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CHEMICAL ENGINEERING NEWSLETTER

University of Iowa

Advisors Corner

By Professor David W. Murhammer

Greetings to Hawkeye Chemical Engineers!! The Fall 2006 issue of our AIChE Student Chapter Newsletter begins with an article about our student chapter's participation in the 2006 AIChE Annual Student Conference in San Francisco. This issue also contains four "topical papers" that were written by four different students in my Process Calculations course. Two of these papers address the history of fossil fuels, while in the other two articles the students discuss their view of our energy future. Other articles in this issue are Alex Conway's account of his cooperative education experience at Cargill, Inc. and a description of a plant trip to Cedar River Paper Company (Cedar Rapids) taken by some of our students. This newsletter concludes with a list of student and faculty awards received since our Spring issue.

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

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AIChE National Conference

By Kate Cannady

The AIChE Annual Student Conference was held November 11th-13th in San Francisco, California. This conference, hosted jointly by the Oregon State University and UC Berkeley, provided chemical engineering students from across the country the opportunity to attend various sessions designed to enhance the chemical engineering experience, present research and compete in the ChemE Car competition.

Eight University of Iowa undergraduate students attended the November conference, where they chose to attend some of the many workshops available, a "Meet the Sponsors" career fair, ChemE Car competition and the Student Awards Brunch. The University of Iowa was honored during the brunch and presented with an "Outstanding Student Chapter" award recognizing student involvement in local, regional and national areas of AIChE. The University of Iowa Student Chapter has won this award 13 out of the last 14 years. Awards were also presented to two University of Iowa students. Alex Conway was awarded the Donald R. and Mildred Topp Othmer National Scholarship Award and Ryan Whittaker received the Donald R. Othmer Sophomore Academic Excellence Award.

In addition, two University of Iowa students had the opportunity to present their research at the conference. Katie Doherty, representing the AIChE North Central Region, presented a talk entitled "Isolation and Characterization of Insect Cells with Inactive Mitochondria" in the National Student Paper Competition. Furthermore, Jacqueline Alcántar presented a research poster entitled

"Effects of Temperature & UV Light Intensity on Acrylate/Epoxide Hybrid Photopolymerizations" and took first prize in the Materials Engineering and Sciences division.

Overall, the weekend was fantastic. Everyone that attended had the opportunity to meet chemical engineering students from all over the county (including many from Puerto Rico) and to share experiences. I think we could each say we came away with a little bit more than what we went in with. San Francisco was the perfect backdrop for the conference as it is a beautiful city with plenty to see and do. Despite the long flight, all that attended the conference agreed it was certainly worth it!

Sustainable Energy Future

By Matt Christensen

It is no secret that the world today faces an energy crisis. Simply turning on the television, glancing at the newspaper, or filling a vehicle with gasoline provides frequent reminders of this urgent issue. We hear about the necessity of utilizing non-fossil fuel energy sources to a much greater extent than presently, but why is it so vital to accomplish this task in such a timely fashion? One reason is that fossil fuels are not unlimited. This implies that the world will eventually become fossil fuel depleted, and inherently world regions that are rich in any fossil fuel virtually control prices of their natural resource throughout the rest of the world. Another major problem with relying too much on one type of energy source is that one event, such as a natural disaster, possesses the power to deter the ability to access this necessary source of energy.

A prime example of the fossil fuel monopoly-like control over the world is the Middle East and its control of the price of gasoline. For example, Saudi Arabia, alone, produces one-fourth of the world's oil and is responsible for fifteen percent of the oil imported to the United States (Oil Price Increases of 2004-2006). The Middle East, which includes Saudi Arabia, is the worldwide leader in oil production. The war in Iraq coupled with instability in Saudi Arabia correlate with skyrocketing gas prices around the world (Saudi Arabia), as can be understood by considering that supply of oil is incredibly low when these countries do not provide at low prices.

