University of Iowa—

AIChE FALL 2011 & SPRING 2012

EDITORS: JACOB BRANDENBURG and TAYLOR MALOTT

Advisor's Corner

By: Dr. Murhammer, Advisor of the University of Iowa's AIChE Student

Greetings to Hawkeye Chemical Engineers!! This combined Fall 2011/Spring 2012 issue of our AIChE Student Chapter Newsletter begins with an article about the 2011 National AIChE Annual Student Conference held in Minneapolis, MN. Our student chapter won numerous awards at the meeting, including 2 student poster presentation awards, a prestigious AIChE Scholarship, and an Outstanding Student Chapter award. This issue also contains articles about the hosting of a Halloween Day Camp for kids, student study abroad and internship experiences, and the Spring 2012 AIChE and SWE Regional Conferences. Our student chapter also did very well at the AIChE Regional Conference with a student receiving 3^{rd} place in the Paper Contest and 1^{st} and 2^{nd} place (among 8 competing teams) received by our ChemE Jeopardy teams. The winning team will represent our regional in the national competition being held at the 2012 National Conference in Pittsburgh, PA. Finally, this issue contains student-written topical papers from our sophomore-level Process Calculations course about energy-related themes and from our junior-level Chemical Process Safety course about chemical regulations and protecting chemical plants from terrorists.

Regarding other happenings in the Department of Chemical and Biochemical Engineering (CBE) at the University of Iowa, Alec Scranton, a CBE faculty member, has been appointed as the permanent Dean of the College of Engineering (he had been serving as interim Dean). As of July 1, Professor Allan Guymon will become the Chair of our department and I will again become a regular faculty member. Finally, on May 12^{th} the College of Engineering Graduation commencement was held at the Marriott Hotel and Convention Center in Coralville, Iowa. A Chemical Engineering Student, Scott White, gave the graduating senior address, and an alumnus of our department, Roger Koch, gave the charge to the graduates. Congratulations to all of the 2012 Chemical Engineering BSE graduates!

University of Iowa American Institute of Chemical Engineers

INSIDE THIS ISSUE:

2011 National AIChE Annual Student Conference

By: **Samantha Westerhof - Senior Chemical Engineer and Fall 2011 President of UI AIChE Student Chapter**

This year's National AIChE Annual Student Conference was held October 14th-17th in Minneapolis, Minnesota. The trip for The University of Iowa AIChE Student Chapter started with 11 chemical engineering students piling into minivans and making their way north. The first event Iowa students attended was a welcome ceremony on Saturday morning where students received an outline of the weekend's events.

The conference proved to be extremely beneficial for students because there were many exciting opportunities to network with professionals in the field and meet chemical engineering students from Universities throughout the United States. One networking event was a brunch on Sunday morning where students were able to sit down and engage in conversation with company representatives, advisers and students from various schools. Another networking opportunity was the Meet the Sponsors event where company representatives were available to students to answer questions they had about the opportunities available to them as young engineers.

University of Iowa students were active participants at this year's annual conference events. Six students presented posters at the Undergraduate Student Poster Competition; and students also presented a workshop on the Halloween Day Camp for Kids put on every year by Iowa students.

The six students that presented research were Caitlin Andersen, Jonathan Bachman, Benjamin Behrendt, Jessica Carlson, Taylor Malott, and Samantha Westerhof. All six posters were entered in the Environmental division with Jonathan Bachman and Samantha Westerhof winning awards in this category.

Students were encouraged to attend the Student Chapter Workshops where various schools gave talks on the best practices for successful chapter operations. University of Iowa students presented to attendees about our Halloween Day Camp for Kids fundraising event and how to set one up at their school with little cost to their student chapters.

During the Awards ceremony, the University of Iowa was presented with two awards. Abby Neu was awarded a Donald F. and Mildred Topp Othmer National Scholarship Award, which is an award given for outstanding academic achievement and involvement in student chapter activities. Only 15 of these awards are given annually in the United States. The University of Iowa was also awarded the Outstanding Student chapter award, which was due in large part to the efforts of past presidents, Alex Carli and Abby Neu. Iowa has won this award 18 of the last 19 years. This award is given annually to the top 10% of student chapters in the United States.

2011 Halloween Day Camp For Kids

By: Kelly Barnett - Senior Chemical Engineer

The University of Iowa's AIChE student chapter hosted the second annual Halloween Day Camp for kids. The Student Council sponsored the event and all proceeds were donated to the Iowa City Shelter House. The Halloween Day Camp was started as an alternative fundraising activity for the Spooky Sprint due to the large number of 5Ks planned in October. The Day Camp was well received, both by the participating children and their parents. Its success has led our student chapter to make the Halloween Day Camp and annual event and to consider adding a second annual day camp for children during the spring semester. At the 2011 National AIChE conference, our chapter gave a presentation detailing the event, to encourage other Universities to begin their own day camp for kids.

On Halloween 20 children, between kindergarten and third grade, arrived in costume at the Seamen's Center for a fun-filled day. Chemical engineering students conducted the various activities and entertained the kids. The experiments included "Oobleck," Diet Coke and Mentos, liquid nitrogen, dry ice, and an iodine clock reaction. The "Oobleck" demonstrated the properties of a pseudo-plastic material. The iodine clock reaction, or Witch's Brew to the children, displayed a rapid color changing liquid in a beaker. The most popular experiments were the liquid nitrogen and dry ice. The dry ice was used to carbonate apple juice while the liquid nitrogen was used to freeze bananas, tennis balls, balloons, and marshmallows so that they were able to be shattered against the floor. Crafts included painting candleholders and making stained glass pumpkin decorations.

The event was a great success, not only raising money for a good cause, but also encouraging the kids' curiosity for chemistry. There was positive feedback from their parents and an expressed interest in creating similar events.

South Korea Study Abroad Experience

By: Ben Behrendt - Senior Chemical Engineer

During the summer most engineering students take classes, research, or intern, as did I, but I also traveled to Seoul, South Korea for two weeks to teach English. Our group of seven students stayed at Luther University where we taught an English Bible Camp.

