Chemical Engineering Newsletter

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University of Iowa American Institute of Chemical Engineers

Advisor's Corner

By: Dr. Murhammer, Department Head and Advisor of the University of Iowa's AIChE's Student Chapter

Greetings to Hawkeye Chemical Engineers!! This Spring 2011 issue of our AIChE Student Chapter Newsletter begins with an article about the 2011 AIChE Regional Conference held at the University of Arkansas. Meeshanthini Vijayendran was awarded 2nd place for her research presentation. The University of Iowa also participated in the Chem-E-Car Competition and the ChemE Jeopardy Competition. This issue also contains articles about the 2011 Society of Women Engineers Regional Conference, India Study Abroad Experience, an Internship experience at Genencor in Cedar Rapids, and our plant trip to Fisher Controls in Marshalltown, Iowa. This issue concludes with five student articles from the Chemical Process Safety course that I taught in the Spring semester. These papers are opinion pieces, the first 3 are related to chemical regulation in the United States, e.g., discussing what changes, if any, should be made in the Toxic Substances Control Act (TSCA). The last 2 articles are related to chemical plant safety in the United States, e.g., discussing the role of Inherently Safer Design, if any, to supplement the current Chemical Facility Anti-Terrorism Standards (CFATS) program.

Regarding other happenings in the Department of Chemical and Biochemical Engineering (CBE) at the University of Iowa, Alec Scranton, a CBE faculty member, is currently serving as the Interim Dean of the College of Engineering. At the May 12th Faculty and Staff Awards Ceremony it was announced that Julie Jessop, an Associate Professor in CBE, is this year's winner of the Faculty Excellence Award For Service, and that Natalie Potter, a CBE staff member, is this year's winner of the Mary Sheedy Staff Excellence Award. Finally, at the May 14th College of Engineering held at the Marriott Hotel and Convention Center in Coralville, Iowa, there was a record number (36) Chemical Engineering BSE graduates. Furthermore, Rachel Crome, a CBE student, was acknowledged as the Outstanding Graduating Senior. Congratulations to all of these Chemical Engineering faculty, staff and students!

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2011 AIChE Regional Conference

By: Jacob Brandenburg - A Junior Chemical Engineer, current AIChE Newsletter Editor

On the beautiful morning of April 8th, 2011, just short of 20 students piled into vans and began making their way to Fayetteville, Arkansas for the 2011 AIChE Regional Conference that was being held at the University of Arkansas. Our chemical engineering students would be competing against other students in the region in a multitude of events scattered throughout the weekend. The events our students competed in were the much anticipated Chem E Car Competition, the first ever Chemical Engineering Jeopardy tournament, the paper contest that involves students giving oral presentations about their research.

Upon arrival Friday afternoon, the Chem E Car team, led by Steve Rheiner, was rushed to the gymnasium where they would be presenting their poster explaining how the car was built and the mechanisms behind the chemical reaction that would be powering their car during Saturday's competition. During the poster competition graduate student Clint Cook was presenting information about the University of Iowa and its graduate program. After the poster competition the students were bused back to the hotel for the night prior to an event filled Saturday.

Bright and early on Saturday morning the attendees arrived back at the gymnasium for the Chem E car competition where students from different Universities in the region competed to see whose car could travel the closest to a predetermined distance. After calibration, our car ran exceedingly well, coming in 4th place overall. This was an amazing achievement for the team , considering the past few years the team has not built a car that was able to run. We have applied for an at-large bid to the National Competition since only the top 3 finishers in our region receive automatic bids.

The University of Iowa was lucky enough to have two talented students, Meeshanthini Vijayendran and Na Yeon Kang, that were willing to present their research at the competition. Both U of I participants gave fantastic presentations and Meeshanthini placed second in the entire competition.

The Regional Conference held their first ever Chem E Jeopardy tournament this year. Each school was allowed to enter one team of four students into the bracketed tournament. Our team lost in the first round, but the experience was still both exciting and educational.

Overall the Conference this year was a huge success and the friendships and experiences accumulated on this trip will be lasting ones.

2011 SWE Regional Conference

By: Samantha Westerhof - A Junior Chemical Engineer, current Vice President and next years AIChE President

The 2011 Society of Women Engineers Regional Conference was held February 4-6 in Ann Arbor, Michigan. Seven young women of differing engineering majors from the University of Iowa had an event-filled weekend. The theme of this year's conference was "Going Green" which was implemented in various aspects of the conference. The conference began with a casino night on Friday where women had the opportunity to network with company representatives as they tried to win prizes.

