Intro to Brewing Water

Brighten up your beer through water and pH adjustment

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Why Bother

- You probably don't need to, unless:
  - You are comfortable with everything else first
  - You have fermentation mastered
  - You are prepared to invest in more equipment
- Beer is 97% water
- Water composition influences flavour expression and certain yeast behaviour

Things to Care About - pH

- pH is:
  - Concentration of H+ ions
  - Lower is more acidic, higher is more basic
  - 7.0 pH is the middle
- Tap water is usually around 6.8 to 7.8
  - Drops when you add grain, salts, or acid
- Mash pH should be 5.2 – 5.5 pH
- Beer pH is usually 4.0 – 4.4 pH

Things to Care About - pH

- When the pH is right:
  - hop bitterness is more pleasant and doesn't linger
  - improved break formation
  - enzymatic activity in the mash is increased
  - beer is crisper, more fresh and shows more character
- Read Braukaiser.com post for the much more

Things to Care About - Minerals

- Similar benefits as mash pH
  - Calcium (Ca), Sulfate (SO_4), and Chloride (Cl)
- Calcium affects everything
  - Lowers mash pH
  - Promotes flocculation of yeast and protein
  - Limits extraction of tannins (astringency)
- Most commonly calcium is added as gypsum ($CaSO_4$) and Calcium Chloride (CaCl)

Things to Care About - Minerals

- SO_4 affects perception of bitterness
  - Helps give the beer a drier and crisper impression.
- Cl affects perception of sweetness and body
- Choose ratio (SO_4:Cl) for desired result
  - Seasoning level matters too
- Bicarbonate (HCO_3) helps determine alkalinity
  - Acts as a buffer working against acid additions
  - Can be good to balance against acidic malts

Toronto Water Profile

- Calcium (Ca) – 35 ppm
  - Note that this is <50 ppm
- Chloride (Cl) – 26 ppm
- Sulfate (SO_4) – 27 ppm
- Bicarbonate (HCO_3) – 109 ppm
- Other: Magnesium (Mg) 9 ppm, Sodium (Na) 15 ppm, Potassium (K) 1.5 ppm
- Link to Toronto Water Report

Target Ranges for Minerals

- Calcium (Ca) 50-150 ppm
  - Less than this is okay for lagers
- Sulfate () 0-350 ppm
  - More than this becomes harsh and astringent
- Chloride (Cl) 10-100 ppm
  - Closer to 50 ppm when high sulfate
- Bicarbonate (HCO_3) <50 ppm
  - More acceptable in beers with acidic malts

What Determines Mash pH

- Balancing act between the base water, malts, added salts, and acid addition
- Thinner mash usually means higher pH
- High bicarbonate (HCO_3) requires more acid
- Calcium has a limited effect on mash pH
- Roast and crystal malts are more acidic
- More grain is balanced out by more water
  - Assuming constant mash thickness

What Do You Need

- pH Meter
  - Omega PHH-7011 $101 CAD
  - Milwaukee MW102 (hard to find in CAD)
  - Buying Guide
- Scale with 0.1 g resolution (at least)
- Salts and Acid
- DO NOT USE 5.2 Stabilizer

My Approach

- Pick your software
  - Bru'n Water and Brewer's Friend are both great
- Decide on a mineral profile
  - More than 50 ppm Calcium
  - High sulfate for hoppy/bitter beers (SO_4:Cl > 2)
  - Start balanced for most beers (SO_4:Cl ~ 1.3)
  - More chloride for sweet/malty beers (SO_4:Cl < 0.5)
- Add enough acid to hit desired mash pH

My Approach

- Avoid adding alkalinity by mashing thin
- Use lactic acid instead of acid malt
  - I would try phosphoric if I could get it
- Aim for a mash pH between 5.2 and 5.4
  - 5.2 for malty beers
  - 5.4 for hoppy beers
- Use a light hand in mineral additions

Example 1. Munich Helles

- Recipe: 8.5 lbs Pilsner (2L), 1 lbs Vienna (3.5L), 1.50 qt/lbs, 3.69 gal strike, 5.31 gal sparge
- Light touch, bit more sulfate, mostly balanced
  - SO_4:Cl = 1.5
- Result: Ca = 54.2 ppm, SO4 = 56.9 ppm, Cl = 39.1 ppm, mash pH = 5.32 pH
- Additions: $CaSO_4$ sparge 0.7 g strike 1.1 g, CaCl strike 0.4 g sparge 0.5 g, lactic strike 3.7 mL sparge 2.2 mL

Example 2. IPA

- Recipe: 10 lbs 2 Row (2L), 1 lbs Munich I (6L), 0.5 lbs Wheat (2L), 1.50 qt/lbs, 4.43 gal strike, 4.31 gal sparge
- More sulfate accentuate dryness
  - SO_4:Cl = 3.0
- Result: Ca = 101.9 ppm, SO4 = 154.2 ppm, Cl = 51.8 ppm, mash pH = 5.38 pH

Example 2. IPA

- Additions: $CaSO_4$ sparge 3.8 g strike 3.7 g, CaCl strike 0.9 g sparge 0.9 g, lactic strike 2.9 mL sparge 1.8 mL
- Mash pH measured 5.74 pH, added 1.5 mL more acid, got 5.52 pH
  - This is why you need a meter

Example 3. Robust Porter

- Recipe: 9 lbs 2 Row (2L), 1.5 lbs Munich I (6L), 14 oz Crystal 65L, 12 oz Chocolate (400L), 10 oz Black (550L), 1.50 qt/lbs, 4.91 gal strike, 3.99 gal sparge
- More chloride to accentuate fullness, low pH
  - SO_4:Cl = 0.8
- Result: Ca = 55.2 ppm, SO4 = 42.1 ppm, Cl = 51.8 ppm, mash pH = 5.31 pH

Example 3. Robust Porter

- Additions: $CaSO_4$ sparge 0.5 g strike 0.4 g, CaCl strike 1.0 g sparge 0.8 g, lactic strike 1.5 mL sparge 1.6 mL
- Mash pH measured 5.46 pH, close enough

Example 4. Doppelbock

- Recipe: 13 lbs Munich I (6L), 3 lbs Munich II (10L), 2 lbs Caramunich III (65L), 0.5 lbs Melanoidin (20L), 1.50 qt/lbs, 7.07 gal strike, 3.03 gal sparge
- Low pH, more chloride, watch out for crystal
  - SO_4:Cl = 0.8
- Result: Ca = 55.2 ppm, SO4 = 42.1 ppm, Cl = 51.8 ppm, mash pH = 5.49 pH

Example 4. Doppelbock

- Additions: $CaSO_4$ sparge 0.7 g strike 0.3 g, CaCl strike 1.4 g sparge 0.6 g, lactic strike **0 mL** sparge 1.2 mL
- Mash pH measured 5.29 pH, closer to real target

Questions?

- Further Reading
  - Bru'n Water – Water Knowledge
  - Water Book – By John Palmer and Colin Kaminski
  - Braukaiser - Mash pH Control
  - Scrappy Hound Brewing – Brewing Water
  - Toronto Water Reports