BREWING WATER

LAUTER-DAY BREWERS - FEBRUARY 2014

WHY DO WE CARE ABOUT WATER?

- It’s 90% of your Beer!
- Typical water sources contain chemicals that impact the brewing process and flavors
- Knowing how to handle water will improve your beer

ADJUSTING YOUR WATER WILL:

- Improve Mash effectiveness
- Make Yeast happy
- Protect again off flavors and tannin extraction
- Build water to match style

WHEN YOU SHOULD CARE ABOUT YOUR WATER

Salt Lake Valley water will make good beer. Brewing great beer requires some additional management, especially when:

- Your water is not pleasant to drink (too much iron, salt, other off flavors, or too much chlorine)
- All grain brewing - pH and calcium deficiency impacts mash effectiveness.
- When water mineralization does not match style

WHEN NOT TO CARE

- Extract brewing - Just know what flavors your water might be adding.
- You brew what you brew, and it works
- Talk about ions brings back nightmares of high school chemistry class

WATER RULE #1:

Remove chlorine and chloramine from brewing water

- Chlorine and Chloramine are a result of public water treatment. To my knowledge SLC water contains only Chlorine.
- Chlorine react with phenols to produce ***Chloro***phenols which can give your beer that medicinal or “band-aid” off flavor.
- Filtering with activated carbon, boiling, or just letting your brewing water sit overnight will remove chlorine.
- Chloramine can be more stubborn, but we will not go into that.

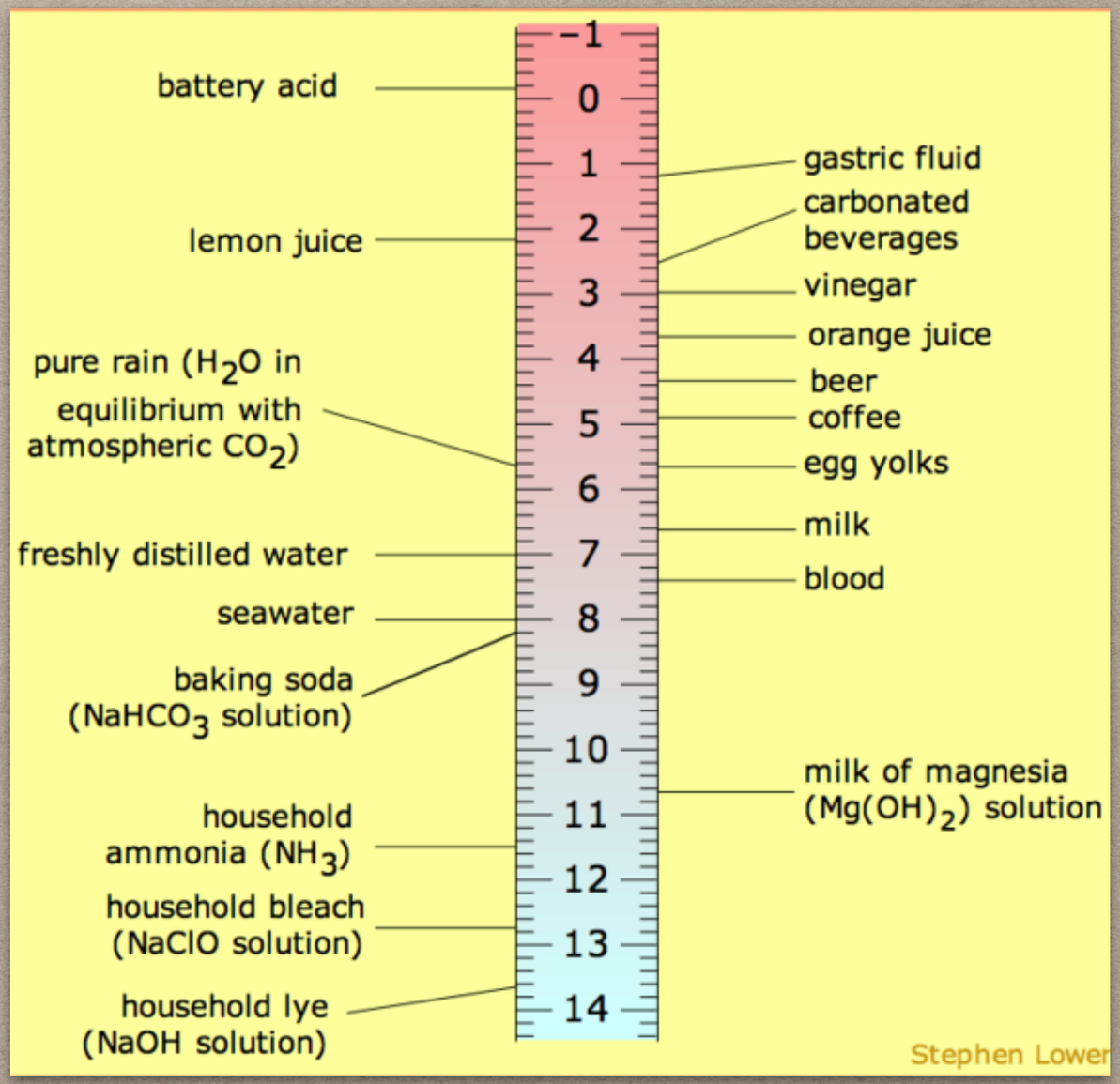
DON'T HAVE A CARBON FILTER OR DON'T WANT TO WAIT?