Not only is it problematic that a single region holds such power over the rest of the world, but vulnerability to natural disasters introduces another dilemma. Hurricane Katrina perfectly exemplifies this fact. One day before the storm ravaged the Gulf Coast, the average United States gas price was $2.50. Following the storm, there were multiple gas stations that were selling gas at nearly $6 per gallon! Although this was a result of illegal price gouging, this was a direct effect of the storm (Economic Effects of Hurricane Katrina). This natural disaster also resulted in the shutting down of two major pipelines which quite possibly factored in enormously to the price increase of gas (Oil Price Increase of 2004-2006).

Unfortunately, the idea that fossil fuels are not renewable (or at least not at a rate anywhere near global consumption level) is not the lone problem. Fossil fuels emit carbon dioxide, a greenhouse gas, into the environment. Greenhouse gas emissions promote global warming, a problem that is thought to fuel climate change and intensify storms (e.g. Hurricane Katrina). The Earth has increased by greater than one degree Farenheit over the past 100 years, most of which is thought to be due to human emissions (Global Warming). As a result of warmer temperatures, melting glaciers have raised the ocean level. The water level along the Atlantic and Gulf Coasts of the United States has risen between 0.08 and 0.12 inches per year over the last century (Sea Level Changes). Combining the two issues of limited fossil fuel availability and dependence on foreign countries, it is obvious that a new route must be taken in providing energy.

There are several possible fuel sources outside of fossil fuels, many of which are currently being utilized. One option is hydrogen fuel cells, which utilize the energy of hydrogen in a clean process to produce electricity. This process is clean because its products are water and heat as opposed to greenhouse gases such as carbon dioxide produced by fossil fuels (Fuel Cells). President Bush announced a $1.2 billion hydrogen fuel cell initiative during his State of the Union Address in 2003. A large portion of this money was committed to providing the technologies and infrastructure necessary to provide for this new energy source in vehicles, homes, and businesses (Fact Sheet: Hydrogen Fuel: A Clean and Secure Energy Future). Fuel cells are not the cheapest form of energy, but are highly efficient and obviously, the United States is making an effort to begin using this source of energy to replace fossil fuel consumption.

A second alternative energy source is biomass, which originates from former living plants. Examples of biomass include switchgrass, sugarcane, and corn (Biomass). An advantage of biomass is that it is very

widely available. At first glance, biomass seems to be just as environmentally harmful as fossil fuels, in that it is carbon containing and consequently, releases carbon dioxide into the atmosphere when burned. However, the carbon that is being released into the atmosphere was formerly carbon dioxide, so there is no NET change in carbon dioxide in the atmosphere (Milster). There is an abundance of success stories involving the substitution of biomass for coal in power plants. The University of Iowa Main Power Plant has replaced some of its coal with oat hulls from the nearby Quaker Oats Plant in Cedar Rapids. The net results are economic savings, because oat hulls are relatively cheap compared with coal, and of course, no net increase in greenhouse gases in the atmosphere (Milster). Another example of the employment of biomass is the University of North Dakota which replaced some of its coal with sunflower hulls (Clean, Renewable Energy for UND from Sunflower Hulls). By doing this, not only is the energy used less harmful to the environment, but it is also cheaper in that biomass is much cheaper than coal. Biomass is a broad and diverse term, and as can be seen, is available in many different forms and locations and thus can be utilized abroad.

Another source of energy that holds potential for powering the future is wind power. Wind energy is created through turbines that catch the wind and rotate, creating electricity. Wind farms can be built for large scale electric grids, as well as for smaller electricity consumption such as for a rural home or locality (Wind Power). Currently, wind is used to provide energy to less than one percent of the United States (Power from the Wind), but advances in technology have significantly reduced the cost of wind energy to 3-5 cents per kW-hour, which already rivals current fossil fuel power costs (Power from the Wind). One major problem with wind power is that there must be an abundance of wind to efficiently and cost-effectively make the most of the turbines that are built. There are only a few regions in the United States that can provide this amount of energy, but government-sponsored studies have shown that, in principal, there is enough potential in wind energy from Texas, Kansas, and North Dakota alone to power the entire United States (Power from the Wind)! Of course, the world does not need to become dependent on one single source of energy so that much power would not be necessary (at least for the United States), but this goes to show that wind power could very easily become a key source of energy in the near future. Although wind power is not a leading source of energy right now, there are success stories. For instance, in the state of Iowa alone, enough electricity is generated to power 130,000 homes and prevents the emission of 1.3 million tons of carbon dioxide annually (Facts and Figures about Wind Power).

