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Chemical Engineering Newsletter

AICHE FALL 2009

INSIDE THIS ISSUE:

Advisor's Corner

Professor David W. Murhammer

Greetings to Hawkeye Chemical Engineers!! I am proud to note that our Student Chapter was again acknowledged as an Outstanding AIChE Student Chapter at the 2009 AIChE National Student Conference. Furthermore, Aaron Irons, a senior student in our department, received the Donald F. & Mildred Topp Othmer National Scholarship Award. This is a very prestigious award that is annually given to 15 chemical engineering students in the U.S. Scott White, a junior student in our department, received the Donald F. Othmer Sophomore Academic Excellence Award (Perry's Handbook). This award is given annually to the student at the UI who has completed the sophomore year with the highest cumulative GPA. Finally, Nick Erdman, a senior student who graduated in December 2009, was the Student Presenter at the Fall 2008 College of Engineering Commencement.

This issue begins with articles about the Sixth Annual Spooky Sprint fundraiser for the Iowa City Shelter House and the attendance of our students at the 2009 AIChE National Student Conference. Next, there are two articles about student summer activities, i.e., academic research and industrial internship. Finally there are 8 student papers from our Process Calculations course. Six of these articles discuss energy future options, while the other 2 articles explore the future of biotechnology.

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 (david-murhammer@uiowa.edu) to discuss specific details.

Above: Professor David Murhammer with students Olga Jennings, Austin Gunn, and Na Yeon Kang (from left to right) at the AIChE National Conference in Nashville, TN.

Left: A mixture of volunteers and runners at the 6th annual Spooky Sprint 5K walk-run on November 1, 2009.

6th Annual Spooky Sprint

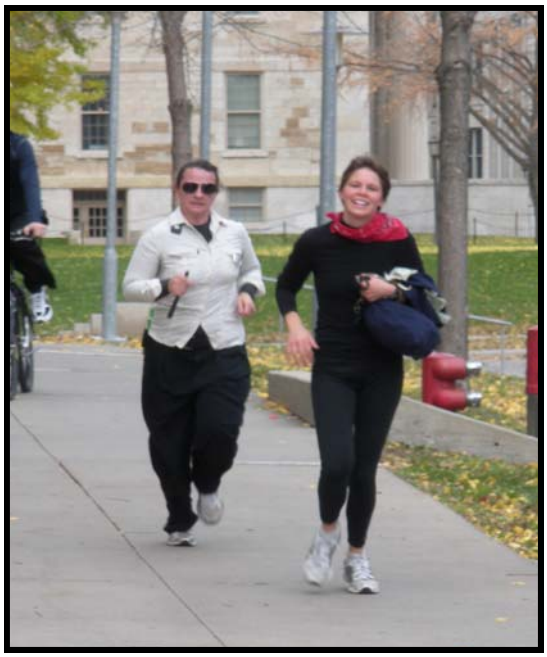
Written By Nick Petrich

Above: The Race Winner Crosses the Finish Line Outside the Seamans Center

For the sixth consecutive year the University of Iowa's American Institute of Chemical Engineers Student Chapter hosted the Spooky Sprint 5k Race/Costume contest. The race was a 5k run/walk that was held on November 1st 2009. The money raised from philanthropic event benefited the Johnson County Shelter House. The Johnson County Shelter House is a non-profit organization that has provided housing and supportive services to the homeless of Southeast Iowa since 1983. The shelter house has provided support and transitional housing to men, women and children, the elderly, and the disabled.

The 5k race was organized by Kimberly Helmkamp, Na Yeon Kang, Nick Petrich, and Rachel Chrome. The planning for the race started months prior to race day, which included getting sponsors, getting volunteers, and recruiting participants. On race day volunteers took their places throughout Iowa City to direct the runners, as well as to hand out water to keep the runners hydrated. The runners and walkers completed the 5k race while wearing Halloween Costumes. Prizes were given not only to the top runners at the different age groups, but also to the participants with the best costumes. The costumes were judged by Engineering Dean Barry Butler and Associate Dean Alec Scranton.

The 2009 spooky sprint had a good number of sponsors, as well as runners participating in the event. The prizes given to the runners and the fruits and water for them after the race were all donated by local businesses of Iowa City and Coralville. The year the race raised $430 dollars thanks to the runners and donations from the community. Other donations such as bottled water and clothes were also given to the shelter house. For more information about the Johnson County Shelter House or the Spooky Sprint, please visit www.shelterhouseiowa.org and www.engineering.uiowa.edu/~aiche respectively.



Above: Runners Race to the Finish Line in their Halloween Costumes

AIChE National Conference 2009

Written by Anne-Marie Marquez

The 2009 AIChE National Conference was held Nov. 8-13 in Nashville, TN. It was a great networking experience for students and professionals alike. There was a virtual career fair, a graduate school fair, and a networking brunch. All students were invited to participate in the virtual career fair online by submitting their resumes, which could be seen by employers in order to set up interviews in Nashville. The graduate school fair allowed students to research the idea of furthering their degrees. And the networking brunch was a great way to meet new students as they competed together in a trivia game over pastries and orange juice.

