CHEMICAL ENGINEERING NEWSLETTER

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University of Iowa

Advisor's Corner

By Professor David W. Murhammer

Greetings to Hawkeye Chemical Engineers!! This AIChE Student Chapter Newsletter is a combined Fall 2008/Spring 2009 issue. Our intent is to have our traditional two separate issues again during the 2009-10 academic year. I am proud to note that our Student Chapter was again acknowledged as an Outstanding AIChE Student Chapter at the 2008 AIChE National Student Conference. This and other student awards received during the 2008-09 academic year are listed on the last page of this newsletter.

This issue begins with articles about the Fifth Annual Spooky Sprint fundraiser for the Iowa City Shelter House and the attendance of our students at the 2008 AIChE National Student Conference. Next, there are a series of "topical papers" written by our students, including (i) two papers from our Process Calculations course about the future of Chemical Engineering, (ii) two papers from our Chemical Process Safety course about the EU REACH program and its applicability to the US, and (iii) two papers from our Chemical Process Safety course about protecting chemical plants from terrorists.

This issue also contains articles about our student chapter's participation in the 2009 AIChE Regional Conference held in Columbia, MO and the ChemE Car Competition held at this conference.

Finally, I encourage our alumni to donate to the Kammermeyer Education Fund, which is an endowment fund used to support our educational mission, including support of student chapter activities. For example, the interest from this endowment will be used to support student participation in the Regional and National AIChE Conferences. If you are interested in contributing to this fund, then please contact me via email at david-murhammer@uiowa.edu to discuss specific details.

INSIDE THIS ISSUE

Spooky Sprint coordinators Kelsey Coulter and Leah Zmolek present Crissy Canganelli, Executive Director of the Shelter House, with a check (left). Participants anxiously wait outside the Seamans Center for the start of the race (above). For more information about the Spooky Sprint event and its purpose, see page 2.

Fifth Annual Spooky Sprint Supports Shelter House

By Leah Zmolek

For the 5th year in a row, The University of Iowa's American Institute of Chemical Engineers student chapter (AIChE) hosted the Spooky Sprint 5K Race. The Halloween themed run/walk was held this academic year on October 26th, 2009. The entry fees and donations benefited the Iowa City Shelter House. The Iowa City Shelter House is a non-profit organization that has provided housing and supportive services to the homeless in Johnson County as well as the surrounding area. Since 1983, the shelter has provided transitional housing to the disabled, the elderly, and others in need. The race provided another excuse for children to wear their costumes, and parents to support their community.

The race was organized by Kelsey Coulter and Leah Zmolek for months prior to race day, coordinating sponsors and volunteers, as well as recruiting participants. On a Sunday morning at 10:00 AM, volunteers from the Iowa City Shelter House and the University of Iowa AIChE student chapter took post throughout downtown Iowa City to direct participants. The runners and walkers completed a 5K race while wearing their Halloween costumes. Prizes were awarded to participants with not only fastest completion times but also best costumes. The costumes were judged by Mayor Regina Bailey and Dean Barry Butler on originality, humor, scariness.

The 2008 Spooky Sprint had a record number of community sponsors as well as runners. All the prizes awarded to runners as well as the post-race breakfast were donated by local businesses. The race's growth is due the community's growing awareness of the importance of such a shelter in the area. The local businesses and residents are beginning to embrace the race and in turn support the community. This year's race turned a $600 profit, not including the non-monetary donations, that was donated to the Shelter House.

For more information about the Shelter House or the Spooky Sprint, please visit http://www.shelterhouseiowa.org/ or www.engineering.uiowa.edu/~aiche, respectively.

2008 AIChE National Student Conference

By Austin Gunn

The 2008 AIChE National Student Conference was held November 14-18 in Philadelphia, Pennsylvania at the Philadelphia Marriott & Pennsylvania Convention Center. The Convention center was located on the historical Market Street within 8 blocks of the Liberty Bell and Independence Hall. Three students (Austin Gunn, Tyler Gunn, and Annemarie Jordan) from the University of Iowa attended along with Professor Murhammer.

Tyler Gunn entered the Paper Competition for the University of Iowa with his paper titled "Seed-Mediated Growth of Platinum Nanoparticles Via Green Chemical Reduction of Platinum Salts." This presentation was based on summer research performed at the National Science Foundation Research Experiences for Undergraduates site at Auburn University. He gave a very knowledgeable and interesting presentation, finishing in 2nd place. His abstract was as follows:

"Monodisperse platinum particles of various diameters were grown from platinum seeds utilizing a stepwise addition of calculated amounts of platinum salt and ascorbic acid. Ascorbic acid, being a weak reducing agent, prevented new seed nucleation while fully reducing the platinum salt in solution. It was discovered that as the platinum seeds were grown into much larger particles they became more faceted; increasing their surface area-to-volume ratio. This new nanoparticle synthesis technique allows the creation of uniquely faceted platinum nanoparticles of controllable size that are ideal for catalysis."

