

INDUSTRIAL BREWING PROCESS

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Abstract:

Beer Brewing Companies have been a very quality product making companies that starts with four main ingredients. The first and foremost would be a quality water that need in extremely large quantity of quality water its pristine as close to perfect brewing water, and the second ingredient that is needed for beer making is barley or can say malted barley need to mill and the milling is really the first process in beer making is to run the barley through mill and the idea here is simply cut the husks off without crushing the barley kernel as so that water to be able to get inside but don't want to produce flower after the barley is milled well then send it through an auger conveyor system that will going to move it in batch hopper which got choppers really silo that sits on top of a scale.

KeyWords –Milling, Meshing, Lauter ton, Grist, Hops.

Introduction-The sole ingredients of beer or specified as water, barley and hops the fourth essential ingredient is yeast. Barley or wheat grains are soaked in water in order to make them sprout this induces the formation of

enzymes, subsequently the grain is carefully roasted the resulting malt is stored in silos and later ground in a malt mill in a bring the inherent substances to dissolve more effectively in the brewing process. Next malt

and warm water are mixed together in the mash tun where they are constantly stirred while the temperature is raised from 45 to 78 degrees Celsius. There are various steps during the mashing process with the mash held at a certain temperature so that the malts natural enzymes can convert the starch into sugar, so called saccharification. Now check the weight or the exact needed amount to be equal what the recipe requires for that particular brew now mill that through the same milling process as done before the bulk array and that's come from outside until make set the recipe all in one spot from that point it is going to move into the collection of tanks that is called the brewhouse first vessel is going to be the mash mixer when it get started with the brew process now move this milled malted barley to that and then add hot water at that point now stirring is done taking something similar to an oatmeal that is generally termed as mesh that process is going to allow that water to get into those barley kernels it's going to allow colour, flavour, sugar and starches and now that entire mixture is going to move it into the fourth vessel in brew house which is the Lauter tun, lauter tun is a tank that has a false bottom, in the bottom of it entire slurry or mash gets moved in there as a whole liquid and solids combined then the liquid is allowed to run through the bottom and that liquid is pumped back over the top it will do this repetitively until a green bed is built in the bottom of lauter tun that creates a natural filter that's going to filter out husks or any milling solids from the barley.

Then take that sugar rich and flavour rich liquid that at this point is called liquor and

now move it to the last vessel called the kettle. Once it is into the kettle the temperature is raised to bring it to boil moment and then after reaching to the desired temperature add Hops. Hops are added at the very beginning of the boil are really going to contribute to those bittering characteristics that is needed and larger IPAs the hops if added in the middle are going to give some fear as eat owns and hops that is been added at the very end of the boil are really going to give some flavour and a lot of aromatics the end of that boil process the entire wort mixture is sent through a Whirlpool process. And that product is then going to pull together any hot particulars or any solids that made it from the lauter ton to the centre to discard them and take and move that to fermenters after passing through a heat exchanger to cool it down.[1] The temperature must be between 68 and 70 degrees Celsius as it is transferring into fermenters at which point addition of yeast takes place.

After the yeast have been added, fermentation will start almost instantly. By product of fermentation is going to be CO₂ and alcohol. The alcohol gets stuck in suspension in the liquid when CO₂ is going to vent out at the top and some of buckets under floor creating a basic natural air lock. Primary fermentation is going to take between 5 and 10 days, and at the end of that period let the yeast sort to condition the product if there is more yeast then it can be used in next brewing process. So, for that it gets moved into a toat where it along with spent grain is been given from the brew process to the local farmers or the

contractors according to the company's requirement. After about 10 days of fermentation and then another 4 to 5 days of conditioning this product at this point is called as beer it is not carbonated it is flat, now after that it is move into one of hand bottom tanks those are called Brite tanks, afterwards send them through a very high tech centrifuge that is going to pull out any of the solids that are in that liquid it was a very consistent uniform product that is then able to package to send to the market.