Something must be done to correct the world's dependence on fossil fuels. The list of options talked about here is no where near comprehensive. In addition to fuel cells, biomass, and wind power there is geothermal power, hydropower, solar power, and others. The fact of the matter is that each one of these energy sources has a success story and each has the potential to assist the world in refraining from the abuse of fossil fuels. Of course some of these sources are more feasible than others. Wind power is only useful where wind is abundant, solar power is only realistic where the sun shines frequently, and hydropower is obviously not a very feasible form of energy in the middle of the desert. As the world becomes depleted of fossil fuels in the next 20-50 years, there is no single energy source that will become the world's savior. Fortunately, through technology and research, several new sources of energy can and are being utilized. The future looks to be filled with a diverse group of energy sources that are less harmful to the environment and more abundant (virtually unlimited) than fossil fuels. If these new energy sources continue to increase in feasibility with new research and attempts to actually use them at large scales, the future of global energy looks to be one of sustainability for centuries to come.

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Wind farm a few miles west of Mason City, IA. Wind farms are scattered throughout northern Iowa and are a great source of energy (Wind Power Photo Gallery)

The Future of Fossil Fuels: Environmental Change, Not Total Elimination

By Karen Haman

The utilization of fossil fuels as a major energy source accounts for a short but troubled history on Earth. By harnessing the solar energy stored millions of years ago in the remains of planktonic animals and plants, humankind has effectively changed the course of history. Though much of this change has enhanced societal comforts and convenience, the fact remains that fossil fuels such as coal, oil, and natural gas, are closely tied to a growing public debate on history's impact on the energy future. This debate covers a wide spectrum of fossil fuel issues: whether or not the world supply is running out, how to proceed in coming years, and the severity of environmental impacts, including global warming. From a chemical engineering standpoint, addressing issues raised by the ongoing debate can be largely incorporated into the chemical energy research effort. Future avenues of fossil fuel acquisition, distribution, and usage methods all fit into this effort, but the most probable chemical engineering application is to reduce the harmful effects of fossil fuels on the environment. By browsing the recent history of fossil fuel usage and taking into account recent chemical engineering research and development (R&D) efforts, the direction future endeavors will take can become clearer. Future R&D must be focused on reducing the environmental impact of fossil fuels by increasing efficiency and adapting older processes to fit new demands rather than implementing a radical discontinuation of fossil fuel use.

A serious look must be taken at the history of fossil fuel usage (especially in the United States) to better understand how future generations will be affected by decisions yet to be made. Coal, the United States' biggest fossil fuel reserve source, has long been in use for a number of applications (Longwell et al.1995). Energy in coal is released by combustion or gasification—conversion of coal into a

cleanable, gaseous fuel for residential or commercial settings—a method in place for 200 years. Gasified coal was a major power source industry until the 1940s when it was largely replaced by liquid fuels during World War II (Longwell et al. 1995). These fuels were derived from oil, a liquid mixture of organic materials that were buried, heated, and compressed for millions of years (Rifkin 2002). Gasoline-powered vehicles and planes became widespread with the onset of the World War I (Rifkin 2002). Today world demand for oil has reached 24 billion barrels per year, but only about 12 billion barrels of readily available crude oil are actually discovered in the same time frame. Scientists seem to agree that roughly 875 billion barrels of oil have been removed from the Earth in the last 140 years, but few find common ground when predicting how much is left to tap (Rifkin 2002). These discrepancies can be attributed to political power plays between foreign oil producers and domestic consumers. Finally, natural gas is a source that has received much attention between the late 1990s and early 21st century for its power potential, which boasts lower pollution emissions than coal or oil (Rifkin 2002). Natural gas usage levels approached those of coal by the early 21st century; however, recent cost increases have reduced the likelihood of extensive natural gas technology development in the future.