"The theme of this year's conference was Going Green…"

Saturday was a packed day that started with opening speakers, Dr. Nancy Love and Pamela Flethcher. Dr. Love is a professor and the department head of Civil and Environmental Engineering at the University of Michigan with her research focusing on environmental biotechnology and water quality. Pamela Fletcher is from General Motors and she talked about the Chevrolet Volt & Plug-In Hybrid Electric Powertrains emphasizing the ways in which General Motors is helping the environment.

After the two keynote speakers, the collegiate and professional business meetings started where the students were able to discuss how women can become more involved as well as the various aspects SWE has to offer. The location for next year's regional conference was also chosen and will be at the University of Wisconsin-Madison.

Women were then transported to the University of Michigan's Engineering campus where they had the opportunity to attend four different sessions, a networking lunch and a career fair. The four sessions were sprinkled throughout the day and women had the option to attend a seminar of interest with a wide variety of topics including: graduate school, women's health, engineering abroad, sustainability and dressing for success.

The networking lunch was provided by an Ann Arbor staple, Zingerman's, and the young women also had the opportunity to sit down with a company representative, in order to get to know them and their company better before the career fair began. The career fair had over 40 companies in attendance including national and even global companies such as Unilever and General Electric.

Saturday ended with a banquet dinner where the young women had the pleasure of hearing from the Dean of Engineering at the University of Michigan as well as Elizabeth Iversen, the Vice President and General Manager of the navigation systems division of Northup Grumman Corporation. The Dean of Engineering, David Munson, as well as Elizabeth Iversen both had empowering talks about being women in engineering and how young women should stick with it.

The conference ended with a 7 am wake-up call and breakfast grab-and-go so that the students from the University of Iowa could drive the seven hours back to school, getting out of Wolverine territory and back into Hawkeye country.

India Study Abroad Experience

By: Amber Johnson - Senior Chemical Engineer and Former President of AIChE

When I left my cozy Iowan home the day after Christmas, I had no idea what to expect for my upcoming three weeks of study abroad in India. I had never travelled so far from home, let alone stamped my passport. Sure, I expected to be jet lagged from the long flights and a little homesick, but nothing could prepare me for the unforgettable experience of being in rural India.

In India, my class of ten students and our professor stayed in Chitrakoot with the Deendayal Research Institute (DRI). The DRI does amazing work in rural India to help small villages become better places to live by making them sustainable and self-sufficient. Their community-based efforts in healthcare, agriculture, education and entrepreneurship improved the villagers' lives while preserving the local culture.

Visiting the villages was very enlightening. I was impressed to see how a community with very little by western standards was thriving. Nearly three-quarters of the country's population lives in rural India, where most do not have access to running water or reliable electricity. Yet, these villages are becoming educated, sustainable, and self-sufficient. While most of us are living in an "advanced" society, we can still learn from rural India. I know I did.

I learned not to take for granted the amenities that are available to us in the states. I also learned that without constant bombardment from the internet, television, cell phones, and radio; life is less stressful. The detachment from the western world allowed me to make better friends with the people around me and, ironically, communicate better.

I learned how to take care of my health. An impressive lifestyle difference in the villages was in healthcare, where a system of life-long health with a basis of prevention rather than cure was in place. Prevention is important in areas where expensive treatment isn't financially feasible or even available. I was lucky to experience Indian yoga every morning and can attest to the health benefits. Continuing to practice yoga has helped me to relieve stress, improve digestion, and improve focus on the present.

I learned so many other things that it would be impossible to list in this short article. The only advice I can give is to explore on your own. Go somewhere new and disconnect from fast-paced daily life. Open your mind to differing ideas and cultures, and learn. If you are able, study abroad. It will change your life, as it has changed mine.

India Winterim is a three week study abroad program for 3 semester hours of credit. Students learn from and interact with Non-Government Organizations in India while benefitting from educational tourism. For more information on the program, visit www.uiowa.edu/~geog/india/ or contact Cory Petersen (corypetersen@uiowa.edu) in the Office for Study Abroad at the University of Iowa.