Now once it is in the brite tank it is needed to get carbonated it. So, to carbonate it is sent through force carbonation stone at this point there are two options for packaging. First one is that draft if it is a draft product than hook up some lines from the bottom of the tank and run them directly to clean and sanitise kegs and then fill those properly sanitised kegs directly through the top filler if it's going into package 12 ounce bottle the best way to follow this just actually follow the bottles as it is seen the first they come into a machine called depalletizer it is doing just that depalletizing every skid of glass that it doesn't contribute any additional flavour characteristics to the end product very important part of the actual packaging of the beer into a bottle of three head filler first thing that is going to happen in every bottles going to get flipped upside down spread with a sanitizer solution allow to gravity dry just put back onto the line and move to the centre of a section of this machine. The centre section of the machine is the actual filler segment, the filler segment is going to suck out by any oxygen it may be in there its then go to fill that bottle with beer

but it will come off go through another small section before eventually before crowned there is a small amount of foam that is above the top of the bottles that foam must be push out any residual oxygen that potentially could have been in that bottle will then passed through a little shower. Little shower is just to sanitise the outside of the bottle before it goes into the label or passed through a little drying device, it is going to blow off any extra liquid or moistures everything outside the bottle before actually entering the labeller itself the labeller is going to apply one label to the body section of each bottle and then it is going to feed it into drop Packer. The drop package drops the bottles into a box.

PROCESS

Beer brewing involves different process and ingredients. The correct performing of these processes by utilizing the ingredients make the perfect beer. The by-products which are remained during the whole process is also useful in different sectors. The main ingredients of beer are barley, water, hops, yeast. In brewing there is a step-by-step process where these ingredients are used and a desired output is achieved.[2]

The process starts with malting in which the wheat grains are soaked in water in order to make them vegetate, this instigates the formation of enzymes and eventually the grain is roasted attentively. During malting enzymes will break down the gummy cell walls and then break down the protein matrix. This breakdown delivers the starch granules making them available for turn out to be sugar. The progressions occurring

during germination are called 'modification'. The maltster can impact the level of change during malting by controlling the dampness content of the grain, its temperature and also the time considered germination.

The procured malt now undergoes milling process where the malt and water are blended together in a mash tun. They are stirred constantly at the temperature in between 45-78 degree Celsius. During milling the mash tun is maintained at particular temperature so that the malts natural enzymes can convert the starch into sugar and this is known as saccharification.

After this the mash is sent to the later tun which segregates the liquid from the grain. Next, the brew is filtered through a bed of mail grist at the base of the tun and made to run through the sieve further. The knives or rotating blades in the later tun provides good flow to the liquid by cutting through the grist and loosening it. The resulting liquid which is containing the dissolved extracts is called wort. The hot water is continuously added to further extract which contains the remaining ingredients. This wort is responsible for the taste of beer. The particles which are not dissolved in the malt such as grains, sprout shells and insoluble proteins can still be used. It can be used as high-quality feed in cattle farming. This increases the milk yield of cows.

At this point of time hops are added to the liquid wort and it is boiled in a brew container for more than two hours at 80 degrees Celsius. The amount of hops used determines the taste and shelf life of the beer. It also depends upon the variety of hops used

and area of cultivation. The more hops used the more bitter the beer becomes. The boiled wort is rapidly pumped in to the whirlpool as this can be considered as filtration process. The solid particles are segregated from the wort due to the rotation as the residues of hops and proteins sink to the centre of the kettle and form as cone.

As the yeast ferments only at low temperatures the hot wort is further cooled in a plate heat exchanger. The hot wort enters the heat exchanger and exchanges the heat with iced water which is flowing from the other side. The heat which is extracted can be reused in brewing process. Cooled wort now is sent to the fermentation tank where addition of yeast takes place. The temperature range of wort in fermentation tank differs according to the type of yeast used. The producer may also use top fermenting or bottom fermenting yeast procedure for producing different kinds of beer. The temperature conditions and beers produced differs according to the fermentation process utilized. Yeast basically converts the wort small sugar into carbonic acid and alcohol. Now the young ready for second stage of fermentation.

The new beer is stored in the storage tanks and kept for secondary fermentation where the left-over sugar is converted into alcohol. The taste is purified and the remaining yeast and protein descend to the base of the tank. Depending upon the type of beer required the new beer stays in storage tank up to 180 days. Lastly, the beer is filled in various repositories such as barrels, bottles or cans. Oxygen being absorbed in the can or bottle will affect the quality of beer, to prevent the

absorption of oxygen this stage is very much important.

