests at Dayton to compare our samples to current industry specs,” Seames noted.

Techno-economic and sustainability analyses will also be conducted using the project's experimental results. UND's participation and leadership in the project is the result of ND SUNRISE's reputation for the development and commercialization of renewable fuel technologies.

“We were approached by researchers at NREL and WSU who were looking for a partner with the experience and capability to take WSU's lab-scale batch reaction and develop it into a larger scale continuous system,” Seames said. “We are looking forward to helping develop this technology towards commercialization with these great university and laboratory partners.”«

UND INSTITUTE FOR ENERGY STUDIES HELPS REGION'S SMALL BUSINESSES WITH R&D

(Extracted from a 11/17/20 UND Today article by Patrick C. Miller)

Whether it's exploring the potential of an innovative idea or getting assistance in solving a difficult technical problem, Professor **Michael Mann's** team of researchers at UND's Institute for Energy Studies (IES) is providing valuable expertise to small businesses.

"I look at us as the research arm for small companies," Mann said. "If you can't afford to have a research and development section, you can work with UND. In essence, the University becomes your R&D component."

Mann lists a dozen businesses inside and outside North Dakota engaged in one or more projects with IES. Some projects are funded by various state programs. Others get their money through federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, most of which address problems relevant to North Dakota.

Steve Kemp, president of Wellspring Hydro in Williston, N.D., first came to UND in 2016 with an idea of how to extract lithium – a valuable element used in rechargeable lithium ion batteries – from "produced water," the salt-laden water produced from deep underground during oil and gas extraction in North Dakota's Bakken shale formation.

"UND worked for us as a business with an idea, but with no research capability and no huge budget," he said. "We didn't have millions of dollars to throw at this problem."

An idea takes shape

The idea became a senior research project for a group of UND engineering students, who determined that mining lithium from produced water wasn't economically feasible. However, the study revealed other byproducts that could be mined, such as the salt. When run through the company's Chlor Alkali process, it can make hydrochloric acid – used by the oil and gas industry and caustic soda – used in a wide variety of industrial applications, including paper and pulp mills, as well as oil refineries. With grants Wellspring Hydro received from the North Dakota Industrial Commission and the city of Williston, Minneapolis-based Barr Engineering conducted a study showing the feasibility of extracting the chemicals for industrial use. And because the economics have improved, Wellspring Hydro continues to work with Mann's research team on the best method and technology to extract lithium from oil and gas wastewater, Kemp said.



Wellspring Hydro's
Steve Kemp

"If we could mine all the lithium from all 1.8 million barrels per day of produced water in the Bakken, we could provide 32% of the world's annual lithium consumption," he said. "The technology for extracting lithium is still a bit on the new side, and that's why we really want UND's help to determine the best path forward. It's a huge win for the state and for the industry," Kemp said.

Jobs, economic development

"Once we prove this concept, we can take it on to the next level," Kemp noted. "This business will produce over \$50 million in annual revenue, provide 60 full-time jobs and a significant amount of revenue for the state. Williams County would receive about an additional \$1.4 million in taxes annually. This idea would have been born and died in 2016 without the help of UND," he offered. "I can say with absolute confidence that we would not have gotten where we are in developing this business without the help of UND."

Making energy more efficiently

Jim Rickson, president and CEO of ELF Technology, is another technology developer who's benefited from working with IES, UND's Center for Innovation and the ND Department of Commerce.

"It's a beautiful thing when you can marry the expertise of these organizations, and the whole becomes greater than the sum of the parts,"



IES Director
Michael Mann



Jim Rickson, ELF Technology CEO, works in an IES lab on a prototype unit of the company's technology in that will be tested in the wind turbines of North Dakota's wind energy farms. Photo by Patrick C. Miller/UND Today.

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MICHAEL MANN

CHESTER FRITZ DISTINGUISHED PROFESSOR
 CEM ASSOCIATE DEAN FOR RESEARCH
 EXECUTIVE DIRECTOR, THE INSTITUTE FOR ENERGY STUDIES

Greetings everyone. It's always a pleasure to reconnect with all of you through our annual newsletter.

It has been an interesting year. While the pandemic has isolated all of us via the various restrictions that were put in place, I actually found that I have met more people face-to-face, although virtually, this past year than I ever have. Now rather than picking up the phone, we hop onto Zoom or Teams. Hopefully we will continue that trend as a new normal as it has been nice to see faces rather than only hear voices. **It's a great way to stay in touch.**

Here at UND my duties continue to drift more and more to supporting activities at the college level, and less for the ChE department. This past year my main roles included serving as Director for the Institute for Energy Studies, CEM Associate Dean for Research, and Graduate Director for the Energy Engineering and Environmental Engineering graduate programs. During the upcoming year, Dean Tande would like me to focus more on growing the research enterprise for the college. This is important not only for the obvious reasons of generating more research opportunities for students, improving our research infrastructure, and continuing to build our reputation, but also because research has a significant impact on the revenues for the college. A portion of the dollars appropriated to UND by the state are allocated to the college based upon their research expenditures. **Therefore, as the college's research portfolio grows, so will our appropriated budget. If we can make a substantial increase in our research funding, this should help relieve some of the budgetary pressures we have been feeling over the past several years.** As the lead article in this edition of *Kinetics* shows [p.1], ChE is already leading the way. To allow me to refocus my time and attention, we are looking to hire a new Director for the IES and have reassigned my graduate directorship duties for the two graduate programs. Hopefully with the extra time I will have I can help make a difference.

The biggest change in my life has been a new grandson. Dawson joined the family this summer. Hopefully Sawyer adjusts well after having been the only child and grandchild. I think grandpa Mike can still spoil them both equally. The only downside is that they live in Minot: Justin took a job with Hess after graduating last year from ChE. After a year hiatus from shooting sporting clays due to **the pandemic, I am back at that this year. It took a while to get back into the swing of things. But it's like riding a bike,** they say you never forget, but the first time back on it is still a little wobbly! I am still helping my daughter with their house remodeling. The main floor is pretty much done, so the focus is now on the exterior. We still have the basement to do, so I think my winter plans are already made. Terrie still spends a lot of time on her gardens and recruits me for the heavy lifting, digging, and other fun stuff.

I wish everyone the best. Please stay in touch, and feel free to video call – that way we can see the kids, maybe the cat, hear the dog..., which is great for a personal update.«



IES RECEIVES ANOTHER \$2.14 MILLION TO CONTINUE DEVELOPING RARE EARTH ELEMENTS TECHNOLOGIES

UND's Institute for Energy Studies (IES) received funds from the U.S. Department of Energy for a two phase project to engineer the extraction of rare earth elements (REEs) from lignite coal. The \$150,000 provided for phase 1 covers a feasibility study while the \$2.14 million in phase 2 will be used for engineering-scale studies of a commercial REE and critical mineral extraction plant.

Adapted from the original by Sydney Mock, GF Herald, 10/20/20

Rare earth elements include scandium, yttrium and the lanthanide series. Critical for national security, they are used in defense alloys, cell phones and more. Currently, the US imports 100% of the REEs used domestically, mostly from China. This grant will be used to generate conceptual designs to extract critical minerals and rare earth elements from coal, as well as coal by-product sources, to support the nation's energy and electronics industries.

"This grant from DOE will support UND's efforts to extract critical minerals from ND's abundant coal reserves, which will lessen our reliance on imports of REEs and enhance our economic and national security," said Senator John Hoeven, R-N.D., in a press release.