The English Bible Camp was open to the public including multiple church-canvassed neighborhoods attempting to get kids involved in the program. Learning English is an important skill for the people of South Korea. It is a useful language for travel and international business because the United States is a major trading partner with South Korea.

Every day we would read through a different Bible account containing new vocabulary, which allowed the children to practice their pronunciation. Afterwards, we would go through the vocabulary and answer any question the children had. Then we would play small group games, such as memory, matching, or bingo with the new vocabulary. Before lunch, we had arts and crafts where the children made an assortment of items, such as sun catchers, necklaces, and crosses, that they could take home. In the afternoon, we would play games outside, such as soccer and have snack time while singing songs.

During this time, I noticed some differences between students in Korea and America. Many Korean students learn by rote, listening, reading, observing and imitating and are unaccustomed to discussion, and debate. They appear passive, timid, defensive, and shy when they are invited to express their opinions and ideas. In contrast to English students, Korean students tend to express themselves in general and indirect ways, even when asked to communicate their ideas. This is because they have been trained to think inclusively and express themselves indirectly so they avoid offending others. Such a reserved attitude originates from Confucian thinking, in which moderation is considered the supreme virtue.

Even though the group's main focus was teaching and enriching children's lives, we were still able to enjoy Seoul. One site was Gyeongbokgung, which is one of five palaces in Seoul from the Joseon Dynasty that ruled Korea for about 5 centuries up to 1897. However, none of the palaces are original due to the numerous wars in Korea since the end of the Joseon Dynasty. It happens that Gyeongbokgung is right in front of the Blue House, which is the Korean equivalent of the White House. The most interesting travel we did was our DMZ tour. We went into one of the four known tunnels from North Korea into South Korea. Three were discovered in the 70s and the last one was found in 1990. These tunnels were made by North Korea to be used as part of a possible attack on South Korea. Some of the tunnels are big enough to move equipment that could reach Seoul within an hour. The depth of the 3rd tunnel that we toured was equivalent to a 20 story building underground. We were able to go 350 yards along the tunnel to the north. Along the entire way we were cold with condensation dripping off the walls and ceiling. The entire way down we had to duck because of the short ceiling. Before we entered the tunnel, we saw a short clip on the Korean war and a case of old weapons that were used. Our group took pictures in front of a mine field next to the entrance of the tunnel. Apparently none of the forests on base were safe to walk through because they were potentially filled with live mines. Afterwards we went to the Dora Observatory where we were able to see the Demarcation Line and North Korea. We had to take pictures of North Korea behind a line because the military did not want us to take pictures of the South Korean military locations. Lastly we went to the Freedom Bridge. The name comes from the fact that prisoners were exchanged over this bridge after the Korean War. Along with the bridge there was a pool in the shape of Korea and a bullet-ridden train. The train was there to show the damage inflicted from the conflict.

Black & Veatch : Internship Experience in Kansas City

By: Kelly McConnell - Senior Chemical Engineer and 2011-2012 President of UI Omega Chi Epsilon Student Chapter

This summer I had the opportunity to participate in a summer internship program with Black & Veatch. Black & Veatch is an engineering, consulting, construction and operations company that completes design work in five major markets. These markets include energy, water, telecommunications, management consulting, and federal. For my internship, I worked in Kansas City, the world headquarters for Black & Veatch, in the water division.

Within the water division, I was able to apply my chemical engineering skills within the chemical and mechanical feed department. The purpose of the chemical feed department is to design the chemical feed systems for water and waste water treatment facilities. Specifically, my work within the chemical feed department included updating P&IDs (Piping and Instrumentation Diagrams), editing equipment specifications, contacting equipment vendors, and compiling cost estimates. I had the opportunity to work on a wide variety of projects and was able to learn a great deal throughout the summer.

In addition to the work that I completed within the chemical feed department, I also participated in the Water Leadership Internship Experience (WLIE) program. The WLIE program is designed to enhance the interns' knowledge of Black & Veatch's core markets and also to enhance the interns' business and leadership skills in relation to consulting services. During the summer, one way that I was able to improve my knowledge of the consulting industry was through preparing and presenting a strategic business proposal exploring potential new business markets to division executives.

I greatly enjoyed my summer internship experience with Black & Veatch and felt that it was a great way to learn about one of the many opportunities available for chemical engineers.

Proctor and Gamble : Internship Experience in Iowa City

By Samantha Weber - Senior Chemical Engineer and Fall 2011 Fundraising Chair of UI AIChE Student Chapter

Over the summer I had the opportunity to work at Proctor and Gamble's Iowa City beauty care plant. Proctor and Gamble is an international parent company that owns a variety of brands that generally involve household or personal products. These brands include Herbal Essences, Crest, CoverGirl, Pantene, Gillette, Tide, Dawn, Duracell, Febreze, Pampers, Old Spice, and many more. At the Iowa City plant I worked mainly with the brands concerning hair care and body wash.

I interned as a process engineer and worked in a department called Making, Packing, & Delivery. This department works with hair care, body wash, and mouth wash products at the plant to ensure that quality is upheld throughout the entire manufacturing process. This department often collaborates with other plants that make the same or similar products to both standardize and optimize the way of producing a product across the globe.

Most of the five major projects I worked on dealt with the validation process. Validation is the testing and documentation required when a product is regulated by the FDA. In the Iowa City plant, Head and Shoulders falls under this category. Although this is the only brand at the plant that requires this level of testing, the plant holds every product to the same high testing standards and has corresponding documentation requirements for each.

Although I did not intern as a chemical engineer specifically, I did use the critical thinking and problem solving skills emphasized in the chemical engineering courses at the University of Iowa. Overall, I had a positive experience at my internship and have since accepted a full time offer as a process engineer at the same Proctor and Gamble Iowa City plant.

