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CHE 391 - Industrial Employment

The Mosaic Company

This summer I had the privilege to work for The Mosaic Company. Mosaic is a world wide mining company. They are actually a Canadian company, but mine in

Carlsbad, NM, Florida, and Michigan. They also have dealings in Brazil and Russia as well as a few Canadian Provinces. I worked in Carlsbad, NM under Steve Gamble. Steve obtained his B.S. in Chemical Engineering from NMSU in the 70's. He has been with Mosaic since the completion of his degree. His knowledge in mine engineering is extensive, and his understanding in salt chemistry and phase chemistry is

amazing. He is Mosaic Carlsbad's lead research and development engineer and no change in the plant is made without his consent when it comes to the chemistry

throughout the plant. He is a vital part to the success of Mosaic Carlsbad and without his knowledge and ability the sylvite production plant would no longer be running.

I assumed I would spend my summer getting coffee and running errands, but when I first met Steve I realized he was a very intense, all business type of guy. I

then realized I would spend my summer working hard and along the way learning a great deal about the mining industry as well as the chemistry associated with

Mosaic.

The first week of my internship I spent all day researching and reading

material written in the 1950s about Mosaic Carlsbad and the chemistry that

occurred throughout the plant. The chemistry was rather in depth (due to the

changes in the phase chemistry) but the overall idea was very simple - take ore and

turn it into a clean easily usable potash for fertilization all over the world. The sheer amount of knowledge I obtained in the first week made my brain hurt.

By week two I was fairly strong in mineral and salt chemistry and ready to begin my job. We started by learning both plants at Mosaic inside and out. This was a great way to start because both plants have many steps and each process is very different.

The sylvite plant is the oldest operation for mosaic and has been around since the beginning. Sylvite (Potassium Chloride-KCl) is a red salt mined from the earth and then processed to make a purer sylvite product. The mining takes place at 750 feet below the surface. This process relies completely on chemistry. The ore is very impure (~8% sylvite). These impurities include other salts but the main concern is clay in the seams of the ore. This causes a great deal of issues. A special mix of polymer is used to help fix the clay issue.

The sylvite plant is a very inefficient plant (~55%). This summer part of my responsibilities included working to figure out how to make the plant more efficient. Most of the projects we focused on involved figuring out how to increase production and increase the amount of product to the warehouse. There are many areas that cause the production to be so low. Most product is lost in the thickeners, belt filter, and compaction.

The thickener is where the polymer is used to separate clay from KCl product. When a thickener goes down it costs about two million dollars to refill it with useable brine. Completely saturated brine must be used because all potash is very easily dissolved with fresh water. If water is used to fill up a thickener even

more product is lost and the plant sees an efficiency of approximately 40-45%. One of my projects with summer was running a 30-day test to compare Hychem Polymer to Soane Polymer. The people in R&D watched the plant 24 hours a day during the thirty days. I worked multiple 16-hour days taking samples and running numbers. The belt filter also causes issues because it goes down a lot causing the plant to run at a lowered ore rate as well as makes a huge mess and loses a lot of product each time it goes down. We also ran tests on the belt filter during the polymer tests we conducted.

In compaction product is lost because the compactors have a hard time compacting dust into a product that can be used. All dust lost is product that cannot be captured. When the dust is lost it can also cause the plant to get fined for not keeping the plant air clean and up to standards. Fines have been given in the \$30,000 plus range. This is a huge concern because it causes profits to go down on an already inefficient plant.

Most inefficiency is due to the plants age and bad ore grade. The plant was made for ore that is 20% plus sylvite. With a much lower ore grade and the increase in clay seams it causes the plant to work much harder to obtain good product. There are many plans in place to upgrade the plant but these renovations will cost a great deal of money and the efficiency is so low it is hard at times to justify the work.

The langbeinite plant (more commonly known as K-MAG) is a new plant (built in 2005). It is much different than the sylvite plant. Langbeinite is mined 850 feet in the ground. The ore is white compared to sylvite ore being red. K-MAG product is much more expensive but works amazingly well for farmers. Three

different types of product are made in the K-MAG plant. Special Standard is very small and used for animal feeds. Standard K-MAG is larger and used for

fertilizer. Granular K-MAG is a larger for used for fertilizers as well. Left over K-MAG product is sent to the Granulation plant to make Premium K-MAG. This is one of the best fertilizers on the market and is always sold out. The wait for this product can be 6 plus months. Premium is a pellet like product that emits almost zero dust. It is

highly sought out by countries all over the world and a great deal of it is exported worldwide. Premium is the plants largest moneymaker so K-MAG and Granulation must always be running to meet prior product obligations.

The K-MAG plant is not as chemistry intensive as the sylvite plant. Instead the process is much more mechanical. Ore is crushed and separated based on size. The K-MAG plant does have a few similarities to the sylvite plant. Brine is used as well because langbeinite is also highly soluble. There is also a belt filter in the K-MAG plant to separate excess brine from the product.

Unique to the K-MAG plant is the Screening Tower. The Screening Tower connects K-MAG and the product warehouse. They are connected by a series of belts. The Screening Tower is used to oil the product to help decrease emissions of dust. As stated before these emissions can become very costly to the company. The product is sent thru a continuously moving screw. There the product is mixed and oil is added.

This summer one of the projects I worked on was changing the type of oil used. Mosaic now uses food grade oil compared to oil previously that had to be handled with much more care. Dustech as it is know is the food grade oil we

taught me how to work with people all over the plant. I went to many meetings with

Doing this project helped me really understand phase chemistry. It also

way for the plant to use it.

was my job to figure out the chemistry of the product in the lake and decide the best

product in Laguna Grande to increase efficiency in the plant by more than 30%. It

working to prove exactly how much. The results were astounding. There is enough

R&D team knew there was a great deal of money sitting in the pond so we began

operation there has not been a plan in place to capture this brine and product. The

deal of product and brine to the effluent streams. Since the beginning of the plant's

plant. Laguna Grande holds all the effluent from the plant. The plant loses a great

My main project for the summer dealt with Laguna Grande and the sylvite

placement and screw.

per unit time. I also worked with a few mechanical engineers to redesign the nozzle

the calculations made to know exactly how much oil was being put on the product

compared to water (the nozzles where calibrated for water). This allowed me from

patterns. I also made many calculations based on the specific gravity of the oil

By the end of this project I had a strong knowledge in nozzle types and spray

was economically relevant.

where we had good coverage and low dust emissions but didn't spend more than

amount of product as the screw turned the product over. We had to find a place

also wanted there to be more than one nozzle because we wanted to cover the max

type of nozzle that would be best. We wanted a spray pattern that covered well. We

switched to. It was my job to decide the amount of oil we needed per ton and the

haul the crystal product but this cost more money. The simplest solution was a larger pump to move the slurry.

Having this internship taught me so much. Having such a large project

allowed me to talk to all different engineers. I enjoyed the responsibilities I had. I also enjoyed knowing everyday at work I had real purpose being there.

This internship also taught me other things about myself. My goals before this internship were to get my bachelors degree and go to work as a process

engineer, but working with these engineers at Mosaic showed me this isn't what I want to do. Since I have returned to school I have applied to graduate school. I was accepted and plan to pursue a master's degree in chemical engineering. I really like the idea of getting my Ph.D. as well but only time will tell. I enjoyed the research at Mosaic and working in the lab. Being in the Research and Development group at

Mosaic really opened my eyes to my joy of discovering new things. I am excited for my new future and all the possibilities to come. This internship was the best thing for me thus far in my educational career because it showed me the things I really enjoy when it comes to engineering. I am so excited to begin my research and have a new type of purpose being a chemical engineer.