UND will partner with DOE's National Energy Technology Laboratory to advance this project.

"This is an important step towards eventually building REE extraction plants in North Dakota," said Michael Mann, executive director of the IES. **"This will involve detailed economics, discussion with equipment vendors on ideal equipment and price, and development of preliminary mining plans to recover the REE-rich coal.** The study should also identify the next areas

(Continued on page 10)

(Continued from page 9)

of research/improvement required to make a commercial plant a reality.”

Previous research has shown that REEs and critical minerals are bound in lignite -- **ND’s predominant coal** -- uniquely in a way that makes recovery of the high-value materials easier than those found in minerals, according to Mann, adding that this allowed researchers to develop a slightly different process to recover these in a more environmentally friendly and less expensive way.

The new grant is focused on developing information needed to attract investors to build the first plant.

“We’re aiming our combined research on reducing U.S. demand for imported REEs and other critical minerals by developing a domestic source, and accomplishing this in a relatively quick way (since coal mines are already open, and **may be faster to permit**),” said Nolan Theaker, UND ChE PhD student and lead researcher on the project.

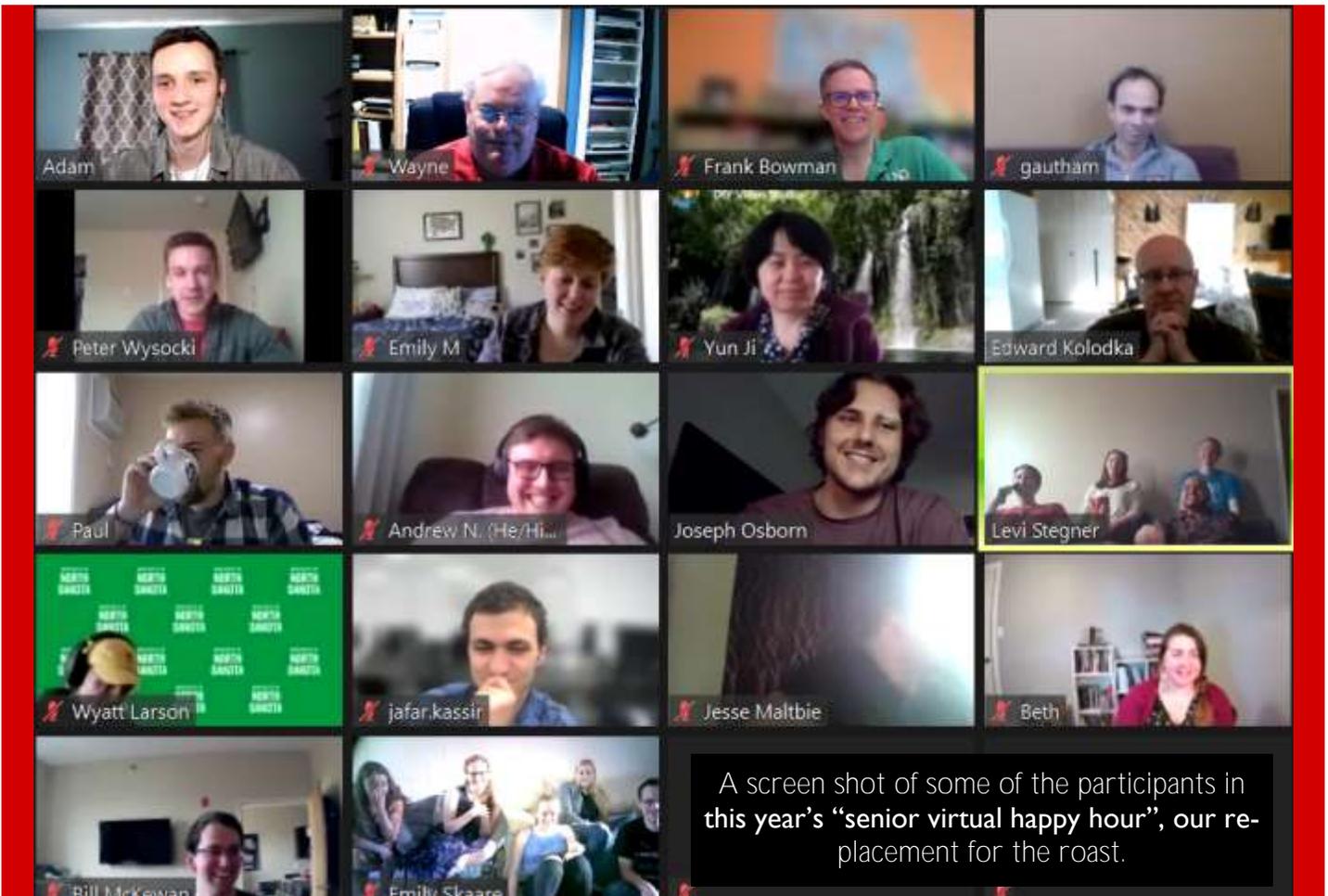
Mann and Theaker said new work will be critical in answering questions relating to final commercial deployment, including whether ND has a viable source of REEs within the **state’s lignite coal supplies and whether the state is capable** of building plants to augment coal revenue within the next few years.



IES Project Staff, Nolan Theaker (PhD ChE student), Brittany Rew (MS ChE'21), Michael Mann (Director), and Joshua Oluwayomi , BSPetE'20

“We think the answer to these questions is yes, and this study will help us build investor confidence so that they can come to the same conclusion,” Mann and Theaker said.

Last year, UND was awarded a \$6.5 million grant from the U.S. Department of Energy and other project sponsors for similar work. That grant was used to build a pilot plant that will extract REEs from ND lignite coal. The university has also received other awards in the past for REE-related research.«



A screen shot of some of the participants in this year’s “senior virtual happy hour”, our replacement for the roast.

IES - R&D for Small Energy Sector Businesses

(continued from page 9)

he said. **“I’ve never seen anything like this before. I’m excited because the quality and caliber of the people in North Dakota is something unique in this country. My experience has been extraordinary.”**

Last fall, ELF Technology, based in Stillwater, Minn., brought its electrostatic lubricant filter (ELF) system to UND for field testing. The ELF system acts as a magnet, positively charging contaminated particles in oil and causing them to stick to metal plates. The oil is thus continuously cleaned and recycled, significantly reducing maintenance needs and downtime costs, both in power plants with large turbines to generate electricity and in much smaller wind turbines. Large-scale versions of the ELF system have been demonstrated at two coal-fired power plants in western ND: the Coyote Station near Beulah and the Leland Olds Station near Stanton.

UND’s IES research team has designed and built a down-scaled version of the system for trials with Xcel Energy and Nexterra in North Dakota’s wind farms.

“The miniature units will go in the nacelle of the wind turbines,” Rickson said. “They’ve got the technology inside of them to read the particle count – the contamination of the oil – and upload that information to the cloud, where it can be downloaded from anywhere on earth. That way, the turbine operator can see the condition of the oil without sending someone up to sample it or look at it.”

If the technology proves viable, it would be similar to having a car in which the oil **rarely has to be changed because it’s being continuously cleaned.** Rickson credits Mann and his research team with helping him tailor the ELF Technology system to meet the needs of industry.