Genencor: Internship Experience in Cedar Rapids

By: Austin Swartz - Junior Chemical Engineer and Current Treasurer

Last summer I had the opportunity to complete an internship with Genencor, A Danisco Division, a company focused on the development and production of industrial enzymes. My internship was in the Applied Innovation Center (AIC), a newly completed laboratory in Cedar Rapids focused on one of the fastest growing divisions of Genencor, grain processing. The main roles of the AIC are technical service, customer support, and application research and development for both the fuel ethanol and carbohydrate processing industries. My role as an intern was to focus on the carbohydrate processing side of the company. Most of my work for the summer, without revealing any intellectual property, focused on the discovery of a new, viable glucoamylase for use in the carbohydrate processing industry from enzymes initially discovered when attempting to make solutions which could be brewed into beer. These new enzymes were tested in conjunction with enzymes already produced by Genencor to determine if a synergistic effect was seen. Nearly all of my experiments consisted of dosing the appropriate amount of enzyme and placing the substrate in a water bath set to a specific temperature to allow the enzyme to break apart the bonds in the starch. Each saccharification process, the process of breaking starch down into glucose in this case, took over 50 hours so most of my time was spent monitoring the progress of the saccharification.

The internship showed me a lot about research in an industrial setting. After having worked in a laboratory on campus the previous year it amazed me how many more resources were available in the industrial workplace. Along with the invaluable experience in a lab setting, this internship gave me great insight into how a biotechnical company works. I was given a great opportunity to witness the complex relationship between product development, production scale up, quality assurance, and customer service during my summer at Genencor. Several new alpha-amylase products were introduced to ethanol producing plants within a span of only a month. Though I was not directly involved with the project, my fellow intern was, I did see how dedicated the people at Genencor were to producing the best product on the market. I enjoyed my time at Genencor so much that I will be completing another internship this summer for their process engineering team in Cedar Rapids.

Fisher Valves Plant Trip

By Samantha Weber - Junior Chemical Engineer and Current Fundraising Chair

Students in Chemical Engineering take four semesters of Professional Seminar over the course of their college career. Each week an individual who has obtained a Chemical Engineering degree comes and talks to the students about where they work and what their job entails. In past years, students have also participated in a culturally and professionally enriching activity of their choosing to complete course requirements. For the first time this spring semester, the requirement for the activity has been changed to entail a plant tour of a facility that utilizes engineers.

This semester the sophomore and junior chemical engineers traveled to Fisher for a plant tour. Fisher is a company that helps their customers reduce plant maintenance costs and is known for their control valves and regulators. In early February, the students were driven by charter bus to the company head-

quarters in Marshalltown, Iowa to view two facilities. Upon arriving, lunch was served by Fisher while several company employees and representatives took the time to discuss what it means to work at Fisher, the impact they have had on the industry, and the high standards to which they hold themselves.

A series of tours were taken of the Fisher facilities. They have the largest pipe for testing valves. The largest testing pipe was a recent addition that our group was able to see. The group photo taken is in front of said testing pipes. The students also were able to view parts of research and development labs as well as the durability testing equipment. After this, a charter bus took the group to the other Fisher facility a few minutes away. This facility focuses largely on production for custom parts. We were shown the machinery used, some of the larger custom parts, and a new addition to the building that allows for larger construction.

At the conclusion of this walk through tour, the students were each given a copy of the group photo and a valve sizing reference book. They were then chartered back to the engineering building on campus in Iowa City. The first plant trip taken by the AIChE student chapter was extremely successful and highly approved of by both the students and staff. The group that was able to attend was grateful of this opportunity that Fisher graciously afforded them.

The Group of Chemical Engineers that went on the Fisher Plant trip for Professional Seminar.

Chemical Regulations – What is the Best Approach for the US?

By David Hunter - Junior Chemical Engineer and Foreign Exchange Student from the University of Newcastle, Australia

Currently, the American Chemical Industry is facing some very prominent issues with legislation regarding the regulation and registration of chemicals being used in all facets of industry and society. The main piece of legislation in use today is known as the Toxic Substances Control Act (TSCA), which became effective January 1st, 1977 and was designed to allow the Environmental Protection Agency (EPA) to secure all information on new and existing chemical substances, as well as authorizing them to control any substances that could put the health of the public or at risk (EPA, 2010). This has now been in effect for over 34 years and needs to be re-evaluated to suit the growing and expanding chemical industry of the modern world.