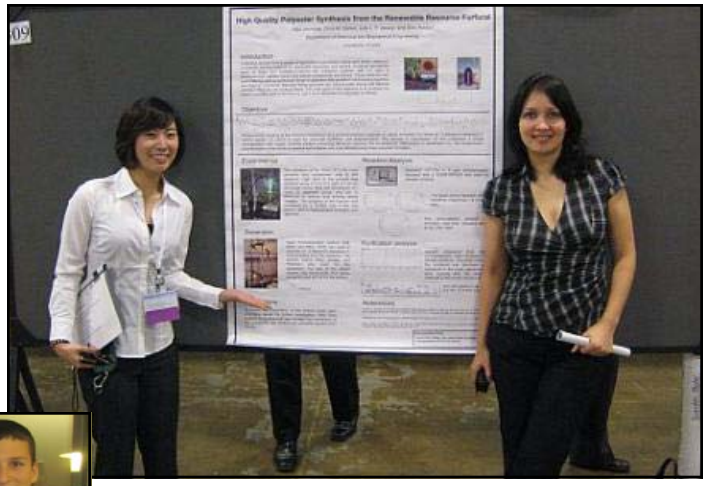
The event was held at the Gaylord Opryland Hotel and Convention Center, which has 600,000 square feet of space, including an atrium with a lagoon, a river with gondolas, and restaurants. It was seated next to the Grand 'Ol Opry where the greats of country music have performed over its illustrious lifetime. It was a wonderful atmosphere in which to meet new people and share experiences.

During the awards ceremony, the University of Iowa managed to take home two awards: one for being an outstanding student chapter, and another for being an outstanding chapter for five straight years. It was a proud moment for the advisor, Professor David Murhammer, who has been an advisor for the university's chapter of AIChE for 19 years.

Although the honors were presented for the chapters under Presidents Rachel Levine and Aaron Irons, this semester's President, Anne-Marie Marquez, was present to accept the awards in their place.

Not to be overlooked, the ChemE car competition was an exciting event where teams from all over the country competed. 1st place went to Northeaster University, 2nd place went to University of Puerto Rico, and 3rd went to Louisiana State University. It was a good chance for the university's ChemE car team Chair, Chris Sedgwick, to get ideas for the Spring Regional conference in Ames, IA.

Overall, the trip was a great experience for all the attendees. Next year's conference is scheduled to be held in Salt Lake City.



Above: Na Yeon Kang and Olga Jennings stand in front of Na Yeon's Research Poster at the AIChE National conference

Left: Professor David Murhammer with students Na Yeon Kang, Chris Sedgwick, Anne-Marie Marquez, and Austin Gunn holding the plaques they received at the AIChE National Conference.

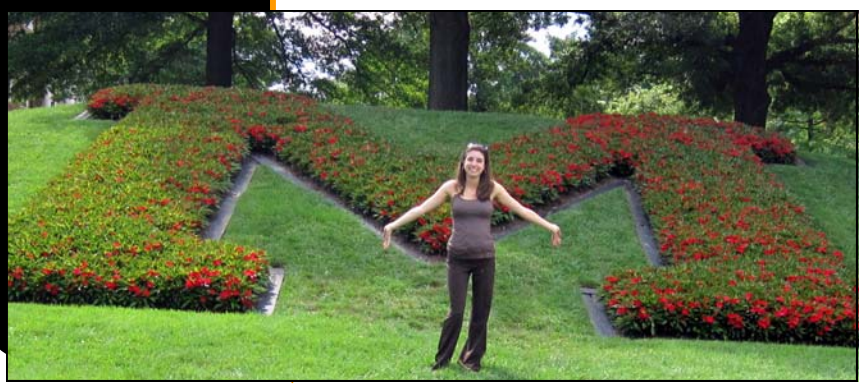
Amazing Research Opportunities for Undergraduates in Three Letters: REU

Written By Laura Northrup

Above: Students participating in a summer REU at the University of Maryland. From left to right: Rasa Ghaffarian (undergrad at the University of Maryland), Janet Hsu (graduate student in bioengineering at the University of Maryland), and Laura Northrup (Junior ChemE at the University of Iowa).

Below: Junior Chemical Engineering Student Laura Northrup during her Summer 2009 REU at the University of Maryland.

Have you ever considered graduate school? Does a career in research interest you? If so, Research Experiences for Undergraduates (REU) are a great way to spend your summer. Sponsored by the National Science Foundation these research programs are found at universities throughout the nation. An REU is essentially a research internship in which you are paid to work in a lab performing research. Each REU has a theme based on the type of research that is to be performed. REUs may be as general as Chemical Engineering Research or as specific as Membrane Sciences. Covering all types of science these programs provide undergraduates with an amazing opportunity to experience life as a graduate student for seven to eleven weeks during a summer. Even more inviting are the benefits these programs provide. Normally a salary of approximately $2500 to $5000 for the summer is provided along with free housing. Usually about 10 to 25 students participate in each program and activities are usually planed for these groups such as tours of the area, group dinners, and field trips to local attractions. For the research experience portion of the program each student is given a specific research project in the lab of a professor, usually working beside a graduate student or independently. Research performed throughout the summer is often presented to the other students or members of the university as an oral, poster, or written presentation in the final week of the program. REU programs offer incredible opportunities to perform research and experience the culture of different university.



During the summer of 2009 I had the opportunity to participate in a Molecular and Cellular Bioengineering REU program at the University of Maryland- College Park. In the program I had the opportunity to work with a Bioengineering Professor who was pursuing research in the field of nanoparticulate drug delivery. I had the opportunity to better understand what research entailed as I was given my own project for which I needed to postulate, perform, and record experiments. Throughout the program I interacted with current graduate students on a day to day basis and gained a better understanding of life as a graduate student. Not only did this program provide me with an incredible research experience, but also it introduced me to another part of the country which I never before had the chance to fully experience. College Park, Maryland is located just outside Washington, D.C. and throughout the program I had the opportunity to tour famous sites along with gaining a better understanding of the culture of our nation's capitol.