Nuclear Fuel Reprocessing

By: Nick Glynn- Sophomore Chemical Engineer

Like all forms of energy, nuclear energy is not perfect. Perhaps the biggest flaw in nuclear energy is that in the process of generating electricity, nuclear reactors produce highly toxic and long-lived nuclear waste. While there are several ideas for how to deal with this unwanted byproduct, there is one method that has the potential to reduce many of the negative aspects of nuclear waste. This method is reprocessing. But exactly what is reprocessing, why is its importance growing, and how will chemical engineers play a role in furthering its development?

In simple terms, nuclear waste reprocessing is the act of separating unused, easily fissile materials such as Uranium – 235 and Plutonium – 239, that are used to produce electricity in nuclear power plants, from the non-fissile material left in the fuel rods. The concept of removing useful materials from the products of a nuclear reaction is not new. In fact, reprocessing has been taking place for as long as nuclear reactors have existed. This is because the plutonium used during the Manhattan Project was separated out from the products of the world's first nuclear reactors (von Hippel 2001). Following the end of WWII and the beginning of the commercial use of nuclear power, the United States had several reprocessing facilities. These were all eventually shut down by the mid 1970's due to the high costs and concerns of the environmental impact of the procedure (WNA 2011). Even though the United States does not have any current reprocessing capabilities, it is considering resuming the process. France, Russia, and the United Kingdom continue to use reprocessing in their fuel cycles today (Bodansky 2006).

The countries that utilize reprocessing in their nuclear fuel cycles enjoy the many benefits the process has to offer. One of the largest benefits is that reprocessing nuclear waste allows power plants to produce 25% more electricity from the fissile materials in the fuel rods by recycling the unused fissile materials in nuclear waste (WNA 2011). As the world's electricity consumption continues to increase, the additional energy that can be generated from reprocessed nuclear fuel will help to keep the costs of nuclear electricity generation low. Using the leftover fissile materials will also prolong the world's uranium supply by reducing the amount of uranium mined every year (WNA 2011).

In addition to increased energy generation, reprocessing nuclear waste has other benefits. Reprocessing reduces the volume of high level radioactive waste (Bodansky 2006). One major advantage of this is that less space is then needed to store the waste long term. By reprocessing nuclear waste, the capacities of current storage sites would be greatly increased, thus reducing the size and number of future storage sites. In addition, the security costs associated with such sites would decrease because more waste could be stored in a smaller area. Furthermore, the waste remaining after reprocessing has much shorter half-lives than non-reprocessed waste (WNA 2011). A shorter half-life means that the remaining waste remains radioactive and dangerous for a shorter amount of time.

Lastly, reprocessing has the potential to lower the risks of nuclear proliferation. Plutonium – 239, a product in radioactive waste that is easily fissile, can be used to make nuclear weapons. Just eight kilograms of plutonium is needed to make a small nuclear bomb (von Hippel 2001). By reprocessing nuclear fuel, the plutonium can be extracted from the waste and used as fuel in nuclear reactors. Once split in a nuclear reactor, the plutonium can no longer be used for nuclear weapons. If the plutonium is extracted from nuclear waste by reprocessing, the chances of that waste being used to assemble a nuclear weapon is essentially zero.

Even though reprocessing nuclear waste has many benefits, it also has its drawbacks. The greatest drawback is widely considered to be its cost. Currently, it is considerably more expensive to reprocess and recycle nuclear waste than to simply dispose of it. According to a government study conducted by France, the country would save $4-5 billion by ceasing reprocessing and simply disposing of its nuclear waste over the remaining operating lifetime of its current nuclear power plants (von Hippel 2001). Taking the cost into consideration, reprocessing is an area in which chemical engineers are bound to make an impact. This is especially important because today, all reprocessing of nuclear fuel is achieved through chemical means. Generally, the waste to be reprocessed is dissolved in nitric acid and the useable, fissile materials are chemically separated from the non-fissile materials (Bodansky 2006). Chemical engineers will thus be of vital importance in finding ways to lower the cost of reprocessing.

Chemical engineers will also play a role in developing new methods of extracting the remaining fissile materials from nuclear waste. One promising new method is using molten salts to dissolve the spent fuel rods and then separating the components of nuclear waste using electricity (WNA 2011). Another separation related problem chemical engineers will help solve is developing means to extract the unused plutonium without completely isolating it. This is important because plutonium alone decays through alpha particles which are not very dangerous to humans (von Hippel 2001). Therefore, a method must be developed to remove plutonium from nuclear waste while keeping it radioactive enough to discourage portability without radiation protection.

Nuclear reprocessing is a field that is likely to remain important for years to come. Despite its many advantages such as increasing electrical generation, decreasing the volume of nuclear waste, and adding extra security against nuclear proliferation, reprocessing still has several problems that need to be solved. Chemical engineers will play an essential role in finding ways to decrease the cost of reprocessing, developing new, more efficient methods of separating the waste components, and coming up with means to safely remove plutonium from nuclear waste while ensuring its security.

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Biofuel Production

By: Ian Armstrong - Sophomore Chemical Engineer

Chemical Engineering is the art of process design and operations behind almost anything imaginable. Chemical engineers work with transforming raw materials into a final desirable product through a specifically designed process. The impact capability is endless of what engineers can do for the world, chemical engineers can change the way we live in multiple ways. Production and improvement of biofuels, purification of drinking water and reduction of carbon dioxide emissions are only a few of the future chemical engineering goals in mind.

According to *The Independence,* in an article talking about the shortage of oil in the world today an interview with Dr Fatih Birol, the chief economist at the International Energy Agency (IEA) in Paris took place. Birol stated that the oil that the world lives off of and depends on is running out faster than anyone ever expected. Birol also said that the global production is likely to peak around 10 years from now (this comment was in 2009) (5). This comment referring to the peak production of oil and the knowledge of the worlds consumption, along with the prediction of the global population hitting somewhere between 7.5 billion and 10.5 billion by 2050 (2), only brings one thing to the minds of Chemical Engineers. Something must be done in order to retain the living styles that everyone has become accustomed to in today's world.

Biofuels are "A fuel derived directly from living matter" (1). This means biofuels can be made from plants that are able to be grown in mass quantities such as in a field or from any living material that can be broken down. This alternative fuel source is said to be essential for future fuel solutions that are affordable, available and clean, according to Arthur Reijnhart, general manager of alternative energies and fuels development strategy at Shell (2).