"...needs to be re-evaluated to suit the growing and expanding chemical industry of the modern world."

The TSCA is now facing criticism on many levels, one of which is that it allows companies who declare new chemicals to the EPA to keep them "secret". Hence, the companies are not required to disclose any information to the public that could harm their business practices (Layton, 2010). This brings to light many ethical concerns that suggest that people could be unknowingly exposing themselves to some severely hazardous materials and not be aware of it because this legislation allows companies to market products without divulging all their chemical components and therefore not putting adequate warnings on the products.

Of course, as the companies are arguing, changing this legislation and forcing companies to fully disclose the contents of their products could cause potentially catastrophic consequences to their business practices and aid their competitors. This could in turn cause a decline in the economy and strength of the chemical market. Hence, it seems that it is necessary to find a middle ground between these two circumstances, where the public and environment can be protected by companies providing full disclosure while experiencing no concerns about their business practices being damaged because of it.

In 2009, a new regulation was imposed in Europe called REACH (Registration, Evaluation, Authorisation and Restriction of Chemical Substances) which could be a good example, that after examination, the US government could develop into an acceptable piece of legislation to replace the TSCA. REACH requires that all manufacturers and importers gather information on the properties of their chemical substances, which will allow their safe handling, and to register the information in a central database run by the European Chemicals Agency (ECHA) in Helsinki (European Commission, 2011). This will then allow the ECHA to develop a database of all the chemicals in use that could be made available to health-care professionals and HAZMAT teams that may come in contact or need to deal with some of these dangerous chemicals.

In my opinion, the EPA should consider establishing legislation that follows a similar structure as the European REACH Regulation, although with a few fundamental differences. It might be acceptable for government facilities to be established to allow the EPA itself to test and evaluate the hazards of new chemicals that are developed and registered by companies. This will enable the EPA to have its own records and a more thor-

ough understanding of these chemicals. In turn, this legislation could and should be developed to force all manufacturers to put substantial warning on their products, which may be done without disclosing the specific chemicals that go into making the product.

As an example, if a product were to contain methyltrichlorosilane (which is not actually a "secret chemical" but for this instance is a good example), which is used in the development of some water resistant resins (Wikipedia, 2011). It may not be necessary to indicate that the product contains methyltrichlorosilane, but it would be necessary to indicate that the substance is highly corrosive and can cause severe burns. Although, if someone were to be exposed to this substance and required medical attention, a database could be made available to health-care professionals which would allow them to find the specific product and have access to the appropriate methods of medical treatment.

Similarly, if a substance such as phosgene (again, just as an example), which is a chemical that can be used to produce hydrochloric acid and was in fact used as a chemical weapon in World War II, (Wikipedia, 2011) were to be spilled on a highway, on the truck transporting the chemical there could be code referenced to the database which specifies this chemical and allows a HAZMAT team to clean up the spill safely and effectively.

Limiting access to such a database to just emergency response teams and health-care professionals would allow the companies to maintain their confidentiality and therefore preserve their business practices whilst at the same time disclosing all of the materials they use along with their potential hazards to the EPA.

With over 700 new chemicals being developed and used every year (Layton, 2010), it is becoming increasingly important for the American Government to develop and implement new legislation to keep the public and environment safe from the potential hazards of these new chemicals. As long as confidentiality can be maintained, for the sake of preserving business practices and the economy whilst maintaining the health and safety of the public, through co-operation between the EPA and the companies that make up the American chemical industry, I believe a solution to this problem will soon be developed.

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United States Industrial Chemical Regulation:

Immediate Action Required to Improve and Reform Out-Dated, Ineffective Legislation

By Kelly McConnell - Junior Chemical Engineer and President of Omega Chi Epsilon

The Toxic Substances Control Act (TSCA) of 1976 was enacted by Congress, which gave the Environmental Protection Agency (EPA) the ability to regulate the chemical industry. Specifically, this act gave the EPA the authority to obtain information from companies regarding any new or pre-existing chemicals and regulate chemicals that are proven to "cause unreasonable risk to public health or the environment" (U.S. Environmental Protection Acency, 2011). Nearly thirty-five years later, having only undergone a few revisions, the TSCA still remains the major piece of legislation regarding the control of hazardous chemicals (Hogue, 2011). While the TSCA may appear good in theory, and is presented in a positive light on the EPA's