One glance at any major newspaper or comparable news source will likely warrant articles apocalyptically lamenting fossil fuel dependence, global warming, and an utter lack of supply. These reports are further enhanced by two major political influences: instability abroad (especially the Middle East) and campaign platforms on the home front boasting plans for a complete reinvention of the energy system, with an emphasis on key words "hydrogen" and "ethanol". Because the media has the ability to spread major concerns with great ease, it is no surprise that the general public has accepted a gloomy prognosis as truth, but a more conservative spin is missing. Though it is true global usage of fossil fuels is startlingly high, there may be more to dwindling reserves than is made apparent by the media. Although the peak of "conventional" oil field discoveries is likely to arrive in the next decade, heavy oil from Venezuela, oil sands in Alberta, oil shale, and even coal are often overlooked as additional fossil fuel sources (Stoffman 2006, Rifkin 2002). Alfred Gunterman, Professional Engineer, adds that although oil shale, oil sand, and coal gasification will be more expensive to utilize than what is available on the current energy market, they offer the lowest cost option for short to mid-term oil and natural gas replacement (2006). Keeping unaccounted fossil fuel reserves in mind, the real issue is not that the Earth is running out of oil, but rather that use of fossil fuels is taking a high toll on the atmosphere.

It is also true that global warming (the blanket of heat-trapping gases above the Earth) exists, but in contrast to the predominantly negative connotations associated with the term, it is actually required (on a lesser scale) for life to exist on Earth (Romm 2004). Even though the extent of global warming may not have reached the severity portrayed by the media, it is important to take steps now to prevent it from becoming a real threat in the future. In her 2006 interview with Mark Jaccard, Donner Prize winning author of Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy, Judy Stoffman makes a strong point. The biggest worry fifty years from now will not be that fuel is running out, but rather that environmental damage has progressed too far (Stoffman 2006). In other words, the step the current generation can and must make will be to develop cleaner and more efficient ways to use the same fossil fuels tomorrow that are utilized today. At this point in time, it is safe to say that future R&D efforts will have the strongest emphasis on improving the efficiency and environmental impact of fossil fuels (Gunterman 2006)

Rather than accept eminent doom and forfeit the present way of life by eliminating fossil fuels altogether, global research efforts have been and should be focused on improving the world's future energy situation. Specifically targeted areas of research are fossil fuel/renewable energy blends, hydrogen as an energy carrier, improvements in fossil fuel efficiency and performance, and reduction of the ecological footprint left by over 100 years of heavy fossil fuel use. Ethanol and ethanol/gasoline blends are the most readily available alternatives today, but these cannot replace the high volume of fossil fuel usage in a short time (Stoffman 2006). Hydrogen is touted by some as the answer to all energy struggles, but since the majority of hydrogen produced for use as an energy carrier utilizes fossil fuels (natural gas), greenhouse gas emissions are not reduced and new atmospheric concerns will arise (increased elemental hydrogen in the atmosphere alters chemical interactions) (Rifkin 2002, Tromp et al. 2006). From an efficiency perspective, as much as one-third of the energy stored in natural gas is lost by steam-reforming it into hydrogen for later use in fuel cells, which in turn have widely disputed electrical efficiencies reported as low as 30% based on higher heating values (HHV) (Barbir and Gómez 1997, Romm 2004). By improving energy alternatives to lower fossil fuel demand and extracting energy from fossil fuels more efficiently and cleanly,

the above research strategies will play a significant role in reducing the ecological footprint left by years of heavy use.