I highly recommend an REU to anyone interested in pursuing research or higher education. These programs provide invaluable experience in the research field along with the opportunity to explore another university. Any interested undergraduate should begin the search for REU programs as soon as possible as application deadlines are commonly in January and February. To search the various National Science Foundation funded REU programs use the website: http://www.nsf.gov/crssprgm/reu/

The Charms of Cheerios

Written by Amy Althoff

As a chemical engineering intern in the packaging department at General Mills Buffalo Plant, I had several different projects to work on over the summer. My first project was to experiment on a line producing Honey Nut Cheerios in order to decrease the amount of extra cereal put in every box above the labeled weight. In an effort to save money, I performed several trials looking at the density of the cereal and how it affected the extra Cheerios put in each box. After several experiments I determined that the density of the cereal varied over time, and that changing the feedback system parameters could more effectively handle the fluctuations.

For my second project, I looked at altering the flow of Lucky Charms to three baggers so that each box would have the same amount of marshmallows. Once again, I performed several tests, and ultimately determined that variation could be reduced by reprogramming the gates that let cereal into each bagger.

All in all, I learned a lot about engineering in the manufacturing world from my summer internship at General Mills. In addition, I met great people and gained memories from experiences in Buffalo and beyond. I am very thankful that I had this opportunity, because after all, I could not think of a better way to start the morning than exiting the 290 to the smell of fresh-baked Cheerios.

Above: Senior Chemical Engineering Student Amy Althoff at the General Mills Plant in Buffalo, New York. Amy will work full-time for General Mills in Cedar Rapids following Graduation in May 2010.

Renewable Energy: Harnessing the Power of the Sun

Written by Matt Banker

The amount of energy that hits the Earth within one hour is nearly the amount of energy required to power the entire planet for almost a year (Science Channel). With our fossil fuel levels steadily decreasing, and our growing worries of global warming, there are only a handful of new developments for using renewable resources. These new advancements include solar power plants and hopefully power panels in space. In hopes of a cleaner, more efficient energy source, there's been increasing technology for harnessing the sun's power.

Solar power plants have become an emergent source for renewable energy. Since it would be more difficult to build smaller units on separate houses or neighborhoods (Discovery: Earth 8), these plants have provided an easy way to allocate and distribute energy towards nearby cities and towns. Yet, there are several cons to relying on solar power plants.

First and foremost, there is the interaction with the weather. Since, it cannot be controlled there will be times where clouds and fog will interfere in collecting the sun's solar energy. Altitude also has a similar effect. Because the Earth's atmosphere acts as a shield, not all of the sun's rays get through; some are absorbed by its layers. Also, energy can't be constantly collected since nighttime allows for only half the time to gather solar energy. Furthermore, there have been heavy debates establishing solar power plants in neighboring habitats (Basin and Range Watch).

The area taken by power plants would be stripped of all plant and animal life. With the removal of plants and the plowing of the land, carbon stored within the soil would be lost (Bason Range Watch). Habitats such as deserts and grasslands have a natural ability to store carbon emissions and stabilize them within the soil to provide a more suitable place for organisms to live a sustainable life. It's also been found that these areas are comparable to absorption rates of forests (Discovery: Earth 5). (CONT pg6)

With so many drawbacks to the fabrication of solar power plants, scientists and engineers look for an alternative way to harness the sun's energy.

John Mankins, lead scientist, former manager of Advanced Concepts Studies at NASA, and currently "employed as an independent consultant on space research and development," has been working with an elite team of other scientists and engineers to produce an alternative way to collect the sun's energy (Discovery: Project Earth 1). Their idea is to develop geostationary solar panels in space, collect solar radiation, and beam energy back towards the surface by low energy-density microwaves (Discovery: Project Earth 2). What this process does is solve many of the previous problems encountered with solar power plants.

Using this system, all the energy collected won't interfere and be absorbed from the atmosphere. Also, the weather will no longer affect the collection of energy. Be it cloudy or foggy, the microwaves are still able to pass through. Also, no matter what time it is, there will constantly be panels continually refueling our energy. Finally, there would be no need to use up as much land on the Earth's surface for collection. This would help prevent habitats from being destroyed, and keep the landscape, the species of plants and animals, and history of the land from being changed (Discovery: Project Earth 4).

Of course every brilliant, new idea has its drawbacks. First of all, it would require a vast amount of money to produce something as large-scale as this. Not only would receivers have to be built for collecting and transmitting the beams, but the cost of carrying all the lenses into space would cost an appreciable amount. Secondly, despite the fact that microwaves present no harm to humans, animals, of plants, convincing the public of using these beams wouldn't be easy. Also, with the presence of microwaves the Earth's temperature would increase, but by a very small amount. Finally there's the question of who would have control and power over something as large and universal as this (Discovery: Project Earth 7). That would be another daunting task in itself.

Despite the disadvantages these new ideas may have, at least humans are taking steps in the right direction. It is because of green technology that we have hope for limitless renewable resources, better lifestyles, and a cleaner, greener Earth. These advancements in harnessing solar energy will establish a prominent role in the future.