Metabisulfite will easily and quickly remove both Chlorine and Chlorimine from brewing water.

- Both Potassium metabisulfite and Sodium metabisulfite (Campden) are equally effective and take only a few minutes.
- Use 1/4 gram or 1/2 campden tablet to treat 10 gallons of water

WATER AND PH

- pH measures a solutions acidic or basic nature
- pH scale ranges from (1 Acidic to 14 Basic)
- Beer pH is low 4's and sometimes even lower
- RO/Distilled waters pH is 7.0 - Municipal water is normally in 7.9 - 8.9 range



WHEN YOU SHOULD CARE ABOUT PH

- When Mashing - Target pH range is 5.2 to 5.6
  - 5.2 for crisp or tart beers
  - 5.5 for darker beers
- When Sparging - Sparge water pH should be < 6.0 to prevent extracting tannins (treat sparge with lactic acid)
- pH in mash is impacted by the grain bill (acids) and the water alkalinity
- pH is typically adjusted by adjusting the grain bill , salt buffers, and/or acids
- It can also be important during and after boiling

WATER AND HARDNESS

Hardness is due to the concentration of calcium and magnesium in the water

- Permanent hardness:
  - Calcium or Magnesium paired with Sulfates of Chlorides
  - Cannot be boiled off
- Temporary hardness:
  - Calcium or Magnesium paired with Carbonate or Bicarbonate
  - It can be boiled off. Bi/carbonate exits as CO2. Calcium stays behind and can sometimes be seen at the bottom of the kettle

Classification	hardness in mg/L
Soft	0–60
Moderately hard	61–120
Hard	121–180
Very hard	≥ 181

A CLOSER LOOK AT CARBONATES AND BICARBONATES

- These ions prevent decrease of pH (act as a buffer)
- Contribute to alkalinity
- Managable through pH adjustments

WATER ALKALINITY

- Generally due to Carbonate and Bicarbonate in water
- Acts as a buffer to pH changes (Buffers absorb acids without changing pH much)
- **Excessive Alkalinity** can make your mash pH too high unless mashing with dark grains
- **Too little Alkalinity** will not work for mashing dark beers. (darker malts lower your pH)

Residual Alkalinity - The measure of alkalinity left after the acidity of the malts react to the water's hardness

WATER RULE #2

Buy a pH meter!

If you want to go head first into chemistry calculations, including residual alkalinity, be my guest.

If you want to simplify things and take the guess work and theory out of the equation, measure your pH with a pH meter and use a water calculator.

Water temp matters when reading pH. True readings need room temperature. At mash temps the range is 5.1- 5.3.