There are three different types of biofuels, first, second and third generation. The third generation biofuel is the most efficient biofuel but at the moment very hard to produce and achieve. The first generation of biofuels is the peak of biofuel production in today's world, which consists of creating ethanol. "Ethanol comes from the starches and sugars in food crops such as corn and sugarcane" (3). The United States is the current leader in production of ethanol as well as the number one consumer of ethanol. The U.S. production is mainly based off of corn and the ethanol production today is said to be produced at prices competitive with fossil fuels today (3). An issue arises when corn is used for the production of ethanol, its efficiency and is not the greatest for the effort needed to process and transform the grain into the desired product of ethanol. Growing corn requires a lot of fertilizers and pesticides that require fossil fuels to produce (2). Although this is an issue, growing corn is a relatively easy process that can be mass-produced in a short period of time, currently ethanol produced by corn is 10% of the United States consumption of fuel, or 13 billion gallons per year (3). Corn also was the first material that was used to produce ethanol; arguably the reason there is such a big push to increase the overall transition from fossil fuels to biofuels today.

Although corn is not the most affective in producing alternative fuels, the design process that is used has been perfected and Barbara Bramble, senior program adviser for international affairs at the National Wildlife Federation stated, "A sad impact is that we have so much corn that it crowds out the space for [next]-generation biofuels. Who would want to go out on a limb to develop more difficult technologies when corn is so easy?" (2). This is where chemical engineers come into play, chemical engineers design the processes used to produced biofuels among many other things. The main goal of a process for chemical engineers is to create a process that is (i) safe for people and the environment, (ii) efficient and economical, and (iii) fast and easy.

The saying reduce, reuse, recycle has been around for ages but has more meaning that many would think at first glance, a process that can follow this saying while maximizing product output will ideally be the best for its job. With the environment and achieving the higher level of biofuel generations in mind chemical engineers can and already have impacted the way the world uses fuel, although can even more so in the future with the increased production of higher level generation biofuels. Biofuels will not only create a cheaper fuel but one that is more environmentally friendly opposed to burning fossil fuels that create harmful carbon dioxide, which is the leading contributor in the greenhouse effect. "The greenhouse effect is a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases, and is re-radiated in all directions" (4). In other words the burning of fossil fuels increases the overall temperature of the planet, which can be directly related to the issue of global warming.

The inventions and design processes of chemical engineers can directly impact the future of fuel consumption and production. Chemical engineers are behind almost every industrial process, which include the processes that are used today to produce the biofuels already in mass production, as well as the processes that produce goods used by the vast majority of the world in any way, shape or form. With the peak production of fossil fuels right around the corner, the lack of infinite supply and the impact fossil fuels have on the environment creates the opportunity to push for an alternative fuel source. Biofuels being able to potentially replace the use of fossil fuels completely in the future opens the opportunity for chemical engineers to create ideal processes that will drastically improve the safety of fuel consumption/usage as well as being economically friendly.

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(3) *"Generations: Biofuels Are Grouped According To Commercial Maturity.*

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(5) *"Warning: Oil Supplies are Running Out Fast." The Independence. Aug. 2009. Web. Sept. 2011. < http://www.independent.co.uk/news/science/warning-oil-supplies-are-running-out-fast-1766585.html>*

Spring 2012 AIChE Regional Conference

By: **Taylor Malott - Editor and Junior Chemical Engineer**

The Spring 2012 AIChE Regional Conference was held at Washington University located in St. Louis, MO. Over 30 of our students piled into vans on a Friday (March 30th) afternoon to prepare for the many events our students were participating in on Friday evening and Saturday.

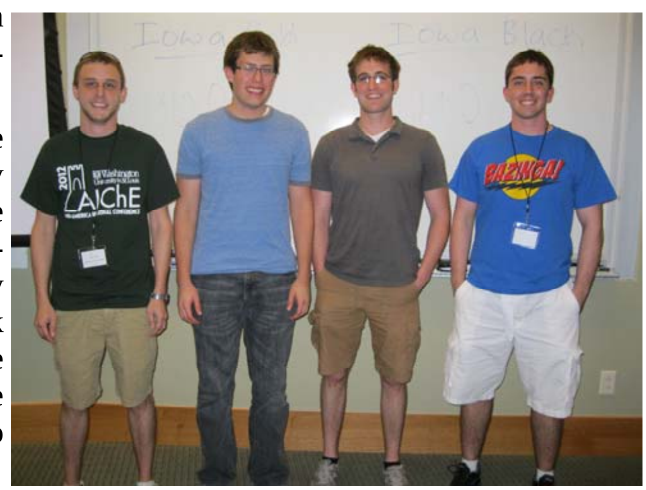
After enjoying a four hour drive, the ChemE Car team immediately departed from the hotel to WashU for the ChemE Car Poster Competition. Other students explored St. Louis for it was a beautiful 80ºF evening!

Before we knew it, Saturday festivities quickly began with Paper Competitions beginning at 8:00 a.m. Participants included junior Matthew Gosse and his research in Polymer and Hydrogel Permeability Studies. Jonathan Bachman, also a junior, presented his research in Iron electron transfer and atom exchange: controls and trace metal implications. Vincent Gutgsell presented the research he has conducted over the course of his junior year on Thiol Epoxy Kinetics Analysis. Last but not least, senior Samantha Westerhof presented at the end of the paper competition on Nanoparticle Phytoremediation of the Poplar Tree. We later learned at the Banquet Dinner that night that Samantha received 3rd place for her outstanding speech and thorough discussion resulting from the diverse questions that arose from her audience.

After attending the paper competition Saturday morning, our two ChemE Jeopardy teams competed against University of Nebraska, University of Arkansas and our cyclone neighbors, Iowa State. However, the other competing schools didn't stand a chance, for both our Iowa teams dominated and competed against one another in the final round. The winning Iowa team consisted of Jameson Schoenfelder, Matthew Gosse, Jonathan Bachman, and Benjamin Behrendt.