Anna Jordan received 3rd place in the "Food, Pharmaceutical, and Biotechnology" Section of the Poster Competition. Her abstract was as follows:

"Acetylcholinesterase (AChE) catalyzes the hydrolysis of the neurotransmitter acetylcholine (ACh) to terminate nerve signal transmission in the central and peripheral nervous systems. A consequence of Alzheimer's disease is the depletion of ACh concentrations in the brain, resulting in a decrease in the brain's capacity to transmit nerve signals and associated cognition impairment. In order to combat the depletion of ACh, our research group is focusing on the design and optimization of AChE inhibitors.

The blueprint for drug design includes a meta-substituted aryl trifluoromethyl ketone functional group that targets the active site of AChE. Inhibitor variants are created through the use of nitrogen-based connectors of different lengths that include an aryl, substituted aryl, or other moiety that targets the peripheral site of AChE.

My individual research role focuses on the kinetic evaluation of inhibitors through UV-VIS spectroscopy. Reaction rate data are first used to determine the inhibitor concentration causing a 50% reduction in ACh turnover. Additional assays yield rate constants for slow, tight binding inhibition, as well as the overall residence time of the inhibitor on the enzyme. The results of the kinetic analyses indicate superior peripheral-site moieties and direct improvements in inhibitor design."

The University of Iowa received the Outstanding Student Chapter award on Sunday, along with others such as: University of California, Santa Barbara; Georgia Institute of Technology; Kansas State University; Oklahoma State University; Oregon State University and Texas Tech University. Iowa has received this award 15 out of the last 16 years.

The ChemE car competition took place on November 16th and had 29 teams. The point of the ChemE car competition is for a student constructed car to be able to run off of a chemical reaction of their choice. They need the car to travel a specified distance between 50 and 100 feet with an unspecified load of water up to 500 mL. The teams do not know the distance or amount of water until 1 hour prior to the competition. The cars ranged from ethanol combustion, to citric acid mixed with carbonate and to hydrogen powered engines. Cornell University came in first with their hydrogen powered car. They stopped exactly on the line, which is a first during the 10 years of this competition. Louisiana State University finished second, and Texas A&M came in third also with a hydrogen gas propelled car.

During the ChemE car safety training class, a nuclear powered car was mentioned, which would make for a very exciting competition next year. The University of Iowa unfortunately did not qualify for the 2008 National Competition, but hopefully they will qualify next year!

Along with the competitions, there were many activities that were interesting and beneficial to attend. Some of the Student Chapter Workshops included, "Networking with Industry and Alumni" and "Community Service: Making an Impact in Your Local Community." There also were some enlightening Career Planning Workshops such as "Interviewing in the Energy Sector: Careers in Traditional and Alternative Fuels" and even one on "Dining Etiquette for Young Professionals." Additionally, there was a Graduate School Fair & Undergraduate Career Fair on Sunday.

Overall the conference was exciting, and with an anticipated 4,500 attendance, many people were involved. Everything ran smoothly for the most part, and it was well organized. The area around the conference was unique, and the Rocky Balboa famous steps of the Philadelphia Museum of Art could be seen from the hotel. The 2009 AIChE National Student Conference will be held November 8-13 in Nashville, Tennessee. Information about the conference and many other helpful links can be found on the AIChE website (www.aiche.org).

Chemical Engineers: The Future of Biofuels Depends on Them

By Stephanie McCoy

In today's world, biofuels are a creative and clean but harmful and dangerous part of the earth's energy future. The world has only a limited supply of oil, and biofuels offer a plentiful alternative. However, challenges in pollution, design, and cost are impeding the manufacturing of biofuels.

At first consideration, biofuels seem like a perfect alternative to the limited and costly supply of fossil fuels. Gas prices are soaring, and burning fossil fuels in cars and trucks emit huge quantities of pollution and accelerate global warming. The earth has only a limited supply of oil, and drivers are consuming it quickly. Fueling with crops appears like a thrifty and practical way to save money. It seems that biofuels would be less expensive to grow and produce, and they would not emit as much pollution as burning fossil fuels. The earth may take thousands of years to replenish its oil source, but farmers can grow corn and sugar cane that can be used in biofuels each and every year (Grunwald, 2008).