How to succeed with business

“Part of the reason we’re successful with some of these businesses is

instead of doing esoteric or academic research, we can show them an end – a process for solving a big problem **particular to their application,” Mann explained. “That’s why the first thing we do is listen very hard to what their problem is and what the concern is. We can propose a research approach that maybe they haven’t thought about.**

“They don’t look at us as being academic researchers,” he continued. “They look at us as being problem solvers. It’s all about how you frame the question, how you frame the work. We focus on the problem at hand, using an engineering approach.”

“When the prioritization of commercialization is combined with legislative support, it creates fertile ground for these projects to bloom,” said Cortnee Jensen, manager of intellectual property commercialization development at the ND Department of Commerce. “As a state, our priority has been on business growth and business maturity. For businesses to grow and mature, they must have access to new technologies and new products they can bring to the market. And that’s done most easily with experienced researchers.

“It’s not just about new start-up businesses – which are critical – but also about creating new opportunities for existing businesses,” she added. “It’s expanding, it’s diversifying and creating new markets. Entrepreneurship as a focus is good for all of us, for our businesses, for our state and for our universities.”»



Nicholas Dyrstad-Cincotta, an IES engineer, shows the difference between an ELF Technology system designed for a power plant (left) and a down-scaled unit designed to operate inside the nacelle of a wind turbine.

Photo by Patrick C. Miller/UND Today.

A Message From Dean Brian Tande

Hello ChE Alumni and Friends,

Greetings from Grand Forks! As you can see in this year’s edition of *Kinetics*, the ChE Department continues to do great work and set the bar for the rest of the college. Despite the pandemic, our students, faculty, and staff have been busy working on interesting and impactful projects and winning awards and grants. I continue to be impressed by how this department has adapted this past year to serve our students safely. We are all looking forward to having our students back on campus this fall.

Thanks to all of you for your support of ChE. Your contributions have a significant impact on our students and are greatly appreciated. My door is always open, so if you get back in Grand Forks please stop by. I also plan to get back on the road to hold a few alumni events and visit many of you across the country this year. I hope to see you soon.

-Brian



GAUTHAM KRISHNAMOORTHY

ANN AND NORM HOFFMAN ASSOCIATE PROFESSOR OF NATIONAL DEFENSE/ENERGETICS

“Awestruck” and “mind blowing” are the words that come to my mind as I recall the remarkable resilience and adaptations demonstrated by our students during the past year! In spite of their worlds being turned upside down, they ploughed through the homework assignments and exams without a complaining word and with an unwavering commitment and **passion for learning**. Many of them even “smiled with their eyes” every time they passed us by in the corridors! As we slowly come out of the pandemic, it is indeed reassuring that our sometimes chaotic world will be safe in the hands of these young problem solvers.

Last year, I taught: CHE301 Transport Phenomena, CHE 530 Combustion Theory and Modeling, CHE509 Advanced Chemical Engineering Thermodynamics and CHE 531 Rocket Propulsion. Something remarkable and serendipitous occurred during the course of the year! Frustrated with the numerous constraints imposed regarding paper-based exams during the past year, I decided to have only take-home or project style “exams” in all of my courses. First, I didn’t want the students to endure the stresses of a time-bound exam in an already stressful year. Second, I felt open-ended problems/projects that need to be solved over a few days are more reflective of the problems that our students are going to encounter in their professional careers anyways! Student feedback to this change was extremely positive! In spite of the fact that the projects demanded more time investment from the students, they seemed to appreciate the opportunity to learn and develop more familiarity with computational tools, and perform more detailed analysis on real-world, open-ended problems instead of tackling these in a time-bound exam! It was truly fulfilling to read through their project reports and exam solutions especially when they really seemed to “get it”! Never before have I had so much fun grading!

Research wise, I am actively involved in two research grants with a few more proposals awaiting a decision. I am truly excited to share some recent accomplishments of my graduate students: Ryder Shallbetter graduated with an MS last fall and will continue his work as a Research Engineer at the Institute for Energy Studies. Monika Kuznia graduated with an MS this Summer and will continue her work with 3M.

On the family front, the kids were able to adapt fairly well to masks and schooling! The photo is from our trip to Southern Missouri last Fall.◀



KRISHNAMOORTHY AWARDED UNIVERSITY COAL RESEARCH GRANT BY DOE'S OFFICE OF FOSSIL ENERGY

CHE's Gautham Krishnamoorthy in partnership with Envergen LLC and the Institute of Energy Studies (IES) was awarded \$398,969 for a three-year grant entitled, “Electro-magnetic Energy-Assisted Thermal Conversion of Fossil-Based Hydrocarbons to Low-Cost Hydrogen” under DOE's University Coal Research program.

Krishnamoorthy, will use fluid dynamic simulations to make targeted improvements to a conventional thermo-catalytic hydrocarbon conversion process using an electromagnetic energy-assisted mechanism, resulting in the reduction of downtime associated with catalyst reactivation or replacement due to poisoning.

The project proposes a dual research approach that will use experimental data generated by researchers in IES and Envergen LLC and computational simulations by Krishnamoorthy's group to understand the fundamental interactions between fossil fuels and their interactions with an electromagnetic energy source.

UND is one of 11 universities to receive funding under this program which sponsors cross-cutting research projects. These awards are administered through the University Coal Research program through DOE's Office of Fossil Energy. ◀

MEET DAVID WETZEL CHE LAB TECHNICIAN

Included in our major DOE grant [pg. 7] was funding for a second CHE laboratory technician. It was our good fortune to hire David Wetzel to fill this new position. Dave Hirschmann was getting stretched pretty thin due to all of the department's recent research activity [see pg. 1 lead article] and our continued increase in enrollment, so this addition will help with the workload.

“Dave W” (or “new Dave”) comes to us from the USDA Human Nutrition Laboratory where he worked as a maintenance mechanic for 15 years. He has an Associates Degree in Computer & Network Technology from Northland Technical College. “Dave H” (“old Dave”) will transition to full-time research support while “Dave W” mostly focuses on student laboratory course support.



Welcome to the CHE Team, Dave!

EDWARD KOLODKA

ASSOCIATE PROFESSOR
ASSOCIATE CHAIR

Hello everybody. It's been an exciting year. A year which none of us will miss! My whole family managed to catch the Coronavirus in October. Fortunately, none of us were super sick. The kids each had minor sniffles and a sore throat and recovered in a couple of days. My wife and I, on the other hand, were quite miserable for about 3 weeks.

Apart from the pandemic, the most exciting news is that I took over ChE 411 Plant Design 1 from Wayne Seames during the Fall 2020 semester. Starting a new, intense class in the midst of a pandemic, while fighting through Covid, made for a very challenging semester! This fall I am once again teaching ChE411 plus ChE 102 Introduction to Chemical Engineering and ChE 562 Graduate Seminar. During the Spring 2021 semester I taught ChE 321 Reactor Design, ChE 416 Product Design, and ChE 232 Lab 1. I also taught ChE 235 DEDP Lab I this summer.



I continue to pursue research focused around polymer engineering. My current projects are developing strategies to accelerate the degradation of commodity polymers such as polyethylene, polypropylene, and polystyrene without adversely impacting their properties or shelf lives and on developing polymeric membranes with novel properties.