Although we accumulated many successes over the course of the Conference, unfortunately our dominating luck ran out when it came time to race the ChemE Car. Due to an incorrect fitting ordered by a WashU technician, the car was not runnable. Although our ChemE Car team forfeited, WashU AIChE members awarded the team with the well-known golden trash can award that has been passed down since 2008.

Overall, the University of Iowa AIChE Student Chapter had a very successful trip to WashU. After acquiring many awards and recognition, it is safe to say our students had a marvelous time!



Spring 2012 SWE Regional Conference

By: **Samantha Westerhof - Senior Chemical Engineer and Fall 2011 UI AIChE Student Chapter President**

The Society of Women Engineers Regional Conference was held February 17-19 at the University of Wisconsin in Madison. Over 20 University of Iowa SWE members headed north for a weekend full of networking, career fairs and fun. The weekend began with a networking event Friday night that gave SWE members an opportunity to visit with employers that would be at Saturday's career fair.

Saturday began bright and early with the joint and collegiate meeting where members could learn about what's happening within our region at the various schools. During the collegiate meeting, the site for the 2013 Regional Conference was chosen to be hosted by the University of Minnesota in Minneapolis. After the morning meetings, breakout sessions were available to conference attendees throughout the remainder of the day. Sessions ranged from learning more about what SWE can do for members on how to handle the professional world.

In order to provide more networking opportunities for students, the companies to be represented at the Career Fair had tables where you could sit down and talk with recruiters during lunch. Once the career fair was in full swing, there were 50+ companies that were looking for every kind of engineering discipline who are located regionally as well as nationally.

SWE members were given the chance to go on four separate tours that highlight what Madison has to offer. The first tour was of the Epic Systems facilities where members got to tour the software companies' site and learn more about the career opportunities they have to offer.

The second tour was of the Wisconsin Institute for Discovery, which is a new state-of-the-art research facility. The research spans from biotechnology to nanotechnology and information technology.

The next tour was of the Babcock Hall Dairy Plant that is the oldest university dairy plant in the United States. The plant supports the research, teaching, and outreach of the Wisconsin Food Science Department and attendees of this tour got an ice cream sample.

The last tour that SWE offered us conference-goers included a Capitol Brewery tour. Capital Brewery produces 16 different beers a year and 22,000 barrels annually and is only one of Wisconsin's 56 breweries. The 21 and over attendees of this tour were allowed a beer tasting at the conclusion.

Saturday's activities concluded with the dinner and a keynote speaker. This year's keynote speaker was a representative from Ingersoll Rand and stressed to the listeners about the importance of going after those things you want in your career path.

At the conclusion of the conference, the Iowa SWE members left with an abundance of employer contacts, more friends in SWE from various schools and overall good memories from the weekend. Iowa SWE members are looking forward to Nationals in Houston this upcoming November and hope it is as fun and rewarding as this years regionals.

NASA: Internship at Ames Research Center in Moffett Field, California

By: **Benjamin Ungs - Senior Chemical Engineer**

In the fall of 2011, I had the opportunity of a lifetime: a semester-long internship at the NASA Ames Research Center at Moffett Airfield, California. It is currently the home of multiple rock star missions, including Kepler – NASA's first mission capable of finding "earth-size" planets, and SOFIA (Stratospheric Observatory for Infrared Astronomy) – which performs infrared astronomy from the aft of a 747.

My internship ("Nanomaterials Development for Sustainable Energy") was in the Planetary Systems Branch, on the Advanced Space Science and Technology project (ASST). More specifically, I worked on a photoelectrochemical cell whose purpose is to convert Carbon Dioxide to Methane. My job was to focus on the anode, improving the cell's photocatalyst, Titanium Oxide (TiO_2) nanowires. Outside the ultraviolet range, TiO_2 absorbs very little light, making it a poor photocatalyst. I was able to increase its absorbance in the visible range using Tungsten Oxide (WO_3) nanowires, which increased the cell's ability to produce CH_4.

> *"The internship really was a dream come true."*

The internship really was a dream come true. Between work and play, there was never a dull moment in those fifteen weeks. We hiked at Big Sur, camped in Yosemite, and biked 65 miles to San Francisco. We got to go on tours of the laboratories at Ames, and attended tours of really neat facilities like the Arc Jet hyper-thermal test facilities, the Advanced Supercomputing Division, the 20G Centrifuge, the Vertical Motion Simulator, and of Ames' 80x120 windtunnel – the largest in the world. We even took a weekend trip to Los Angeles and toured the NASA Dryden flight test facilities.

The internship also provided lots of professional development opportunities. 10 other undergraduates and 2 graduates were sponsored by USRA for projects that semester. I met people native to all parts of the world, including India, China, France, Argentina, and South Africa. Five minutes away in Mountain View, the SETI Institute put on weekly seminars about space science research, and would sponsor astronomers, engineers, and other scientists working at SpaceX, Blue Origin, UCLA, MIT, and others to talk about their work and findings. The richness and availability of information and networking opportunities was nearly overwhelming.

Right from the start, it seemed, I became part of a close-knit jumble of interns, full-time employees, and previous interns in the area who hung out during the week and went out on weekends to explore the area. I will never forget those people, and suspect that someday I will either get to work with or see them again.

The experience, memories, and networking I gained from that semester were truly unique. Doing it may have pushed my graduation back an entire year, but I would do it again in a heartbeat.

NASA Internships can be applied for at http://intern.nasa.gov. For more information, feel free to contact Ben (Benjamin-ungs@uiowa.edu)

Transparent Government Regulations—Freedom from Political Lockdown

By: **Caitlin Andersen - Junior Chemical Engineer and Spring 2012 UI AIChE Vice-President**

Since 1976, the United States government has created regulations in an effort to protect public and environmental health in the area of chemical substances. However, this governing legislation, the Toxic Substances Control Act of 1976, has now become locked in political leverage as the Toxic Chemical Safety Act looks to modernize the policy. This bill was first introduced in 2010 and has yet to be passed by either the House or Senate for political reasons which are seemingly unrelated to the content of the bill. This legislation should move forward solely on the premise of its content—development in the area of chemical documentation and responsible industrial use—in the scope of providing a federal precedent which is public health and safety conscientious.

