# All-Grain: Batch Sparging

Brewing with extracts can produce quality homebrew, but if you want maximum control over a recipe and the feeling of making beer "from scratch" then all-grain brewing is the way to go. As the name entails, all-grain brewing is creating beer from only grains without the use of extracts as a source of fermentable sugars. It is up to the homebrewers to take malted grains and extract the fermentable sugars, a step that is already completed in malt extracts. This process of extracting fermentable sugars from malt is known as mashing and it requires additional steps and equipment during the all-grain brew day.

## What is a Mash?

Mashing is the soaking of crushed grains in a specific amount of water, for a specific amount of time, at a specific temperature. On the microbiological level, the heat of the water enacts enzymes to convert the starches in the grains to fermentable sugars that the yeast can in turn consume and process into $CO_2$ and alcohol. When the conversion is complete, the liquid is separated from the grains, a process known as lautering, and collected in the boil kettle. From there, the brew day is carried on as you would with an extract, extract with specialty grains, or partial-mash batch.

## Additional Equipment

In addition to the typical equipment needed to brew any batch of a beer, a mash tun, extra kettle, and pitcher are needed, with a hydrometer highly recommended.

A mash tun, the vessel in which the mashing process is conducted, is used to maintain rest temperatures and separate the liquid wort from the grain solids, a process known by brewers as lautering. Mash tuns vary in shape, size, and material depending on your current system and goals as a brewer. For many homebrewers, particularly those new to all-grain, a modified rectangular picnic cooler is a cheap and approachable way to upgrade one's setup to accommodate all-grain brewing.

An additional kettle is needed to prepare the sparge water that is added after the mash is complete. The boil kettle is used to heat up the strike water, and the wort is lautered back into the boil kettle when the mash is complete, so an additional kettle is necessary to heat up and add the sparge water to the mash tun.

A pitcher, or small pot with handles, is necessary to conduct the recirculation process that settles the grain bed, known by its German name vorlauf. Before latuering into your boil kettle, it is recommended to collect a pitcher or two of wort, slowly return it to the grain bed, and then begin

draining in your boil kettle. This will prevent an overt amount of grain sediment from making it into the boil kettle.

A hydrometer is not necessary to complete an all-grain brew day, but it is essential if you want to track your progress in regards to conversion and brewhouse efficiency. Many homebrewers will test the gravity of their pre-boil wort to see how close they were to their target conversion. After the boil, you can also measure the gravity of the beer to see how close you are to your target original gravity.

## What is Sparging?

Sparging is an additional step of adding water to the mash tun and rinsing the grains of any remaining sugars. The means of sparging are fly sparging and batch sparging. Both methods achieve the same outcome, but with different means.

Fly sparging, sometimes referred to as continuous sparging, is the process of slowly adding sparge water as the wort is drained. This process can take anywhere from a half hour to two hours depending on how much grain is mashed and the type of system being used. Fly sparging is regarded as the method with the most efficiency, making it very popular amongst commercial brewers.

Batch sparging, on the other hand, requires the brewer to completely drain the wort from the mash tun before adding the sparge water. When the wort is drained, the sparge water is added and the grains stirred. After about 10 minutes, drain the sparge into your boil kettle. Additional sparge steps can be implemented depending on what one is trying to achieve. Batch sparging may not be as efficient as fly sparging, but for homebrewers it is an approachable way to conduct all-grain brew days.

## Preparing an All-Grain Mash Schedule

For the purpose of this tutorial, we will be covering an all-grain brew day utilizing the batch sparge method mentioned above. This method has been popularized by American Homebrewers Association Governing Committee member Denny Conn as a cheap and easy way for homebrewers to experience all-grain brewing. The batch sparge method is also covered in detail in the Introduction to All-Grain Brewing video series.

