THE BREWING PROCESS

That's a good looking beer right there!

words & photos: Don Osborn

Creating beer requires fundamental steps that every beer drinker should know. We have covered the four main ingredients, but we have not yet focused on how they are turned into beer.

There are many different ways to make beer and a great variety of possible ingredients. This article will focus on a basic brewing approach using the traditional ingredients of barley, hops, water and yeast. Also, we will parallel the professional approach with a description of how beer can be made at home. We hope that this will inspire you to try it yourself.

Mash for a large homebrew batch.

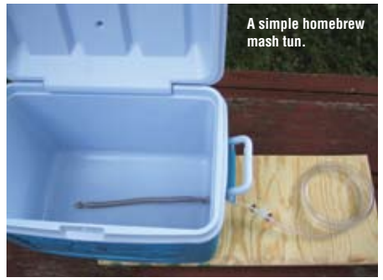
MASH

Mashing is the part of the process that produces sugars for the yeast. Inside barley kernels is starch, but before yeast can eat it, starch molecules must be broken down into fermentable sugars. For that to happen, starch needs to have water added, and the temperature must be in a range of about 140-160 degrees F.

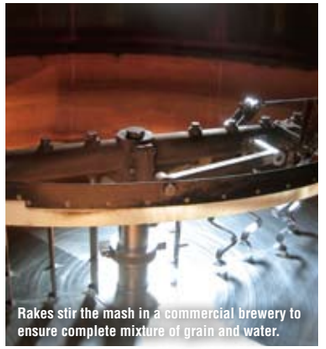
In this temperature range, enzymes (alpha amylase and beta amylase) already present in the barley become activated. Barley is moderately crushed in a milling process and combined with warm water. Then the enzymes go to work breaking down starch's long chains of glucose into shorter chains. Longer chains = yeast cannot consume them. Shorter chains = yeast can consume the simple sugars, and make beer. The mashing process takes about an hour.

Most of us have toured breweries and seen copper-topped kettles. Chances are one or more of those kettles is a mash tun, and they are also often the lauter tun—but more on that in a minute. There are agitators and/or rakes to stir the grain to ensure that all the barley is wet and at the right temperature.

Homebrewers have a couple options for a mash tun. Usually an insulated cooler of some sort is used, either a round Gott cooler or some variety of rectangular style. These options hold heat well, but do not allow you to apply heat during the process. Some brewers like to change the mash temperature to activate different enzymes at different times, and this can be done in a metal kettle. A heat source can be turned on and the mash temperature raised.



A simple homebrew mash tun.



Rakes stir the mash in a commercial brewery to ensure complete mixture of grain and water.

Grain must be properly crushed before being mashed.

LAUTER

After the hour-long mash, the sugar liquid (called "wort") needs to be drained out of the barley. This is called lautering. You can think of the lauter tun as a strainer that lets the liquid run through but holds back the grains. Oftentimes lautering is done in the same vessel as the mash, and that is why you will see that vessel written as the mash/lauter tun. It is, a separate process, though.

When all the starches have been converted, the temperature of the mash is raised to 168 degrees F. There are at least two reasons for the increase in temperature. The higher temperature stops the enzymes from continuing to work so they won't negatively change the wort composition. The higher temperature also makes the wort "thinner," which makes it easier to run off into the boil kettle.

During lautering, brewers will "sparge" the grain with additional hot water. This rinses the barley and coaxes additional sugars from the grain. Sparging can be done in different ways. Most professional brewers do a form called fly sparging, which is efficient, but labor intensive and time consuming. A fly sparge is a slow trickle of water over the grain bed, and a controlled collection rate of the wort. Homebrewers can either fly sparge, or do a simpler (but less efficient) batch sparge. In a batch sparge, all the sparge water is added at once, and the wort is quickly run off.

It's far easier to just drink beer than understand it.

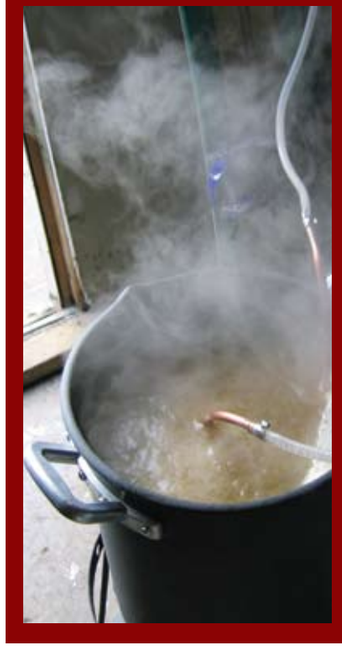
BOIL

After the wort is collected it needs to be vigorously boiled. Boiling the wort accomplishes a number of results. First of all it kills any bacteria and other harmful organisms thus purifying the water.

