My Siebel Experience

By Jeremy Lenzendorf

Here is a bit of background about me before I get into my experiences at The Siebel Institute of Technology. My name is Jeremy Lenzendorf. I became interested in brewing about 12 years ago when I helped my uncle Donny brew a batch, actually I did more watching than helping. After graduating from college in 1998 I hoped to finally start homebrewing myself. My dream wasn't realized until my wife and I moved into a house of our own in 1999. Once we moved in I made a trip to a homebrew shop near Milwaukee and bought the traditional starter kit that most everyone starts with and the ingredients for a Belgian Wit extract and specialty grain recipe the owner was kind enough to give me. Since then I had been putzing along with the hobby, picking up a book and bits of knowledge here and there, but not immersing myself in brewing. After returning from a vacation with my wife this spring I had a message on my answering machine from Rob Moline. I had seen some of his posts on the HBD and knew that he would be notifying the winner of the Lallemand Scholarship for Brewing Technology. I thought to myself that there must be some other reason he had called, but he had said he had good news for me, so I immediately called him back. He said that I had been chosen as the winner! Well, I couldn't putz along anymore! I spent the next few months reading the HBD more intensely, re-reading my back issues of *Zymurgy*, reading John Palmer's *How to Brew*, talking with my uncle and brewing on my own. Rob told me I would be inundated with information during the two-week course, so I knew I had to understand the basics of brewing so I didn't get lost when the discussions got in depth. When September rolled around I was finished with all of my reading and had done my first all-grain brew and was ready to make my trip to Siebel. The text that follows includes factoids and statistics that I found to be of interest, brief summaries of what we covered and other items I thought brewers of similar experience may find intriguing. This only scratches the surface of the information given during the two-week Concise Course at Siebel. More information about the Concise Class and other courses the Siebel Institute of Technology offers can be found at www.siebelinstitute.com. I would like to thank the AHA and Lallemand for this wonderful opportunity. I encourage everyone reading this to sign up the for the scholarship next year.

Monday, September 16

The first day of class has finally arrived. I met a few of my classmates before the first class in the alumni room. In the first class we all were asked to give our reason for attending the Concise Course and a bit of background about ourselves. We have quite a diverse crowd in our class of 11 including homebrewers looking to get into the craft brewer business, a representative from a tank manufacturer from The Netherlands, a brewer from a large brewery in the Bahamas, and craft brewers from around the USA. We then started with an overview of the brewing process. A few interesting items here: hops have been used in brewing for only about the last 1000 years, lager yeasts have been used much more since the Industrial Revolution because of refrigeration, and vintners and distillers do not reuse their yeast as brewers do. The next class was an introduction to sensory evaluation. A color handout of the beer flavor wheel will be very helpful in evaluating my beers in the future.

After lunch we spent two hours on how important water is to brewing. Mike Babb gave an excellent real-world example of a water treatment procedure that he worked up for a brewer who could make a great Pilsner but was having trouble with his Pale Ale. Mike found from their water analysis that their water very close to that from Pilsen which made it a lot different than the water from Burton-on-Trent, where Pale Ales originally gained popularity. He showed how to calculate salt additions to the water to achieve similar characteristics that may aid in matching a particular style. I plan on getting my local water analysis as soon as I get home so I can see how close I am to water profiles usually used for certain styles. The history of brewing ended up being our last class of the day. The material covered here can be debated because alcoholic beverages have been around longer than written languages. There were a couple of interesting factoids brought up in class. Fish swim bladders, which are now ground and used as a clarifying agent, may have been used as carrying vessels in the past and had the unanticipated result of clarifying also. Louis Pasteur was working on making beer last longer when he discovered pasteurization.

