UNIVERSITY OF IOWA
AMERICAN INSTITUTE OF
CHEMICAL ENGINEERS

Chemical Engineering Newsletter

AICHE FALL 2010

INSIDE THIS ISSUE:

A Chem E wins the Mr. Engineer Pageant!

By Stephanie McCoy, editor-in-chief

At left: Engineering Math II professor Dr. Stroyan accompanies the 2010 Mr. Engineering Pageant winner, Corin Nisly, who is currently a senior chemical engineering student.

A Chemical Engineering student, Corin Nisly, won the 2010 Mr. Engineering Pageant. The Mr. Engineer contestants participated in games including drinking soda through a licorice straw, a paper airplane contest, and drawing professor Stroyan's, portrait with markers. Twelve contestants participated in this year's pageant, and Corin had the highest overall score. The judging panel featured engineering professors and administrators.

UIowa AIChE Student Members

Senior AIChE Members (2010 Fall)

Junior AIChE Members (2010 Fall)

Advisor's Corner

Written by Dr. Murhammer

Greetings to Hawkeye Chemical Engineers!! This Fall 2010 issue of our AIChE Student Chapter Newsletter begins with an article about a Chemical Engineering student, Corin Nisly, winning the 2010 Mr. Engineer Pageant. Congratulations to Corin! This issue also contains articles about the Halloween Day Camp for young children hosted by our AIChE Student Chapter, student and advisor attendance at the 2010 AIChE Annual Student Conference, a Schlumberger field engineering internship in Alaska, an International Paper process engineering internship in Louisiana, and a photopolymerization research experience. This issue concludes with two energy-related topical papers written by students in Professor Julie Jessop's Process Calculations course (a Sophomore-level course). Finally, I would like to note that our AIChE Student Chapter was awarded an AIChE Outstanding Student Chapter award for the 2009-2010 academic year, which is the 17th time in the last 18 years that our student chapter has won this award. This award is given to the top 10% of student chapters in the United States. I am so proud of our students whose involvement in AIChE-related activities over the years has been recognized by award.

Finally, I encourage our alumni to donate to the endowment fund that will be used to support our student chapter activities. If you are interested in contributing to this fund, then please contact me via email at murham@engineering.uiowa.edu to discuss specific details.

First Annual Halloween Day Camp

Written by Rachel Crome

With the best of intentions, the AIChE executive board had planned on a Spooky Sprint for the Fall of 2010 to benefit the Johnson County Shelter House. However, when school resumed in the fall, it was discovered that aside from our Spooky Sprint, there were three other 5K's planned for the month of October. Not easily deterred, the group brainstormed other potential fundraisers and had a great idea. Instead of hosting a 5K, this year the AIChE student chapter hosted a Halloween Day Camp for kindergarteners through 3rd graders. The event was generously sponsored by the Engineering Student Council and all registration fees ($10 per child) were donated directly to the Shelter House.

After a Halloween afternoon filled with exploding soda, silly putty, pseudo-plastic fluids and liquid nitrogen, 30 sticky children went off to Trick-or-Treat while 35 tired engineering Juniors and Seniors went to finish their homework. The event was a fantastic success, raising over $300 for the Shelter House and helping to encourage children's interest in chemistry. We received 100% feedback from parents encouraging us to create more events like this one. With that in mind, the committee is already contemplating the addition of a spring event.