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Using Cellulose As A Viable Fuel Option

Written by Austin Swartz

Some of the most important discoveries happening in the scientific community are those involving sustainable energy for the future. Not only are the cost of crude oil and crude oil goods going up financially but the cost to our environment is also increasing. Due to these rising costs, there has arisen a large need to find some respite from burning fossil fuels for energy. Currently one way to offset the use of fossil fuels is through biofuels made from corn and soy beans. Not only can this production of fuel not sustain the United States' need, but it also decreases the amount of grain available for food. Due to this, a new direction is needed for biofuels. One new revelation is the use of a type of plant matter called cellulose which is present in all parts and types of every plant.

In the article "Grassoline at the Pump," George W. Huber and Bruce E. Dale discuss the need for a second generation of biofuels. (CONT. pg 7)

Huber and Dale state that the most promising new way to produce biofuels is through the use of cellulose, which is the framework inside the cell which enables plant matter to stand erect. Cellulose has a long crystalline structure made of glucose molecules ($C_6H_{12}O_6$) packed tightly together. It is found in all plant material and currently is not used for many applications. The material is usually left behind in the form of silage or sawdust in most farming and lumber applications; however, many scientists and chemists are finding that this material that is being thrown away could be used to form many types of fuels. Due to the abundance of cellulose it is estimated that the US could produce nearly fifty percent of the fuel it uses each year through biofuels (Huber, 2009).

The key to being able to use cellulose for energy needs is breaking apart its glucose molecules into specific molecules that can be used for fuel. Chris Ladd (2009) explains the difference between natural crude oil and the hydrocarbons from cellulose in his article "Trees in Your Tank? The Future of Green Gasoline: Earth Day Extra." Natural crude oil is quite easily converted into gasoline as it contains almost only hydrocarbon compounds, compounds only containing hydrogen and carbon atoms. However, glucose molecules contain ample amounts of oxygen which needs to be discarded in order to make a fuel product. The main technology needed to allow the glucose to be used for fuel is for the ability to transform glucose's oxygen rich molecules into pure hydrocarbons. One method of doing this is called catalytic fast pyrolosis (Huber, 2009). In this method the cellulose is heated to 500°C in less than a second to break apart the combined glucose molecules into smaller, oxygen-rich molecules. These smaller molecules fit into a three-dimensional catalyst which helps the molecules to react, forming molecules without oxygen that used for fuel, namely the same ethanol found from corn and soybean biofuels.

Once this technology is available in a widespread fashion, it will be much easier to produce large quantities of fuels from cellulose than current biofuels. One reason this is possible is by using the cellulose of waste plant matter will not only offset the cost of fuels and food prices, but it is much easier for the United States to grow it in bulk. The climates in Iowa, Nebraska and Illinois are great for growing corn and soybeans, but most places in the United States do not have the right growing season, rainfall, or soil to be able to produce these crops for biofuels. However, switch grass is already grown in almost all areas in the United States including the dry, usually unfarmed west. Ample timber is also available in the woody northeast where lumber companies only use a fraction of the timber they cut down (Huber, 2009). Through these and many other plant types that could be used for biofuels, much more fuel could be produced. Many more people would also be able to harvest crops for sale. In the long run Huber and Dale (2009) believe the cost of the capital to begin the production of cellulose into fuels would be offset by the boost to the economy its benefits would produce.

With a shortage of crude oil eminent, a new direction must be taken to produce fuels. The use of plant waste matter is one of the most cost effective new designs being engineered. With the availability of cellulose and the areas in the United States capable of producing ample amounts of plant material to sustain manufacturing, this method is a very real possibility in the future. The only real deterrence to the production of fuels from this biowaste is the capital costs involved, but with government funding and the long-term positive affect this will garner on the economy the message is clear: cellulose must be used for the production of fuels in the United States.

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The Answer to Energy

Written by Kim Floss

When some people imagine the future, they picture flying cars. They see robots doing our daily tasks, computers that can do any job, and people living in outer space. These *might* be realistic ideas, but I think they will not be a reality for a few hundred years. When I think of the future, I think of something that is going to be available a lot sooner: electric cars. With the energy crisis our country is in, I think one of the most important ways we can address this is to find a more sustainable energy source for our transportation. Electric cars are better for the environment, they are more cost efficient, and they would decrease our dependency on foreign, unsustainable energy sources.

The average household in the United States owns 2.2 cars (Green, Frank). These cars are run on gasoline, which means that they create harmful emissions. Scientists have been stressing for years that our over-use of cars is one of the causes of global warming. In fact, 33% of carbon dioxide emitted in the United States is from gasoline powered cars (Juarez). Electric cars would significantly reduce the harmful emissions that gasoline powered cars are putting into our air. Because these cars use electricity as their power source, there is no carbon dioxide emission. While some automakers are hesitant to pursue manufacturing electric cars, many others agree that it is a realistic opportunity for us to cut down on our emissions. BMW and Volkswagen are both developing a form of an electric car, and Chevrolet has created an electric car, called the Volt, which it plans on making available as soon as 2011 (Dougherty 4). As you can see, electric cars are a very realistic solution to decreasing the negative impact we are having on our environment.