In an effort to clarify chemical regulations and develop responsible use, the proposed act first and foremost sets forth the provision which "establishes the data that constitute[s] the minimum data set for chemical substances (chemicals) and mixtures; and requires chemical manufacturers and processors to submit their minimum data sets" ("Toxic Chemicals," 2010). Currently, there is a lack of transparency as to which chemicals require pertinent information with respect to toxicity in industrial and public use. There is no established federal baseline for the scientific information in order to accurately assess the level of potential harm. This is governed on a state level; however, it is in public interest that appropriate documentation be available and utilized. This is to ensure that whether the chemical is intended for direct public use or used in the manufacturing of goods for public use, it is safe and free from health implications. By establishing federal regulations for chemicals, a sense of uniformity and clarity will be lent to the industrial use and public understanding.

The development and implementation of modern chemical legislation has been examined within the scope of industry and public health with the guidance and urging of national organizations. The American Chemistry Council takes a progressive, scientific stance on screening by urging Congress and the Environmental Protection Agency (EPA) to derive modernization of this system "from core principles including…prioritize[ing] chemicals to determine which substances warrant additional review and assessment…and make safety information public while protecting intellectual property"(American Chemistry Council, n.d.). The protection of intellectual property is a large concern of industry and scientific development; however, it is necessary to protect the public's wellbeing throughout a development process. By implementing a system with enforceable regulatory and quantitative standards for a chemical's impact, this impact can be determined uniformly for all substances in the areas of health, environment, and economics. Federal regulations allow for accountability in the industrial application of chemical substances while allowing the corporations to maintain their assets. Regulations such as requiring a comprehensive data set for a chemical are not meant to inhibit the progress of technological growth or the meeting of consumer needs. They are in place to protect the consumer and those directly or indirectly associated with the process. By requiring the "manufacturers and processors to bear the burden of proving that chemicals or mixtures meet such safety standard[s]", responsible and safe chemical practices will result.

> *"...data should remain unbiased and free from the lockdown of political leverage in the interest of public safety."*

The provisions contained within the proposed Toxic Chemical Safety Act of 2010 are numerous and several carry merit and address public health as it is impacted by industrial use of chemicals. The provision which compiles a list of all chemicals which fail to meet the proposed regulatory standards is a point of contention among politicians, industry officials, organizational leaders, and the public. The argument is made that this will generate public alarm and that all substances are toxic when dosed in the appropriate quantity. Rather than a list, a ranking system with quantitative measurements of the toxicity in respect to a reference material would suffice for public use with a database available with detailed information. In providing such a database, it is imperative that regulations and data sets be provided for chemicals without the influence of commercial or government interest. Regardless of process, production, or application of a chemical substance, data should remain unbiased and free from the lockdown of political leverage in the interest of public safety. A third party agency should be responsible for developing the data required for a chemical's documentation with consideration given to the areas of health, environment, and economics; however, an appeal procedure should be put in place as well should the company affected feel as though the assessment of a chemical is skewed from reality. By having a series of checks and balances within the analysis of chemicals and the enactment of regulations, all parties involved have fair and equal representation.

It must also be argued that in order for the Toxic Chemical Safety Act to become an enacted statute, the lens used by politicians and industry professionals must be that of public safety, health, and awareness. By creating federal toxic chemical regulations with this mindset, all parties will benefit—politicians will gain support, industry will gain cliental, and the public will gain peace of mind. From a safety and health perspective, federal regulations will provide a means to eliminate public concern and allow for scientific development while caring for the wellbeing of consumers. Explicit expectations of toxic chemical documentation will allow for more effective safety plans and more responsible industrial practices. By accomplishing this on a federal level, uniformity will also be achieved in industry and lend the potential for productivity on a national and international scale.

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Chemical Regulation—What is the Best Approach for the U.S.?

By: **Taylor Malott - Editor and Junior Chemical Engineer**

From the beginning of the Industrial Revolution to present time, technology has widely developed from the simple steam engine to a battery-powered automobile. As the United States and the rest of the world have transitioned toward a technology-driven industry, there is a need for improvement in the chemical industry specifically related to chemical regulation of hazardous materials. Within the last 50 years, U.S. government agencies such as the Environmental Protection Agency (EPA) have put in place laws and regulations like the Toxic Substances Control Act (TSCA) to improve the protection of human health and the environment through better identification of chemical substance properties. However, TSCA has been under scrutiny for its lack of flexibility to determine whether chemicals pose harm, lenient regulations on chemicals that are frequently used, and the level of discrete information for chemicals. Based on comparison, I believe it would be best for the United States to pass regulations to address these gaps and consider incorporating ideas that the European Union REACH regulations contain. If the U.S. can come to an agreement to revitalize TSCA in 2012, we can create a safer, cleaner, more secure chemical industry that can also keep up with our fast developing world.

In 1976, the EPA created the Toxic Substances Control Act (TSCA) to regulate the introduction of chemicals, new or pre-existing, to determine if any risk to people or the environment is present (8). When this act was first introduced, the EPA did not require screening of toxic substances before they entered the marketplace and only had the authority to control toxic substances once damage or an accident had occurred (6). Over the years, lawmakers have fine-tuned TSCA to allow the EPA to require reporting, record-keeping, testing requirements, and restrictions on chemicals (9). However, it has been suggested that it hasn't been enough and an updated TSCA is required.