2010 AICHE Annual Student Conference

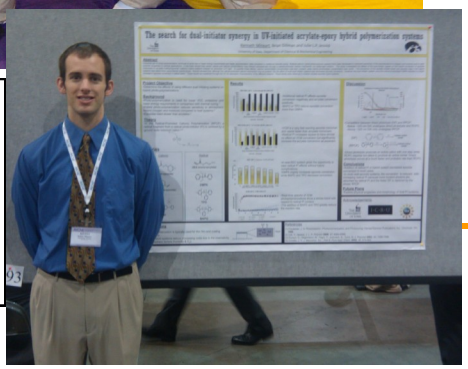
Written by Steve Rheiner and Alex Carli

The 2010 AIChE Annual Student Conference was held on November 5th- 9th in Salt Lake City, Utah. Six juniors and seniors attended the conference: Alex Carli, Nayeon Kang, Steven Rheiner, Abby Neu, Annie Kock, and Kenny Mineart, who presented in the Poster Contest on the final day of the conference. The conference took place at the Salt Lake City Convention center which is located minutes walking distance from the downtown area. The national conference provided a variety of networking activities such as a networking brunch and a graduate school fair. At the networking brunch, students and advisers could interact with other schools as well as company representatives. The graduate school fair gave prospective students a look at many different schools interested in recruiting chemical engineers. It is also a valuable tool for anyone unsure of which school they want to attend in the future. The fair had approximately 40 schools in attendance. After the fair there was the ChemE Car competition. The competition lasted a few hours and showcased schools from all over the country and even a team from Puerto Rico. Cornell University took first place this year.

There were numerous workshops at the national conference that were very beneficial to students. These included a "Research Experience for Undergraduates (Domestic and International)" workshop, a "Unique Industries & Opportunities for Chemical Engineers" workshop, a "Women Undergraduates in Chemical Engineering: Academic and Industrial Career Opportunities" workshop, a "Graduate School: Is It Right for You?" workshop, and a "Job Search/ Interview Skills" workshop. The workshops could range anywhere from a half hour to three hours long based on their topic. The workshops were extremely helpful for juniors and seniors seeking full time positions or summer internships. The interview and communications workshops helped strengthen students' skills and techniques for the application process. The Women in Engineering workshop went over career opportunities for women, resume format and content, and networking through common internet sources like Facebook and LinkedIn.

To finish the conference, the officers attended the annual awards ceremony to receive the outstanding student chapter's award. The UIOWA AIChE student chapter has received this award 17 of the last 18 years.

Left: Kenny and Steve engage in a sumo wrestling battle at the national conference.



Above: Six students attended this year's AICHE national conference, accompanied by Dr. Murhammer, the chapter advisor.
Right: Kenny Mineart posing by his research poster entitled "The search for dual-initiator synergy in UV-initiated acrylate-epoxy hybrid polymerization systems."

A Schlumberger Field Engineer Internship

By Maribel Treto

Left: Maribel stands next to a nitrogen pump tank.

In a span of three months, I flew on 8 different flights, lived in 3 different states, experienced 3 different climates, spotted wild caribou and musk ox, and stood 10 feet from the Arctic Ocean shoreline on a man-made island. These were just a few of my experiences on a fun, adventurous and educational internship with Schlumberger this past summer. Prior to interning with Schlumberger I never thought I would work for any type of oil company. Now, having interned in the oil industry, I have learned so much and have come to better understand the world's dependency on oil. From meeting 60 plus interns from all over North America to traveling thousands of miles from home, the internship with Schlumberger proved to surpass my expectations for the summer. My experience began on May 31, 2010 when I flew out of O'Hare Airport in Chicago, Illinois heading towards Houston, Texas for Schlumberger's internship orientation. Training in Tulsa, Oklahoma immediately followed the orientation where I learned as much about Schlumberger as I could while building strong friendships with other interns and familiarizing myself with all our recruiters and instructors.

On Wednesday June 23, 2010 it was time to say farewell to all the interns and recruiters and travel alone to Anchorage, Alaska. When I arrived at Anchorage I was greeted with a cool breeze, typical of what would be felt on a day in October in the Midwest; however, this was summer weather for Alaska. It was great! The first couple of days I was in Anchorage I visited the Schlumberger offices and attended more safety training. This training was titled "Northern Slope Training Cooperative (NSTC)" and was mandatory for all people working in the northern part of Alaska. At this training I learned about the severity of hydrogen sulfide gas, the possible exposure to bears and wild life, and other warnings regarding the working culture in northern Alaska.