We spent some time in the alumni room on draft and bar orientation. The correct glass cleaning procedure using the new Spulboy Glass Cleaning System was shown to us and Mike instructed us on how to correctly tap a beer. We were also shown the carbon dioxide, nitrogen, and beer pump setup in the basement. The entire setup is well organized and efficient. The diploma course is also going on at the same time as ours so there are 30 to 40 people in the school at this time. After class was over for the day everyone gathered in the alumni room for beers, to get more acquainted with classmates and to ask the professors any questions they may have. What a great first day, I can't wait to get back going tomorrow!

Tuesday, September 17

We started the day discussing the business of brewing. Kirk Annand went through tips and helpful hints on starting and successfully running breweries of different sizes. He helped keep the discussion interesting by explaining some personal examples. I found this class interesting as a starting place if I decide to pursue a brewpub in the future. We had our first taste sampling this morning. It consisted of a control sample, a sweet

sample (2% sucrose), a sour sample (200ppm Acetic Acid), a salty sample (0.4% Sodium Chloride), and a bitter sample (50 BU). Our next class was on enzymes in brewing. This was a very interesting class that discussed what enzymes worked at different temperature and pH ranges. The enzymes have to work in a specific sequence. For instance, the cell walls must be broken down before the starches can be converted to sugars. Enzymes are delicate structures. They have optimum temperature and pH ranges and are inactivated by excessive pH and temperature.

After lunch we talked about beer styles. Differences in beer styles should be quantifiable by measurement and taste. They have been defined by many different sources including historical records, beer enthusiasts, national organizations and even journalists like Michael Jackson. It is understandable that many styles were developed because of the local barley types, water sources and yeast strains. I don't know a lot about beer styles so this class was quite informative. We didn't go in depth into each style because of the time that it would take, but it's good to know the basis of how they were developed.

The next two hours were spent covering hops. Hops were probably not used in the early beers. They have been used for "spicing" beers for about 1000 years. Only the female hop plants are used for beer production because they have higher yields. Hop plants are productive for approximately 20 years and then are replanted. We were shown a German hop making video detailing the growing, harvesting, and processing of hops. We also smelled examples of hop oils, pellets, and whole hops. These varied from very nice smelling fresh hops to older, cheesy smelling hops to very old hops with almost no smell. One fact I found interesting was that only 30% of the hop's initial bitterness actually makes it through to the beer. These losses are caused by isomerization, pH drop, precipitation, filtration, etc. This discussion was very valuable for calculating hop additions and also because I hope to grow some hops in my back yard next year.

To finish the day we had styles tastings. Our class and the diploma class gathered in the alumni room to sample various beer styles ranging from a German Pilsner to a Barley Wine. It was very interesting sampling so many different beers and listening to experienced critics give their opinions of what aromas and tastes they got from each beer.

Tuesday evening our class took a field trip to a Goose Island's Clybourn Brewpub in Chicago. There we were able to sample many of Goose Island's awesome beers. We are also lucky to have a brewer from Goose Island in our class, so we were given a tour of the facilities. They have a larger production facility, but are able to use the brewpub facility for trying new recipes and making small batches. We also made sure to venture across the street to a store that had the widest beer selection I've ever seen. I ended up picking up a Belgian beer recommended that I had never tried before.

Wednesday, September 18

Most of the day was spent on various aspects of malt with Mary-Jane Maurice from Froedtert Malt in Milwaukee, Wisconsin. We started by going through the composition of a barley kernel. There certainly are a lot of important components packed into each little kernel. It was pointed out many times during the week that barley seems

to exist specifically for making beer because of its composition and characteristics. The maltster has a very important job, that is, to make barley into the valuable malt that can be used by brewers. The objectives of steeping barley are to separate the grain from any dirt and floating material, increase the moisture content so germination may be initiated, provide sufficient oxygen to the seed, and to remove carbon dioxide and growth inhibitors. The grain will take more water quicker with an increase in temperature, but if the temperature is too high the reactions inside the kernel go too fast. Various methods of steeping were presented. The chemical and physical changes that occur during germination were also discussed. The objectives of kilning are to stop the malting process, reduce moisture for storage, stabilize the enzymes, and develop the color and flavor desired. Six-row barleys are generally predisposed to greater DMS formation due to higher protein content. Approximately 20% of the starting weight of the barley will be lost. This means that the maltster needs about 120 pounds of cleaned barley to produce 100 pounds of cleaned malt. We also discussed specialty malts. Different roasting times and temperatures create the different colors in specialty malts.