Life in the age of social distancing was a challenge for my family. Or rather for parts of my family. I'm a typical introverted engineer and we were born for social distancing! My son has (unfortunately for him!) inherited my disposition and has barely missed a beat transitioning to all online instruction and life spent almost entirely at home. However for my wife and daughter it was an entirely different experience. They both had nearly terminal cases of cabin fever. After receiving our vaccinations, my wife informed me that we would escape from the late ND winter for a week to Florida (this is where the family picture was taken).«

SUMMER RESEARCH EXPERIENCE FOR UNDERGRADUATES PROGRAM ADAPTS TO COVID-19 RESTRICTIONS

Six chemical engineering and chemistry students from across the country participated this summer in a 10-week Research Experience for Undergraduates (REU) program. The Interdisciplinary Renewable and Environmental Collaborative (IREC) REU is led by **ChE's Frank Bowman and funded by a National Science Foundation grant. This year the program was run virtually** - students connected with their UND faculty and graduate student research mentors daily over zoom and met all together several times a week for seminars, training, and socializing.



Because of the virtual format, most of the projects involved modeling of some sort, including CFD model development for post-combustion carbon capture, modeling of membranes separations for water desalination and membrane distillation, sustainability assessment of chemical recycling of plastic waste, optimization of power plant power recovery cycle design, and lignin degradation analysis. As a part of the program, students also received weekly training in science communication, research ethics, and preparing for graduate school.«

GENEROUS DONATIONS HELP OUR STUDENTS

Thanks to the generosity of many of our alumni and their companies, CHE is able to **enrich the learning experience for our students. A full list of this year's donors is provided on p.21.** Here are two specific examples from this past academic year:

1. Dennis (BSCHE 76) and Muriel Finken (shown in photo at right) established the Dennis & Muriel Finken Engineering Scholarship Endowment to fund scholarships **for students in ChE, donated to UND's Open Doors scholarship and to the Tom Owens Endowment.**
2. Matt Kuzel, **BSCHE'02, Facility Manager, Global Grain & Processing, CHS Inc. arranged for his company to donate a used ICP-AES analytical instrument to the department where it will be used primarily for inorganic analysis.**



THANK YOU TO ALL OUR GENEROUS AND FAITHFUL DONORS!«

ALI ALSHAMMI, ASSOCIATE PROFESSOR

Dear Friends and Alumni,

I hope you and your family had a safe and healthy year.

What a year it was! Who would have thought that the past two years would emerge as a pivotal time period in the world history? Everything seemed to have changed from a professional and social perspective. The general word is that many of these changes are here to stay.

In the course of few months, we went from needing to request approval to work from home to request for permission to work in our offices! The notion of remote teaching and learning went from being a remote and rare possibility to a firm **and very much needed option. It is as if the concept of “snow days” will no longer** be with us for much longer since learners can now be taught from a distance.

In fact, for us here at UND and more specifically the college of engineering, hybrid and/or blended teaching models are becoming the norm. Although most colleges were caught by surprise, and needed to adjust to remote teaching on the fly due the pandemic, COVID-19 seems to have only accelerated the trajectory we were already on. Our Distance Engineering Degree Program (DEDP) had positioned us nicely for this sudden change. For over 30 years, our distant engineering students have been learning and receiving the proper amount of guidance they needed to succeed. The only additional change we had to implement was getting the on-campus student cohorts onboard and adapted to learning remotely during the pandemic.

Now that we seem to be getting this pandemic behind us, we will put to work the many things the pandemic taught us. Pedagogically, we will continue to enhance and further optimize the blending of traditional and non-traditional instructional methods to deliver the best learning experience to our students. The past year I taught: 1) CHE 305, Separations and 2) CHE 315 Statistical Data Analysis & Design of Experiments in the Spring, 3) CHE 431 Laboratory IV in the Summer and Fall, and CHE 505 Biochemical Engineering in the Fall. All courses were taught via the blended teaching method. I also continued to serve as the coordinator for CHE 397, Cooperative Education program.

As for research, things continued go along pretty well. We continued our ongoing work on advancing production of biofuels via fermentation of carbon monoxide from waste effluent gases, and also to develop membranes for both gas and liquid separations. «



EXTERNAL ADVISORY COMMITTEE MEETS WITH FACULTY TO REVIEW CHE PROGRAMS

An important contributor to ChE's assessment process for continual improvement is our External Advisory Board. This diverse cohort of alumni and external stakeholders meets with the ChE department faculty every other year as part of our quality assessment process. The board provides input and guidance on our curriculum, programs, and strategic planning. We held our first entirely virtual EAB meeting in January 2020 and welcomed new board member Kory Kotrba.

During the meeting we discussed how both the department and board member companies have been making adjustments due to the pandemic, updated the board on fundraising efforts for the Tom Owens Endowment campaign, brainstormed ideas for additional fundraising strategies, and considered ways to increase internship and co-op opportunities for our students. In preparation for our upcoming ABET accreditation visit we reviewed updated wording of our program educational objectives that now emphasize **UND ChE graduates will “be trained, prepared, and ready from day one of their jobs”**

External Advisory Board members generally serve six year terms. In addition to the board meetings we also encourage board members to visit campus annually (in person or virtually) to share their experience and wisdom with our current students during a class, lunch seminar, or AIChE chapter meeting. We are always looking for volunteer members. If you are interested, please let us know.

THANK YOU TO ALL OUR PRESENT AND FORMER EAB MEMBERS FOR YOUR SERVICE! «

Current External Advisory Board Members

Jim Albrecht, BS 84, ComDel Innovations
 Adam Driscoll, BS 06, Barr Engineering
 Mark Jesh, BS 86, Medtronic
 Kory Kotrba, BS 06, Brooks, Cameron & Huebsch
 Scott Houghton, BS 12, Ford Motor Company
 Lily Herzog, BS 14, Boeing
 Brandon Pavlish, BS 06/MS 12, Cirrus Aircraft
 Julie Renner, BS 07, Case Western Reserve Univ.
 Steve Rosenau, BS 95 – American Crystal Sugar

YUN JI ASSOCIATE PROFESSOR DIRECTOR OF CHE GRADUATE STUDIES

Hello everyone! This is my 12th year at UND. This year I am teaching ChE 303 Chemical Engineering Thermodynamics and ChE 515 Design of Engineering Experiments in the fall semester and ChE 332 Lab III and ChE 435/535 Materials and Corrosion in the spring semester. During 2020, I was fortunate that my courses were small enough that I was able to teach the classes on campus with social distance.

As ChE graduate program director, I am happy to see that number of our online master's (M.S. and M. Eng.) students have steadily grown. If you would like to work towards a masters, I would be happy to talk over the program with you and help you to decide if this option is a good fit for you.

As a personal note, we finally were able to take the kids for a road trip in June after we were vaccinated. We visited Bismarck Museum, Mount Rushmore, Badlands, and the Black Hills Forest. Our kids enjoyed seeing the wild animals and the helicopter tour the most in Keystone, SD.◀



Photo from left to right: Briley, Casey, Yun

MAY 2021 BSCHE GRADUATES (ALL LOCAL)

- Brook Anderson
- Evan Bloom
- Ross Dietzsch
- Andrew Dockter
- Akash Gogate
- Therese Hilpisch
- Jafar Kas-sir
- Maddisyn Kemmer
- Alex Mailles
- William McKewan
- Zachary Meduna
- Emily Myskewitz
- Andrew Neshem
- Joseph Osborn
- Kathryn Pinch
- Graham Prochazka
- Emily Skaare
- Paul Tomsche
- Nicholas Voelker
- Joshua Wilmer
- Peter Wysocki
- Allison Zipp

A Screen Shot of Many of our Seniors from their exit interview with Dean Brian Tande



BETHANY KLEMETSRUD

ASSISTANT PROFESSOR

Hi everyone!