website, in practice the TSCA makes it very difficult for the EPA to actually perform its regulatory duties. One main reason for this difficulty is due to the fact that the law places the responsibility of proving a chemicals hazardous effect on the EPA and not on the company which produces the specific chemical (Schwarzman & Wilson, 2009). Also, the TSCA does not require companies to test their chemicals for environmental and health risks; additionally, they are not obligated to provide the EPA with toxicity information unless the EPA can prove that the chemical has the potential to pose a hazardous threat to the public or environment (Schwarzman & Wilson, 2009). In my opinion, this legislative catch-22 renders the EPA nearly ineffective and therefore needs to be reformed immediately to model the current European Union REACH Program.

"...in practice the TSCA makes it very difficult for the EPA to actually perform its regulatory duties."

In addition to the bureaucratic hoops the EPA must overcome in order to regulate a toxic chemical, the TSCA also allows companies to withhold any information that may be considered "confidential business information" (Hansen, 2010). This ambiguous part of the law has allowed companies to take advantage of the TSCA and conceal a great deal of information regarding the nature of the chemicals produced. This is done in order to protect what companies consider to be "trade secrets" from their competition (Layton, 2010). While I believe it is important to promote competition and innovation within the chemical industry, I believe that the current version of the TSCA provides too much protection to companies. By allowing companies to withhold chemical information from the public under the context of the information being a trade secret, companies are not truly held accountable for the effects of the chemicals they manufacture. In my opinion, if the EPA were able to force companies to disclose more information to the public, this would hold each company to a higher standard and provide more incentive for safer chemicals to be developed that will have a smaller negative impact on the environment and public health (Schwarzman & Wilson, 2009).

Recently, the TSCA has begun to gain attention from the Obama Administration for its ineffective regulation policies and, in June of 2010, a TSCA reform bill was introduced into the House of Representatives. The problem was that the bill was unable to gain support before the conclusion of the 111th Congress and now must start over with the newly elected House of Representatives (Houge & Erricson, 2011). The general consensus among both parties is that the TSCA must be reformed; however, the degree of reform which should be enacted varies. The Obama Administration, for instance, has focused on reforming the TSCA by giving the Environmental Protection Agency more authority in regulating chemical toxicity (Houge & Erricson, 2011). The TSCA is clearly outdated and in desperate need of reform, the problem is that with many other issues considered by Congress to be more pressing, TSCA reform is not expected to be discussed until late this year (Hogue, 2011).

Compared to the United States' outdated and ineffective chemical regulation laws, the European Union has enacted a great deal of innovative legislation regarding chemical regulation through the REACH Program, REACH stands for: Registration, Evaluation, Authorization, and Restriction of Chemicals (European Comission, 2011). One main difference between the TSCA and REACH is that REACH requires companies to supply hazard data regarding the chemicals they produce. Thus, the company is respon-

sible for demonstrating that the adequate safety requirements have been met (Schwarzman & Wilson, 2009). While I do think that the European Union's REACH legislation is headed in the right direction as far as holding companies responsible for producing safe, environmentally friendly chemicals, some of their goals for chemical testing seem to be pushing what is currently, realistically possible. For example, in order to test each chemical produced in the European Union it would require up to 54 million vertebrate animals and has estimated to cost up to 5.9 billion Euros over the next ten years (Hartung & Rovida, 2009).

In my opinion, the United States needs to follow in the same path that the European Union is headed. By remaining only a few step behind, the United States will be able to enact the legislation that appears to be working within the European Union, without the risk of enacting legislation that will be ineffective. I think that it is worth investing now in chemical regulation in order to prevent any drastic long term effects that are likely to surface in the future. One important effect that has the potential to arise in the future would be the negative health effects that these hazardous chemicals can have on people from long term exposure. It is very difficult to study the long term health effects of potentially hazardous, due to the extended length of the study trials. Also, in the future, if an industrially produced chemical were to surface that posed a serious threat to public health, the EPA needs to have the authority to take swift action and immediately begin to control the use of this dangerous chemical. One example where the EPA was unable to do exactly this was when asbestos was discovered to have adverse health effects and despite a great deal of mounting evidence proving this fact, the EPA encountered many difficulties when attempting to curtail the use of asbestos in 1981 (Layton, 2010).