In the morning we had our second taste sampling. This consisted of tasting a control sample with no UV exposure that was stored cold and comparing that to a lightstruck beer that had been exposed to indirect sunlight for 6 hours at 72˚F. The lightstruck beer could be described as being very skunky.

In the afternoon we discussed milling. Milling is done to crack the outer husk and separate it from the endosperm, crush the endosperm so it is exposed and can be quickly degraded by the enzymes. We examined different types of mills with 2, 4, 5, and 6 rollers. This was quite interesting since I had just recently purchased a 1-roller mill for use at home. Hammer mills were also discussed, these are used mainly by brewers who use mash filters because they pulverize the grains and don't leave the husks intact so they can be used for the lauter filter. Proper milling of malts leads to improved brewhouse efficiency by helping the mash conversion and lautering.

Mashing was the last class of the day and carried over to the following morning. We talked about different grist ratios and why you would want a thin or thick mash. Something else I didn't know, grist ratios should be based on weight, not volume. The different factors affecting the mash enzymes were detailed. These include the malt modification, endosperm particle size, having a homogeneous mixture, pH, time, temperature and enzyme activity. We discussed mashing schedules and what is occurring during different times of a step mash. Mash ramp ups should be about 1˚C/min (1.8˚F/min). When using a decoction mash, enzymes are killed during the boil, but there will be enough left in the mash to do the conversions. The boiling helps to gelatinize the under-modified part of the malt. Because of energy costs and malts that are well-modified now, decoction mashes are not necessary very often. If it is used, the boiled portion must be mixed back in slowly so it doesn't kill the enzymes that are still alive in the mash. If adjuncts are used with a decoction mash it may be necessary to add enzymes.

Thursday, September 19

After finishing up with the rest of the mashing discussion from yesterday we had our daily taste sample. This one was on esters and included the control sample, a sample with ethyl acetate at 100ppm (nail polish remover), one with isoamyl acetate at 8 ppm (banana aroma), and one with ethyl hexanoate at 0.5 ppm (red apples aroma). Our next lecture was on the use of adjuncts. The only adjunct that is allowed by the Rheinheitsgebot is malted wheat. US beers have continued to use more and more adjuncts in their beers to where now the ratio is about 50% malt to 50% adjunct. This ratio does vary widely depending on whether the brand is a local beer, a premium brand, a specialty beer, etc. I found this class quite interesting as I had read discussions on the HBD about using potatoes and other unique sources of starch in beer. Our next class was on brewhouse calculations. We went through a problem where we were given two malts and their extract values, the brewhouse material efficiency, malt ratios, OE desired and fermentor brew size. From this information we worked backwards to see how much of each malt was necessary to give the required amount of extract. We also determined how much water would be used in all processes by utilizing some rules of thumb and the given data.

Our last two hours of the day were spent talking about lautering. Although the discussion was mainly about very large lauter tuns I found much of the information about filter bed formation, vorlaufing (wort recirculation) and sparging to be useful in helping me understand how I can improve my setup at home. One very important point I got was to make sure to keep sparge water an inch above the bed to prevent oxidation of the top surface. In lautering we are again reminded of how naturally perfect the barley is. By maintaining most of the integrity of the husk we have a nearly perfect filter bed to extract the sugars. I also found it interesting that the formula for calculating ideal lauter tun design is the standard form for filter calculations since lautering is a natural filter.