However, by accelerating global warming, using up forest land, and endangering the hungry, biofuels are currently hurting the world much more than they are helping. The most popular biofuels today are made from either corn products or sugar cane. To produce more of these materials, farmers are destroying rain forests, such as the Amazon Rainforest in Brazil. Workers light scorching fires to clear land, and in setting the land ablaze, large amounts of carbon dioxide are released into the air. Furthermore, rainforest plants have an important responsibility to convert carbon dioxide to oxygen. Without them, more carbon dioxide is left in the atmosphere to accumulate every year. Currently, the cost to the environment of destroying the land necessary for corn production outweighs the gains reaped in using ethanol or other biofuels in cars. Destroying the rainforests for biofuels production is especially sickening to locals who see the beautiful forests go up in flames. "It's like witnessing a rape. Out here on the frontier, you really see the market at work," said one Texas resident on the matter (Grunwald, 2008). The cost to the natural beauty of the earth is surely immeasurable. In addition to harming the earth, biofuel production is harming people's well-being. Because farmers are selling corn and sugar as fuel instead of food, the production of biofuels is endangering the poor's supply of food. According to *TIME magazine*, the amount of corn it takes to fill an SUV tank with ethanol gasoline would feed a person for a year (2008). It is pertinent that a non-edible or much more efficient fuel be developed.

Chemical engineers and other scientists are working to develop superior biofuels. The first biofuels developed were destructive to the environment: corn ethanol and soy biodiesel. The 'new generation' of biofuels being developed include sugarcane ethanol, algae, and waste products. According to *NY Times'* "Gassing Up With Garbage," "Virtually any material containing hydrogen, carbon and oxygen could potentially be turned into motor fuel" (Wald, 2008). There are endless possibilities for alternative fuels. For example, one company founded five years ago hopes to commercialize an algae-to-fuel process. Not only would algae make a completely green fuel, it also grows well in high carbon dioxide conditions. Companies are also looking into creating fuels from pine forests' wastes. Fuels could be produced from the most unusual materials: wooden utility poles contaminated with arsenic could be converted into fuel. Wheat straw and even turkey guts are being tested as fuel. The Federal Energy Department and some large companies like General Motors are taking interest and investing in these 'wild' fuel prospects (2008).

Although converting turkey guts and wheat straw to fuel may seem far-fetched, the projects that DuPont and Genencor are adopting seem very practical. They plan to make ethanol from the non-edible parts of corn and sugar cane. Sugar requires less land to grow on than corn, so it could be more suitable for biofuels. Sugar plantations in Brazil, for example, produce 45% of Brazil's fuel on only 1% of its land. Brazilians have converted the leftover biomass into electricity and reduced fertilizer use while increasing yields of sugar (Grunwald, 2008). CEP gives us a glimpse of what this process looks like:

> By selecting different catalysts and processing conditions, various types of sugars, including mixed sugar streams and polysaccharides, can be reliably converted into the desired non-oxygenation hydrocarbon fuels ("Catalytic Process", 2008).

This process is complicated, but it may be an efficient and reliable prospect for future producers of biofuels.

It is of the utmost importance in the future of world energy that chemical engineers develop fuels that require no more land to be cleared. Chemical engineers must use the world's land as efficiently and sparingly as possible. They must further develop fuels from materials that grow in denser fields, such as sugar cane (Grunwald, 2008). Engineers cannot use too much biomaterial that could potentially be used for food. Instead, they must fully research non-edible and waste materials that do not steal from the world's bread basket. The final challenge for chemical engineers is to develop a fuel that (in addition to all the previous criteria) costs less to produce than current methods of production. Chemical engineers are essential in the future of world energy.

The horizon for biofuels is wide and varied, with prospects anywhere from turkey guts to sugarcane and corn. Problems with materials, design, and environmental issues must be overcome by today and tomorrow's chemical engineers. The world's oil supply is running low, and the environment is in peril. The United States' pride is at stake. Chemical engineers must design a cheaper, more efficient fuel.

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The Future of Chemical Engineering: Biopharmaceutics

By Laura Northrup

Although modern pharmaceutics is barely a century old, huge leaps are already being made in the field of biopharmaceutics (Walsh 1999). Biopharmaceutics encompass drugs produced by genetic engineering and other biotechnology techniques (Encarta 2007). These drugs are usually designed through the manipulation of biological organisms or molecules in order to create new substances which are useful to mankind (Schlesselman 2004). In the near future chemical engineers will play a large role in the production process of biopharmacuetics.

At the turn of the 20th century, there were only four pharmaceutical drugs available which had been scientifically proven to treat their targeted ailments (Walsh 1999). Today over 10,000 pharmaceutical drugs are on the market, and about 100 of these are biopharmaceutics. Drugs produced by biotechnologies are used to treat many different diseases, including cancer, AIDS, multiple sclerosis, diabetes, hepatitis, cystic fibrosis, and Alzheimer's disease. "Currently, another 350 more biotech products are undergoing clinical trials" (Schlesselman 2004). Most biopharmaceuticals are protein-based therapeutic agents, but many nucleic acid-based drugs are being researched. These nucleic acid-based drugs have the potential to be used in the creation of vaccines for certain cancers (Walsh 1999). The possibilities for future developments in this field are endless, and therefore this industry is destined to grow.