Since the Federal government is failing to properly regulate industrial chemicals, many states have begun to enact their own specific regulatory legislation. If states begin to enact separate legislation, this may complicate business for national companies that must comply with different regulations for each state (Schwarzman & Wilson, 2009). I believe that in order to prevent this, the Federal government needs to unify the country under strong, effective legislation that will properly control the production of hazardous chemicals in the United States. Also, I believe that the most effective way for the United States to enact such legislation is to follow in the foot-steps of the European Union REACH guidelines.

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Improvements Needed in Chemical Regulation in the United States

By Samantha Weber - Junior Chemical Engineer and Current AIChE Fundraising Chair

The chemical industry is a vital part of American society that affects both the economy and the standard of living. Although the industry has contributed positively to both, there is a point at which the physical wellbeing of the consumer should be considered more important. When the current regulation procedures are amended it is crucial that our lawmakers take a strong stance on the issue of safety as the top priority. Since chemicals can so utterly destroy lives if used inappropriately, it is the duty of the government to enforce the chemical industry to act ethically to ensure the health of its citizens. In particular, there should be a standard of research that all chemicals must undergo to determine health risk and hazards. It should also be legal to disclose this research to emergency responders and medical personnel if an accident occurs.

"Since chemicals can so utterly destroy lives if used inappropriately…"

The main problem the American public faces is the corporate world's abuse of current laws. In particular, businesses will submit chemicals to the Environmental Protection Agency as trade secrets to avoid needing to list all ingredients (Hanson, 2010). If this were only true in cases where the divulging of information about safe and innovative chemicals would negatively impact a company, I suppose that would be acceptable. However, companies are using this part of the law to be negligent and dishonest with their consumers. Almost 95 percent of submissions to the EPA are declared secrets (Hanson, 2010). Trade secrets may put certain businesses ahead in profits, but they are simply not worth the lives of people who are unknowingly subjected to chemicals about which they are not able to become fully informed.

A particularly disturbing example of just how detrimental the current system can be to the lives of ordinary citizens is the situation faced by a Colorado nurse, Cathy Behr. A man who suffered from chemical poisoning came into the hospital where Behr worked and due to her treatment of him, she too suffered medical complications. Her liver began to shut down and she has respiratory problems to this day. When doctors called the company to learn of the nature of her exposure, they did not give out the ingredients present in the chemical (Layton, 2010). The company stated only the hazards and by legal standards did nothing wrong. The government should not be protecting the interest of its businesses over the health of its constituents. If Behr's doctors had been privy to the information, no trade secret would have been exposed, but an ill woman may have been helped sooner and more efficiently.

In lieu of the weaknesses of the laws controlling chemical regulations, some states have taken it upon themselves to do what the national government has not. According to the senior vice president for global corporate affairs, communication, and sustainability at S.C. Johnson and Son, Kelly M. Semrau, "These various state initiatives could have the undesirable effect of establishing differing sets of requirements for evaluating chemicals; assessing potential alternatives; and, if necessary, eventually substituting chemicals" (Hogue, 2011). If the state governments have seen this issue as a problem big enough to act upon, the national government has an obligation to create a uniform standard across the United States. Semrau, a member of the chemical industry, even

states that stronger regulations could be beneficial to the economics of chemical use. According to her, the stronger regulations would "strengthen consumer confidence" (Hogue, 2011), which would ultimately strengthen the market.

Given that it is unrealistic to simply deny all companies that use chemicals their rights to trade secrets, there are many improvements that could be made which would be a reasonable compromise for both sides. Companies should be required to prove to the EPA in their submittals that the divulgence of their "trade secret" would be detrimental to the company's finances. Also, an extensive and predetermined level of safety and hazard research should be performed and submitted to the EPA before permission to use these substances is granted. In cases where there is a significant risk to human health, the ingredients and specific information about the chemical should be made legal to disclose to emergency responders and medical personnel if the situation arises. These professionals could be held under the same laws as the current EPA employees in regards to divulging trade secrets of which information has been made privy to them. It is clear that improvements of some sort must be made to stop the abuse of secrecy protection. It is up to our lawmakers to ensure that these improvements are geared toward helping public health over helping businesses.