Adaptations to the current fossil fuel economy including increased efficiency, reduced emissions, and a shift to alternative fossil fuel sources, such as oil sands, will save the planet from future energy despair. Further discussion among members of the scientific community will likely hold the key to solving posterity's energy dilemma. Technological advances spanning over more than a century have been made possible by harnessing energy from the sun stored in organisms millions of years old. The future of fossil fuels is dependent on a similar pace of discovery: because drastic changes occurred in just over one hundred years, applying knowledge gathered from that time makes possible further changes to the history of fossil fuels.

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A Renewable Energy Future

By Chuck Kozlowski

With ongoing research involving renewable fuel sources, it seems as if a sustainable energy future is within grasp. The rising cost of fossil fuels and their decreasing finite supply have given rise to an increase in the use of renewable fuel sources. These sources include wind and hydroelectric power in homes, and ethanol for transportation purposes. Although a renewable energy future is still in the research stages, through further technological advancements, refinement of current technology, and conservation, an affordable, renewable energy future will likely occur.

Renewable electricity can be made possible through a variety of sources including wind power, hydropower, and solar power. Developments in wind turbine design have made wind power more viable. Innovative turbine design has made turbines more compact and more efficient. The more efficient design has made wind power more affordable, allowing it to compete economically with non-renewable fuel sources such as coal and nuclear power. Technological advancements have resulted in the use of wind power, increasing by more than 400 percent over the last five years. Wind power now accounts for 23 percent of the electricity used in Denmark (Wikipedia, 2006). In addition to wind power, solar power can be used to harness renewable energy. Solar energy utilizes semiconductors to dislodge electrons that can flow freely as electricity (Aldous, 2006). In recent years, the use of grid-connected solar photovoltaic (PV) cells has increased significantly. From 2000-2004, the use of PV power grew by 60 percent each year. PV units are commonly used to provide a single home with electricity through a solar panel located on the roof of the house (Martinot, 2006). However, in Nevada, researchers are working on a large-scale solar power unit that will produce 64 megawatts of power and provide electricity to 40,000 homes (Robins, 2006). Even more common then wind power is hydropower, which is the most widely used renewable source of power in the United States. Due to the abundant water resources, hydropower can easily be harnessed. Hydropower utilizes the flow of rivers and streams to turn

turbines, which produce electricity. Hydropower currently comprises ten percent of the United States' total electricity production (Martinot, 2006). Hydroelectric plants can be found throughout the United States and locally in Iowa City. Wind power, hydropower and solar power serve as excellent renewable fuel sources. They are currently being made more affordable through process refining and further technological development. Due to geographic restriction, none of these sources alone will provide a complete solution for a renewable energy source. However, if they are used in combination, along with conservation, hydroelectric, solar, and wind power can effectively provide enough electricity to power the world.

When used to provide electricity to homes and businesses, hydroelectric, wind, and solar power all emit significantly less pollutants than conventional fossil fuels. None of these power forms require a combustion reaction, therefore significantly reducing the harmful emissions of carbon dioxide. Harmful emissions due to automobiles can also be reduced through the use of renewable resources. Ethanol emissions have proved to be less hazardous to the environment than those of traditional gasoline. Blends of 15 percent gasoline and 85 percent ethanol reduce emissions of carbon dioxide by up to 25 percent, and the use of pure ethanol can reduce these harmful emissions even further (Canadian Office of Energy Efficiency, 2004). Less negative environmental impacts also prove the need for sustainable renewable energy.

Much research has been conducted on the beneficial use of ethanol as automobile fuel. Ethanol is currently being produced from corn kernels, soybeans, and sugar cane. Between the years 2000-2004, ethanol production and use grew by more than 11 percent yearly and with the rising cost of oil, will continue to grow. Brazil, the world's leading producer in ethanol, introduced its "ProAlcool" program in 1975, which requires the sale of 25 percent blends of ethanol and gas (E25) and pure ethanol (E100) at all fueling stations. Brazil, also one of the leading producers of sugarcane, manages to produce its ethanol through the processing and distillation of the sugars in the plant. Brazil currently has 340 sugar mills and distilleries working to produce four billion gallons of ethanol each year. The United States comes in second in ethanol production and has 95 production plants nation wide, which yield an annual production of approximately three and a half billion gallons of ethanol from corn. (Murray, 2005).