The area of biopharmaceutics will face many challenges in the future, almost all of which will be directly related to chemical engineering. The foremost of these challenges is the attempt to decrease costs. Due to the extensive technology required to create biopharmaceuticals, these medications often carry a price tag much larger than most others in production. The majority of biopharmaceutical products currently on the market are produced by recombinant DNA technologies, usually within *E. coli* cell lines (Walsh, 1999). This process can be expensive and only produce low concentrations of the desired product. As the biopharmaceutical industry increases, chemical engineers will be called upon to scale up, increase the yield of the product, and develop new, improved methods of production. Many cheaper and more abundant sources for biopharmaceuticals are currently being researched, including the use of stem cells and xenotransplantation, the use of animal organs and cells (Schlesselman 2004). Unfortunately these methods raise many moral concerns, causing difficulties in receiving funding and approval for further research.

Another challenge facing the biopharmaceutical industry is the demand for generic versions of the drugs. Almost all traditional medications on the market have cheaper generic equivalents, but it can be enormously difficult to create a generic biotech medication. "Because biopharmaceuticals are the result of a cellular process rather than a chemical one, they are generally much larger and more complex than traditional medications" (Schlesselman 2004). This complexity leads to more specific regulations and requires more testing to have a generic approved. The cost of such testing deters most companies interested in creating a generic biopharmaceutical. In addition, biomaterials can be extremely difficult to patent. Patents of biotechnologies can become complicated to acquire due to the fact that biotech products often represent an entity that belongs to all living things, such as a gene sequence, which can make it incredibly difficult to determine if the patent should be approved (Schlesselman 2004).

As the population ages there will be an increasing demand for more superior and innovative pharmaceuticals, such as biopharmaceuticals. However, this industry will be unable to move forward unless all aspects of production can be improved. Due to such challenges facing the biopharmaceutical industry, chemical engineers will need to play a large role in securing a prosperous future for biopharmaceutics.

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REACHing for Chemical Safety is Good, but Not for the US

By Amy Althoff

In June of 2007, the European Union (EU) approved a new law for the chemical industry across Europe, dealing with the registration, evaluation, authorization and restriction of chemical substances, called the REACH program. The regulations in this program were created to improve chemical safety as well as to increase the competitiveness of the chemical industry in the EU. Overall, the REACH regulations are an improvement for the EU, but they should not be applied to the United States.

The REACH program was created for two main purposes: to protect human health and the environment from chemical risks, and to enhance the competitiveness of the EU chemicals industry. The regulations are meant to improve safety by requiring chemical manufacturers and importers to obtain relevant safety information for the chemicals they use or create. Additionally, the program mandates data sharing between companies as well as to the public in order to make chemical hazards public knowledge ("REACH: In Brief," 4-5). Another way REACH hopes to make the industry safer is by requiring that less harmful substances be used if less toxic alternatives are available (Kumar). Apart from safety, REACH was developed to shorten the time-intensive process which was previously needed to approve new chemicals for use, thereby making the European chemical industry more competitive with other countries, such as the United States or Japan ("REACH: In Brief," 3). Both of the REACH program's aims make it a beneficial law for the EU.

The REACH program is advantageous for the European Union for many reasons. First, the program is important to create consistent regulations for all European countries. With the program, the EU does not have to worry about import and export regulations between countries, because all nations will be controlled by the European Chemicals Agency (ECHA) located in Helsinki, Finland ("REACH: In Brief," 6).

Another benefit of the REACH program for the EU is that it requires chemical companies to develop more information on the effects of chemicals on human health and the environment than the previous regulations. Before any new chemicals are manufactured, the manufacturers must register the chemical as well as any potential hazards. Additionally, the usage and hazards of existing chemicals are monitored by the ECHA. This is a definitive improvement over the pre-REACH system, where all chemicals being produced before 1981 were not regulated ("Chemical Regulation," 7). Therefore, the REACH system is safer because it has a central organization, the ECHA, to regulate the amounts and dangers of chemicals in use in addition to requiring safety information for both new and existing chemicals.

Finally, the REACH regulations are constructive because they encourage extensive sharing of research data, which was not regulated in the past. This allows companies to view other companies hazard findings, which lets them save resources and prevents unnecessary animal trials ("REACH: In Brief," 7). Additionally, the increased data sharing relates to the public. The non-confidential chemical information such as hazards are published, giving the public a right to know and allowing them to make decisions about which chemicals they choose to use ("REACH: In Brief," 15). Overall, the REACH program is a positive step in chemical regulations for the EU over their previous system.

While the benefits of the REACH system are an improvement for the EU in comparison to its previous regulations, the program is not applicable to the United States for numerous reasons. In the US, chemicals are currently governed by the Environmental Protection Agency (EPA) as part of the 1976 Toxic Substances Control Act (TSCA), which was created to control chemicals that pose an unreasonable risk to human or environmental health ("Chemical Regulation,"1). The TSCA has been successful since its inception, and contains many of the regulations in the REACH program which make it beneficial. For example, the TSCA regulates existing chemicals as REACH does, with 62,000 of its 82,000 inventoried chemicals having been in use before 1979 ("Chemical Regulation," 2). Another positive similarity for both programs is disclosing certain information to the public. In general, many of the benefits to the REACH system are already a part of the TSCA, and applying the REACH program to the United States would be unnecessary.

