Chris Muhich
Summer 2008
MT-Energie
The University of Michigan
cmuhich@umich.edu

My Summer in the TREE Program
By Chris Muhich

My name is Chris Muhich, and I am currently a senior at the University of Michigan studying chemical engineering. This summer I worked as an intern at MT-Energie in Rockstedt, Germany as part of CDS's TREE program. MT-Energie is a small, 250 employees, but quickly growing bio-gas technology company. MT-Energie is currently located in Rockstedt, but is soon moving to Zeven in Lower Saxony. This summer I not only worked but got to learn a great deal about renewable energy, the work place, got to know some wonderful people, and saw cool places around Germany.

In biogas production, a substrate, be it liquefied manure (most often from cows, but pig and chicken manure can also be used), and/or a corn or other sorts of silage (ground up plant material) is digested anaerobicly. Anaerobic digestion means that the process is run in conditions completely or very nearly devoid of oxygen. An army of microbes brake down the substrate into methane, carbon dioxide, and a few other gasses in very small quantities. This is biogas which can either be combusted to create electricity and heat or purified to create bio-methane which can be used for many different purposes.

Over the summer I worked on several projects, either working to improve MT-Energie's biogas systems or my main project, being the removal of ammonia from the digested substrate. This needs to be done, because there are many restrictions about disposal of substances with high ammonia contents due to run off and air pollution. Not only does this help prevent pollution, but the removed nitrogen can be used to fertilize the soil, preventing large carbon dioxide emissions from chemical fertilizer production, and lowers fertilizer's high costs.

In the beginning of the summer, I spent a good portion of my time doing background research on not only nitrogen removal but also biogas technologies in general. After learning the basics, I was put in charge of my first project. In order to monitor the quality of the biogas coming out of our biogas plants and the health of the entire system, I was to create the layout for the piping of a miniature gas chromatograph (a device used to measure the different chemical components in a gas stream). To do this, I need to research, and purchase the parts for the sample injection system. After completing this, I was put in charge of modeling ejector pumps. An ejector pump pumps liquids and gases with out using mechanical means. I did this so that MT-Energie could better understand the fluid mechanics behind their operation; in addition to allow modeling for future building of our own pumps, rather than purchasing other company's pumps. To model and size the pumps I used Microsoft Excel to run the calculations developed from my mathematical models of the fluid mechanics and physics of the pump.

After the ejector pump I started my work on ammonia removal. My first part of the project was to run test on the digested substrate. I first created titration curves of the substrate using both a strong base, sodium hydroxide, and then with a solution made from burnt lime, a cheep and commonly available chemical. This allowed for the evaluation of the use of chemicals to help remove the ammonia. After these curves were created I spent a week boiling the substrate. This entailed using a counter-top, pug-in pot as the heating element and taking substrate directly out of the digester to measure changes in pH, temperature and ammonia concentrations with time. While the results were interesting, the actual testing was quite smelly.

With the results from both the chemical and thermal treatment of the substrate, I started work on the designing for the separator. In order to separate the substrate most efficiently, I developed several different models of heat exchangers. The basic ones were calculated using Microsoft Excel. These first tests were used to gain a basic understanding of the different options, and functionalities of the heat exchangers. Then I designed more robust and intricate heat models for the exchangers, including starts and stops in addition to using several different heating media. I created several versions of a Visual Basic program to run the calculations of the model. At the end of the internship I worked with my supervisor to come up several different separator system layouts and then drew them up as basic schematics.

The work culture was very different than I had thought it would have been. I was prepared for an exceedingly formal work environment and was shocked to find the atmosphere was very communal and conducive to cooperation. Not only was everyone, from the CEO down to me, the intern, addressed informally (using *du* instead of *Sie*) but everyone was on a first name basis. Though I am not sure why this occurred, it made me feel much more apart of an integral team more than I would have felt with more the formal barriers I had expected.

The work I did this summers is closely related to my plans for the future. Currently I am planning on pursuing a Ph.D. in chemical engineering, specifically looking into renewable energy. Not only did I gain a large amount of knowledge about biogas, but I also got to be in an actual engineering environment doing engineering work. I also got to design and carry out both modeling of systems and experiments, things that I find interesting and that I hope to do both in graduate school and afterwards.