I now have been at UND for 4 YEARS! I watched the first freshmen students I met, graduate this year and it was bittersweet [and made me feel kinda old at the same time].

This year has been busy. I now advise three graduate students! We are working on developing plastic waste pyrolysis units. The Daves [Hirschmann and Wetzel] have been incredibly helpful getting a pilot scale unit set up. My collaborative work with Alena **Kubatova in Chemistry has also been incredibly valuable. It's** amazing what chemists and chemical engineers can learn when we work together. This past year I have submitted my NSF CAREER grant and have my fingers crossed for positive reviews.

Along with **Frank Bowman** I am part of Project EXCEED, an engineering education research grant [see p. 3]. We were awarded an NSF DRK-12 Grant focusing on Culturally Relevant Engineering Design for middle schoolers. We are doing Professional Development with middle school teachers from Devils Lake, Mount Pleasant Rolla and Rolette. My sister was a part of this first cohort and it has been so rewarding to see how my work here at UND impacts my community.

I have also gotten to work with the American Indians in Science and Engineering Society (AISES) which received an NSF INCLUDES Planning grant. We are working with tribal colleges and 4 year institutions on best practices to help Native students in STEM succeed when transferring with a STEM Degree.

I also continue to collaborate with others for Life Cycle Assessments, **I'll be conducting the LCA for a DOE EERE Grant to convert corn stover lignin into jet fuel with **Wayne Seames** [p. 7].**

This past year I taught hybrid models of ChE 206 Unit Operations, ENGR 340 Professional Integrity, and ChE 103 Computing Tools [p. 2]. Computing Tools is turning out to be a really fun class and students are getting comfortable with Aspen Plus and Excel. We were able to teach ChE 311 Lab 2 and ChE 335 Summer Lab 2 on campus this last year following CDC and University

guidelines. I am teaching ChE 311 Lab 2 this fall and next spring will be teaching ChE 206 Unit Operations and ChE 103 Computing Tools.

I am also ChE's representative on the Jodsaas Center, leadership team. Last year we worked closely with the Center for Innovation and have been doing a lot more tasks focused on entrepreneurship and business plans. This next year we are hoping to start a **Student Run Enterprise, called "Prodigy Engineering."** If your company is looking for additional help, consider reaching out to me to see if there is a good fit of your needs with the Jodsaas Center.

I'm also the faculty adviser for the UND AISES Chapter. We didn't get to travel anywhere for the conference this year, but they did a fantastic job hosting a virtual event.

In terms of my personal life, this past year with the pandemic, **I didn't really travel anywhere, but I did complete the life Olympics.** My partner, Tawanda, and I got engaged, married, purchased a house and have a big wedding ceremony planned at the end of September. We are hopefully going to be able to have a small reception with his family during winter break. They live in Harare, Zimbabwe and we are hoping to spend part of our time at Victoria Falls! With home buying and a wedding nothing too exciting happened this past summer, but we did manage to sneak away to the Cities and get some time on Lake Superior. We were excited to finally visit family and friends and fully enjoy a Midwest summer.

My wish to each of you is for an exciting year full of challenges and adventures.◀



AUGUST/DECEMBER 2020 GRADUATES

August 2020 (all DEDP unless indicated):

- | | | |
|-----------------------|-----------------------|-------------------------|
| • Abdikarim Ali | • Stanislav Gulevskiy | • Trevor Taylor (local) |
| • Abdullah Bin Mahbub | • Mark Holliday | • Anthony Welling |
| • Casey Collins | • Ackim Maduvu | • Anthony Youso |
| • Zachary Faber | • Brian Peacock | |
| • Benjamin Gallon | • Eli Peske (local) | |



CONGRATULATIONS TO ALL OF OUR
2020/2021 B.S. GRADUATES!!

December 2020 (all local; clockwise from left): Jacob Ableitner, Noah Shane, Auroura Eckberg, and Nayana Batham. Not shown: Sam Zandstra

Faculty Research Highlights

AWARDED GRANTS

- Wayne Seames and Bethany Klemetsrud in collaboration with Alena Kubatova, UND Chemistry and researchers at Washington State University, the University of Dayton and two national laboratories were awarded \$3.75 million from the Department of Energy/EERE/BETO for a project entitled “Scale-up of the primary conversion reactor to generate a lignin-derived cyclohexane jet fuel”. UND also received a 2 year \$100,000 grant from the North Dakota Corn Council for this project [see p. 7].
- Michael Mann heads a team that was awarded \$2,299,999 from the U.S. Department of Energy for a project entitled “Feasibility Study of a One Ton Per Day Rare Earth Oxide Extraction and Concentration Plant from Low Rank Coal Resources.”
- Michael Mann is co-PI on a \$667,465 grant led by Xiaodong Hou, IES funded by the U.S. Department of Energy, the North Dakota Industrial Commission and the North American Coal Corporation for a project entitled “Lignite-Derived Carbon Materials for Lithium Ion Battery Anodes.”
- Frank Bowman and Bethany Klemetsrud together with Julie Robinson from UND College of Education and Human Development, and in partnership with the Northeast Education Services Cooperative, were awarded \$450,000 from the National Science Foundation for a project titled: “Exploring changes in elementary and middle school teachers' engineering design self-efficacy and practice through ongoing, collaborative, and culturally-relevant professional development” [see p. 3].
- Xiaodong Hou and Michael Mann lead a team that was awarded \$443,088 from the U.S. Department of Energy and the North American Coal Corporation for a project entitled: “Crosslinked Microspherical Adsorbents from Lignite-derived Humic Acid for CO₂ Capture”.
- Gautham Krishnamoorthy and Michael Mann were members of a team (led by the Institute of Energy Studies) that won a DOE-NETL Award for “Electromagnetic Energy-Assisted Thermal Conversion of Fossil-Based Hydrocarbons to Low-Cost Hydrogen.” UND Award Amount: \$398,969 [see p. 12].
- Xiaodong Hou along with Michael Mann were awarded \$248,229 from the North Dakota Department of Commerce and TKK & Associates for a project entitled “New Battery Charging Technology”.
- Ali Alshami receive a \$72,000 Equipment Award from the ND EPSCoR Office STEM Solicitation program for a Gel Permeation Chromatography (GPC) Analytical System for Polymers Research and Development.
- Wayne Seames is the co-PI on a \$67,900 grant with Prakash Ranganathan, UND Electrical Engineering and Burton Johnson, NDSU Plant Sciences Dept. on one year project, “Early Identification of Soybean Cyst Nematode (SCN) Disease by monitoring Plant/Soil Health using Big Data Framework and Artificial Intelligence Algorithms: A Big Data Framework” funded by the ND Agricultural Product Utilization Commission.
- Yun Ji is the Co-PI on a \$42,420 grant, funded by ND Agricultural Product Utilization Commission, for a project entitled “Design and Development of Biofoams for Functional Applications”.
- Michael Mann was awarded \$3500 from Barr Engineering for a project entitled “Energy Storage and Hydrogen Technologies for the Power Grid Short Course”.