Another reason that the TSCA is superior for the US chemical regulating needs is that it allows for greater success in the chemical industry. In the US, most of the responsibility to research chemical hazards falls to the EPA. Therefore, the EPA ensures the safety of chemicals rather than placing the burden on manufacturers and importers as is the case in the REACH program ("REACH: In Brief," 5). Putting manufacturers in charge of chemical information creates the risk of spending too much time and money having to research chemical hazards. The extra responsibility for businesses may deter chemical companies from competing in the industry, which is one thing REACH meant to improve. Additionally, the REACH program relies on the good faith of the companies to disclose information, presenting "a major challenge to make sure that balanced and well-informed socio-economic analyses are produced" (Kumar). As seen by these drawbacks, the REACH program has issues to work out before the United States would want to adopt its regulations.

The European Union's REACH law provides a step forward in chemical regulations for the EU by creating a universal system for European countries, requiring safety data for new and existing chemicals, and publicizing hazard data. Although advantageous for the EU, the REACH program is not applicable to the United States, which already has a successful regulatory program created by the Toxic Substances Control Act. The TSCA shares benefits with the REACH program without its significant drawbacks, making it unnecessary to adopt REACH at this time.

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To REACH or not to REACH?

By Anne-Marie Marquez

The Toxic Substances Control Act (TSCA) was signed into law in 1976 by President Gerald Ford. It was designed to provide a means for the Environmental Protection Agency (EPA) to oversee the regulation of chemicals manufactured and imported into the U.S. Although this act has held an important role in the last 30 years, it has become cumbersome and outdated. It is time for the U.S. to take a fresh look at regulation of the chemical industry and perhaps start by looking at the most recent regulation enacted by our allies in the European Union: the Registration Evaluation & Authorization of Chemicals (REACH) program.

For many years the EPA has held a firm grip over the chemical industry. It has been able to effectively restrict the use of chemicals such as polychlorinated biphenyls, chlorofluorocarbons, and lead (EPA.gov, 2008). But that is not necessarily where the TSCA seems to lack. It has quite enough authority to request information on any substance that it considers "may" pose reasonable threat to health and safety (Hogue, 2007). But the main issue that remains unresolved by the TSCA is the ability of the public to obtain information on toxic substances. Only about 2200 chemicals are represented in the EPA's recent crowning achievement: the High Production Volume (HPV) Challenge that encourages companies to offer up information voluntarily regarding chemicals produced in volumes of 1 million or more pounds per year. But considering that there are somewhere between 8300 and 83,000 chemicals in commerce, this hardly seems acceptable (Hogue, 2007). And although the EPA has the authority to request information regarding any substance, it has no authority to regulate that substance in any way until it has garnered a mountain of scientific evidence. This evidence not only has to prove that it is an unnecessary risk to health and safety, but it has to provide alternatives or suggest safer methods of use for the substance. For example, many point to the EPA's inability to ban the use of asbestos as a shining illustration of how the burdens of the TSCA make chemical regulation very difficult even for chemicals that are known carcinogens such as asbestos (Hogue, 2007).

The REACH program has a highly streamlined approach to the regulation of chemicals. It ensures that all chemicals of "high concern" are dealt with appropriately and effectively using a method of registration and evaluation (European Commission, 2007). It even provides a means for data sharing under a central database that will be controlled by the European Chemicals Agency (ECHA). This database will promote non-animal testing by allowing industries to communicate and pool data to either eliminate or reduce the need for further testing on vertebrates. It also states "Information relating to health, safety and environmental properties, risks and risk management measures is required to be passed both down and up the supply chain" (European Commission, 2007). This means that information must be available to anyone involved in chemical commerce. This database is the first step in a modern approach to chemical regulation. REACH also makes any information that is not already confidential (i.e., a part of a patented manufacturing process) part of the public domain to further promote safety at all levels of commerce (European Commission, 2007). This differs from the TSCA which does not mandate all information on any chemical regarding health and safety be made part of the public domain. It only requires that a limited amount of data on chemical hazards be made available and many companies find loopholes that allow their information to remain "unnecessarily confidential" (Hogue, 2007).

Although the TSCA was a defining moment in chemical commerce's history, it is now in need of modernization. It is cumbersome, and does not allow the EPA enough room to control substances effectively. Not only this, but it does not allow the public to be involved or aware of the hazards pertaining to chemicals used on a daily basis. The REACH program has a very streamlined view of chemical regulation. In order to be able to share data more effectively and reduce tedious or unnecessary testing, a database has been created to allow information to be shared between everyone involved in chemical industry. It has also managed to find a way to involve the public and allow more safety information to become available which is a far cry from the HPV challenge initiated by the EPA. In essence, the REACH program is a fresh way to look at the regulation and control of chemicals. It an example of legislation the U.S. should consider enacting.