Another way that electric cars will help many people in the United States is by reducing their cost of operating a vehicle. Last year we saw gas prices go up to over four dollars a gallon across the country, and we had no control over it because we are dependent on cars powered by gasoline. If we had electric cars, the money spent on gas would decrease significantly. Obviously there are some challenges to developing the electric car. The biggest challenge we face is the cost of buying an electric car. The Chevrolet Volt could cost around $40,000 which is why some people think it is an unrealistic idea for the United States (Dougherty 4). Consequently, the car companies are looking for ways to offset this high cost. Chevrolet is confident it can sell the Volt in part because of a $7,500 tax credit that would be offered to people who buy electric vehicles (Dougherty 4). If people were willing to think about the cost of operating their gasoline powered cars, compared to the cost of operating an electric car, they might be more open to buying the electric car to save more money in the future.

Finally, one of the biggest reasons electric cars should be the vehicle of the future is because of America's dependence on foreign oil. Even though America has imported 13 million barrels of oil a day since 2006, the cost of those barrels has increased by over thirty dollars each (Roberts 30). We are dependent on oil from countries like Saudi Arabia, a country the United States has not always gotten along with very well. This creates a situation where we are undoubtedly vulnerable to even higher costs. Even our country's biggest enemy, Osama bin Laden, called the United States dependence on foreign oil, "the umbilical cord and lifeline of the crusader community," (Dougherty 4) He was pointing out that we are unable to detach ourselves from these countries, often enabling them to continue attacking other countries including ourselves. Electric cars use mostly battery powered energy to power their cars with a back up gas tank for emergencies, so we would become more self sufficient (Dougherty 4). Obviously it is unrealistic to imagine a world where the United States is not using any oil, but electric cars would significantly decrease the amount of oil we are dependent on.

Obviously there are some obstacles that come with changing something as important as the type of energy that powers our cars. However, it is even easier to see the ways in which electric powered cars would help our country and decrease some of the factors that have caused a major energy crisis in the United States. (CONT. pg 9)

Whether it is the way electric cars could help our environment, the low cost of operating an electric vehicle compared to a gasoline powered car, or decreasing our dependence on foreign oil, I think pursuing the possibility of electric powered cars is very worthwhile in our search for a more sustainable energy source.

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Harnessing The Wind

Written by Samantha Weber

The wind has often been thought of as a metaphor for things that cannot be seen, but felt. But in today's world wind has a much greater potential than that of a witty metaphor. Wind has the potential to be harnessed as a prime form of sustainable energy in the future due to the applications of engineering.

Wind energy is essentially a form of solar energy. Wind is created when the sun heats different parts of the earth at different rates. For example, the air over land heats more quickly than air over water. Also, the closer to the equator an area lies, the faster it heats to high temperatures (3). As a basic law of thermodynamics dictates, all processes "want" to go towards equilibrium. When one area of air is cooler than another, the heat energy moves to the area of lower energy, thus creating wind (3). By utilizing this knowledge of solar effects, chemical engineers have been able to make lasting contributions to the efficiency of wind turbine technology over the last few decades.

The most common types of machines used for harnessing the energy of the wind are horizontal and vertical wind turbines. The horizontal axed turbines are the most popular choice around the globe. These turbines look like large posts with approximately three blades attached on the side of the top to spin and capture the energy the wind provides. The axis on which the blades are mounted hold the materials needed to convert the kinetic energy that is wind into electricity. "The wind turbine blades are usually tied into something akin to the alternator in one's car. The alternator works because many loops of copper wire spin around at high speeds around an iron core, producing an electromagnetic current (electricity)" (2). This electricity is then transported to the desired location or grid. Vertical turbines function much the same but are often described as having the appearance of "egg beaters" (3).

The reason wind energy is being worked on so diligently is because it is renewable, cost efficient, and clean. Kinetic Energy of wind is one hundred percent renewable energy. As long as the sun heats the earth, wind will be created by the varying temperatures across the globe (1). Another advantage of wind energy over alternative sources of energy is the low cost. According to the U.S. Department of Energy, "wind energy is one of the lowest-priced renewable energy technologies available today, costing between 4 and 6 cents per kilowatt-hour, depending upon the wind resource and project financing of the particular project"(1). In addition, the actual turbines and their substituent parts produce no toxins to hurt the atmosphere while collecting and converting energy.

Given the logistics of wind generated electricity, engineers are necessary to perfect the process that is, as of now, impractical for powering the majority of the world's population. For one, chemical engineers are well schooled in the area of thermodynamics. (CONT pg 10)

Thus, they are apt at finding the most fruitful locations for wind farms based on calculations of heat transfer from the sun to the air in different conditions. Furthermore, this knowledge would allow engineers to predict methods that utilize the technology's full potential.

Another current holdup in mass use is the transport of the actual wind turbines. Engineers who specialize in the processes required to make these machines are bound to find more and more efficient ways of making parts. Potentially, they could make turbine parts so that they could be assembled on location. Additionally, chemical engineers will find ways to make the production of assembly parts more eco-friendly and efficient in their tasks.

All in all, the potential is there to power at least a large part of the world in a "green" and ever-lasting way with the wind. The technology to utilize wind for the powering of the world's needs is a work in progress. Even though there are currently a few roadblocks, chemical engineers are certainly the key to clearing those roads. If government, public, and financial support continue to increase, there is no reason why wind will not be a major contributor to the world's energy consumption one day in the future. This will change the age old metaphor of wind, since everyone will be able to physically see the results of clean wind energy.