HOPS

Humulus Lupulus , which is the other name of hops , they are green coloured cone-shaped flowers of humulus lupulus . Since these flowers contain a lot of alpha acids , they are the main primary source for bittering and balancing the sweetness added during brewing process in a beer. This bitterness from hops is because of the yellow pods which is present inside the cone shaped flower or hop cones , these yellow pods are also called as lupulin.[3] Aside from the bitterness , these lupulin or yellow pods also provide aromas , strong flavours and many times the trademark taste . In the modern times , and the refrigeration systems now a days the hops can also be used as preservatives.

The extraction of bitterness and several other flavours from hop is a very complicated process. To extract the bitterness , there are several steps involved , which needed to be done to obtain the optimum benefit. Since the acids inside the lupulin are not very soluble , to extract the bitterness , brewers perform different types of steps according to the type and quality of aroma and bitterness they want to extract from the hops . Hops are added during kettle boiling process , for delivering the bitterness element. The oils which are present inside the lupulin are of very volatile in nature , so that the reason addition of hops depends upon the type flavour which needed to be extracted and according to that its decided whether hops should be added during the fermentation

process , or after the fermentation process is over . Selection of hops is also a important procedure which needed to be done, because there is wide variety of different hops present which have different sense of bitterness and variety of aromas, eg :cascade hops , wine grapes hops , magnum hops etc . They all have different and unique uses.

Before we introduce hops in the brewing process , the first process is to grow hops and pick the rightly ripened hops . The hops can grow best in rich soil and in moderate climate . Hops also need abundant sunshine to grow , but high heat degrees and rain can pose a threat to the yield. After this to check whether the hop is ripened or not . The procedure to check this is to gently squeeze the cone of hop plant , if the cone stays compressed its unripe and if it feels dry then its ripened enough. Also if it has a pungent smell then also it means that hops are ready to be cut. After checking then comes the stage for harvesting , the harvesting of hops can be done either by hand picking or by cutting down the bine . For first year harvest hand picking is preferred , and for the years after that cutting down of bine is done.

After the harvest drying of hops is next step which has to be done . This step also can take place in two ways , one in which hops are added in brewing process without drying and in the other process hops are dried at the optimum conditions , the temperature should not exceed 60 degrees and drying should not last more than three days. Some of the process for drying of hops are –

- Using oven which is well ventilated .
But in this process above conditions

should be taken care of and if using oven continuous checking should also be done.

- Using food dehydrator , this ensures proper air movement and it also maintains air temperature.
- Using of drying screen like window.

Many other methods are also there but we should always keep in mind the temperature, ventilation, duration. Because these factors can change the taste, aroma and bitterness of hops .

The dried hops can be now easily stored for the future use, and to store hops of different sizes can be separated out and stored in plastic bags for future.

Whenever brewing, the addition of hops comes into effect. Addition of hops is done mostly after the mashing process. After mashing when the grains is mixed with hot water, Fermentation is the next process which is being done. If the hops are added in starting of this process, it is a possibility that due to long duration of boiling , it might lose its flavours. The aroma from hops is produced by some essential oils in hops and they can also get effected by heat. So hops are added after the fermentation process is over, or it close to end so that hops are not boiled for long time and the flavours remain intact.

These are some main points which are always taken in account while brewing and rest depends upon the recipe, the duration and timing and the various techniques which determines the type of flavour . This is what makes a trademark taste .

Overview of the brewing process:

Malt as we all know is the key ingredient in every brewery and it is the most essential component without which the brewery cannot function. So as the very first process malt is sent to milling machine where milling operation is performed on the raw malt so as to convert them into fine powder for the future processes that are about to arrive. Malt is further converted into grist with the help of cereal adjuncts and additions of water.[4] Grist is the more powdered form of malt that is produced when the milling operation is done on them. Cereal adjuncts are the add-ons that are required to fine tune the malt mixture. Adjuncts are un-malted cereals and sugars that are used as a subsidiary (usually in part) for malted barley (or other malted cereals such as wheat, sorghum, oats, etc. Adjuncts are often referred to as starch-rich cereals other than barley and wheat malt that are used for several reasons. Further water in rich form is added to the grist to convert it into mash. In this process cereal adjuncts are used. Cereal adjuncts are very essential components & without it mash and grist cannot be produced and will overall hamper the production of the respective drink i.e. beer. Then the very next step is sending the mash converted from grist into mashing wort separation. The method of separating the wort from the mash solids and the equipment used is mainly a matter of opinion on the part of the individual brewer, and sometimes of tradition. Wort separation may be carried out by any of a number of different methods: 1) the mash tun, 2) the lauter tun, 3) the mash filter, or 4) Strainmaster. The lauter tun is internationally