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Chemical Plant Security Clashes with State Sovereignty

By Zach Rodenburg

In light of recent terrorist attacks both domestically and throughout the world, national attention toward this topic has grown considerably. Additionally, the emphasis on dealing the challenging issue of terrorism has undergone an ideological change: one in which the focus of our country's intelligence and security efforts have become more proactive and less reactive. By focusing on preventing terrorist attacks, the United States has indeed become a less desirable target, and therefore has undoubtedly served its people in further deterring such acts of violence both in the present and future. One common suggestion regarding ways that the effects of terrorism can be made even less severe, however, is to take additional precautionary measures to secure vulnerable chemical plants. These manufacturing outfits, which often store and process large quantities of potentially hazardous, toxic, and highly explosive materials, are considered by the government, media and public to be likely targets for future attacks. Under the right conditions, such plants have the potential to harm or kill humans and damage the environment due to the nature of the materials they process. It is for these reasons that new laws should continue to be enacted to further isolate and secure these sites from those who wish to wreak terror on society.

After the attacks of September 11, 2001, the US Congress gave authority to the country's Department of Homeland Security (DHS) to "analyze vulnerabilities and suggest security enhancements for [the chemical industry's] 'critical infrastructure'" (Schierow, 2006). Following this action, congress quickly passed The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (P.L. 107-188) and the Maritime Transportation Security Act (MTSA, P.L. 107-295), which included provisions for "vulnerability assessments" and "emergency response plans" for chemical plants located in ports or supplying drinking water (Schierow, 2006). Although these regulations were quick to be implemented as protection for US citizens, little legislation was passed between their approval and 2007, which begged the question of whether these regulations were sufficient. The acts excluded a number of other chemical facilities that may present a danger to the public if attacked, such as manufacturers of dangerous chemicals and wastewater treatment plants.

One specific incident in which a chemical plant, much like the ones left unregulated by the aforementioned laws, was attacked was in February of 2007 when Sunni terrorists blew up chlorine gas cylinders in Iraq as they were transported from a manufacturing facility. The resulting toxic fumes killed and injured dozens of people (Ember, Securing Chemical Facilities, 2007), and the event served to remind citizens and lawmakers of the potential threat that such chemicals can pose without adequate security and regulation. The event happened shortly after the DHS was given the authority to implement "'interim final regulations' for the security of certain chemical facilities in the United States," (6 CFR Part 27) however, indicating that the country had perceived these threats and sensed the need to implement additional regulations. This provision was passed in late 2006 and the DHS released their final rules, which classified all chemical facilities into various "risk tiers" that require different levels of security, in April of 2007. The new regulations were a much-needed addition to those passed in 2002, but still left plenty of room for improvement according to lawmakers and environmental groups (Ember, Chemical Plant Security, 2007).

One complaint regarding the new regulations comes from New Jersey house representative Steve Rothman, who describes the bill as "outrageous" (Ember, Securing Chemical Facilities, 2007). In his state, where chemical industries abound and strict state standards for plant security have existed for some time, the new federal regulations would supersede state laws, thereby actually reducing security. State environmental groups also complain that the DHS rules prevent the state from actively pursuing even more stringent requirements in the future, further limiting the state's potential to remain a leader in the area. As of 2007, state officials have continued to work on modifying the bill so that states like New Jersey can retain the right to implement their own security standards above and beyond those prescribed by DHS (Ember, Securing Chemical Facilities, 2007).

Overall, the United States has made significant progress toward securing chemical plants since the terrorist attacks of September 11th. Several new laws were passed from the years of 2002 to 2007, and for the most part they have reduced the ability of terrorists to make use of such facilities as weapons. In some cases, such as in the state of New Jersey, however, overzealous federal laws have actually had the effect of reducing the security of already well-regulated chemical industries. Therefore, it would be prudent for the United States to continue their efforts of securing these facilities, but allow more ambitious states to develop their own standards if they exceed those prescribed at the federal level.

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Law For Securing Chemical Plants: Good Policy? How Can It Be Improved?

By Olga Jennings

On August 28, 2008, an explosion occurred at the Bayer CropScience chemical plant in West Virginia and nearly destroyed a methyl isocyanate (MIC) holding tank. While this incident resulted in the deaths of only two people, it could have been much, much worse. At that time, nearly 200,000 pounds of MIC was stored on site at the plant. This was more than double the amount that was released during a similar disaster at the Union Carbide plant in Bhopal, India, which resulted in the deaths of more than 15,000 people. As reported by the House Energy and Commerce Committee, Bayer CropScience intentionally withheld information regarding the incident while citing anti-terrorism-related laws as an excuse to do so (Frommer, 2009). This example provides clear evidence of the poor regulation in chemical manufacturing facilities in the United States, and shows how these facilities might be potential targets for future terrorist attacks.