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Advantages of Inherently Safer Technologies

By Nate Brimeyer - Junior Chemical Engineer and Member of the University Marching Band

A recent focus has been placed on the need for security in the chemical process industry; specifically, was brought to the attention of the government after the unfortunate events of September 11, 2001. The renewed importance the government places on security in the chemical process industry can be seen by the Chemical Facility Anti-Terrorism Standards (CFATS). The CFATS has established the level or degree of security for chemical facilities based on the risk the facility has for a terrorist attack. There are three main criteria defining risk as outlined by the department of homeland security. These criteria include consequence, vulnerability and threat (Risk for Chemical Facility Anti-Terrorism Standards (CFATS)). The likelihood and severity of the CFATS criteria would determine the security measures needed to protect the chemical process facility from a terrorist attack. It has been proposed that, in addition to the CFATS, chemical facilities would also have to implement inherently safer technologies. This has been placed in the spotlight after a 2008 explosion involving a near miss incident at Bayer CropScience pesticide manufacturing plant in West Virginia. In this incident, an explosion in one area of the facility sent shrapnel toward a vessel that often contains roughly 13,000 pounds of methyl isocyanate (Johnson, 2011). Inherently safer technologies and designs would have eliminated or greatly reduced the amount of methyl isocyanate kept in the facility at any point in time. Methyl isocyanate is the dangerous sub-

"These criteria include consequence, vulnerability and threat…."

stance that took thousands of lives after accident at chemical plant in Bhopal, India. The Society of Chemical Manufacturers and Associates are opposed to the requirement of using inherently safer technologies in addition to CFATS (Van Arnum, 2011). Their opposition boils down to the "if it isn't broken, don't fix it" rational. While the Society of Chemical Manufactures and Associates may disagree, it is my belief that the highest level of security within chemical facilities can be attained using a combination of Chemical Facility Anti-Terrorism Standards and inherently safer technologies.

The addition of inherently safer technologies to the CFATS will increase the security and decrease the risks involved with a potential terrorist attack. In the case of the Bayer incident, as explained earlier, the implementation of inherently safer technologies would have forced the reduction or elimination of the storage of methyl isocyanate. The reduction or elimination of this extremely toxic chemical would not only have made the process inherently safer, it would also have made the facility less appealing as a terrorist target site. By reducing the consequences of a potential terrorist attack, the level of security required by the CFATS would be reduced. The implementation of inherently safer technologies will increase the security of a chemical facility and decrease the risk of a terrorist attack on the plant, while also increasing the safety of the facility workers and the surrounding community members.

Initial implementation of inherently safer technology has a cost, but in the long run this implementation could save the facility money. The startup cost associated with inherently safer technology involves the purchase of new software and process equipment, as well as researching new methods to avoid using dangerous chemicals and reduce the likelihood of accidents. If these new technologies are avoided, than a chemical process accident is more likely. Such an accident would almost certainly be more costly than the upgrade itself. While the chemical process facilities will never see the money saved, adopting new inherently safer technologies could be thought of as an insurance policy. The facilities have to pay relatively small, initial payments to ensure that they avoid paying a large, accident related payment later.

It only makes sense to incorporate inherently safer technologies into the Chemical Facilities Anti-Terrorism Standards. It seems apparent that the reduction of hazardous chemicals necessitated by inherently safer design would make many chemical processes less appealing as potential terrorism sites. As the consequences following a potential terrorist attack decline, so would the requirements needed to be in complacence with CFATS. Also, implementation of the inherently safer technologies will work as an insurance policy to save chemical facilities money. For these two main reasons, it is clear that, despite the additional effort required, it is worthwhile to require chemical facilities to abide by both CFATS and inherently safer technologies.

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Inherently Inert Operators

By Michael Baker - Senior Chemical Engineer and future graduate student at Iowa State University.

On the tails of the debate to renew the Department of Homeland Security's (DHS) Chemical Facility Anti-Terrorism Standards (CFATS) program to secure sensitive chemical manufacturing, storage, and processing facilities from terrorist threats, a similar bill was reintroduced to help secure the same facilities from far more common threats (Amum, 2011). The Secure Chemicals Facilities Act (SCFA) puts in place requirements for the implementation of Inherently Safe Design (ISD) principles to mitigate and reduce the likelihood and consequences of potentially catastrophic accidents (Amum, 2011). While the idea of protecting chemical plants from terroristic actions has provoked no objections from industry groups such as the Society of Chemical Manufacturers and Affiliates (SCMA), the SCFA has proved to be anathema to those same groups due to the costs and process disruptions associated with their implementation along with the lack of existing quantitative guidance in relation to ISD (Amum, 2011). An incentive-based approach utilizing tiered regulation standards favoring safer methods of operation helps address these concerns while ensuring the correct implementation of ISD for existing facilities. Furthermore, the standards of ISD should be a requirement in new capital projects to ensure that successive generations of chemical facilities begin their lives with minimized risk. It is through this combination of policies that a self-sustaining regulatory system based on ISD can be formed which amicably reconciles the safety of the public with the practices of industry.