The current means of producing ethanol in the United States require the use of corn kernels, soybeans and other valuable crops for the extraction of vital sugars. It is believed that the cellulose in plants such as switchgrass and corn stalks can be broken down into their component sugars, which could then be converted into a useful fuel source. Switchgrass is much easier to grow than corn, soybeans, or sugarcane, and can be grown on rough, relatively useless land such as mountains. Switchgrass and other forage crops are much less labor intensive to produce than the crops currently being utilized. Although the necessary sugar molecules in forage plants are imbedded within complex carbohydrates, methods are being explored to extract these sugar molecules. With a cost-effective extraction process, ethanol from switchgrass will likely become the primary means of producing automobile fuel. The current processes used to produce ethanol are too costly and could not produce enough fuel for the United States. Research from the University of California Berkley reveals that, for each kilocalorie of energy invested in the growing of switchgrass, its energy yield is 11 kilocalories. The downside to the production of ethanol from switchgrass is that the current method of producing a liter of ethanol from switchgrass is nine cents higher than that from corn (Pimentel, D. & Patzek, T., 2005). However, innovative research is being conducted that would allow for easier extraction of the vital sugars found within the cellulose of forage plants such as switchgrass and other grasses. With further development, ethanol from cellulose could eventually produce enough fuel to replace the petroleum in automobile fuel and eventually fuel the world. Less costly means of producing ethanol would make the production of ethanol from crops more cost effective and less environmentally hazardous than petroleum-based fuels (Des Moines Register, 2006). Shell Oil Company has predicted that the global market for biofuels such as cellulosic ethanol will grow to exceed $10 billion by 2012 (Greere, 2005). With the help of government funding and further research, the production of ethanol from cellulosic material could be made possible in the future. Current conditions show that with the dwindling supply of oil, the future of automobile fuel relies upon the production fuels from cellulosic sources.

Due to the recent shortage of fossil fuels, renewable fuel sources have only been widely explored as a permanent alternative to petroleum within the last decade. The current means of producing electricity from renewable resources are sufficient to provide enough power to the world and with further development could be made even less costly and more efficient. The current methods of producing renewable automobile fuel are not efficient enough to provide the world with sufficient fuel. Through further research and development in cellulosic production of ethanol, a renewable alternative to petroleum is probable. Both renewable

electricity and renewable automobile fuel prove to be less destructive toward the environment than the fossil fuels presently used. The many benefits of renewable energy and the limited supply of fossil fuels prove that with time and further research a sustainable renewable energy future will be achieved.

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The Grim Future of Fossil Fuels

By Zach Rodenburg

Fossil fuels, ubiquitous in our collective global society, are undoubtedly shaping the future of our planet. In the past decade or two, advances in scientific climate research have shown that if our world's reliance on these primitive fuels is not curbed—and soon—that our environment could be damaged irreparably. Scientists in many different fields today regard global climate change, and its link to anthropogenic emissions caused by the combustion of fossil fuels, as fact rather than theory—and nearly all acknowledge the necessity to reduce their use dramatically in coming years. These fuels are not only an exhaustible, non-renewable resource upon which no global energy infrastructure should be erected, but they are also key contributors to air pollution and acid rain, in addition to the ever-overshadowing issue of global climate change mentioned above. Fossil fuels are also less environmentally friendly than alternative, renewable fuels, and their replacement with such fuels could help to reduce and perhaps reverse the problems fossil fuels have already created. It is for these environmental reasons that I will confidently state: the future of fossil fuels is grim, and a drastic reduction in their use is absolutely necessary to reduce the risk of harm to our planet and our future generations.