I then traveled to Deadhorse, Alaska where I stayed at a camp to work in rotations (2 weeks on, 1 week off). Going from a hot humid climate to a cold, dry, 24 hours of sunlight region was a fascinating transition to experience. There was not much livelihood up in the north, but it was a neat experience to live in the middle of no-where with the only things surrounding us being camps, heavy machinery, pipelines, wellheads and wild animals. My first time out on a job dealt with cementing a production liner. During that activity, I helped rig up, rig down, and was positioned as "spill champion," which meant that I had to be in charge of detecting any leaks or spills from the iron. For my second field job, we maintained a pump truck on location that continuously converted liquid nitrogen to a purging gas used on several of BP's pipelines.

Other field jobs involved pumping hydrofluoric acid down a well in order to maximize the production of oil. Also, in the lab, I tested the compatibility between common slurries that were pumped for cementing in Alaska. These slurries involved different types of cements, displacement fluids, and drilling muds. All in all, I had a fun and exciting experience with Schlumberger this past summer, and I would recommend Schlumberger's internship program to anyone.

Thinking Outside the Box

By Kate Douglas

This past summer I worked as a process engineering intern in the technical department at International Paper Red River Mill located in Campti, Louisiana. Red River Mill produces containerboard from recycled cardboard and virgin wood pulp. The containerboard is then shipped to various box plants where it is turned into cardboard boxes used for packaging.

Over the summer, I had several different projects that I worked on simultaneously. One project was an MSDS audit of the entire mill. After crosschecking all of the chemicals located in the mill with those in our system, I was able to determine which chemicals were no longer in use and which chemicals had not gone through the appropriate approval process. The MSDS audit provided me with the opportunity to familiarize myself with the entire mill while creating an easier way to use the MSDS system.

Another project I worked on this summer was the development of a DCS database using PI software. The DCS screens located in each control room contain process information ranging from product flow rates to tank levels. This information is utilized by operators and engineers on a daily basis to make process decisions. However, the information was only accessible in the control rooms, which were often an inconvenience to those who needed the information. Therefore, I built a database that simulated each DCS screen in PI so that everyone could have access to the real time data at their individual computers.

Another project I worked on was the kappa project. In the paper industry, the kappa number is used to determine the degree of delignification of the pulp. The operators then use this information to control the amount of liquor that is added to the process. A kappa analyzer is normally used to test the pulp's kappa number, but since it was found to be inaccurate I ran several manual tests. I found on average the analyzer was reading six points too high, which resulted in an inaccurate amount of liquor being used in the process. As a result of these findings, the analyzer was recalibrated.

The next step in the kappa project was ensuring that the pulp mill operators were using the correct testing procedures when performing their manual kappa tests. After working with several operators, I discovered that an out of date procedure was being used that was further skewing the kappa results. I rewrote the testing procedure and worked with the operators to implement the changes. The recalibrated analyzer and updated testing procedures provided a more accurate kappa number for the operators to use when adding or removing liquor to the process. These changes resulted in an improved product and overall cost savings for the company.

This summer, I learned that working in a paper mill isn't always the most glamorous job, but it is an exciting atmosphere where you will be faced with new challenges each day. I consider myself very lucky to have had this opportunity, not only for the work experience, but also for the new friendships and memories I made in Louisiana.

My College Research Experience: The Unprecedented Exploration within Photopolymerization

By NaYeon Kang

I first began to work in Dr. Jessop's lab in Summer 2006. I had the chance to shadow in her lab to fill my curiosity about the application of science in technical laboratories. I worked as a lab assistant under her graduate students; however, after being accepted as part of ICRU fellowship, I was able to be more involved in hands-on research.

In the first year of my participation with research, my primary challenge was time management. It was a challenge to take a number of engineering courses, some with lab components, and also find time to work in Dr. Jessop's lab. Through doing this, I learned how to manage time and also had a learning experience outside of classes and course materials. With help from my mentor, Dr. Jessop, this new lab experience was less burdening and more exciting than I had ever expected.

My research area was on photopolymerization, which is using light instead of heat to form polymers. Since my research involves light, I had the opportunity to learn how to use difference instruments and tools. This was very interesting because by using the *in-stitu* instrument, I was able to see how monomers interacted to form polymers.

