brewery Value Chain - green bench Khris - brewing process

Hi, I'm Khris Johnson. I'm the head brewer at Green Bench Brewing Company. And today we're going to walk through the process of how to make beer.

The first thing I guess to know is that beer has four main ingredients. It starts with malted barley. Then you add water, hops, and then yeast. And then those four things through the process will create beer.

Essentially the malted barley looks like this. They're like little kernels, almost a grain. And the idea is that we have to crush it because what we are the inside. There's a lot of starches in there that we need. So we'll run it through this device first. And this is called our grain mill. The idea here is that the mill will crush the grain so we can get to the inside for what we need for the next process, but it won't absolutely pulverize the hulls which we actually also need in the next process.

So it will go through this mill, get crushed, and then it will go through this PVC piping right here, which is actually called an auger. So it gets pulled up through the auger, or augured up through the PVC piping that is, through the ceiling and then to the next step where we mash in.

So after we crush the grain and it augers up through the auger, the auger ends at the top of this case right above the brewhouse. That's what this entire system is back here. This is sort of the heart of the brewery. This is where we make the beer. So it goes in that top case. That's actually called an elevated grist case. It's a giant conical tank above the brewhouse. The idea there is that it just holds the milled grain. It's a place to store it after it goes through the mill.

From there, it drops through this device called a mash hydrator. The mash hydrator literally just adds hot water to the grain as it falls into what's called the mash tun. The mash tun is the first big vessel in the brewhouse, and that's where the brewing starts.

In the mash tun, you're enzymatically converting starches into sugars by adding hot water. The temperature at which you do this is important. If it's a little bit colder, you're going to get a lot of dextrose, which on a molecular level is a very simple chain sugar. If you mash a little bit higher in temperature, usually about 155 to 160'ish, you'll create a lot of dextrin. Dextrin is, on the molecular level, a very complex chain sugar. This is important because depending on how much dextrose and dextrin you have, the final product is going to taste a little different.

If there's a lot of dextrose, you'll be very dry because the yeast strain that we use as brewers, also called saccharomyces cerevisiae, it'll actually breakdown dextrose very easily. And it will convert that.

Dextrins, however, are a little bit too complex for it. So if you mash a little higher, what you're going to have are leftover sugars in the final product because they can't break that down. What that will give you is an added sweetness on the back end in addition to mouthfeel and body characteristics. Also, just things that as brewers we can sort of play with as far as how we want the product to come across.

So from this vessel, we also have what's called a false bottom in there. There are these like little screens with tiny holes in them essentially. And the idea there is that acts as a filter for the grain. What we like to do is we like to pull the liquid off which is now sugar water. It converts all those starches into sugar. But we need to leave the grain behind.

So the next step is what's called a vorlauf A vorlauf just means a recirculation of the wort. Wort is pre-beer by the way. Wort. So you recirculate the wort just to set the grain bed naturally. As you pull down from the bottom, what happens is all the little particulate inside the grains will get sucked through the bottom as well, and they're added back on top. What doesn't get pulled through the bottom are the hulls, the stuff that we needed to keep behind and not pulverized in our mill.

So what that does is acts as a natural filter itself. It keeps all that small particulate on top. It keeps it from going through. So the liquid can easily come through the false bottom and then back on top. Once you've recirculated it enough that the wort is clear-- there's no particulate in suspension-- then you do a process called lauter.

Lauter is a separation of the grain in the liquid. So the false bottom acts as that filter to keep the grain behind. You pull that liquor off. That's what they call that as well. It's just a term I guess we use in brewing a lot is liquor. You'll probably hear that a couple more times. So you pull that liquor off during the lauter, and you move that to the boil caudle.

The boil caudle is the second vessel. The second vessel is where we literally boil it. That's where over time-- over usually an hour to two hours depending on what beer you're making and a lot of times what brewery you're in-- that's where you add hops, any sort of flavoring additions that you'd like to add to the brew process in this stage.

What happens at the end of that though is you literally concentrate the wort. So imagine you're boiling, you're evaporating, but what you're evaporating is water. What you're going to be left with is a really concentrated wort, more sugars because you pulled all that water off.

So your gravity-- let's I guess quantify that as well-- gravity is the density of the liquid. So you start with a certain gravity, and you'll end with a different gravity. The starting gravity is going to be-- at least when you're boiling-- it's going to be lower than the final gravity of your boil. So picture it like this. You've extracted sugar into water. Right. Water is not dense at all. Now that you have sugar, you have a very dense liquid. Your wort becomes dense. The measurement, or the gravity reading of this liquid, will tell you how much sugar you then have in suspension.

So what you start with before you boil is a sugar, a liquid, right, that has a lot of sugar in it. And then as you boil it and you evaporate of all that water, your gravity is going to increase because now you have a more dense liquid. There's more sugar in concentration. So that gravity number is very important later on.