> ***"...ISD principles to mitigate and reduce the likelihood and consequences of potentially catastrophic accidents."***

The primary resistive force to the implementation of ISD in existing chemical facilities is inertia (Moore). Not only are the costs involved powerful disincentives, plant operators are also especially loathe to the idea of disrupting an existing process for a matter involving the perceived probability of an accident (Moore). Bill Allmond of the Society of Chemical Manufacturers and Affiliates industry group, for instance, claims that ISD is essentially a zero-sum venture in that "a reduction in hazard will reduce overall risk if, and only if, that hazard is not displaced to another time or location, or results in the creation of some new hazard" and that ISD is unprepared to assess and weight hazards sufficiently (Amum, 2011). While it is true that ISD as it stands today lacks a clear system of measurement on the acceptability of risk, it still has a strong foundation on principles which can be used to make almost any process safer (Moore). Minimization and intensification of hazardous materials, for example, are general principles which have the ability to significantly reduce the scope of a potential accident (Moore). Likewise, the substitution of hazardous materials with less hazardous ones and limiting the effects of a potential accident are both excellent guidelines which will work towards creating a safer process (Moore).

The quantitative qualification which people like Bill Allmond desire will be implicit in any implementation of these guidelines. Currently, a system of classification which can also be applied to the implementation of ISD exists already under the DHS's CFAT standards. The CFAT standards involve the use of a tiered system in which each facility is given a numerical designation between one and four to identify the risk involved (Shea, 2011). Applied towards safety in general and ISD in particular, a similarly tiered system

could differentiate between lower-tiered plants which have reduced the potential for accidents through inherently safer design and higher-tiered plants which continue to accept risk rather than mitigate it. These tiers would not only be defined by the individual hazard posed by the chemicals handled within the plant, but also their respective amounts and the extent of appropriately applied countermeasures implemented to reduce the likelihood and consequences of an accident. Higher-tiered plants would be subject to a much harsher system of standard regulatory requirements in regard to reporting and reduction of consequences while lesser requirements would be placed upon lower-tired systems. Such a difference in regulatory requirements would encourage plant operators to overhaul their existing facilities with ISD in mind in order to reduce their tier classification. A system like that encourages plant operators to improve their facilities on their own volition ensures better compliances and requires less regulatory resources to enforce than a universal blanket requirement of ISD in all existing plants.

Although some leeway must be given in regard to existing plants to accommodate plant operators, newly constructed plants should be held to a higher standard. In the construction of new facilities, there is no excuse for ignoring inherently safer design principles. The human cost alone in an accident can amount to at least $0.1 million per injury and $1 million per fatality (Drake, 2005). Furthermore, environmental fines and other civil and criminal penalties involved in a serious accident increases the overall financial impact (Drake, 2005). Adapting the safety procedures through trial and error is not only morally reprehensible, it is also expensive. From the point of view of plant operators, the potential liabilities involved with a major release of dangerous materials or disaster within the lifetime of a given facility more than offset the initial investment involved with the implementation of ISD (Drake, 2005). It is for this reason that sufficient ISD standards should be a requirement for any new facility to minimize the potential for future catastrophic loss and the need of further major corrections.

The greatest benefit of a regulatory system which requires new plants to conform to ISD standards and encourages existing plants to meet ISD standards on their own is that it is a self-sustaining system. As a facility ages, the tiered regulatory system will continue to persuade operators to keep up with current advances in chemical process safety technology. Similarly, ISD requirements on plant construction will ensure that each new chemical facility starts off at its safest possible state and likely reduces the need for any large-scale safety-related overhauls in the future. This combination of policies will provide the best outcome for both the safety of the public at large and members of industry who are currently skeptical of ISD.

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Your help is much appreciated!

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