Above: Spring 2009 Engineering Open House – Na Yeon Kang receives "The Best Poster Award" and takes a pose with her mentor, Dr. Julie Jessop.

Above: Spring 2010 Engineering Open House – Na Yeon Kang receives "Undergraduate Popular Choice Awards" and takes a pose with former College of Engineering Dean Butler.

It has been two years since I started this research, and the goal has been determining how much polymer product can be produced by measuring reactive centers. It has been challenging because this project is unprecedented and we had to choose among thousands of chemicals through analysis to know which materials were most appropriate. We also had to discover the most appropriate protocols to ultimately achieve the final goal of the project. This was very fun yet extremely challenging. It took a lot of patience to persevere. It was very interesting to try out different methods and many unexpected

results occurred. Book-knowledge was not very useful many times due to the varied environments.

There's still much to do to discover the best suited methods and procedures to measure the reactive centers. During this research, there had to be a lot of trial-and-error tasks, and many times I was solely focused with the research in laboratory perspective. However, as I had the privilege to travel and present in different conferences, I learned how the current research project is/can be applied to new spectra in practicality.

Beyond the knowledge and experience I acquired in lab, I had chances to present my research in different meetings. One such meeting was the 2009 National meeting of American Institute of Chemical Engineers (AIChE) which took place in Nashville, Tennessee in November of 2009. At the meeting I was able to present my research poster in front of many chemical engineering students and professionals from all over the nation. I also attended the Spring National meeting of American Chemical Society (ACS) which took place in San Francisco, CA in March 2010. I received an ICRU's traveler fund and other special funds that supported my flight and transportation costs. This meeting was my favorite because I had the chance not only to present my research poster for chemical engineers but also people who study science from all over the world (with different science backgrounds). It was challenging to share my research with the people with different science background. As I shared my research with them, we shared different comments and advice for each other's troubleshoots faced in research. Also, different questions I received about academics and industry helped me to view my research from a different perspective. It gave me a different view point of my research. My favorite part of this meeting was attending different talks relating to the theme of the conference, which was "Green Chemistry". In one such meeting, I realized that my research can also be in part of "Green Chemistry" since photopolymerization requires less energy since it uses light instead of heat, and also it requires less solvent (low volatile compounds). I became more aware of this area after attending the conference.

Besides these two national meetings, I also presented my poster at The University of Iowa Engineering Open House in 2009 and 2010, and at the OSTC (Optical Science Technology Center) Symposium. In these different meetings I had to present my research in front of different audiences – from chemical engineering undergraduate students to industrial professionals. I had great experiences networking with them, sharing different perspectives in research, and mostly how research can have a global impact. At the 2009 Engineering Open House, I was fortunate enough to receive the Best Poster Award and in 2010 I received the Most Popular Poster Award. Despite many difficulties, I found joy and satisfaction in this research through the hands-on learning experience from my mentor and graduate students, and also by sharing my research with others. I will be conducting research until I graduate with support from the ICRU Fellowship. My research experience in Dr. Jessop's lab helped me to overcome my questionable dilemma from freshman year: "Why do I have to learn these things in chemistry class? When am I going to use this knowledge?" I found that the majority of things I had learned in science classes were actually applied to my research, even basic lab techniques that were acquired in my freshman year in chemistry lab. I also gained an appreciation for research by attending different conferences and sharing research information. I realized that even different research endeavors seemed to have one goal—the betterment of the world.

Algae to Biofuel

By Taylor Malott

Currently, the race to discover economical, renewable energy has become a widespread challenge for chemical engineers. Fossil fuels release many pollutants into the atmosphere and it is expected that in the future, the supply of fossil fuels will diminish (1). Therefore, many engineers are researching and testing ideas to find alternatives. Another reason for the creation of new oil-substitutes is politically driven, as much of the world's oil supply is located in unstable regions. Additionally, because of the nationwide controversy regarding offshore drilling, engineers are determined to find a new, politically sound outlet. Therefore, several technology-driven oil companies are investing to create oil from green, photosynthetic organisms, or what is known as algae.