Once you get to your original gravity, which is a post-boil density reading, you can do a process called whirlpool where you'll spin the wort really fast in the kettle. The idea there is that you use centrifugal force. So the liquid is heavier than all the particulate in suspension. The liquid goes to the outside, and all the particulate, hot matter, protein, all sort of stuff like that, clump up in the middle, and they settle out on the very bottom.

What this allows you to do is pull the clear wort off the side, so you're not pulling all that hops and stuff that you added in the boil that you don't actually need for the next process. Once you get done with your whirlpool, you pull that clear wort off the side, you then run it through this guy down here. Now, this is called our heat exchanger. The idea there is that you literally-- there's like little plates inside of there-- and you run boiling wort on one side essentially and cold water on the other. They get really close together, and they'll exchange heat. So that's the idea.

So you'll have boiling wort coming in on one side, it will come out around 60 to 70 degrees depending on what temperature I want it to come out at. And the cold water goes in at about 39, and it comes out at about 170 degrees. From here though, the wort, which is the important part, comes out of the heat exchanger cold and then we run it through our fermentation line. So basically, we have what's called a tank farm, and it's got fermenters there, and that's where we'll run the wort to. And that's where we add yeast. And that's the next step, which is fermentation.

After we pump the wort through the heat exchanger, we move it over here to the fermentation farm. So this is where our tanks are. This is where we ferment the beer. Fermentation for ales usually takes about two to three weeks. So once it's over here, it sits for a little while.

This tank right behind me is actually one of our tanks. This is a 15 barrel fermenter. So it's a stainless steel fermenter. It's got a conical bottom. It's designed essentially for fermenting beer. The reason that there's a conical bottom is because what happens is we add the yeast, the yeast eats those sugars that we created, and it converts it into a lot of things. The main ones being alcohol and CO_2.

So as the yeast goes through a metabolic phase in which it propagates. It will literally multiply in order to get the job done during fermentation. At the end of that, it does a process called flocculation. Flocculation is how well the yeast settles out of suspension. So when it settles out, it needs a place to go essentially. And that's what the conical is for. The idea here is that we can collect the yeast off of the bottom and then re-use it in another batch.

Once we finish fermentation-- and the way that we know that is by-- I mentioned it earlier, the gravity readings. So we'll start with what's called an original gravity. And that comes out of the brewhouse. It's where we brew the beer. We'll take a gravity reading. We know what our original density is. How much sugar we started with. After we ferment for a couple of weeks, we'll come back periodically, every few days, and we'll take a sample off the fermenters, and we will measure the density as we continue to move along.

What happens is that number is going to get smaller, and smaller, and smaller because the yeast will eat the sugar and convert it into CO2 and alcohol. So we'll know what alcohol we have by taking a difference between our original gravity and our final gravity. Because if I know how much the yeast ate, I can then calculate how much alcohol they produced. And so that's how you get that number. That also then tells us when the beer is done.

Sometimes we won't know until you take a gravity reading. It may-- there's actually buckets down here, and it's actually-- you may hear it-- but it's bubbling CO2 off the top. That's what's called an airlock. It may stop bubbling all together, and so we think that it's finished, but we won't actually know until we take a gravity reading off of the tanks. That process is called attenuation.

Attenuation is the percentage at which the yeast eats the sugars. So we start with an assumed attenuation percentage. And then we measure it. And then we write it down. And then once it's done fermenting, we'll drop the yeast off, store it for use in another batch, and then it goes through a bit of an aging process. Essentially what we do is we crash the beer. Crashing is when you drop the temperature quickly, usually overnight. And we'll usually hold that temperature at least one day, sometimes up to three or four days. And then afterwards, we'll transfer it to this vessel right here. This guy's called our brite tank.

The brite tank is where we carbonate the beer. So we'll move it in here cold. And then we'll literally inject CO2 into the liquid. And that's what carbonates it. It usually takes between six and eight hours, and then it's carbonated. And then we'll take kegs and we'll literally keg the beer off of the brite tank. And from there, we'll put in the cooler for distribution or for consumption in the tasting room.

So actually, I'm going to show you this too, just because I can. I figure since we're here, I'll show you this. This is actually called a carb stone. This is what we use to carbonate the beer. So we'll actually put CO2 on this side, and it will come through this stone, which has really tiny, tiny holes in it, and that is what injects the CO2 into the liquid. The smaller the surface area of the injection, the more efficient the carbonation becomes. And the colder the liquid is, the more it accepts CO2.

So this process also goes through a bit of a calculation. The pressure that you're adding the liquid, how much head space you have above it, which also equates to how much surface area you're going have of CO2, also equates to how much pressure there is against the CO_2 stone as you're carbonating, and then the temperature, also time, literally go into a little calculation. And I can predict sort of how long it will take to carbonate a beer with all those variables.