I am also considering going to graduate school or working in Germany after I graduate. The experiences which I gained from this summer have greatly added to this desire. In addition, it has greatly increased my abilities to live and work in a solely German speaking environment, which makes me feel much more at ease about my ability to either live and work or study in Germany.

I lived in a company owned house in Zeven, a city of about 12,000 inhabitants. The house was quite new and very nice. It consisted of a living room, kitchen, laundry room and one bed room on the first floor and four bedrooms and a bathroom on the second floor. The house was used by me and other employees of MT-Energie, who did

not live in or in the areas around Zeven and were only there for the work week. There were several people who lived there most of the weeks that I was there, but there were also many people who would stay only a day or two. Although there were always new people in the house during the week, I had the house to myself on the weekends.

Zeven is largest city around for quite a ways, the nearest being Rotenburg (Würmme) which is 24 km away. It is located between Hamburg and Bremen on a small river called the Oste, and is surrounded by many small forests and farm land. Though it is the biggest city around there is no passenger train service, although there is a freight train stop. In order to leave Zeven, you have to take a bus to either Bremen or Hamburg and then take a train. In the past it was home to a cloister. In addition to MT-Energie, which will soon move to Zeven, it is one of the basis of Nordmilch, a large milk producer in Germany. There are many small farming villages surrounding Zeven including Rockstedt (two villages to the North) where MT-Energie is now located, which are very nice to ride a bicycle through.

The highlight of social activity in Zeven came on the third weekend in June with the Stadtfest Zeven (the city festival). The main pedestrian street, a long cobble stone street lined by shops, and square was taken over by people selling food, beer, nick knacks, and music groups. This is where I meet a nice German family, with whom I watched the European Soccer Championship. Aside from them I had some trouble meeting people, though those I talked to were mostly very nice. Most of the locals went out to the bar with a large group of their friends and family and it was a bit difficult trying to brake into these groups.

Although there was not much to do in the evening, having almost no night life, there was a movie theater, and the nice scenery around Zeven allowed for great biking. On the weekends that I stayed in Zeven I spent a great deal of the time biking through the surrounding villages and forests. One weekend's bike ride took me all the way to Worpswede, a city which has played host to an artist colony for over a hundred years. Because there were so few people around, if the skies are clear one can see the stars amazingly well.

Although I did not meet many people in Zeven outside of work, I spent several very nice evenings with my colleges. On several occasions, we all got together at one of our houses and cooked dinner, chatted and played German board games. These evenings made life much more enjoyable and greatly helped my German, being able to talk about random social things for several hours at a time. I also got to attend a barbeque at my boss's house and meet his family.

During the week I spent a lot of time reading. On nice days after work I would read outside in the beautiful park in the center of the city, or at my house when it rained. During the European Championship, I watched several of the games at the house of the people that I had met at the Stadtfest. I spent about half of my weekends in Zeven and half outside of Zeven. Over the summer I went to Hamburg, Bremen, Munster (for a wedding), Worpswede and Berlin three times.

When I stayed in Zeven, I usually tried to meet people by going to the local bar or movie theater on Friday night, and then biking around on Saturdays and or Sundays. After the first month or so of not meeting people I spent most of my weekends visiting people and seeing other cities.

Several of these weekends were spent with other TREE participants. My first trip to Berlin was spent with seven of the other TREE participants. This gave us all the opportunity to catch up with each other after Freiburg, attend the Christopher Street Day Parade and go to the Russendisko, in addition to seeing Berlin. Later in the summer I met up with Priya Gandhi and Lisa Keaton in Hamburg. We spent the weekend wandering through and seeing the city. The trips to Munster and the other times I went to Berlin were to visit German friends I have had for a long time. I found the wedding in Munster particularly interesting; it was the civil wedding and I have been to civil wedding ceremony in the US let alone Germany, it was quite interesting to see how the German marriage system worked. My trips to Worpswede and Bremen were merely to see the cities and, at Worpswede, the art and artist colony, and proved very pleasant and beautiful.

This summer was an amazing learning experience. I expanded my knowledge of green technology, working in an engineering environment, and German language and culture. I believe that I have learned more this summer than any other summer in my life. I not only recommend the TREE program to people I know studying German and interested in renewable energy, but also recommend that companies in both Germany and the United States consider taking part. I feel that my company benefited not only from my engineering capabilities, but also learned a lot about working with people from the United States, an area of the market they are trying to get into. If given the chance to go back and be a TREE participant again, I would do it with out a second thought.