

Brewing Water – An Overview

KEY CHEMISTRY

Water affects beer and brewing in three key ways:

- ❖ Direct Flavor Contribution
- ❖ Process Contributions
- ❖ Off-Flavors

DIRECT FLAVOR CONTRIBUTION

- Ions that directly impact flavor by their presence.
- Additions impact flavor when added at any point – even in the pint glass!
- Affect Extract and All-Grain brewing equally
- Sulfate, Chloride, Sodium primary contributors.

• PROCESS CONTRIBUTIONS

- Ions that indirectly impact beer by their effect on the process
- Impact dependent on when added. Effect is greatest on Mash pH.
- Primarily affect all-grain brewing.
- Calcium, Magnesium, Bicarbonate primary contributors.

• OFF-FLAVORS

- Ions that result in off-flavors.
- Chlorine / Chloramines primary concern for tap water.
- Bad tasting water = off-flavors in beer.

BUILDING AND ADJUSTING BREWING WATER

Building a water profile has three basic steps:

- ❖ Determining Target Profile
- ❖ Determining Water Source Profile
- ❖ Determining Adjustments

DETERMINING TARGET PROFILE

A target profile begins with the desired recipe and flavor profile. The goal is to determine what aspects of the beer are to be accentuated by the water profile to get the desired end result.

- Beware of classic brewing water profiles from famous cities – while they influenced the styles, the water wasn't the same between breweries and often had to be modified before use!
- Chloride and Sulfate levels have the greatest impact and can be used to accentuate different flavors
- Don't make absolutes! Compromise is often needed. Decide what's important to the beer.
- Experiment! IPA's traditionally are high sulfate to accentuate bitterness, but some now use high chloride to accentuate hop flavor (ex: Heady Topper)

Reference Intro to Water Chemistry for more details on the ions and their effects.

http://wichitahomebrewers.org/resources/Intro_to_Water_Chemistry.pdf

DETERMINING SOURCE PROFILE

- Know your water!
 - Municipal Water Reports
 - Lab Test Reports
 - Home Testing
- Consider blending water
- Reverse Osmosis provides a blank slate
 - RO is only a starting point!

DETERMINING ADJUSTMENTS

Water adjustment calculations are best done using spreadsheets or water calculators. Popular calculators are listed in the next section.

- Done via Salt Additions, Acid Additions and Blending.
- All adjustments affect multiple variables
 - Components are ions – each addition introduces a positive (cation) and negative (anion) component.
- Typical Brewing Salts
 - Gypsum - Calcium Sulfate (CaSO_4).
 - Calcium Chloride (CaCl_2)
 - Epsom Salt – Magnesium Sulfate (MgSO_4)
 - Chalk – Calcium Carbonate (CaCO_3)
- Typical Brewing Acids
 - Phosphoric Acid
 - Lactic Acid [Acid Malt]
 - Hydrochloric (Muriatic) Acid*
 - Sulfuric Acid*

*Not recommended for homebrewers.

CALCULATING AND MEASURING

AVAILABLE CALCULATORS

Some popular brewing calculators

- Brewers Friend
<http://www.brewersfriend.com/water-chemistry/>
- Bru'n Water
<https://sites.google.com/site/brunwater/>
- EZ Water Calculator
<http://www.ezwatercalculator.com/>

USING CALCULATORS

Brewing water calculators take inputs of your water profile, beer recipe (grain profile) and salt additions and output final ion levels and mash pH.

Typical use is to start with your normal water and add the grain profile (either grain bill, or quantity and expected color). Salt additions and Acid additions are added to achieve the desired ion profile and mash pH.

TIPS AND TRICKS

- Start with salt additions as required to achieve flavor ion levels.
- Flavor salts can be added at any point; when added to the mash, they help lower pH
- Acid's are most effective at lowering pH
- Mash thickness affects pH due to buffering affects - volume control is needed for effective pH control
- Most beers do not need adjustments to raise mash pH. Typically better off to not attempt to raise pH.
- It's not always possible to achieve targets. Lowering an ion level can only be achieved by blending in water with lower values.
- Acidifying sparge water (to neutralize alkalinity) can reduce/prevent tannin extraction.
- Five Star 5.2 Mash pH Stabilizer doesn't work if you own a pH meter.
- If in doubt – less is more

MEASURING STARTING WATER

- Municipal Water Supply
 - Yearly water reports required by EPA
 - Google (city name) Water Quality Report
 - Results of interest are “secondary” or “asthetic” data.
 - Results are an average of the year, actual water may vary through the year.
- Commercial Water Testing
 - Ward Labs offers brewing specific reports for homebrewers.
 - Other services may offer useful testing – watch out for salesman!
- Home Testing
 - Aquarium Test Kits are useful.
 - GH/KH test kits give sufficient info to determine hardness and alkalinity to estimate mash pH
 - Can use to monitor for changes in water supply.
 - Can also test for free chlorine (off flavor)

PH METERS

A good pH meter is an essential to any brewer wanting to adjust water chemistry and control mash pH. A lot of factors affect mash pH and not all can be accounted for. Testing and good notes are needed for repeatable results.

Brewing deals with a fairly narrow pH range: mash ranges of 5.2-5.6, finished beer of 4.4-4.8 are typical. Lower end pH meters often don't have sufficient accuracy for reliable readings. A 0.01 resolution is typically needed.

Frequent calibrations are necessary with pH meters, and the probe ends eventually wear out, necessitating replacement.

Temperature compensation is useful, but it is important to know that pH varies with temperature as well. Temp compensation does not account for this change. Most brewing references for pH are for room temp samples.