Friday, September 20

We started out Friday with a class on mash filters. Mash filters are not something to be used by homebrewers or even craft brewers, they are more for large brewers. The mash filter takes up less space and has faster run-offs than a lauter tun, but some designs are not as flexible with mash volume changes and their filter material is expensive to replace. It was interesting to learn Coors switched to mash filters during Prohibition so they could make dry extract for Mars candy so their business could survive. After Prohibition was over, they kept and redesigned their mash filters.

Today we sampled various levels of diacetyl to find our threshold. We started with the control beer, then 50ppb of diacetyl, I could not sense it yet. We then went to 100ppb and I could barely pick it up, only because I knew what I was looking for. When we got to the last sample, 200ppb, it was very easy to pick up the buttery smell and taste.

The next class was on wort boiling. Some of the reasons for boiling the wort are the evaporation of water, removing volatile substances, sterilizing the wort, denaturing the enzymes, formation of the hot break, and extraction of the soluble hop constituents. I had been unaware that there were so many reasons for boiling the wort. I had always assumed part of the reason was to kill anything that shouldn't be in the wort, but now I realize how many functions are done during the boil. Many of the options for heating the

wort discussed are only practical for craft and large breweries, but it is still necessary for everyone to achieve a good rolling boil to keep a homogeneous wort.

We next discussed wort clarification. We learned what the major components of hot and cold break trubs are and the possible ways of removing them from the wort. It was noted that trub does not speed up the initial rate of fermentation. Research has found that this is primarily due to the surface area of the trub causing nucleation sites and faster release of carbon dioxide. The same effect could be obtained by adding activated carbon to the fermentor. Another misconception is that the yeast assimilating the lipid content of the trub causes faster fermentation. This is not significantly true. The moral of the story is, the disadvantages of not removing trub outweigh the perceived advantages. One way that large breweries remove their trub that can also be done by homebrewers is whirlpooling. The large brewers have mechanical whirlpools, but homebrewers can use a ladle or paddle after boiling and swirl their wort in a circular fashion and then allow it to settle. Most of the trub will accumulate in the middle of the kettle and the wort can be racked off from the outside.

In the afternoon we discussed centrifugal pumps. There are other types of pumps used in the brewing industry, but most of them are centrifugal. We went through how to read pump curves, what the difference is between atmospheric, absolute and gauge pressures, and some general rules for pump applications. Being an engineer it was nice to review pump details, but it was really good to see how they are an integral part of the operation of the brewery.

Our last class of the day was on process troubleshooting rules. Gary Grande, a consultant who has been in the industry for over 25 years, went through the steps normally taken in problem solving and then offered a different way of looking at the problem. Specifically, the problem needs to be defined completely, objectivity needs to be maintained, effective generation and use of information, care in application of change and viewing teamwork as a means, not an end. Obviously this wasn't really pertinent to me doing homebrew in my kitchen but everyone in class was shaking their heads when we were talking about the normal ways of attacking a problem and then finding out the answer was down a different path. His theory for problem solving can be applied to any industry, it wasn't necessarily tied only to the brewing industry.

Friday night many of the students from both classes and some of the instructors made their way to Piece Brewpub in Chicago. Piece has excellent pizza and won a 2002 World Beer Cup silver medal for their Worryin Ale and a bronze medal for their Kolsch. One of my classmates had spent enough time at Piece earlier in the week to be able to get all of us a tour of the brewery. They have a nice 7 barrel system with 2 14 barrel fermentors. Overall, it was a nice clean setup. We also ventured to the Map Room which has a great selection of microsbrews and live music.

Saturday, September 21

We didn't have any classes today but were given the opportunity, along with the diploma class, to travel to Briess Malting Company in Chilton, Wisconsin. We arrived at the malt house and were split into two groups after introductions. The group I was in

started in the lab. We were shown various of pieces of lab equipment. Briess keeps sample jars of every malt they made that year in the lab so if a customer has a problem they can work with them to find out what has changed. We were then led up four stories of stairs to the top of the steeping tanks. Two were being filled and the other two were intermittently being sprayed with water. We then went down to the germination boxes and were able to view the barley in four different stages of germination. We were unable to see the kilns because they were in use. We did get to see the roasters. The old rotating iron ball roasters were not being used so we could the paddles and geometry inside for distributing the heat uniformly. We also got to see the newer and larger rotary drum roasters that were in use at the time.

