Spring 2015 Co-op Experience with The Dow Chemical Company

My name is Jessica Miller, and I was born and raised in Las Cruces, New Mexico. During my senior year at Oñate High School I enjoyed taking an AP Calculus course, as well as an AP Chemistry course taught by the irreplaceable Mr. Steven Ewing. I excelled in these classes and discovered my love for both math and chemistry. During this time, students from the American Institute of Chemical Engineers (AIChE) at New Mexico State University (NMSU) visited my Chemistry class and explained how chemistry, math and physics could be applied through a Chemical Engineering degree to solve important problems in the real world. I decided to pursue a degree in Chemical Engineering at NMSU to learn what the program had to offer and to be a part of the NMSU CHME culture.

My time in the Chemical Engineering department at NMSU has been very productive. I immediately got involved with the AIChE chapter and started planning events, fundraising, and running for chair positions. While getting to know the department and trying to find my future career, I joined Dr. Reza Foudazi's lab group and worked with WERC/IEE on cellulose nanocrystal extraction and characterization. Now I am a junior, having completed Transport Operations II: Heat and Mass Transfer (CHME 391). Certain CHME classes like Fluid Mechanics and Thermodynamics piqued my interest in industry, so I applied for and received a co-op position with The Dow Chemical Company.

At Dow, I was placed in a facility that makes two related types of chemicals with two very different processes. One of the plants uses a batch process to produce polyethylene glycol (PEG) which acts as an excipient, binder, and filler, among other things. The other uses a semi-continuous process to produce and refine glycol ethers (GE), a family of solvents. I worked as a production/improvement engineer. The objectives of my work term were broad and incorporated improvement, production, quality, logistics, and operations type roles. Specifically, I was tasked with: improving EH&S performance by completing LOPA/DowGEP actions and gathering information on current deadhead protection and emergency block valves; improving plant productivity through a long-term reactor clearing project; and

helping to meet quality requirements by generating a tank qualification and commissioning protocol. My background in Chemical Engineering helped me to understand the fundamentals of the projects, but my supervisor and mentors at Dow taught me how different pieces of equipment work together to make a chemical plant run safely, and how to complete work specific to the company.

Inherently, a lot of the work in a chemical plant is safety-related; my work term was no different. I worked with the technology center and operations to evaluate the status of pump deadhead protection and emergency block valves. I found gaps in record keeping that required work to close. This was important because deadheading some of the pumps in this facility could have resulted in serious safety incidents. Similarly, having emergency block valves on the wrong inspection schedules or un-inspected entirely, could result in valve failure when process containment is most needed. Coming into my co-op term, I knew how to calculate the head produced by a pump, and I knew valves were an integral part of a plant. However, I did not know all the different types of pumps and valves, and how that affects their application, maintenance, and performance. This all had to be learned from engineers and operators at Dow who had been working in the industry for years.

As an improvement engineer, one of the big projects I worked on aimed to increase productivity by improving the operation of the batch process plant. Similar to most batch plants, the goal was to move product through the reactor as quickly as possible. This project looked at the effect of changing vessel pressures during reactor clearing, in an attempt to reduce the time needed to empty the reactor. I worked with the technology center, quality, and process automation engineers to calculate the minimum pressures needed, identify the code that needed to be changed, and write a validation protocol. Because the plant produced food grade material, special care needed to be taken to ensure product quality when any process changes occur. The validation protocol accomplished this by outlining a procedure for changing the pressures incrementally, while verifying the product quality along the way. While I did not get to see the project through to the end, if it is completed and found to be a viable option, the change could increase plant productivity by $1-3 million. This project taught me invaluable lessons about process engineering, process automation, and instrumentation that I could not have learned in a class.

Another long term project I worked on was a tank commissioning and qualification. I wrote a protocol for inspecting and qualifying a new tank for food grade service. While working on this project I got to sit in on a lot of meetings and see how large projects pull on the resources of many different

departments to finish safely and on time. To commission a tank like this one that holds a main feedstock, coordination between logistics, marine, rail, scheduling, quality, operations, and maintenance was necessary. There was a tight schedule for contractors to re-line, re-paint, and repair the tank. At the same time, production engineers were working with schedulers and marketing to determine the best time to start using the new tank in order to reduce downtime. Piping and valves needed to be installed along with the corresponding code for the logic solver and operators to be able to use the new tank. On top of all this, there was a state-determined deadline to stop using the old feedstock tank driving the project forward. From my Chemical Engineering background in school, I knew tanks were integral and orderly piping imperative, but I had no idea how involved something as seemingly simple as putting a new tank in operation could be.

Some day-to-day tasks that helped me complete these projects and others included: reading piping and instrument diagrams (P&ID's), reading vessel drawings, looking up documents in the plant's library, reading pump curves, studying logic solver code, and inspecting process trends. These tools are used by all engineers in a chemical plant on a daily basis, but may not be covered in standard Chemical Engineering courses. It is better to gain this experience as an intern or co-op while still in school, as it will make the transition into industry easier after graduation.

The Dow Chemical Company places great value on the safety of its employees both on and off site by constantly trying to improve process safety and working conditions. The beginnings of most meetings in a Dow site include a "safety moment" where one of the attendees shares an example of an identified and corrected safety risk, or a method to counteract inherently unsafe conditions. This, along with extensive safety training that never really ends, keeps safety at the forefront of everyone's mind. Everyone working on site, including a co-op, has the responsibility to be as safe as possible in every aspect, in order to keep themselves and others from harm. These responsibilities include but are not limited to: driving safely around the plant, wearing appropriate PPE, mitigating unsafe conditions, and suggesting safety improvements.

Working as a co-op gave me the unique opportunity to ask engineers of all trades and levels of experience questions regarding equipment, processes, and chemistry. At the same time, I was expected to interact and collaborate with engineers, technicians, operators, and sales representatives in an appropriate and professional manner as the job required. Communication skills played an integral role in my co-op term. Most of the communication on the job was in face-to-face meetings, over the phone,

and through email. There were few days that I did not log onto my computer to find several emails that required follow-up, and I always had at least one meeting a day. More importantly, I gained an appreciation for communicating the right information to the right people, as small mistakes have the potential to become big problems in a chemical plant.

I would undoubtedly recommend an industrial internship or co-op to any engineering student who has the time and the means. It is eye opening to see the concepts you read about in textbooks applied on a large scale Not only did I learn how the fundamentals of core engineering classes are applied in industry on a daily basis, but I saw firsthand how much true engineering one cannot learn in a class and must learn through experience.