BREWING WATER IONS

Just the ones you should care about… I promise

Calcium (CA++)

- Protects enzymes from thermal degradation, extends activity in the mash
- Improves trub formation during boil which in turn promotes clarity, flavor, and stability
- Vital to yeast health
- Decreases pH during mashing and boil
  - 100 ppm calcium addition decreases pH by 0.4 pH units
  - However adding calcium is not the most effective way to lower mash pH

  General Rule:

  - 40-60 ppm is needed in all finished beer. In order to get there, 80-120 ppm is needed when mashing

Magnesium (Mg++)

- Magnesium salts are much more soluble than those of calcium
- Less effect on wort pH
- Can provide slightly bitter or sour flavor to beer.
- Vital yeast nutrient

General Rule:

- < 50 ppm

Sodium (Na+)

- At lower concentrations (<100 ppm), sodium gives a slightly sweet flavor to beer.
- Over 100 ppm will give a salty flavor

General Rule:

- < 100 ppm
- < 50 ppm for dry, crisp beers

SULFATE ($SO_4 2-^{-}$) / CHLORIDE (CL–)

- Chloride increases palate fullness and gives a mellow flavor to beer
- Sulfate results in drier, more bitter flavors in beer
- Sulfate can be the source of SO2 and H2S formed during fermentation that can give beer a sulfury note (common in Burton style ales).
- Sulfate to Chloride ratio is generally used to target beer flavor profiles. A high ratio accentuates bitterness; a low ratio, sweetness
  - 2:1 - Sulfate to Chloride = great for pales, IPAs
  - 1:1 - Sulfate to Chloride = Balanced beer
  - 1:2 - Sulfate to Chloride = Malty beer

General Rule:

- Chloride below 100 ppm
- Sulfate below 100 ppm as a general rule, however higher can work up into the 400 ppm range for distinct pale ale character

WATER RULE #3 AND #4

- Rule #3 - Know your water! Contact your municipal water supplier, or have your own water tested. Ward labs offers water tests for the home brewer.

- Rule #4 - Use a water calculator! The are excel based and online versions.

A TYPICAL WATER REPORT FROM WARDS

pH	7.8
Total Dissolved Solids (TDS) Est	272
Electrical Conductivity, mmho/cm	0.45
Cations / Anions, me/L	4.7 / 4.6
	ppm
Sodium, Na	30
Potassium, K	2
Calcium, Ca	48
Magnesium, Mg	12
Total Hardness, $CaCO_3$	170
Nitrate, NO_3-N	0.4 (SAFE)
Sulfate, SO_4-S	14
Chloride, Cl	53
Carbonate, CO_3	< 1
Bicarbonate, HCO_3	132
Total Alkalinity, $CaCO_3$	109
	"<" - Not Detected / Below Detection Limit

APPLYING THE REPORT TO A WATER CALCULATOR

Bru'n Water

Link to Bru'n Water website for updates and to donate

Water Report Input

Hover cursor over cells w/ red triangles to display helpful comments

Cations	Enter Ion Concentrations from Water Report (mg/L or ppm)		Anions
Calcium (Ca)	48.0	132.0	Bicarbonate (HCO_3)
Magnesium (Mg)	12.0	0.5	Carbonate (CO_3)
Sodium (Na)	30.0	42.0	Sulfate (SO_4)
Potassium (K)	2.0	53.0	Chloride (Cl)
Iron (Fe)	0.0	1.8	Nitrate (NO_3)
		0.0	Nitrite (NO_2)
		0.0	Fluoride (F)

If water report provides only Total Alkalinity (as $CaCO_3$), use the calculator below to estimate the Bicarbonate and Carbonate concentrations. Insert the estimated results in the table above.

Reported Total Alkalinity (as CaCO3) (mg/L or ppm)	Reported or Measured Water pH	Estimated Bicarbonate Concentration (ppm)	Estimated Carbonate Concentration (ppm)
109.0	7.8	132.2	0.4

Ion Balance Results			
Total Cations (meq/L)	4.74	0.16	Cation/Anion Difference
Total Anions (meq/L)	4.58		

Hardness and Alkalinity Results			
Total Hardness, as $CaCO_3$, (ppm)	169	110	Alkalinity (ppm as $CaCO_3$)
Permanent Hardness, as $CaCO_3$, (ppm)	59	145	RA Effective Hardness, (ppm as $CaCO_3$)
Temporary Hardness, as $CaCO_3$, (ppm)	110	68	Residual Alkalinity (RA), (ppm as $CaCO_3$)

Water calculator resources:

Bru'n Water:
https://sites.google.com/site/brunwater/

Ez Brew:

http://www.ezwatercalculator.com

Brewers Friend:

http://www.brewersfriend.com/mash-chemistry-and-brewing-water-calculator/