We next went to where the finished malt was stored. Nearly everything was made of wood in this area as it was over 100 years old. We then went through the bagging and palletizing area. Briess sells super sacks that can hold up to 2000 pounds of malt. They also offer their customers the convenience of premixing malts in these sacks if that is desired.

We then got back on the bus and traveled to their new warehouse and saw products that were ready to be shipped to many big name brewing and foodstuff companies. There were also shipments ready for the breweries of some of the students. We also visited the new pilot brewery that could be used to make six gallon test batches. After all the touring was done we went back to the office area and had subs, cheese curds and various micro brews. Everyone appreciated how nicely the people at Briess treated us. To top off the trip, we were given a Briess pint glass and a bag of malted milk balls to take with us. We were given the remainder of the micros and cheese curds to take back on the bus with us also. This trip was definitely worth getting up early and leaving Chicago at 7:30 in the morning! Thank you very much to people at Briess!

Monday, September 23

We started the day talking about yeast with Dr. Graeme Walker. I was surprised to learn there are approximately 1000 species of yeast in the world. Yeasts are classified according to how they reproduce, look and behave. There are hundreds of different strains of ale yeast, but relatively few strains of lager yeast. It is thought that 65% of all German beer is brewed by only one yeast strain. Brewing yeast cells divide by budding, that is, they develop a bud that continues to grow until it has nearly the same size and composition as the mother cell and then it breaks off, leaving a scar. Mothers can produce approximately 20 daughters before they begin to die. The number of scars can be used to determine the age of a yeast cell. We went through the differences between ale and lager yeasts, which are genetic, morphological, biochemical, and physical. We also went through the detailed composition of the yeast cell.

Our taste sample today was on organic acids in beer. We started with a control and then tasted a beer with isovaleric acid (old, cheesy), then caprylic acid (rancid, fatty) and finally caproic acid (goaty, barnyard). These were some of the worst tasting beers so far.

The next class was on wort cooling and aeration. I learned that wort should be at fermentation temperature within two hours after the boil to maintain flavor quality. I think for homebrewers it can be achieve sooner than this. The longer the wort remains at a high temperature more DMS can be produced. We also covered some of the different cooling systems and chillers. Wort aeration was covered because yeast growth is dependent on it. Yeast uses the oxygen very quickly. High gravity beers sometimes need to be aerated again 24 hours after the initial aeration to get more dissolved oxygen.

Dr. Walker then went over yeast growth and fermentation with us. Yeast growth is the uptake of nutrients that are in the wort and using this food to produce more yeast cells by budding. Yeast fermentation is the process that converts malt wort into alcohol, carbon dioxide and secondary flavor compounds. Brewers are more interested in the fermentation part, but need to have yeast growth also to accomplish this. We examined the batch yeast growth curve that shows a period of no growth when the cells are adapting to their environment (lag phase), a logarithmic growth phase where the yeast population increases by 3 to 4-fold doublings, and a stationary or resting period when fermentation slows down because most nutrients are gone.

We next discussed brewery hazards. There are many possible hazards in a brewery but they can be minimized by taking safety precautions. We watched a video on grain explosions that showed just how powerful and devastating dry grain dust explosions can be.

Recipe formulation was focused on in the next lecture. Brewers have the dilemma of brewing to styles and their own tastes or brewing to sell to consumers. The consumer isn't always going to want the beers that the brewer thinks are best. This lecture was an overview of how to formulate a recipe using styles and other brewers for reference. Other brewers that have used the ingredients, processes or equipment that you may be trying for the first time are a valuable resource and may save you from repeating someone else's mistakes.