After the 9/11 attacks, Congress took actions to increase homeland security. They produced legislation which required the Department of Homeland Security (DHS) to examine existing methods and propose new tactics to increase the nation's safety. The DHS office released a report providing background information on the existing methods, and summarized methods to reduce the risks associated with the production, processing, storage, and use of chemicals. This report did not, however, contain federal response or safety guidelines for the transportation of the chemicals. The report described the potential threats based on the recent terrorist activities and estimated the potential damage that could be caused based on the known quantities of hazardous chemical stockpiles. It also established federal regulations to reduce the risks and improve the security around chemical plants (Schierow, 2006).

Two federal laws regarding accidental releases of hazardous chemicals, the Emergency Planning and Community-Right to Know Act (EPCRA) and the Clean Air Act (CAA), were enacted to increase safety at chemical processing facilities. EPCRA required local officials to provide information to the public about the emergency plans and chemical hazards. EPCRA also required facilities to report any evacuations and emergency planning, but did not require them to reduce the volumes of chemicals stored on their premises. The CAA, on the other hand, gave power to the Environmental Protection Agency (EPA) to evaluate the risks associated with the storage of hazardous chemicals. The EPA's role was to recommend reduction strategies for more than 100 toxic and explosive chemicals stored in the facilities. The EPA was initially granted full internet access to the company's databases, but some disagreements with the privacy policies prevented this from occurring (Schierow, 2006).

The recommendations by the federal government, however, did not specify to which extent the agencies were able to enforce their regulations. Many of the regulations suggested changes rather than requiring them. The senior refinery associate from the American Petroleum Institute (API), Ron Chittim, criticized the proposed regulations, explaining that the regulations failed to define specific actions and were overly ambiguous. Initially, the DHS office was required to determine whether a given facility could pose a potential safety risk if attacked by terrorists. Chittim believed that many of the API member companies did not pose a significant health risk and thus should be excluded from the DHS's supervision (Amber, 2007).

Many other companies also suggested that the DHS regulations were not applicable to their specific manufacturing processes. For example, the Synthetic Organic Chemical Manufacturers Association (SOCMA) represents companies focusing on small batch processes. The association argued that it was difficult to apply the proposed regulations where use of different chemicals is not systematic and varies from day to day. SOCMA thus recommended that the DHS regulations only be applied to ACC facilities where systematic chemicals were used (Amber, 2007).

In general, the chemical companies showed no significant opposition to the DHS regulations. Most of the DHS regulations came as suggestions on how to improve company security and did not require chemical companies to make significant changes regarding the storage or use of hazardous materials. It was also stated that if these safety improvements significantly interfered with a company's profitability, then they could be ignored and no specified actions by the government would be taken. Public interest groups, such as OMB Watch and Public Citizen strongly opposed the corporate desires to "soften" regulations at their facilities. These public interest groups argued that the DHS office failed to fulfill their obligations to increase public safety and encouraged the DHS to tighten the existing regulations. These groups also suggested increasing the use of safer chemicals and processing technologies and allowing full public access to information regarding chemicals used in industry (Amber, 2007).

While the privacy of a company's synthesis protocols is necessary for protection from potential competitors, at the same time, when it comes to the potential safety hazards, it is necessary to enforce the laws that would guarantee public safety. As mentioned earlier, the Bayer CropScience plant took advantage of the weaknesses of the existing system to escape the possible penalties associated with the accident. The occurrence of this incident and its cover up clearly illustrated how the DHS regulations regarding storage and handling of dangerous chemicals were ignored. This suggests that many other chemical facilities could also ignore DHS suggestions and be potential targets for terrorist attacks. As a result, the DHS policies should be revised to avoid ambiguity and be strongly enforced at all facilities where hazardous chemicals are used.

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2009 AIChE Regional Conference

By Aaron Irons

On Friday, April 3rd, 2009 almost 40 enthusiastic University of Iowa Chemical Engineers set out to Columbia, Missouri for the AIChE Regional Conference. Schools from around the Midwest were greeted at the hotel and sent downtown for the first events of the weekend.

The conference kicked off with the poster competition for the Chem. E. cars. About 15 cars were presented from schools involved in the conference. The judging seemed to take a long time for the presenters as they eagerly anticipated their chance to show off their cars. Many hours and bags of chips later, however, the judges had reached their decisions and the students returned to their hotel to rest up before another eventful day at the conference.

The next day began bright and early with the Chem. E. Car Competition. Competitors were frantically trying to prepare their cars for the 65 feet they were supposed to make them travel. Iowa was one of the last to attempt the distance, but, undeterred, they loaded their aluminum and table salt fuel cells and placed their car on the ground. The crowd was cheering; they knew this car had the potential to take first place this year. The team flipped the switch and the car was off! Literally, the car was turned off; it didn't move an inch. Disappointed, but not discouraged, Iowa fans continued on their day. They were already thinking about the next year's competition.