For this example, we will be using a recipe form *Brewing Classic Styles* by Jamil Zainasheff and John Palmer:

## American Amber

**Ingredients for 6 US gallons ( L):**

- 9.25 lb (4.19 kg) | British Pale Ale malt
- 1 lb (0.45 kg) | Munich malt
- 0.75 lb (340 g) | Crystal 40L malt
- 0.5 lb (227 g) | Crystal 120L malt
- 0.5 lb (227 g) | Victory malt
- 0.6 oz (17 g) | Horizon hops, 13% AA (60 minutes)
- 0.25 oz (7 g) | Cascade hops, 6% AA (10 minutes)
- 0.25 oz (7 g) | Centennial hops, 9% AA (10 minutes)
- 0.25 oz (7 g) | Cascade hops, 6% AA (0 minutes)
- 0.25 oz (7 g) | Centennial, 9% AA (0 minutes)
- Yeast: White Labs California Ale WLP001, Wyeast American Ale 1056, or Fermentis Safale US-05

**Specifications:**

- **Original Gravity:** 1.052 (12.8 P)
- **Final Gravity:** 1.013 (3.3 P)
- **IBU:** 35
- **Color:** 13 SRM (25 EBC)
- **Alcohol:** 5.1% ABV (4.0% ABW)
- **Pre-boil Gravity:** 1.044 (10.9 P)
- **Boil:** 60 minutes

## Determining Strike Water Volume

Strike water, the term used for the water prepared for the mash, has to be of a certain volume and at a specific temperature in order to properly carry out the mash as the recipe intended. Grain-to-water ratios for strike water vary from 1-2 quarts of water per pound of grain. For this recipe, we will use an average ratio of 1.5 quarts of strike water per pound of grain. Based on the recipe, this will require a strike water volume of 18 quarts (4.5 gallons).

**(Total Grain Weight (lb) x Water to Grain Ratio (qt/lb)) = Strike Water Volume**

**(12 lb x 1.5 qt/lb) = 18 quarts (4.5 gal) strike water**

## Calculating Strike Water Temperature

Strike water temperature generally has to be 8-12°F (4.4-6.6°C) warmer than the intended mash temperature to compensate for heat loss when the colder grains are added. The amount of heat lost differs from one system to the next as well as depends on the temperature of the grain, so it is a good idea to keep notes on volumes and temperatures (amongst other things) in order to be able to dial in your process more precisely. For this recipe, the mash schedule calls for a rest at 154°F (67.8°C) for 60 minutes. We will assume a temperature loss of 12°F (6.6°C) when adding the grains, so our strike water temperature should be heated to 166°F (74.4°C):

**Mash Temperature + Amount of Heat Lost Mashing In = Strike Water Temperature**

**154°F + 12°F = 166°F strike water temperature**

## Determining Sparge Water Volume

The sparge water should compensate for the rest of the pre-boil volume that is not collected from the mash. There are a few variables necessary to define that will help in accurately calculating sparge volumes: pre-boil volume, boil-off rate, and grain absorption.

Boil-off rate varies from one system to the next, which means the pre-boil volume will also vary. This is another instance where keeping notes will aid in dialing in your system and being able to accurately predict/control what you are producing. For the purpose of this recipe, we will assume a boil off rate of 1.5 gallons per hour. This means that over the course of an hour, 1.5 gallons of volume will be lost from the boil kettle. Since the recipe is for 6 gallons at the end of the boil, the pre-boil volume is 7.5 gallons.

**Recipe Batch Volume (gal) + (Boil-off Rate (gal/hr) X Boil Duration (hr)) = Pre Boil Volume (gal)**

**6 gallons + (1.5 gal/hr x 1 hr) = 7.5 gallons**

Now that you know the target pre-boil volume is 7.5 gallons, we need to predict how much wort is going to be collected from the mash, and based on this information the sparge volume can be determined. The dry grains are going to absorb some of the strike water, meaning the wort collected will be less than the initial strike water volume. Generally speaking, one pound of grain absorbs about 0.1-0.125 gallons of water, but this is yet another variable that is best determined by diligent note taking. For this tutorial, we will assume an absorption rate of 0.1 pounds of water is lost per pound of grain. Applying this absorption rate to our recipe, about 1.2 gallons of strike water will be absorbed during the mash process. This means that there should be about 3.3 gallons of wort collected from the mash.

**Total Weight of Grains (lb) x Absorption Rate (gal/lb) = Total Water Absorbed During Mash (qt)**

**12 lb x 0.1 gal/lb = 1.2 gallons absorbed**

**Strike Water Volume (gal) – Total Water Absorbed (gal) = Volume Collected from Mash Step (gal)**

**4.5 gal – 1.2 gal = 3.3 gallons collected**

Assuming 3.3 gallons are collected from the mash, and because we are aiming for a 7.5 gallon pre-boil volume, the sparge volume should be 4.2 gallons (note: after the mash, the grains are fully saturated and grain absorption is negligible).