The first main environmental problem associated with fossil fuel combustion is global warming, which is caused by a process known as radiative forcing, or a climate system's positive change in radiation (heat). This phenomenon is being caused on Earth by the release and accumulation of Greenhouse Gases (GHG's) in the atmosphere (largely due to fossil fuel combustion), which cause the planet to trap and retain more heat. On Earth, global warming can have a variety of negative repercussions such as impacts on wildlife and ecology, reduction (melting) of polar ice caps and thus an increase in sea level, and increased severity of storms, among other problems. All of these potential disasters have the ability to displace or harm thousands or millions of people. It is because of these issues that I feel the use of fossil fuels should be discontinued and that renewable fuels, which have less an impact on global warming, should instead be used in their place.

Renewable fuels, such as ethanol, biodiesel, and solid biomass, while emitting many of the same greenhouse gases exhausted by fossil fuels, are less punishing to the environment and are less likely to lead to global warming. This is because fossil fuels contain energy (in the form of carbon, hydrogen, and oxygen) that has been accumulated and transformed in chemical composition over millions of years compared to less than one or two years for renewable fuels (which have a similar chemical structure). What this means is that the gases released by fossil fuels are being emitted many times more rapidly than they were stored. Renewable fuels, on the other hand, are removed from the

environment a very short time before their release back into the atmosphere (relatively speaking) and essentially there is a balance of gas removed and gas emitted, and no net GHG's are accumulated.

While critics will argue that the amount of fossil fuels going into the production of renewable fuels is greater than the energy contained in the renewable fuels produced, this only seems to be because the infrastructure of renewable fuels is not yet as large as fossil fuels. Thus, not all of the machines or processes used to create renewable fuels have evolved enough to be powered by sustainable fuels alone, and some fossil fuels are still used. However, through the expansion of renewable fuels, hopefully one day all energy used in their production could come from renewable sources as well, and net GHG accumulation could approach much lower levels. This could effectively reduce global warming, and prevent the earth from heating to temperatures that could produce catastrophic results such as mass flooding of large coastal cities, ecological disruption, and massive damage to cities caused by supercharged tropical storms.

Fossil fuels are not only partly responsible for the warming of the Earth, but they also significantly reduce the quality of our environment through air pollution. These fuels are responsible (or have been in the past) for the emissions of the majority of six major air pollutants regulated by the EPA's Clean Air Act of 1990. The culprit pollutants listed in the Act are carbon monoxide, nitrogen oxides, sulfur dioxide, lead, particulate matter, and ozone[3]. According to a recent presentation given by the University of Iowa Power Plant Manager and Senior Engineer, Ferman Milster, energy produced by burning biomass (oat hulls—a renewable fuel) instead of coal is similarly effective and has fewer nefarious emissions, particularly of acid-rain causing compounds such as nitrogen oxides (which also contribute to ozone formation) and sulfur dioxide[1].

Acid rain has been notoriously problematic for coal-fired power plants because coal contains amounts of sulfur, which through combustion forms sulfur dioxide. Sulfur dioxide dissolves in atmospheric water vapor, forming strong acids, and is then returned to the ground via precipitation. This acidified precipitation can weaken trees and limit the nutrients available to them, strip away tree leaves and needles, and lower the pH of water bodies (which can harm aquatic life)[2].

All of the problems listed above can be directly linked to our world's overzealous use of fossil fuels, and all of which are of extreme importance to our rapidly developing world and the maintenance of its age-old environment. If problems such as global warming and air pollution, and their linkage to fossil fuel combustion are not acknowledged by more of today's society in the near future, global temperatures could rise and pollution problems could grow even worse. It is for these reasons that I would like to reaffirm my position that the future of fossil fuels is grim, and their use should be reduced and replaced by more sustainable, renewable fuels.

1. "Global warming." Wikipedia, The Free Encyclopedia. 22 Sep 2006, 14:33 UTC. Wikimedia Foundation, Inc. 22 Sep 2006 <http://en.wikipedia.org/w/index.php?title=Global_warming&oldid=77174400>.

2. "What Are the Six Common Air Pollutants?" 2006. U.S. Environmental Protection Agency. 17 Sep 2006. <http://www.epa.gov/air/urbanair/6poll.html>.