PEER-REVIEWED PUBLICATIONS

(Student authors are underlined)

- S. Cowart and G. Krishnamoorthy, (2020) On the Relative Contributions of Soot to Radiative Heat Transfer at Different Oxygen Indices in Ethylene - O₂/CO₂ Laminar Diffusion Flames. Fuel; DOI: <https://doi.org/10.1016/j.fuel.2020.119269>
- J. Masud, J. Thakare, T. Aulich, M. Mann, J. Zhao, “Magnéli Phase Ti₉O₁₇-Catalyst Support Materials for ORR”, ECS Meeting Abstracts, Vol 58, pp 2849.
- S. Gupta, M. Dey, S. Javaid, Y. Ji, S., (2020) On the design if novel biofoams using lignin, wheat straw and sugar beet pulp as precursor material. ACS Omega, 5(28), 17078-17089.
- A. Kohler, W. Seames, I. Foerster, C. Kadrmas (2020), “Catalytic Formation of Lactic and Levulinic Acids from Biomass Derived Monosaccharides through Sn-Beta Formed by Impregnation”, Catalysts, 10, 1219; doi:10.3390/catal10101219
- A. Kohler, W. Seames, C. Shaeffer, C. Bjerke, J. Dahl, (2021) Techno-Economic Analysis of a Process for the Aqueous Conversion of Corn Stover into Lactic and Levulinic Acid through Sn-Beta Catalysis. Processes 2021, 9, 436. <https://doi.org/10.3390/pr9030436>
- G. Krishnamoorthy, L. Clarke, J. Thornock (2021) Accelerating the Convergence of Multiphase Flow Simulations when Employing Non-Uniform Structured Grids. J. of Applied and Computational Mechanics, 7(1) 235-253.

(Continued on page 22)

FOR OUR FRIENDS, ALUMNI, AND PARTNERS . . .

After a year of immense change here at UND, we spent this summer slowly and carefully returning to our normal face-to-face activities. Despite all of the adjustments made this year, one thing remained constant, the excellence of the ChE department in teaching, research, and service. The lead article in this issue of *Kinetics* **highlights the department's successes in obtaining external funding** and using it to support the training of the next generation of engineering scholars despite the limitations imposed on experimental research and a shortage of graduate students due to the reduction in Visas and then closure of the U.S. border. You can read about some of the more significant projects in other articles throughout the newsletter. As described on page 4, at this year's UND Founder's Day, two ChE faculty and one ChE alumnus received their first UND-wide awards for individual excellence. These awards spanned the entire spectrum of academic accomplishment – research ([Krishnamoorthy, Bowman](#)), teaching ([Bjorgaard, Bowman](#)), and service ([Bowman](#)). We applaud their extraordinary efforts!

This spring, the ND Legislature provided funding comparable to that provided in the previous (2019) session, enabling us to avoid further reductions in staff but without restoration of the funding cuts that occurred in the 2017 legislative session. The department continues to rely on the generosity of our donors to balance the books. Any assistance you can provide would be greatly appreciated by the hard-working faculty and students.

There are multiple ways you can help. One is shown on page 19. By contributing to the [Tom Owens Endowment](#), you contribute directly to the faculty salary pool that ChE needs to balance their budget. Another is to contribute to one of our existing student scholarship endowments [p. 20] or to establish **a new endowment like Dennis BSChE'76 and Muriel Finken [p. 12]**. You could also provide funds for a special departmental need – a list is provided on the ChE webpages that can be accessed via www.und.edu. Perhaps you can arrange to have a gently used instrument to be donated from your company like **Matt Kunzel BSChE'02 [p. 12]**. **If you are in doubt, a contribution designated to ChE for general needs is always appreciated.**

To learn more about providing support to UND ChE, contact Robin Turner by phone, text, or email.

To make a gift:

- 1) Visit undfoundation.org/engineering and select **“Chemical Engineering” from the Designation menu**
- 2) By check – you may indicate **“Chemical Engineering” or “Owens, Chair of ChE Endowment” in the memo line** to: UND Foundation, 3501 University Ave. Stop 8157, Grand Forks, ND 58202-8157

ChE Alum Tom Erickson Receives Regional Honor

Tom Erickson, BSChE '88, MS '90, Director, State Energy Research Center and director of Intellectual Property and Technology Commercialization at the UND EERC, was a recipient of **Prairie Business Magazine's 2020 Leaders & Legacies Award**.

The magazine created the award in 2019. The award recognizes executives **“for the great things they have done in business, whether in recent years (Leaders) or over a lifetime (Legacies),”** said Prairie Business Publisher Korrie Wenzel.

Colleagues from across the region nominated individuals for the award based on their exemplary leadership and accomplishments while serving as an executive. Prairie Business also nominated a few regional executives.

Prairie Business is a regional business magazine covering an area centered on the Red River Valley, including most of North and South Dakota plus Western Minnesota. It is published by Forum Communications, which also publishes the daily newspapers in Grand Forks (the Herald) and Fargo (the Forum).

DEB AUSTRENG

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UND Alumni Association & Foundation
Director of Development

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701-739-3211 Mobile
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3501 University Ave Stop 8157
Grand Forks, ND 58202-8157



CONGRATULATIONS TOM!

Add update on the progress of the fund-raising here—get info from Robin



HONOR DR. TOM OWENS AND DOUBLE THE IMPACT

A donor has provided a dollar for dollar match of up to \$250,000 through Dec 31, 2020, that will elevate the Thomas C. Owens Endowed Chair of Chemical Engineering to the next level.

ADVANCE TOM'S GOOD WORK

Take this opportunity to honor Dr. Tom Owens, longtime faculty and leader in UND's College of Engineering & Mines, and ensure a position for high caliber faculty. Many have reaped the benefits of Tom's passion for education. **Today, we are calling on those who have been touched by Tom's unprecedented service to take up this match challenge.** Time is of the essence. Will you help us secure the funds and advance the good work Tom started? Your gift today will make a difference for tomorrow's engineers.

DR. THOMAS C. OWENS

Dr. Tom Owens taught at the University of North Dakota College of Engineering & Mines for 33 years; serving as a department chair in Chemical Engineering for 23 years from 1974 to 2000. He also served as the interim dean of the College intermittently from 1989 to 2001. In addition to being an outstanding teacher, Tom developed strong relationships with students and went out of his way to help them achieve success. Tom retired in 2001, but his enthusiasm for excellence continues on through the Thomas C. Owens Endowed Chair of Chemical Engineering.

THE ENDOWED CHAIR IMPACT

As leading scholars in their fields, endowed chairs are influential thought leaders whose expertise and leadership draw top-notch faculty and students. Their influence has a lasting effect on learning inside and outside the classroom. Endowed chairs secure research grants and private support, bring in national conferences, and foster media attention and partnerships. This is one of the few endowed chair positions at the University of North Dakota.



An endowed chair position was named after Dr. Thomas C. Owens in 2004.



Dr. Owens served as professor, department chair and interim dean of the UND College of Engineering & Mines.

TO MAKE A GIFT OR GET MORE INFO:

Robin Turner, '89
 Director of Development,
 College of Engineering & Mines
 701.777.1428
robint@UNDfoundation.org



Use this QR code or visit
UNDalumni.org/owens

UND ALUMNI ASSOCIATION
 FOUNDATION
 LEADERS IN ACTION

Even multi-year pledges and employer matches qualify for the immediate 1:1 match!

Won't you join us in honoring Dr. Owens?