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The Energy Source of the Future: Nuclear Power

Written by Jacob Brandenburg

Did you know that if all the used nuclear fuel from the last 50 years was stacked end to end, it would only cover an area about the size of a football field and be about ten yards thick? (Storage 2009). An energy source that only produces this much waste in a 50-year span would normally seem remarkable, but nuclear energy has developed a terrible reputation and is feared by the general population. The truth about nuclear energy tells a very different story than the public's opinion. Nuclear energy is the industrial-scale sustainable energy of the future; it is environmentally friendly, affordable and safe. If people knew the true facts, they would be petitioning for a nuclear plant in their backyard.

One of the biggest reasons that nuclear energy will become the energy source of the future is that nuclear power plants are environmentally friendly. Nuclear power plants release no greenhouse gases and are in complete accordance with The Clean Air Act of 1970 (Rogers 2009). Nuclear plants can achieve this because they "generate heat from fission rather than burning fuel" (Clean Air 2009). Nuclear fission happens when a nucleus splits apart into smaller fragments and releases two or three neutrons. Under the right conditions the neutrons released will cause other nuclei they collide with to split apart and release more neutrons. The end result is a huge output of energy, which is then harnessed at the plant, and used to generate electricity (Nuclear Fission 2009). Nuclear power plants also have little effect on the ecology of the environment it resides in. This is possible "because it does not emit air pollution, isolates its waste from the environment and requires a relatively small amount of land" (Ecology 2009). Nuclear power plants even go as far as providing safe habitats to certain kinds of endangered species, like the manatee (Ecology 2009). (CONT pg.11)

Nuclear energy is a much better option for the environment and the ecological system it resides in than current large-scale energy sources.

Nuclear energy is an extremely affordable and cost effective form of energy. According to the 2008 Electricity Production Cost by Fuel Type, nuclear energy came in as the lowest priced major fuel type in terms of kilowatt-hour (kWh). Nuclear energy cost 1.87 cents per kWh with coal being the next cheapest at 2.75 cents per kWh, and natural gas and oil as the most expensive at a stifling 8.09 cents per kWh and17.26 cents per (kWh), respectively (Economic Growth 2009). "Nuclear power is the lowest-cost producer of base load electricity…This includes the costs of operating and maintaining the plant, purchasing fuel, and paying for the management of used fuel (Economic Growth 2009)." After seeing how nuclear energy compares to other fuel types, it becomes very clear that nuclear energy is a clean and affordable option for the future of sustainable energy. The only questions left unanswered are how nuclear energy will affect everyday human life and is it is safe for humans to use?

An obstacle that nuclear power plants have had to work around is their association with the negative words that go along with nuclear, like explosion and weapons. The truth is that nuclear power plants have nothing in common with nuclear weapons and explosions. The nuclear fission reactions that go on inside a nuclear power plant are controlled; the uranium isotopes are enriched to only about 9 percent of the total reactant that goes into the reactor. The total energy output is not large enough to cause a nuclear explosion. For something to be considered a nuclear weapon, the uranium isotope capable of going through nuclear fission has to be enriched to about 80 to 90 percent of the total amount of uranium present. When this many molecules get close enough together, the energy output becomes exponential and a nuclear explosion is achieved. It should be clarified that a nuclear explosion can never occur with the percent uranium used at nuclear power plants because the molecules are not close enough together to achieve an exponential energy output, but a more controlled and reasonable energy output. These nuclear reactions still give off radiation (usually in the form of gamma rays) which can be extremely harmful to humans. For this reason many precautions are taken to ensure the safety of both plant employees and surrounding neighborhoods. Another obstacle nuclear power plants have had to overcome is the disaster that occurred at the Chernobyl plant in the Soviet Union. "The Chernobyl accident in 1986 was the result of a flawed reactor design that was operated with inadequately trained personnel and without proper regard for safety."(Chernobyl Accident 2009). Since the plant reactor was not encased in the steel and cement dome that is a required safety measure in today's power plants, the radioactive material was released into the atmosphere and many workers at the plant became sick with radiation poisoning. What happened at Chernobyl happened many years ago, and numerous safety procedures and measures have been taken to ensure that a disaster like Chernobyl will never happen again. Even if something does go wrong with the reactor, the radiation will not be able to escape the steel and concert dome surrounding the entire reactor. Since Safety always comes first; that is why "the design of each plant emphasizes the reliability of plant systems. Nuclear plants also feature reliable and diverse key safety systems and strong physical barriers to prevent incidents that could pose a threat to public health and safety. The same features that protect the public and the environment from a radiation release also protect the reactor from outside interference (Plants Security 2009)." There is very little threat to people and the environment from a nuclear power plant, making it a safe energy choice for the future.

Nuclear energy will become the industrial-scale sustainable energy of the future; it is environmentally friendly, affordable and safe. The goal of scientists and engineers should be to promote the economical benefits of nuclear energy and educate the people on the safety measures taken to protect the people and the environment from disaster. The energy source that the general public fears today, may end up being the one that saves them in the future.

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Biotechnology: The Future or Future Disaster?

Written by Jocelyn Dixon

Malnourishment is a current problem that more than 960 million people around the world face (Hanlon & Hay, 2008). Currently there are many relief agencies and nonprofit organizations trying to end world hunger through the donation of money and groceries, but what if chemical engineers could provide a solution by a different means? Through the use of biotechnology, chemical engineers have the potential to eradicate world hunger by creating genetically superior crops, which would be more nutritious and have the ability to withstand harsher weather, pests, and soil conditions. In order to end world hunger, after developing methods to genetically engineer crops, chemical engineers also have to determine if altering foods by the use of biotechnology is ethical.