Many people may be curious about using seaweed to light homes or power automobiles. However the oil, or biological lipids, from algae is somewhat similar to the oil produced from fossil fuels. Biological lipids are chemicals called triglycerides, composed of a central glycerol unit with three fatty acids attached (2). When viewing algae microscopically, it has a very similar composition to that of petroleum, including long chains of carbon and hydrogen.

With respect to the composition of algae, a cultivating process is currently under development by several companies. In fact, companies have developed many different ways to mass-produce this organism. One procedure includes pumping water into bioreactors, or plastic tubes, which are exposed to a source of light (3). Another cultivating method companies have invested in is the use of open-pond systems, since algae accumulation is prevalent in this environment. Well-known companies such as ExxonMobil have adopted both of these methods. ExxonMobil recently joined with Synthetic Genomics Inc. (SGI) to create a greenhouse, which is home to both the bioreactor and open-pond procedures (4). Once the algae have been cultivated, it must undergo a series of separations in order to retrieve the desired oil product. Simply put, the process includes separating the algae and solution, separating the oil from the algae, converting the oil to diesel grade fuel and separating the glycerol from the biodiesel after the reaction is complete (2).

With refining processes underway, like those using bioreactors and open-pond systems, one company has already taken the next step to practicing this process commercially. UOP, a biofuel technology developer and a Honeywell company, teamed up with Continental Airlines to test this biofuel (5). On Wednesday, January 7th, 2009, Continental Airlines conducted a 1 hour and 45 minute demonstration flight, using a mixture of algae-oil in one of the two engines (6).

Algae based fuels offer some interesting advantages compared to other fuel sources. Unlike petroleum, which releases new CO_2 into the atmosphere, photosynthetic algae simply return the CO_2 that was originally taken in during cultivation (2). An advantage of using algae-oil compared to plant-based biofuels is algae-fuel can be easily cultivated on land or nourished with water that cannot be used for plant and food production (4). Additionally, algae require relatively cheap resources to grow, such as a light source, water, and CO_2 (2). Finally, algae has the potential to yield large volumes of fuel, as compared to other biofuels such as corn, soy, and vegetable oils. ExxonMobil reported that algae could have

a yield of 2000 gallons of fuel per acre (4). This can be compared to a yield of 50-250 gallons of fuel per acre for soybean or corn oil (4).

The main challenge that faces all renewable energy programs, including algae-based biofuel, is the cost to grow and harvest the oil. Although stated previously that the resources to produce algae, i.e., sun, water and CO_2, are relatively inexpensive, the equipment required to make the biofuels, such as bioreactors, are very costly (3). If algal-fuels were successful in the oil-industry market, naturally oil prices would decrease. This could deter consumers from investing in renewable energy (3). Based on conservative estimates, algal biofuels produced in large volumes with the current technology would cost more than $8 per gallon (in contrast to $4 per gallon for soybean oil today) (7). Another problem in using biological lipids as fuels is the fact that lipids are much more viscous than the traditionally refined petrochemicals which make up gasoline, diesel fuel, kerosene, and other petroleum-based fuels (2). As a result, unrefined lipids will not be completely burned off; thus, leftover product that did not burn can accumulate in the engine of a vehicle (3).

Algae-based biofuels are getting considerable attention from many oil-refining companies, as well as many universities. Again, algae has the ability to grow quickly and with minimal attention as compared to other plant-based fuels. This characteristic makes it a viable candidate for possibly playing a role in the world's fuel supply. However, the cost to grow and harvest algae-oil is still too high to compete with traditional fossil fuels, or even corn or soybean oils. Therefore, chemical and biochemical engineers must continue to improve the growth, harvest and refining processes for algae-oil.

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Solving the Energy Crisis from the Heartland

By Vincent Gutgsell

Energy. This one word is the driving force that keeps all things on this Earth moving. Whether through motion or stored energy, it surrounds us and even sustains life. Energy is so important that many lives have been sacrificed through war over it, billions of dollars have been spent on its research and innovation, and millions of years have been spent pondering it- from wor-

shipping the sun in early culture to creating solar panels to capture the sun's energy. But through all this, the problem that has evolved from energy has not been solved. Society still looks for one answer to solve all the world's energy needs since fossil fuels have run low and harmed the environment. The world wants to know the energy of the future. There are many answers, but the two that would affect Iowa the most are ethanol and wind energy.