**Pre-Boil Volume (gal) – Volume Collected from Mash (gal) = Sparge Volume (gal)**

**7.5 gallons – 3.3 gallons = 4.2 gallons**

**Lets Recap the full mash schedule based on the calculations above:**

- **Strike Water:** 4.5 gallons heated to 166°F
- **Mash In:** Hold mash temperature at 154°F for 60 minutes
- **Sparge Water:** Heat 4.2 gallons of water to about 170°F, stir, and lauter.

## Conducting and All-Grain Brew Day

With the mash schedule outlined above, we are now ready to begin the all-grain brew day. The only difference from an extract brew is the mashing step. The boil and post-boil routine is exactly the same less any extract additions. Follow the subsequent steps (**Note:** the volumes and temperatures are based on the figures above. If you have different values for the variables used above, calculate your own numbers for more accurate brewing)

1. **Heat Up Strike Water:** Heat up 4.5 gallons of water in your boil kettle to 166°F. While this strike water is heating up, boil a few cups of water and add to your mash tun. This will heat up the tun and reduce the heat lost when transferring your strike water to the vessel.
2. **Mash In:** When the strike water reaches 166°F, transfer it to the mash tun. Slowly stir in the grains, ensuring none of the grains are left dry or in clumps. When your temperature stabilizes at 154°F, cover and let sit for 60 minutes.

3. **Prepare Sparge Water:** While the mash is resting, heat up 4.2 gallons of water to 170°F in preparation for the sparge.
4. **Optional Step:** Using iodine test materials, test the mash to ensure conversion of starches to sugars is complete (See the Introduction to All-Grain Brewing video series).
5. **Vorlauf:** When the mash is complete, it is necessary to conduct a step that will aid in settling the grain bed and ultimately clarifying the wort of sediment. This process is known by its German name, vorlaut. A vorlauf is conducted by collecting a few quarts of runnings into a pitcher and slowly returning them to the mash until the wort runs almost clear. Open the valve slowly to prevent any sediment from clogging the mash tun manifold.
6. **Sparge:** When the mash is completely drained, close the mash tun valve and add in the prepared sparge water. Stir the grains, breaking up any clumps, let sit for about 10 minutes, vorlaut like before, and lauter into your boil kettle.
7. **Measure:** Measure your pre-boil volume and use a hydrometer to determine pre-boil gravity.
8. **Boil:** Continue on to the boil and post-boil process as you would any batch of homebrewed beer!

## Troubleshooting:

If you made it through your first all-grain experience without a hitch, crack open a brew in celebration; that is no easy feat. If you are like most new all-grain brewers, you probably hit a few common issues that can be remedied.

1. **My mash temperature stabilized too high/low:** This will be a common issue until you have brewed a few all-grain batches on your system and determined how much heat is typically lost when mashing in. In the meantime, there are easy ways to fix a mash temperature that is too high or too low. If your temperature is too high, simply stir the mash until the temperature drops to the target temperature. If the temperature is too low, slowly stir in boiling water until your reach the target temperature.
2. **My Mash Tun Won't Drain:** If wort stops running out of your mash tun but there still appears to be liquid in the vessel, then you may be experiencing a "stuck sparge." First, simply try blowing into the valve of the mash tun to try and dislodge any material that may be clogging the manifold. If this doesn't work, add some more hot water, stir, vorlauf, and try to lauter again. If using large quantities of wheat in a recipe, it is recommended to use rice hulls to allow the wort to easily percolate through the grain bed when lautering.
3. **I collected more/less wort from the mash than anticipated:** If you collected more wort than anticipated, compensate by decreasing the sparge water volume. Remember, little to no water is absorbed when sparging, so the amount needed to reach your pre-boil volume

is as simple as subtracting the mash volume collected from the target pre-boil volume. If you collected to little wort, make up for it by adding the shortcoming to the sparge.

4. **My pre-boil gravity is very low/high:** Assuming your volumes are all as intended, if your pre-boil gravity is lower than anticipated, you can use malt extract to make up for any shortcomings. If the gravity is too high, you can stir in water until the target pre-boil gravity is reached.