All-Grain Brewing

Most homebrewers get their start in the hobby by making extract batches, and many continue with this method. Although fine beer can be made using malt extract and a partial boil, many brewers choose to take the step to all-grain brewing. What *is* all-grain brewing?

It involves creating wort by mashing malted grains (mainly barley), instead of reconstituting concentrated wort, which is what malt extract is. All beer originates from grain, but if we choose to brew from malt extract, we are essentially paying someone else to do the mashing.

Mashing involves several steps:

- Milling the grain to crack the husk and expose the starchy endosperm.
- Wetting the grain (also called “doughing in”) to hydrate the starch, allowing the enzymes to do their work.
- Adjusting the temperature to allow protein degradation and conversion of starches to sugars. In practice, this is often done at the same time as wetting the grain, simply by using warm water.
- Allow the mash to rest, which gives the enzymes time to convert starches to fermentable sugars.
- Recirculating (or Vorlauf) to achieve a clear runoff of sweet wort.
- Collecting the sweet wort and sparging the grain bed (rinsing with warm water).

At this point, the wort is similar to that made by dissolving malt extract and the subsequent steps are the same. The main difference is that the wort is often more dilute, and a full volume boil is required.

What are the **advantages** of all-grain brewing?

- Greater control over the grains (or grist), allowing many variations in the types and amounts of various malt and specialty grain types.
- More control over the sweetness or dryness of the finished beer. If a lower temperature is used for starch conversion, a less sweet and more alcoholic beer will result. If the starch conversion temperature is higher, a sweeter, fuller-bodied beer will result.
- Alternative hopping techniques such as mash hopping and first wort hopping may be practiced.
- Grain is generally less expensive than malt extract.
- A more fermentable wort, rich in yeast nutrients will usually provide an improved fermentation.

What are the **disadvantages** of all-grain brewing?

- It usually takes much more time than extract brewing.
- More equipment is needed for the extra steps.
- A larger brewkettle is required, since a full volume boil must be done.
- More physical labor is required, from grinding the grain to mixing the mash to emptying the mash tun.
- There is more waste generated (spent grain), though it makes great compost.

The most challenging part of all-grain brewing is understanding the multiple steps and types of mashing equipment. Like most aspects of brewing, all-grain can be done simply or with many steps.

The most common all-grain technique is the single infusion. This requires highly modified malt, which includes almost all modern malts. With a single infusion, the mash water temperature must be adjusted to achieve the desired starch conversion temperature. This will vary depending on equipment, and must be determined by trial-and-error. For most systems, the mash water temperature should be about 15-20°F higher than the desired starch conversion temperature.

Starch conversion takes place due to the action of amylase enzymes, which break down starches into smaller starches, dextrins, or sugars. Starch breakdown, or saccharification, takes place between about 145°F and 158°F. There are two main amylase enzymes: β-amylase, which works best at the lower end of the range, and α-amylase, which works better at the higher temperatures. These are important because they work differently, and the wort composition is affected by which enzyme dominates.

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There are more complex mashing methods, including multiple step infusion and decoction. These are usually employed when making a specific style that calls for the additional steps. Single stage infusion works fine for about 90 % of the styles.

Multiple step infusion involves resting the mash at several temperature ranges, allowing different enzymes to carry out their reactions. The various rests include the acid rest (95-105°F), which acidifies the mash and is rarely needed with modern malts and the protein rest (usually around 122-131°F), which breaks down large proteins. A protein rest is usually used with a grain bill that has large amounts of protein. It can be used when brewing a hefeweizen, for example, and is important for specific styles, such as witbier or oatmeal stout. A protein rest "digests" the large proteins, allowing them to be used as yeast nutrients, and providing additional body and enhanced head quality.

Decoction mashing involves removing a portion of the mash, heating it through one or more rests, and eventually boiling the decoction, which is then stirred back into the main mash. This raises the temperature of the mash, as well as darkening the mash. It also develops rich malt flavors which improve the flavor depth of malt-oriented styles, such as Oktoberfest or bock. It is very labor-intensive, and it also uses significantly more energy. It is used mainly by homebrewers and brewpubs for a limited number of styles.

Multiple decoctions may be used, though single decoction is probably most common. Double and triple decoctions add to the malt character, but take even more time and energy to carry out. Decoction mashing pre-dates the invention of the thermometer, when brewers could only determine a few temperatures: body temperature and boiling temperature were most important in brewing. Volume could be measured accurately, and brewers learned by experience how much of the mash to remove, boil, and return to achieve the desired rest temperature. Decoction mashing is mainly used by brewers who wish to stick to traditional methods, and it is rarely necessary with today's well modified malts.

The best introduction to all-grain brewing is to observe an all-grain batch. Several SCBC club members brew regularly, and welcome visitors.