Creating genetically modified food has existed for centuries, beginning with the simple survival of the fittest model. For example, a farmer wants a corn crop that can survive a very dry season, so he plants corn and selects the seeds from the strongest and healthiest cornstalks harvested. Eventually, the farmer will develop seeds that can survive a drought. This technique is referred to as selective breeding. From this, scientists and chemical engineers have developed today's genetic engineering techniques that eliminate the trial and error process required in the past for selective breeding (What are Genetically Modified GM Foods?, 2000).

Chemical engineers have developed various methods to genetically engineer plants, such as: electroporation, biolistics, and calcium phosphate precipitation. Electroporation occurs when chemical engineers prepare target cells that are immersed in a special solution with the selected DNA and a short but intense electric shock passes through the solution. This shock causes small tears in the cell wall, which allows the new genetic material access to the nuclei. Afterwards, the cells are placed in another solution which allows the broken cell walls to repair themselves. Then the selected cell is placed within the host chromosomes to provide the host with a new gene (Genetically Modified Food-Techniques, 2008). Another way to genetically engineer plants is through biolistics. This is accomplished by attaching the selected DNA to microscopic particles of gold or tungsten and firing it like a gun into the target cells, by using a burst of gas under pressure. Calcium phosphate precipitation may also be used to alter the genetic makeup of plants. During this process, the selected DNA is exposed to calcium phosphate, which creates tiny granules in which the DNA is contained. These granules are then surrounded and ingested by the target cells, allowing the granules to release the DNA and deliver it to the host nuclei and chromosome (Genetically Modified Food-Techniques, 2008). From all these methods, chemical engineers have been able to create plants that can withstand rougher environments in hope of beginning to solve the problem of world hunger.

Although many believe that ending world hunger by genetically modifying plants is a logical solution to a difficult problem, chemical engineers face the challenge of determining if this method is ethical. The ethical dilemma they face is, "…whether the benefits of developing and supplying the world with genetically modified foods outweigh future consequences that these products may have for the human species, animal life, and the ecosystem" (Jefferson, 2006). Some of the advantages of using biotechnology to genetically modify foods are faster and larger crops that have a greater resistance to pests, heat, cold, and drought. Benefits for the environment are seen by the reduction of the use of pesticides and herbicides. Furthermore, a far-reaching goal for genetically modified food is ending world hunger and alleviating the agricultural demands that occur with a growing population (Jefferson, 2006).

Although there are numerous benefits of using biotechnology to engineer better food, the main problem with foods that contain genetically modified substances is the unknown effects they may have on the human body. Currently, manufacturers that use these techniques are exposing humans to one of the largest uncontrolled experiments in modern history. While the government claims that these food products are based on "sound science", neither the government nor the manufacturers have studied the effects of genetically altered organisms on people (Herbert, 2000). (CONT pg 13)

Another dangerous aspect of genetically engineered crops is the fact that they may trigger allergies or diseases in humans. Since a gene could potentially be extracted from an allergenic organism and placed into another one that typically does not cause allergies, a person may unknowingly be exposed to an allergen. There is also the probability that new allergens could develop from the mixing of the genes of two organisms ("Ethical Concerns and GM Foods"). Overall, it becomes a chemical engineer's responsibility to decide whether the advantages outweigh the disadvantages when using biotechnology to modify the genes in different crops.

Chemical engineers attempting to end world hunger through the use of biotechnology must first develop processes to modify plant genes and then determine whether or not these processes are ethical. During this procedure, chemical engineers have to come back to the central question of whether or not the biotechnologically advanced crops' benefits outweigh the potential consequences. Chemical engineers have to answer the difficult question of whether saving people's lives now matters more than the future outcomes of this procedure. Once this challenging question is answered, chemical engineers will either be able to continue using biotechnology in an attempt to end world hunger or they will have to develop another strategy for solving this global problem.

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Drug Delivery: Not Just For The Black Market

Written by Nathan Brimeyer

Renaissance men are defined as people who excel in a wide variety of fields or subjects. Chemical engineers embody the essence of renaissance people better than possibly any other branch of engineering or profession. Because chemical engineers are so well schooled in such a variety of disciplines, such as chemistry, physics and mathematics, they are bound to impact the future in ways unimaginable. One impact could be in green technology to help prevent the threat of global warming, such as an efficient hydrogen fuel cell car, or filters to help reduce or eliminate the pollution caused by factories large and small. Arguably the most important field that chemical engineers will work to improve upon is the area of pharmaceuticals. New or improved medicines or medical practices will surely have a positive impact on the lives of many. One of the most current and ever-changing practices dealing with drugs and chemical engineers is the field of drug delivery. The future of drug delivery is dependent upon chemical engineers to update old practices and create new and better methods of curing diseases or aiding in the betterment of people's health. Current drug delivery methods, such as pills and injections, are effective but could certainly be improved upon. One of the most profitable areas for pharmaceutical companies is the modernization of these relatively old methods of drug delivery. One such example of an outdated procedure deals with injections. Although injections are a fast and efficient way of getting the needed medication directly into the body, some feel that they are painful and dangerous. New developments are being made to nearly eliminate the need for (CONT. pg 14)

syringes and liquid injections. These devices are termed needle-free injections. One of the newest needle-free injectors is made by Glide Pharma. They have developed a way to inject solids into the body tissue as opposed to the liquids required for previous syringes. The advantage of this is that the solids no longer need to be refrigerated like the liquids. For that reason, people in all corners of the world could potentially have access to all of the medicine they could need. They would no longer have to worry about the drug expiring. Also, people who are scared of needles no longer need to fear doctor visits (Megget). The advantages of this new medical technology are great, but this is just one of many new products chemical engineers are hard at work developing.