Lunch was served and guest speakers gave students insight on Chemical Engineering in the real world. Directly following the guest speakers, students who had elected to present their research were beginning to give talks in the paper competition. Five students from the University of Iowa presented at the conference: Na Yeon Kang, Leticia Fernandez, Olga Jennings, Aaron Irons, and Tyler Gunn. From pharmaceutical drug delivery to photo-initiated polymers, the topics covered by the presentations showed the vast array of areas studied at the university.

At the end of the day the students attended the banquet where awards to students who participated in the paper competition or the Chem. E. car competition were presented. A plethora of food was prepared for the Chemical Engineering group, so much that people trading and taking extra desserts could be seen around the room. The banquet was finally wrapped up after a lengthy discussion about how beer is made, and students enjoyed their last night at the hotel before returning home. No doubt, each student still had at least one homework assignment to finish before the next week began.

2009 AIChE ChemE Car Competition

By Chris Sedgwick

This spring, students once again attended the AIChE regional conference to present research, listen to interesting presentations, support their fellow classmates, and, of course, compete in the Chem-E-Car competition. This year, Chris Sedgwick lead a team of three other students, Adam Smith, Eric Burknap, and Austin Gunn, to design and build a car to try to improve on Iowa's recent performances. The rookie lineup of Chem-E-Car engineers final results was an aluminum-air half fuel cell car, powered by strips of aluminum cans, salt water, and activated carbon (fish tank filter carbon).

The team began work in the early weeks of the spring semester, after being proposed the idea by former Chem-E-Car team member Zach Hachmeister. Some research was done, and initial testing began. After many adversities and much frustration in achieving a functional power source, they sought out help from Johna Leddy, a chemistry professor and fuel cell enthusiast. The team was persistent in conducting experiments and engineering their system, and eventually had some great breakthroughs, which eventually evolved the system into a well designed cell.

The cell used strips of aluminum Red Bull cans, as the anode, in a solution of salt water made from tap water and regular table salt, which acted as the electrolyte. Activated carbon was used to introduce extra oxygen into the system, and act as the cathode. Individual cells were produced, each producing approximately 0.8 volts and 120 mA of current. The team was successfully able to produce a functional moving car through various stages of construction, and had high hopes for the upcoming competition.

The Iowa Chemical Engineer Aluminum Team, the team name decided by the members, arrived in Columbia, Missouri Friday evening to present their poster and obtain a safety inspection by judges. The team also had a chance to interact with other teams, and learn about their projects and various systems, and exchange stories and experiences of building their cars. The team passed the safety check and prepared for a good night sleep before waking up, downing a few Red Bulls, and getting the car ready for its maiden voyage.

Unfortunately, the "Iowa Bull", as named by the team, had a bit of stage fright, and refused to move from the starting line. The cause of the failure was never pinned down, and the team was never able to prove the success from their months of work. However, the competition was not a failure. The team gained valuable experience from many aspects of the project and competition. The veteran team hopes to use their newly gained knowledge and experience to continue to improve Iowa's Chem-E-Car program and produce a competitive team for the following years.

The team would like to thank everyone who supported them in their Chem-E-Car experience, including the Chemical Engineering Department for the use of their lab and the funds to cover the expenses of building and testing. We would also like to thank Dr. Murhammer, Dr. Jessop, and Dr. Leddy for their help and support, as well as the students of the Iowa AIChE chapter for their support at the competition. And, of course, Red Bull, for keeping us up to work on the car, powering our car, and giving us wings.

AIChE Student Awards: Fall 2008 and Spring 2009

UI AIChE Student Chapter – *AIChE Outstanding Student Chapter Award*

Tianjiao Wang – *AIChE Sophomore Academic Excellence Award*

Karen Haman – *Tau Beta Pi Department of Chemical and Biochemical Engineering Outstanding Senior*

Stacy Sommerfeld – *Fall 2008 Outstanding Graduating Senior, College of Engineering*

Annamarie Jordan – *Student Presenter at the Fall 2008 College of Engineering Commencement*

Tyler Gunn – *AIChE Student Paper Competition Finalist*

Editor-in-chief Adam Smith would like to thank the following people for their contributions to this issue of the Chemical Engineering Newsletter:

Faculty Advisor: Prof. David Murhammer

Contributors: Amy Althoff, Austin Gunn, Aaron Irons, Olga Jennings, Anne-Marie Marquez, Stephanie McCoy, Laura Northrup, Zach Rodenburg Chris Sedgwick, and Leah Zmolek

Your help is much appreciated!

Interested in speaking at professional seminar? If so, then contact AIChE Student Chapter Vice-President Amber Johnson at anjoo@engineering.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.