3. "Air Emissions." 2006. U.S. Environmental Protection Agency. 17 Sep 2006. <http://www.epa.gov/cleanrgy/emissions.htm>.

4. "Effects of Acid Rain." 2006. U.S. Environmental Protection Agency. 17 Sep 2006. <http://www.epa.gov/airmarkt/acidrain/effects/>.

My Internship Experience

By Alex Conway

On May 23rd I woke up at 5:00 in the morning to go to my new job. That new job was a Co-Op with Cargill, Inc at their Cedar Rapids corn milling facility. I had absolutely no idea what to expect when I arrived at the front gate to get my security badge. I had heard others talk about their experiences at various companies, but what they said never really made a connection with me.

The first week and a half at work I sat in a chair listening to presentation after presentation on topics ranging from safety to plant management structure. After orientation I was released to my position as Environmental Coordinator Co-Op. During my stay at Cargill my position took on more of a

project engineer role. As a project engineer I was tasked with project design and implementation. I have worked on identifying and fixing a major sewer leak that was causing one building's foundation to sink,extended a 56 ft. movable safety platform to accommodate larger rail cars, designed a better way to make a caustic solution that is used to control the pH of several scrubbers, modification tanks, and sewer flows, and helped with the initial design of a new scrubber.

I have been involved in a very diverse range of project and have learned many things during each one. The most important skill that I have learned during my co-op is the ability to effectively communicate ideas to people of varying technical backgrounds. For those of you out there who are considering an internship or a co-op, I would highly recommend it for two reasons. First, you will learn a lot about engineering as well as your preferences in this type of work (helpful for choosing a job later) and you will earn a very decent wage (okay, a great wage). All in all, my experience has been very informative in helping me make decisions about how I want to pursue my future.

Paper Mill Plant Trip

By Jennifer Pratt

On October 2, 2006, six AIChE members visited Cedar River Paper Company in Cedar Rapids, Iowa. Cedar River Paper is a Weyerhaeuser plant that produces paper products. This particular plant also happens to be where AIChE member, Pierce Stark, is working on a CO-OP. The visit included a safety presentation, detailed plant tour, and a question and answer session. The tour was led by Pierce himself and his CO-OP mentor. Each visitor to the plant was provided with safety attire and a headset with which to hear throughout the plant.

Weyerhaeuser was founded more than 100 years ago, and the company focus is on timberlands. Today, Weyerhaeuser is an innovator that manages forestry holdings and develops new ways to utilize this renewable resource. They have ranked in the Fortune 200 since 1956. Staffing at this site is 224, and they have a team-based, high performance work system environment. They actively recruit for Chemical Engineers at local career fairs and via EXPO

Cedar River Paper receives bales of recyclable product which are reprocessed to produce a pulp that is used in manufacture of cardboard products. At the mill, the pulp is blended with additional pulp from wood chips to strengthen the reused fibers from the recycled material. Recycled paper fibers and new pulp are blended to make linerboard. The medium and linerboard are then shipped to a boxboard plant, where the manufacturing process is finished. For more information on Cedar River Paper or other Weyerhaeuser companies, visit www.Weyerhaeuser.com.

Plant tour enthusiasts and future chemical engineers.

Faculty and Student Awards Fall 2006

Faculty

John Wiencek Collegiate Teaching Award

Undergraduate

Jessica Heth Randall Meyer Scholarship

Jackie Alcantar best poster award, AIChE National Student Poster Session

Alex Conway: Donald F. & Mildred Topp Othmer National Scholarship Award

Ryan Whitaker: Donald F. Othmer Sophomore Academic Excellence Award (Perry's Handbook)

Anyone interested in speaking at professional seminar should contact Steve Gant at sgant@engineeering.uiowa.edu for specific details.

Anyone interested in making a tax-deductible contribution to the University of Iowa AIChE Student Chapter please contact Professor David Murhammer via email at Murham@Engineering.uiowa.edu for details.

Editor in Chief: Jesse Shuck would like to thank the following people for their contributions to the Fall 2006 Chemical Engineering Newsletter:

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