accepted and continues to be the predominant wort separation device. After that the mashed malt is converted into sweet wort which is further sent for boiling purposes. A large part nearly 85% brewery waste is sent to spent grain for the disposing job which includes the worn out malts and covers along with waste water. The spent grain is a very important part of the overall brewery plant as it separates desired and undesired product. Most of the waste which is collected into spent grain is solid residue and a little portion is only liquid. Spent grain is also act as a effluent treatment area with the help of necessary add-ons. Now after passing from the mashing wort separation chamber or the unit the mashed wort is allowed to boil along with the hops plant which is added to inculcate or introduce the flavours such as bitterness , natural stabilizers in the beer . Hops are flowers that are also called seed cones or strobiles . They are also used in beers to add some flavour of flowery and citrus taste into it .Hops acts as a stepping stone to achieve the iconic taste of the beer that we all desire. Along with the hops addition into the sweet wort sugar syrups are also added to introduce the sweet flavour in the beer. Hops is added to increase bitterness and sugar syrup is added to add the sugary taste and balance the bitterness so as to achieve the best taste. Moving on the hopped wort which contains sugar syrup and hops is transferred to wort clarification chamber or unit we say. Wort clarification. So basically in the kettle in wort is boiled we can see that there are two different sections are formed hot and cold break which happens at the initial stages of the boiling. This is visible to us a formation of scum on

the top of the wort. The cold break is also formed in such a similar fashion when the wort is rapidly chilled. During the whirlpooling process the wort is pumped at a very fast pace creating a shallow structure inside the wort. It allows the hopped wort to form a downside facing cone in the centre of the kettle. Then after this process the desired materials is sent for cooling and aeration and the residues is sent to spend chamber for the waste treatment. As we have observed that after the wort clarification process a whirlpool is formed. Depending on the type of beer the wort is cooled down quickly to 7-35 degree centigrade as it moves through the heat exchanger. The functioning principle of the heat exchanger is that glycol is present in the colder side and when the hot wort is passed through it the glycol extracts all the heat from it and eventually the wort is cooled. So as a next step this hopped wort is cooled down and aerated with the help of yeast. Yeast is added for the fermentation process to happen or take place. After the wort is cooled down in the heat exchanger the wort is further introduced in the fermentation tank. Fermentation is initialised when yeast is added to the wort and is called primary fermentation. Yeast becomes active and consumes sugar present in wort and produce carbon dioxide in addition it also produces alcohol. After fermentation yeast wil sink to the bottom and the liquid will turn greenish in color. In the same process the excess yeast is taken out and used for the next batch of wort after the cooling process. Further down the line the feremented beer is taken for process aids which means aging and conditioning. As we all know that fermentation is a very complex process and

sometimes residues of the fermentation remains in the beer in the form of sediments. So as to eradicate this thing conditioning is done. Moreover it improves the quality of beer produced. Conditioning process will also remove the unwanted flavours which are present in the beer. In the same conditioning process the beer will be stored at 0-4 degree centigrade which will allow proteins and polyphenols to get condensed and drop to the bottom. After that another step of clarification takes place which includes packaging, biological stabilization and yeast chill haze.[5]

Before packaging quality some quality checks are needed to perform to ensure the safety and quality of the beer produced. It includes dissolved oxygen rates, dissolved CO₂ rates and color and bitterness.

There is a direct production of beer after the aging and conditioning process where the conditioned beer is packed in cask and bottles and converted into live beer without any stabilizers. These kinds of beer are called Ready to Dispense beer. But after clarification and adding biological enzymes for better stability and to improve the shelf life of beer it is further converted into large pack, small packs depending on the market demand.

Conclusion:

Beer brewing is not a new process, it has been practiced since long time at various places in the world. Many houses in the west have their own small brewing units. Time to time the process of beer making has gone through

various changes and experiments for different flavours, it has acquired a large area of market like in cold weather places it is a daily consumable drink just like water. In search of new market and customers it has implemented new technologies and flavours. For different flavours different raw materials are being used just like wheat, barley, maize and rice. Many breweries use different milling processes like two sets of rollers or three sets for the required grist. Hops is an ingredient that differentiates beer from other alcoholic beverages. Generally, beers have alcohol percentage between 3%-7%, as per the need flavour alcohol percentage is set.

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