In April of 2011, Senator Frank Lautenberg (D-N.J.) summarized the primary concerns of many Americans in relation to TSCA. Senator Lautenberg stated, "America's system for regulating industrial chemicals is broken. Parents are afraid because hundreds of untested chemicals are found in their children's bodies. The EPA does not have the tools to act on dangerous chemicals, and the chemical industry has asked for stronger laws so that their customers are assured their products are safe" (3). Over one hundred thousand chemicals are produced globally that have many exposure routes into the human body. Chemical exposures in the workplace can be of great concern as contact to higher concentrations of chemicals can harm workers and offspring. It should also be considered that cumulative effects of multiple exposures could have adverse affects on human health such as chronic disease, asthma, cancers, and reproductive, learning and behavioral disorders (7). Therefore, I think there needs to be improvements with regulations around chemical manufacturing of hazardous materials and to build on TSCA.

One of the main criticisms of TSCA is that it prevents the EPA from determining if a chemical is harmful unless it can demonstrate that the risk is unreasonable. Or more simply put, does a chemical pose a risk to health or the environment and if so, what should be done to prevent that risk. This most certainly infringes on a consumer or company's ability to decide whether or not a substance is a risk (1). This rule could definitely cause a threat to human health if government action must take place before a chemical can be labeled as hazardous. Therefore, to account for this long timeframe it has been suggested to allow chemical manufacturers to prove that a chemical is harmful in order for immediate action. But others have argued that when manufacturers submit data on a new chemical species to the EPA, only about half of the new chemical species reported are submitted with toxicity data (5). Therefore, because of the firm regulations TSCA contains on whether a new species poses a threat as well as the flimsy rules for companies to submit new chemical data, improvements to TSCA are needed. I think it would be in the best interest of the U.S. for the EPA to make improvements to TSCA based on the learnings from the EU's REACH legislation. When REACH was created in 2006, it was built to put the pressure on industry, with the motto, "no data, no market" (4). Therefore, if a company wants a chemical on the market, they should be accountable for providing the proper data and information on the product and to submit it in a timely fashion. I think placing the burden of proof on the chemical companies instead of the EPA would be much more effective. Then it relies less on regulatory agencies to decide if a chemical poses any type of risk while containing strict rules for companies to follow.

Another well-known criticism of TSCA is its regulation for chemicals that are already on the market. When TSCA was created, it "grandfathered-in" around 62,000 chemicals that were already in use. However, no safety testing took place for these chemicals, and companies were allowed to keep them on the market (2). Naturally, this causes concern for the industry and the public if no one has conducted any type of safety review for these substances. By adopting regulations similar to REACH, these chemicals would be assessed based on hazard, exposure, or risk characteristics. Furthermore, based on the application a company submits, which includes economic factors, the cost and benefit of the chemical, and the possible alternatives, REACH can make a more informed decision to grant authorization (1).

Finally, TSCA has frequently been criticized for its "secrecy" characteristic. Under TSCA, companies can label their chemical's information as trade secrets when submitted to the EPA. By law, this prevents the EPA from sharing the information, even if it includes health and safety material (2). Although companies want protection on the chemicals and ideas they create, this has caused excessive use of trade secrets and is in no way beneficial for the public. However, more transparency exists with the way REACH was constructed. Companies are required to provide chemical toxicity information for all registered chemicals and it is made publicly available (4). Therefore, if TSCA was reformed this would be another factor that could benefit from the learning's of REACH.

Based on these few comparisons between TSCA and REACH, I think it is clear that TSCA must be reformed to better protect human health and the environment. Due to its firm rules for deeming a chemical hazardous, this causes a much longer timeframe for analysis. But by adopting regulations similar to REACH, efficiency would be increased for the responsibility would lie on companies to obtain the necessary data. As for the chemicals that TSCA "grandfathered-in" in 1976, using rules developed by REACH, further scrutiny would occur for many chemicals on the market whose overall health or environmental impact still may not be well understood. Finally, using REACH's regulation to force companies to provide more trade secret chemical information could also reform TSCA's secretive reputation. If Congress can come to an agreement this year, I believe it would be beneficial for the public and chemical industry workers if TSCA was reformed and included regulations similar to REACH.

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Chemical Plant Security: A Case for Inherently Safer Design

By: **Nevin Vijh - Junior Chemical Engineer**

Lost amid the financial turmoil currently affecting the global economy lies a serious environmental issue that also delves deep into the core of American political philosophy: the matter of the regulation of chemical plant security by the national government. With the increased involvement of the chemical industry into almost every facet of modern daily life, security within dangerous chemical plants has become a very carefully monitored problem. When dangerous chemicals fall into the hands of terrorists, the United States faces serious risk of civilian casualties, particularly near large metropolitan areas. In June of 2007, the United States Congress enacted the Chemical Facility Anti-Terrorism Standards (CFATS) in an effort to address this issue. Essentially, CFATS established safety mandates for chemical facilities to reduce the likelihood of destructive terrorist attacks. However, it is clear that a government mandate as per the current legislation is actually placing an unnecessary monetary burden upon industry. As such, it is obvious that CFATS should not be modified to further mandate inherently safer design within chemical facilities. Instead, CFATS should be expanded to allow for rigorous security compliance checks to replace a series of empty, unenforced regulations.

Inherently safer design as it applies to chemical plant security can be defined simply as the design of chemical facilities such that systems remain in a non-hazardous state after significant deviations from normal operating conditions (Bollinger, 1996). Inherently safer design uses chemistry and physics as well as quantities, properties, and operating conditions of materials to avoid hazardous situations. An example of inherently safer design would be to substitute water for a potentially flammable solvent (Bollinger, 1996). The introduction of CFATS established risk-based performance standards for chemical facilities within the United States, requiring “facilities that make, use, or store threshold amounts of 322 listed chemicals of interests” to conduct vulnerability assessments, develop site security plans, and submit plans to the Department of Homeland Security (DHS) for approval (Hess, 2012). Generally, environmentalists and congressional Democrats have led the push to further the authoritative power of CFATS to mandate inherently safer design. There are several reasons for which inherently safer design should not fall within the scope of CFATS: most importantly, CFATS is not currently set up in a cost-effective manner that would allow proper monitoring of chemical facilities. In addition, a mandate would significantly increase production costs for many chemical industries, and subsequently decrease production in these industries.