STUDENT ACCOMPLISHMENTS

2020-21 Academic Achievement Awards were conferred at a virtual ceremony held during the last week of the Spring semester

FRESHMAN

Student of the Year—BriAnna Amundson

BriAnna was also received the

AICHe Freshman Recognition award

Finalists—Angelika Neumann and Manny Salgado

SOPHOMORE

Student of the Year—Alex Hinshaw

Finalists—Ethan Hunter and Adam Cragun

AICHe D. F. Othmer Sophomore Academic Excellence Award—

Kelsey Baker

JUNIOR

Student of the Year—Rebecca Seemann

Finalists—Rachelle Amundson and Charlie Lien

SENIOR

THE AM SOUBY AWARD FOR EXCELLENCE IN PLANT DESIGN

Akash Gogate, Maddisyn Kemmer, Emily Myskewitz and Levi Stegner

“Biodegradable Polymers from 1,4 Pentanediol”

This group also was awarded second place in the CEM-wide Andrew L. Freeman Design Innovation competition (photo below from left: Brendan Kennelly, Sr Manager Power Delivery Engineering, Minnkota Power Cooperative, Stegner, Gogate, Kemmer, and Myskewitz)



THE CHE ALUMNI AWARD

Evan Bloom, Jafar Kassir, William McKewan, and Joshua Wilmer

“Acetaminophen Production”

SPONSORED AWARD IN SENIOR PLANT DESIGN

ND SUNRISE sponsored a design project entitled “Conversion of Lignin into Jet Fuel and Co-Products” which was completed by Wyatt Larson, Andrew Neshem, Joseph Osborn, and Nicholas Voelker.

2021 CEM-WIDE SENIOR DESIGN EXPO

A virtual expo was held using 3-5 minute presentations from each design project. For CHE student groups, their in-class 5 minute pitch presentations were used. The following CHE student group won the design category:

Andrew Dockter, Jesse Maltbie, Zachary Meduna, and Anthony Reybok

“Monomers from the Pyrolysis of Plastics”

You can watch their award winning presentation at:

[Watch the Monomers from the Pyrolysis of Plastics Team Video.](#)

We appreciate the hard work of the students on these projects and the support and willingness to assist them provided by both external sponsors and ChE faculty advisors. **If you'd like to sponsor a student design project**, please contact Wayne Seames at wayne.seames@und.edu or 701-777-2958 to discuss your ideas.

CONGRATULATIONS TO ALL OUR AWARD WINNERS!

ChE master's student Evan Lowry received 3rd place in the engineering category at the Feb, 2021 Grad Day. Evan is advised by Gautham Krishnamoorthy. [Congratulations Evan!](#)



CHEMICAL ENGINEERING AND ASSOCIATED MERIT AID & SCHOLARSHIPS

The Daryl L. and Diane A. Anderson Scholarship
Clara Kaufmann & Alexander Bennett — \$1250 ea
Rachelle Amundson & Gavin Romanick — \$1000 ea
Keri Sauvage — \$500, Caylie Graeber — \$250

The Lisa and Todd Barnes Scholarship
Rachel Blasczyk — \$2500

The Charles W. Boise Scholarship
Abbie Radermacher — \$1000

The Albert Cooley ChE Scholarship
Luke Bigelow — \$750, Marcus Pena — \$500,
Abigail Wiese — \$250

The E.E. Gullekson ChE Scholarship
Andrew Myers & Rebecca Seemann — \$1000 ea
Blair Dupre, Abbie Radermacher, Grant McDonald, & An-

gelika Neumann — \$750 ea, Morgan Schmitz — \$500,
Christopher DeJesus — \$300, Lindsey Malina — \$250

» The Ross Hefta ChE Scholarship
Madelynn Heydt — \$1000, Caylie Graeber — \$750, Braden Soderberg — \$250

The Hess Leadership Scholarship
Kelsey Baker — \$25

The Professor Wayne Kube Memorial ChE Scholarship:
Samuel Williams & Brett Weber — \$750 ea
Cole Taggart & Christopher DeJesus — \$450 ea

The Dwight A. Lang Scholarship
Kelsey Baker — \$715

(Continued on page 23)

Alumni Contribution Report

Thank you for your generous contributions!

A record number of people donated to ChE programs this past year!

- \$135,300 to the Thomas Owens Endowment which will be doubled by a matching donation! [p. 19],
- \$89,472 to student scholarship endowments [p. 20], and
- \$9,291 for ChE department priority needs.



Many of you also contributed to UND's Angel Fund and Open Door Scholarships to help students in need with tuition and other expenses. UND ChE relies on your contributions to help us balance our budget each year. Direct contributions to the general department fund and earnings from endowment funds currently provide almost 10% of our annual budget. In addition to our day to day operating expenses, your donations helped us to upgrade and add new lab experiments, provide academic achievement awards [p. 20], purchase additional software licenses for students working remotely because of the pandemic, provide faculty professional development training, and even pay portions of faculty salaries. Additionally, earnings from ChE scholarship endowments allowed us to award \$31,525 in scholarships to chemical engineering students over the past year [p. 20].

Thank you again to all that have given to the department this year and in the past. We are so fortunate to have such loyal and supportive alumni and friends.

If you are supposed to be on this list below but we somehow missed you, please forgive us; it is not intentional. This is an amateur production!«

ALUMNI AND CORPORATE CONTRIBUTORS

INDIVIDUAL GIFTS (JULY 2020-JUNE 2021)

- Gayle Aafedt
- Jesse Ahlers
- Tessa Alexander
- Ali Alshami
- Diane Anderson
- Myron Backhaus
- Keith Bader
- Vickie Batroot
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- Navin Shah
- Jeffrey Sieler
- Frederick Stern
- Sean Stucke
- Michael Swanson
- Brian Tande

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- Cargill
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- Barbara Walz
- Adam Webster
- Sandra Weekley
- Joseph Weldon
- Edward Werre
- Matthew Wuebben
- Jerome Zink«

Faculty Research Highlights (continued from pg. 17)

- Jinbao Li, P. Feng, H. Xiu, M. Zhang, Jinyu Li, M. Du, X. Zhang, E. Kozliak, Y. Ji, (2020) Wheat straw components fractionation, with efficient delignification, by hydrothermal treatment followed by facilitated ethanol extraction. *Bioresource Technology*, 316, 123882
- B. Nespor, R. Cochran, H. Jeong, F. Bowman, D. Delene, E. Kozliak, A. Kubatova, (2021) Occurrence of both nonvolatile and semivolatile carbonaceous air particulate markers using thermal desorption-pyrolysis-gas chromatography-mass spectrometry. *Atmospheric Environment*, 246:118058.
- S. Onaizi, M. Alsulaimani, M. Al-Sakkaf, S. Bahadi, M. Mahmoud, A. Alshami. "Crude oil/water nanoemulsions stabilized by biosurfactant: Stability and pH-Switchability." *Journal of Petroleum Science and Engineering* 198 (2020): 108173.
- C. Senior, E. Granite, W Linak, W. Seames, "Chemistry of Trace Inorganic Elements in Coal: A Century of Discovery", *Energy & Fuels*, Dec 2020
- P. Seshadri, W. Seames, M. D. Sisk, F. Bowman, **S. Benson (2020)**, "The Mobility of Semi-Volatile Trace Elements from the Fly Ash Generated by the Combustion of a Subbituminous Coal – Effect of Combustion Temperature", *Energy & Fuels* 2020, 34, 12, 15411-15423.
- J. Thornby, A. Alshami, **M. Haghshenas**. "The Influence of Processing Methods on Corrosion Rates of Magnesium – Carbon Nanotube Nanocomposites: A Short Review" *Current Nanomaterials Journal* (2020), 6 (1).
- K. Viswanathan and G. Krishnamoorthy, (2021) The effects of wall heat fluxes and tube diameters on laminar heat transfer rates to supercritical CO₂. *International Communications in Heat and Mass Transfer*, (2021), DOI: <https://doi.org/10.1016/j.icheatmasstransfer.2021.105197>
- F. Xiao, A. Bedane, S. Mallula, P. Sasi, A. Alinezhad, D. Soli, Z. Hagen, M. Mann, "Production of granular activated carbon by thermal air oxidation of biomass charcoal/biochar for water treatment in rural communities: A mechanistic investigation", *Chemical Engineering Journal Advances*, (2020), Vol 4: 100035
- H. Xiu, F. Ma, J. Li, X. Zhao, L. Liu, P. Feng, X. Yang, X. Zhang, E. Kozliak, Y. Ji (2020) Using fractal dimension and shape factors to characterize the microcrystalline cellulose (MCC) particle morphology and powder flowability", *Powder Technology*, 364, 241-250.
- S. Xu, J. Zhou, J. Wang, S. Pathiranaage, N. Oncel, P. Ilango, X. Zhang, M. Mann, X. Hou, "In Situ Synthesis of Graphene-Coated Silicon Monoxide Anodes from Coal-Derived Humic Acid for High-Performance Lithium-Ion Batteries", *Advanced Functional Materials*, (2021), 2101645.