Another procedure that is currently being improved upon is the treatment of glaucoma and other eye ailments. The standard procedure for curing most eye problems is eye drops or surgery. A new treatment places the medication in a contact lens, which then slowly releases the drug into the eye. Instead of patients remembering to place eye drops in their eyes at fixed intervals, they will instead just wear normal contacts (Rauscher). As this research develops, it could be used to treat a plethora of eye problems and possible more health issues.

Finally, at the University of Iowa, research is being done on lung illnesses and diseases. The research is being conducted by chemical engineer Jennifer Fiegel. The study deals with an attempt to use an inhaler -like device, similar to the inhalers used to treat asthma, to deliver medications straight to the lungs. The advantages to this are that the drug is absorbed quickly and it goes directly to the source of the problem (Fiegel). While this is still a relatively new idea, researchers continually strive to evolve this design into something people around the world could see in the near future.

Even though the drug delivery methods of the past and present day suffice, important improvements are being made by chemical engineers. To improve the quality of life for humans, young and old, changes are being made to medicines and the drug delivery methods.

The needle-free injector, for example, is a new invention that could prove useful for getting drugs that have a short shelf life to some impoverish nations in dire need of medications. Very few are better suited to deal with this research and development than chemical engineers, who are working to improve disease treatment with diseases ranging from lung ailments to glaucoma. Great strides are being made in the field of drug delivery in large part due to the hard work of chemical engineers.

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Geothermic/Geothermal Power

Written by Michael Toraason

In the immediate future the petroleum and natural gas industry will encounter a very serious problem. Supply will not meet the exceedingly high demand for fossil fuels in the world. Sustainable energy, such as geothermal energy, is a must if everyone in the world wishes to be able to heat their homes or drive their cars within the next 60 years. Geothermal energy is the heating of a certain gas to turn a turbine to create electricity. It also happens to be infinitely abundant. It harnesses the heat at the edge of the earth's crust to potentially power everything in the world. Geothermal energy can be extracted from the earth by numerous methods, and geothermal power plants can be maintained for much cheaper prices than fossil fuel powered plants. Geothermal energy makes sense economically, it is sustainable while also being clean energy, and is a must if the world wishes to continue living the life that it does ("Clean Energy Ideas").

Geothermal energy can be extracted by two methods. The first, which is the most common, is simply known as geothermal power. Geothermal power plants start by finding hot spots around the edge of tectonic plates, which are the plates that make up the earth's outer crust, and drilling until a significant heat source is found. Once the temperature is suitable (generally at 250-500 °C), a long heat resistant pipe is fed down to it. Then small amounts of water are fed to the heat source, creating steam which then rises back to the earth's surface (in some instances gasses are released from the hot spot and very little water is even needed). This steam is used to generate electricity by turning turbines inside of the power plant (Bonincontro; "Clean Energy Ideas").

The second method, which is much newer and less commonly used, is known as geothermic power. Geothermic power utilizes a new drilling method known as Sirex Vertical Tunnels (SVT). These tunnels have a maximum depth of 12 miles. This allows for much hotter temperatures to be reached, and also opens up a

much broader area where this method can be used. Geothermal power can only be used on the edge of tectonic plates, due to thinning of the Earth's crust, but geothermic power can be used in many areas of the world. The tubing inserted into the crust is even earthquake resistant and uses an inert gas, such as nitrogen, to heat up and power the turbines in order to produce electricity (Gawain).

Geothermal energy is not only sustainable, but it also has many other practical applications. It uses almost no outside fuel. Geothermal power plants create little or no pollution. In fact, the only pollution created is the release of carbon dioxide and hydrogen disulfide that is carried up to the surface with the steam used for producing electricity. This pollution is only a small fraction compared to the emission intensity of fossil fuels. Geothermal energy also has a somewhat high efficiency rating of ~16%. This number may seem low but the Carnot efficiency, or the best that the efficiency could possibly be theoretically, is just over 20%. The EPA has even said that geothermal heating is the most efficient way to heat homes in the future ("Geothermal energy"; Bonincontro).

The final argument for geothermal energy is based simply on economics. The Homes that utilize small geothermal pumps built specifically for personal use save 80% in energy bills alone. Not only do personal geothermal pumps save money, but an economic argument can made for large-scale geothermal plants as well. They may cost about $1 million more per megawatt (10^6 Watt, where 1 MW powers about 800 homes annually) of capacity than fossil fuel plants, but the miniscule operational costs (5 cents per kW) and lack of fuel costs(20 liters of water per MW) make geothermal energy a money saving investment ("Geothermal energy."; "Health Goods").

The future of the world depends on finding a sustainable energy source, such as geothermal energy. Not only is geothermal energy sustainable, but it also is much cleaner than the current fossil fuels being used to generate electricity. It also uses less money to maintain while still achieving a high efficiency. Geothermal energy is the best sustainable alternative to fossil fuels on the market, and our future depends on its utilization.

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Congratulations to the AIChE Chapter officers for the Spring 2010 Semester:

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Your help is much appreciated!

Interested in speaking at professional seminar? If so, then contact AIChE Student Chapter 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.