We next moved to another section of brewing calculations. This one dealt with using the mixing formula. Some applications of using the mixing formula are caustic make-up, heat balances, dilution water addition, and alcohol correction. The formula allows you to use known values of what you have in volume and concentrations to determine what would result if you mixed them together. It can also be used to determine the volumes needed if the desired result is known. This is useful in high gravity brewing to determine the amount of dilution water needed to achieve a desired alcohol concentration.

The last class of the day was on pump troubleshooting. We were given theoretical situations with a pressure gauge, a pump, another pressure gauge and a flow meter. Different situations had different problems that were shown by the gauge readings and we were to determine the reason for the gauge readings. This was quite an interesting class because it made us think about different causes for the problem.

Tuesday, September 24

The first class of the day was on wastewater or brewery effluent. Large breweries have departments dedicated to wastewater treatment. Smaller brewers hire consultants for this task. Some of the things brewers can do to help wastewater management are good housekeeping procedures and reclaiming water when possible.

Our taste sampling today dealt with phenolic flavor impressions in beer. We started with a control and then went to the second sample that had 4-Ethyl Guaiacol at 400ppb (spicy, clove-like). The third sample had Eugenol at 400ppb (cloves) and the fourth had Ortho-Chloro-Phenol at 8ppb (chlorine, soapy).

The next class was about cleaning and sanitizing. Cleaning is important for appearance, microbiological control, plant efficiency and safety. It is important for efficiency because if you have a buildup of sugars in the brew kettle the heat transfer will go down and more energy will need to be used. Cleaning is removing the food that microorganisms need to live, not removing the actual microorganisms. Sanitization is necessary in breweries to prevent spoilage of the product at any stage of the process. Sterilization is not necessary in breweries except in the lab areas. We also went through the pros and cons of different cleaning and sanitizing agents.

Yeast maintenance and propagation was the next topic to be covered. This dealt with having a pure yeast culture and being able to reuse it in later batches. One area covered was the different methods that can be used to achieve a pure yeast culture. We also covered methods and reasons for propagating yeast.

After lunch we discussed fermentation practices. Fermentation is dependent on three basic parameters: wort composition, yeast and the process conditions. For the most part, brewers can control all of these parameters at some point in the brewing process. We discussed each of the parameters and their components and how they affect fermentation. We learned how and why some of the factors are more important than others.

We next covered yeast management. A point that was stressed throughout the yeast lectures is that yeast is a living organism; it needs to be handled with care. In this class we discussed yeast handling, cropping, storage, pitching and acid washing. Some of the key points were to crop the yeast within 24 hours of attenuation to minimize yeast stress and autolysis and minimize yeast metabolic activity to preserve viability and vitality during storage. When pitching yeast, it is important to check strain purity and ensure good yeast viability. Wort oxygenation is also very important to yeast growth in the initial stages of fermentation. The procedure for acid washing of brewing yeast was detailed for us. A note here is that wild yeasts are unaffected by acid washing.

The last class period of the day was dedicated to another styles tasting session. This time we tasted the “Eccentric Brews of Belgium”. These brews ranged from a Belgian Wheat (Wit) Beer to Trappist Beers to Abbey Beers to Lambic and Fruit Beers. We also tried an “alco-pop” that was not very well received by many of the students.

Wednesday, September 25

The first class today was on Quality Assurance and Quality Control. Quality Control has come to be defined as the systematic measurement of carefully defined variables of the raw materials, product in process and end product by standardized procedures to assess whether these variables conform to predetermined standards. Quality Assurance is now defined as a system of activities that assures that the quality goals are achieved. This includes evaluating the effectiveness of the quality control system, reporting deficiencies and documenting remedial actions and, in some cases, setting the quality goals. The relationship between QC and QA can easily be seen from their definitions above. For most homebrewers quality is important, but not to the point where it has to be repeatable within predefined limits.