RESEARCH PRESENTATIONS (Student authors are underlined)

- Ali Alshami, "Towards Optimal Trade-off between Permeability and Selectivity in Polymeric Membranes for Gas Separation", American Chemical Society Virtual National Meeting, San Francisco, August 16-20, 2020.
- Abdulaziz Ellafi, Hadi Jabbari, Olusegun Tomomewo, Michael Mann, Mohammed Geri, **Clement Tang**; "Future of Hydraulic Fracturing Application in terms of water management and Environmental Issues: A Critical Review", SPE Canada Unconventional Resources Conference, virtual conference, Sept. 2020.
- Olusegun Tomomewo, Michael Mann, Abdulaziz Ellafi, Hadi Jabbari, Clement Tang, Mohammed Geri, Oladoyin Kolawole, Azeez Adebisi, Omolara Ibikunle, Moones Alamootei, "Creating Value for The High-Saline Bakken Produced Water by Optimizing its Viscoelastic Properties and Proppant Carrying Tendency with High-Viscosity Friction Reducers", SPE Western Regional Meeting, virtual conference, April 2021.

M.S. AND PH.D. STUDENT GRADUATES

DECEMBER 2020

Ryder Shallbetter, MSChE, "Design of Spouted Fluidized Bed Computational Models for Advanced Energy Applications", Advisor: [Gautham Krishnamoorthy](#)

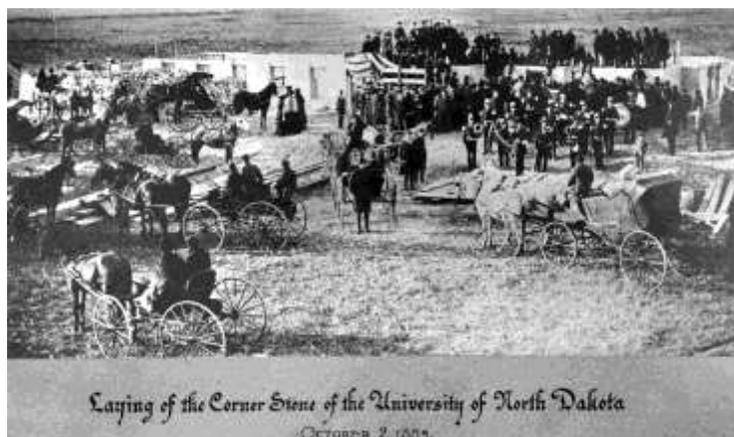
MAY 2021

Ian Foerster, PhD, "The Production of Bio-based Chemicals and Materials from Renewable Sources", Advisor: [Wayne Seames](#)

AUGUST 2021

Monika Kuznia, MSChE, "Predicting Ash Deposition during Oxy-Combustion of Coal Using Computational Fluid Dynamics", Advisor(s): [Gautham Krishnamoorthy](#) and [Wayne Seames](#)

James Lepke, MSChE, "Upgrade of Rare Earth Element Concentrate by Selective Dissolution and Ion Exchange", Advisor: [Michael Mann](#)





DEPARTMENT OF CHEMICAL ENGINEERING

UPDATED INFORMATION

Please stay in touch! Remember, UND ChE alumni never really leave the department after graduation — they just do less homework!

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_____ Check here if you are enclosing a donation to the UND Chemical Engineering Department with your information form.

_____ Check here if you would like someone to contact you with more information about contributions supporting the Chemical Engineering Department or the Tom Owens Endowment.

Please send to: Department of Chemical Engineering
The University of North Dakota
243 Centennial Drive, Stop 7101
Grand Forks, ND 58202-7101

Fax: 701.777.3773

email: und.chemical.engineering@und.edu

CHE-RELATED SCHOLARSHIPS

(CONTINUED FROM PG. 20)

The Michael and Sitney Lodoen Eng Scholarship
Lindsey Malina — \$2000

The William and Inez McDonald Scholarship
Wyatt Larson — \$2000, Rachelle Amundson — \$1972,
Angelika Neumann & Clara Kaufmann — \$1000 ea

The Mark and Monica Musich Family Scholarship
Kelsey Baker — \$950

The Olson Family Scholarship
Alexander beneett — \$2000

The Continental Resources Leadership Scholarship
Rebecca Seemann — \$1347
Charlie Lien & Marcus Pena — \$1000 ea
Kelsey Baker & Lindsey Malina — \$500 ea

The Arthur Severson Eng Scholarship
Zachary Meduna — \$900

The Society of Women Engineers
Angelika Neumann — \$1000

The AM Souby ChE Scholarship
Lindsey Malina—\$1000, Rachel Blasczyk—\$750,
Braden Soderberg & Annika Bastian —\$500 ea,
Abigail Wiese — \$250

Wendy Sellheim Spenst Memorial Endowment

Charlie Lien — \$1250

The Raymond & Edyth Sullivan Eng Scholarship
Samuel Williams — \$1500
Rebecca Seemann —\$1153

The George & Joi Hase Swiggum Scholarship
Kelsey Baker — \$250

The David A Veeder Scholarship
Ianna Osborn, Davis Patton, Faith Stoll, Kaitlynn Klebe, Emma Nissen, Mason Warner, & Jady Guidinger—\$800 ea; Riley Clancy & Isabel Furness —\$600 ea
Jake Doll, Luke Peterson, & Brooklyn Altendorf—\$500 ea;
Nicholas Sholy & Natalie Deason — \$400 ea

The Anna Peterson Walsh Memorial Engineering Scholarship: Kelsey Baker—\$930

The Everett Webb Engineering Scholarship
Caylie Graeber & Madelynne Heydt — \$2000 ea

The Roy Wehe Scholarship
Alaina Irvine — \$1000, Clara Kaufmann — \$500

The Whiting Petroleum Corp. Scholarship—\$1000 each
Kelsey Baker, Rachel Blasczyk, & Caylie Graeber

The Margo A. Wolff Scholarship
Rachelle Amundson — \$528«



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