More importantly, the boil extracts bitterness and flavor from hops. The duration of the boil is typically an hour, but is sometimes longer for different reasons. Some brewers boil longer to extract more bitterness, while others wish to caramelize the wort for certain styles.

A third reason for the boil has to do with a final step of denaturing enzymes, which we talked about at the end of the mash. Any enzymes still active after collecting the wort will not be active once a boil begins. This and other related effects are said to stabilize the brew.

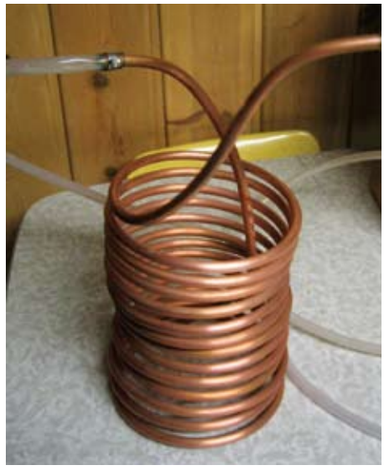
The equipment needed to boil wort is pretty obvious. We have all seen the large boil kettles used by commercial brewers. Homebrewers, on the other hand, have the option of boiling a portion of their wort in a concentrated boil and then adding water later (typically done in extract brewing), or having enough of a heat source and large enough kettle to boil the entire volume at once (typically all-grain brewing).



COOL

After the boil is complete the brewer wants to cool the wort as fast as possible. We discussed this in the "Tools and Inventions" article in *Beer* #15. This part of the process is simple to understand. Yeast would die if added to hot boiling liquid, so the wort must be cooled to temperatures safe for the yeast (80 degrees F or below).

We don't want to re-hash info previously stated in issue #15, but suffice it to say that commercial brewers have a large volume of wort to chill and must use advanced cooling equipment like large plate chillers. Homebrewers, on the other hand, are working with a smaller volume, and have a number of options when it comes to cooling. Beginning brewers might chill their wort in an ice bath in the sink. Homebrewers with larger volumes of wort might graduate to an immersion chiller. As batch sizes get larger or the brewer's geekery expands, he might move to counter flow or plate chillers.



Anchor Brewing's large plate chiller.

PITCH YEAST

It is said that brewers make wort, but yeast makes beer. The requirements for both professionals and homebrewers with respect to yeast are similar. There has to be a sufficient amount of yeast in good health, the wort needs to be properly oxygenated, and the appropriate temperature for the specific yeast being used must be maintained.

Some breweries re-use their yeast from batch to batch. If they do, they must practice exquisitely careful sanitation and cleanliness so the yeast won't become infected or mutate. Many have their own labs to help with this (see the lab at Dogfish Head in the "Brew Masters" TV show for example). Other breweries just buy a pitchable amount of yeast for each production batch.

Homebrewers love to play with yeast. They often make yeast starters before brew day to grow up a larger cell count. They might also use yeast from one batch to the next. Mixing different strains is also a technique that is sometimes used, but the same criteria mentioned above for commercial brewers holds true for those brewing at home (cleanliness and sanitation).

FERMENTATION

Once the yeast is pitched, fermentation begins. At this point the main task of the brewer is to keep the yeast fermenting at a temperature at which they will be happy and productive. Each yeast strain has a preferred temperature range. Fermenting a yeast strain at the upper or lower end of its range will accomplish different things, and skilled brewers will use this knowledge to achieve certain effects. For example, a certain wheat beer strain might produce more clove flavors if fermented warmer, but more banana esters if fermented cooler. The brewer can change the taste of the beer by adjusting the temperature at which the beer is fermented.

Commercial brewers use temperature controls to keep fermenters at the desired temperature. Homebrewers often are at the mercy of their environment. Some brewers make lagers in the winter and ales in the summer. More advanced and well-bankrolled homebrewers might have a dedicated fridge, chest freezer, or other homemade temperature-controlled box to help with the fermentation temp.

Commercial fermenters at Surly brewing with homebrew fermenters in the foreground at an AHA Rally.

SUMMARY

Packaging was discussed in *Beer* #17 when we covered the steps in the bottling process. After the beer is fermented, it needs to be packaged one way or another. Now you know more about just how that beer in your hand went from grain to glass. The next time you gaze at your beautifully made beer, take a moment to think about that. Maybe you will be looking at a beer that you made, and be all the more satisfied.

This is almost like science lab.

We already discussed our package?