Today we were given a control beer to be compared with an oxidized beer. The beer was oxidized by heating to 180˚F for 45 minutes. It tasted somewhat like wet cardboard, kind of skunky.

Control of fermentation flavors was our next topic. Dr. Walker wanted us to realize that there are important flavors contributed to beer by the yeast and fermentation process, not just the malt, adjuncts and hops. I found it amazing that there are about 950 chemical components that contribute to the flavor in beer. 400 of the chemical components are contributed by the yeast and yeast activities. Strategies for reducing unwanted flavor compounds like diacetyl were also discussed.

The next lecture was on maturation and aging. The objectives of maturation are carbonation, chillproofing and stabilizing, clarification, standardization and flavor maturation with the last probably being the most important. We examined each of the objectives in detail. Temperature is the most important factor during maturation. One interesting point is that long cold storage can nearly be matched by warmer shorter storage.

Gary Grande was back in to explain different types of valves and their application in the brewing industry. The service characteristics that are most important in valves are the type of flow control, speed of actuation and how difficult they are to clean. We were shown how to specify which valve is the best for certain applications. The butterfly valve is probably the most common in the brewing industry.

The last class of the day was on carbonation and air exclusion. Carbonation is a natural result of the fermentation process. Even beer in open fermentors contains between 1.0 and 1.7 volumes of carbon dioxide per volume of beer. Carbon dioxide being released during pouring affects head formation and releases many taste and aroma compounds. We also learned some safety tips in dealing with carbon dioxide and nitrogen and their acceptable limits. Different techniques for carbonating beer were discussed including natural and artificial techniques. One interesting piece of information I got from the class was that South American lagers have higher carbonation levels because the drinkers became used to soda before beer. When the brewers first used North American carbonation levels the customers thought the beer was somewhat flat. So South American lagers tend to have 3.0+ volumes of carbon dioxide per volume of beer, while North American lagers are around 2.7.

Thursday, September 26

The first two hours of the day were dedicated to filtration. Filtration is used to remove yeast and other solids from the beer to make a clear product since consumers don't like hazy beer. In large breweries sterile filtration is an alternative to pastueurization. We learned about the ways that different filters remove particles. If filtration is done poorly it can lead to oxidation and reduced shelf life. If it is done correctly it provides taste and physical stability. Most packaged products (bottles, cans, etc) are filtered now.

Today we had a review of common flavors in beer. Besides the control we had Isoamyl Acetate at 8ppm (banana aroma), DMS at 100ppb (cooked corn), diacetyl at 200ppb (buttery) and Iso-valeric Acid at 5ppm (vomit, cheese).

Our next class was a short discussion of carbon dioxide collection. Carbon dioxide is used in the production of beer, but it is also used to protect the beer from oxygen. Large breweries have found that it is cost effective to collect the carbon dioxide coming off the fermentor. They can collect between 80 and 85%. After it is collected it needs to be purified. A simple check for how clean the carbon dioxide is would be to bubble it through some water and then taste the water for any flavor. If there is any flavor present it would be imparted on the wort or beer the carbon dioxide was being injected into or covering.

The first topic after lunch was colloidal (haze) stability. The major components involved in chill haze are tannins and proteins. Temporary chill haze is formed at a cold temperature, but redissolves when the beer is warmed up. Permanent haze is caused by successive cycles of cold-warm temperature swings that lead to the stabilization of the tannin-protein complex which can then not redissolve. The polyphenols (tannins) involved come from the malt and hops. The proteins involved come mostly from the malt. We went through a variety of different chillproofing agents. I learned that Irish Moss, which is added to the boiled wort, is more for trub setting, but does help clarification some. Also, chill haze and chillproofing is somewhat beer dependent because of the levels of the components produced.

