



GETTING TECHNICAL WITH BEER

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The Fundamentals of Wort Boiling

Wort boiling offers several advantages. It enables the precipitation of harsh tannins, complements the use of hops, reduces undesirable compounds through evaporation, and kills off microorganisms.

Whether you're an extract or all-grain brewer, the wort boiling process is the same. For extract brewers, the process starts with wort collected by extract and water. All-grain brewers begin wort collection with mash and sparge. Either way, the wort is put under heat in the boil kettle until a stable rolling boils is achieved.

The kettle contents are typically boiled between 30 and 120 minutes. Wort boiling has a high energy demand and accounts for as much as 40% of gas consumption in the home brewing process. As a result, home brewers should always have an extra gas tank handy.

Wort Sterilization

Raw materials used in brewing – such as, malt, hops, and sometimes the water itself – are full of contaminating microorganisms. These contaminants need to be killed by the boiling process to prevent wort and beer spoilage.

Halting Enzyme Activity

Malt enzyme activity must be stopped as soon as possible after the mash process is complete to avoid altering the fermentability and flavor of the wort. All-grain brewers will benefit from a five minute mash-out at 168°F at the end of mashing before the sparge process. Applying heat to the boil kettle as soon as several gallons of wort are collected from the mashtun will help to halt enzyme activity. A little gas goes a long way at this point, so adjust accordingly as more wort is collected. Enzyme activity becomes denatured at temperatures above 168°F.

Concentration and Evaporation of Wort

Evaporation is a necessary process in brewing because it drives off undesirable volatile components such as DMS (dimethyl sulphide) and other substances that lead to undesirable off-flavors. However, wort becomes more concentrated as water is driven off the kettle as steam. The water

removed is directly proportional to evaporation rate, and efficiency is affected by kettle shape and design. Never use a lid. A typical converted keg has an evaporation rate of 11-13%. Be sure to take evaporation losses into account when choosing your starting boil. Add more water to compensate for evaporation to achieve the final volume desired.

Isomerisation of Hops

Isomerisation is a rapid reaction with production of over 90% of wort bitterness in the first 30 minutes of boil. Maximum isomerisation occurs around 60 minutes and beyond. During boiling, the insoluble hop alpha acids are extracted and converted to more soluble iso-alpha acids. Higher temperatures and proper wort density accelerate this reaction. Extract brewers will benefit from full wort boils to achieve better hop utilization.

Darkening of Wort Color

The color of wort will increase during the boil. Significant oxidation and HSA (Hot Side Aeration) will lead to a darker wort color and should be avoided.

Reducing Wort pH

The pH of wort decreases during the boil, and the final pH measured upon boil completion provides important information. A final target pH of 5.0 is ideal. It creates a better cold break for protein coagulation, improves beer flavor, encourages yeast growth, helps inhibit the growth of contamination, and stabilizes the storage of beer.

Precipitation of Tannins

Proper boil helps remove harsh hop and malt tannins which are precipitated as hot break during the boil. They play an important role in flavor and removal of chill haze components in the final beer.

Changes in the boil process will help you achieve better quality beer. Now, let's get brewing!



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- *Be sure to take evaporation losses into account when choosing your starting boil.*
- *Higher temperatures and proper wort density accelerate the isomerisation of hops.*
- *A final target pH of 5.0 is ideal.*



About the Author

John Lundy has been home brewing for 14 years. He is 2006 president of the Treasure Coast BrewMasters (www.tcbrewmasters.org) and manages Home Brew Unlimited, a Web site chronicling his home brew experience and rating breweries and brew pubs around the country. Log on to www.homebrewunlimited.com.