The current CFATS as administered by the DHS is extremely inefficient. The DHS was given only six months to develop and implement a full-scale regulatory program; as a result, people were hired before they were even given a job description. This hasty organization has led to inadequate training of regulatory officials, an over-reliance on expensive consultants, and an uncertainty of the level of regulatory authority carried by the DHS. Rand Beers, the head of the DHS’s National Protection & Programs Directorate, speaking in front of the House of Representatives Committee on Energy & commerce, acknowledged that CFATS “needs a whole lot of work” (Hess, 2012). CFATS has absorbed as much as $103 million per year from Congress, and according to Rep. Joe L. Barton (R-Texas), “CFATS has received 4,200 site security plans without conducting a single compliance inspection” (Hess, 2012). The CFATS program is in too much disarray to further burden it with the responsibility of monitoring the widespread implementation of inherently safer design, which would carry an even greater time commitment and higher economic cost. It is clear that the CFATS program needs to be restructured so that properly trained officials can act as true mediators to ensure that chemical facilities are complying with all safety standards created by the original CFATS. As such, the CFATS program should be transitioned into more of a collaborative process with the chemical industry, as opposed to the current administrative setup.

The overarching goal of the program was not to incur excessive fines on the chemical industry, but to ensure the safety of the American public.

Another problem with mandating inherently safer design is the inevitability of massive cost increases for the chemical industry. Requiring all systems to be redesigned in an effort to be inherently safer would require complete overhauls of existing systems. In general, it is not as simple as just replacing a flammable solvent with a nonflammable solvent. Much more money would need to be put towards research and development to find safe alternatives to existing processes. For example, the pharmaceutical industry would be devastated by this mandate: previously approved drugs would have to be re-approved if the process to produce the drug was significantly altered. Clinical trials would be delayed for years; excessive production costs would be pushed to consumers in the guise of skyrocketing drug prices. Dr. M. Sam Mannan, director of the Mary Kay O'Connor Process Safety Center at the Texas A&M University, has stated that "the most effective steps to further infrastructure protections will likely include incentives, rather than new regulations" (SOCMA, 2008). It is obvious that mandates upon the chemical industry will hamper the American public more than it will help by placing monetary burdens on the chemical companies that will eventually be pushed to American consumers.

It goes without saying that the safety of the American public is much more important than incurring large costs to chemical industries. However, if a mandate for inherently safer design through the CFATS program were to be introduced anytime soon, it is unlikely that the American public would be any safer. This may be attributed primarily to the lack of quality organization within the administration of the program. However, if the current CFATS program were modified to include more security checks, and possibly mandate more explicit safety measures, chemical facilities would immediately become safer. These measures could include mandatory fail-proof lockdown procedures, or simply a greater security personnel requirement. After all, as the chemical engineering code of ethics states, the safety, health, and welfare of the general public is always held paramount to all other objectives. In order to ensure the safety of the American public, legislators need to work collaboratively with the chemical industry to determine the best possible shared outcome.

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Inherently Safer Design

By: **Andrew Hesselink - Junior Chemical Engineer**

Chemical plants are necessary for society to function. Unfortunately, chemical plants also use extremely dangerous, toxic, corrosive, and/or explosive compounds which could be released by terrorists to cause severe harm to the public. The Department of Homeland Security (DHS) claims to understand the danger posed by chemical plant terrorist attacks, and in response, created the Chemical Facility Anti-Terrorism Standards (CFATS) in June of 2007. The program requires plants that handle certain high-risk chemicals to assess and improve safety standards and implement security programs to prevent terrorists from utilizing their facilities or materials to cause harm (Hess, 2012, p. 28-29). While this regulation is a start, promoting safety in chemical plants should not require the threat of terrorism, and should not consider terrorism the only threat. A proper policy governing the safety of chemical plants should require inherently safer design, which looks to minimize risk by postulating a chemical plant's worst case scenario, and making every effort to design the processes within to withstand these conditions (Crowl and Louvar, 2012, p. 416).

Inherently safer design can be applied to all stages of a process in industry to reduce the associated risk. Using vessels with pressure ratings exceeding those required to lessen the chance of a runaway reaction causing a rupture, or replacing a flammable solvent with a water-based one to prevent fires, or performing an evaporation with a vacuum rather than heat to prevent fires or pressurizations, are all design improvements that can make a facility drastically safer (Crowl, Louvar, 2011 p. 416-417). The goal should be to make the processes in industry as safe as possible even when operating outside of normal conditions.

A plant built with inherently safer design in mind should be prepared for a terrorist attack. It should also be prepared for a runaway reaction, a leaky valve, a disgruntled employee, and the multitude of other scenarios that could all result in the same disastrous release of a toxic chemical. The DHS is only concerned with threats posed by terrorists, but if the results could all be the same, why not write a policy that covers them all?

Just as important as the policy is the enforcement thereof. The DHS is currently under fire for its lack of enforcement of CFATS. Since its inception, the DHS has reviewed over 40,000 facility risk assessments, but has not performed a single inspection to assure manufacturers are effectively implementing the proposed improvements (Baum, 2012, p. 3). If the manufacturers aren't making changes, then the entire process was a waste of time and tax money. If a policy is expected to elicit any change in industry, the government must be prepared to back it; however, fines should not be the only form of feedback. All manufacturers, not just those handling "high-risk chemicals" should be required to perform safety analyses of existing and new processes within their facilities. The government should work with manufacturers to implement inherently safer design principles, and should perform inspections to assure that positive changes are being made, and being made according to specifications. Legal action should be taken against any manufacturer not willing to cooperate as they clearly do not value the safety of the public or their own employees.

The goal of government policy regulating chemical plant safety should be to promote to inherently safer design. By making a process safer under even the most dangerous operating conditions, the risk to employees and the public can be reduced. There would be no need for specific policy concerning terrorism, as it would be accounted for during the design process.

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Your help is much appreciated!

Interested in speaking at professional seminar? If so, then contact AIChE Student Chapter President Jonathan Bachman at jonathan-bachman@uiowa.edu or Student Chapter Advisor Prof. David Murhammer at david-murhammer@uiowa.edu for details and availability!

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