We next spent two hours going over beer packaging. I have never seen a large brewery beer packaging line, so seeing a video with the beer bottles moving around very quickly was quite interesting. It is amazing how much is done to each bottle in such a short amount of time. But with everything moving so quickly there is a greater chance for mistakes. Gary showed us examples of labels that were upside down and puckered, bottles that were half-filled and one extraordinary bottle that had a "bird swing". A bird swing is a strand of glass that connects the sides of a glass bottle. He had only seen three in his career so we had to be quite careful passing this bottle around the room!

The last class of the day was on brewery CIP (clean-in-place). CIP was originally developed for the dairy industry because they had to take their pipes apart every night to clean them. We went through the various options for CIP equipment including the spray ball, rotating spray ball and rotary tank cleaners. These don't really have an application

to homebrewing, but will be good knowledge for the future if I get into the brewing industry.

Friday, September 27

Flavor stability was the first class of our last day at Siebel. Oxygen, light and heat all contribute to flavor changes over time before a beer is consumed. Miller developed the first non-lightstruck hop product so they could use clear bottles and not have to worry about the flavor changing if bottles came in contact with sunlight. We went over various suggestions for improving flavor stability. Homebrewers don't need to pasteurize their beer as long as they bottle condition because the yeast is a very good protector.

We had our taste analysis quiz this morning. I had a difficult time taking it and thought I didn't do well, but ended up getting 5.5 out of a possible 7. I was unable to pick up the bitter beer, but Keith Lemcke said many of us were switching back and forth between samples and would have needed to let the bitter sample linger to identify it well. This quiz emphasized the fact that it is difficult to pick out and identify problems with a beer when you aren't sure exactly what the problem is. The tastings during both weeks weren't so difficult because we knew what we were tasting, but now we had to reach back on that knowledge and use it to identify the problems here. I'm glad we were given the flavor wheel in week 1 so I can use that later to help identify tastes.

Our next class was on beer analyses. We identified the difference between accuracy and precision. Accurate results are close to the real value, while precise results are close to each other but may not be near the real value. We also learned the closer the pH of a yeast slurry is to the pH of the beer it came from, the healthier the yeast is. If the pH of the yeast slurry is greater than 1.0pH unit different than that of the beer, do not reuse the yeast because a significant amount of the yeast is dead. An interesting point that Lyn Kruger mentioned is that it is easier to make consistent beer when you have the ability to blend as opposed to doing batches and having them match exactly.

The final class we had for the Concise Course was kegging and dispensing. Draught beers are usually less carbonated than bottles or cans. Draught beer sales have been a decreasing percentage of the total beer sales in the US for the past 50 years. In the year 2000 draught beer was only 9.2% of the total US beer production. We also talked about the differences between kegged beer and cask-conditioned beer. Correctly setting up a draught system was explained. This will be very helpful when I am able to setup my own draft system at home.

After lunch we had our graduation ceremony and were given our certificate of attendance. We also were given applications to the Master Brewers Association of the Americas, the American Society of Brewing Chemists and the Institute of Brewing Studies. Some of us stuck around for an hour or so, sampling more of the seven or so beers that were on tap in the alumni room. We were very thankful that our classmate from Goose Island made sure we never ran all of the taps dry. Another benefit of the class was the library that Siebel has available to students and alumni. I spent some time in there between classes and after lunches in awe of the amount of brewing knowledge available and look forward to using it in the future.

What an unbelievable two weeks! I would like to thank all of the Siebel staff for their dedication and hard work in preparing this course. I can't wait to get back and start putting some of their knowledge to work on my homebrew. I also would like to thank the AHA and Lallemand for making this course available to homebrewers. Additionally, I would like to thank Rob Moline for helping me prepare for this and making this experience so great. I encourage everyone to make every effort they can to find a way to get to Siebel. We were shown that August Busch III attended Siebel some time ago. I guess no matter how long you've been brewing you can always learn something new. From this homebrewer's point of view, I could not have found a better way to spend two weeks. Thank you, Siebel.