Wind energy is the most popular source of energy in the United States (Turner, 1999). It is popular because of its usability, meaning that anywhere with wind has potential for wind energy. This is very appealing to Iowans since it allows for land to still be used for farming and ranching. Iowa took advantage of the flat farming lands to build these wind turbines on and became one of the first pioneers for wind energy and turbine use (Bird, 2005). Iowa just recently passed California for wind energy capacity and ranks second only behind Texas. But between Texas and Iowa, Iowa has more wind capacity per capita than any other state (Haluzan, 2010).Wind energy makes up 15% of the total energy used throughout Iowa. But according to calculations, Iowa could potentially produce 4.8 times more energy than is consumed within the state (Haluzan, 2010). Most of Iowa's wind energy comes from the west and north portions of the state. Some of the incentive to get more farmers across Iowa to put up wind turbines is the $4,000 to $5,000 payment they receive each year for having one (Philips, 2007). Not only are farmers paid to install turbines, but the turbines are economically self-sustaining.

Wind turbines are very cost effective since they only take 3 to 4 months to pay for themselves (Turner, 1999). Wind energy is one of the cheapest energy technologies only costing 4 to 6 cents per kilowatt-hour. The disadvantage is wind energy requires a huge initial cost, anywhere from $30,000 to $50,000. Wind energy outside of the U.S. is more widely used by the European Nations. This energy is 35% of the new energy installation in Europe (Appleyard, 2010). Wind energy is spreading across the world in its importance. Iowa is helping lead the way for United States not only in wind energy, but also in ethanol production.

A direct replacement for the fossil fuels that people use every day is ethanol. Ethanol reduces U.S. oil imports by 128,000 barrels each day (Dodds, 2010). The U.S. is the world leading producer of ethanol, producing over 9 billion gallons of ethanol in 2008 (Haluzan, 2010). Ethanol is so widely used in the U.S. that eight million U.S. cars consume it (Haluzan, 2010). Ethanol is used so much because of its positive effects on the environment. Ethanol reduces the amount of carbon dioxide by 4 tons in the air since the crop used to make ethanol uses that carbon dioxide (Dodds, 2010). Ethanol is vital to help reduce the carbon "footprint" and create a reliable, renewable energy source.

The impact of ethanol as an additive in gasoline hits very close to home. In fact, Iowa owns 78% of the ethanol market in the US. With its 39 plants across the state, Iowa employs 80,000 more people with the increase in ethanol production than it did before ethanol was put in biofuels. Across the nation, people benefit from the reduced price of gasoline with ethanol: anyone who uses this gasoline saves an average of 45 cents at the pump (Dodds, 2010).

There are many more solutions to the energy crisis, but these are just a few of the ones that will affect the heartland, specifically Iowa. Chemi-

cal engineers across the nation and the state of Iowa are working to create a world that depends only on renewable energy. The state of Iowa has shown that renewable energy may cost initially, but it is financially smart to switch from fossil fuels. Iowa is only one of the many states taking affirmative action and making the right steps towards an energy efficient future. Iowa, like many states, is taking advantage of the qualities that make their state unique in solving the energy crisis. The future is starting to take image from the different answers to the energy problem, but chemical engineers are helping everyday to paint that image.

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Assistant Editors: Sarah McCoy, Jake Brandenburg

Your help is much appreciated!

Interested in speaking at professional seminar? If so, then contact AIChE Student Chapter President Abby Neu at abby-neu@uiowa.edu for details and availability!

Would you like to make a tax-deductible contribution to the University of Iowa AIChE Student Chapter? Please contact Prof. David Murhammer at david-murhammer@uiowa.edu for more information.

Congratulations to the AIChE Chapter officers for the Spring 2011 Semester:

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