STRATEGIES TO CONTROL BEER pH

Altering Wort Buffering Capacity

- Barley adjuncts (+)
- % Adjunct in formulation (-)
- Carbohydrate syrups (-)
- Malt nitrogen content (+)
- Krausening (+)
- High gravity brewing (+)
- Altered malt mill settings (+/-)
- FAN/TSN Ratio (-)
- Unmalted wheat adjuncts (+)
- Dark malt (-)
- FAN (+)
- Under modified malts (-)
- Phytase/Phosphatase Activity (+) opt. at pH 5.0, 50 - 55^{0}C (122 - 131^{0}F).
- Protein rest (+)
- Poor wetting of malt during period of phosphatase activity (-)
- Two row < six row (less protein & less phosphatase activity).

Adjusting Wort pH

- Carbonate addition (+)
- Malt storage areas exposed to ammonia vapors will increase wort pH.
- Installation of grant increased beer pH by 0.15 units.
- Process changes to decrease malt color will increase pH …less soluble protein buffering at lower pKa's.
- Alkali addition (+)
- Mineral acid addition (-)
- Lactic acid bacteria acidification (-)
- Gypsum addition (-)
- Dibasic ammonium phosphate addition (+)

Beer pH

Factors Which Promote Growth

- **"Assimilated Yeast"** ...lower pH's reached when propagate and pitch with this method.
- Carlsberg type yeast (-), Tuborg (+)
- Agitation (-)
- Temperature (-)
- Reduced yeast growth (+)
- 0_2 (-)
- FAN
- Zn (-)
- Reduced yeast pitching rate (+)
- Strain (+/-)

Adjusting Yeast Acidity Production

- In aging, pH little changed in middle upper regions of tank, but bottom can rise from 4.1 to 5.0 over 40 days. Likewise FAN from 60 to 700 ppm in bottom, especially low MW nitrogen!
- **Kirsop: 30%** of the increase in [H+] of fermenting wort could not be attributed to known causes such as organic uptake of basic amino acids from wort, uptake of acidic amino acids, production of CO_2 or adsorption of primary phosphate.....the remaining 30% driven by **ATPase and proton gradient**!
- Yeast strain, with cell volume directly correlating with pH (Sapporo)...larger the yeast, higher the pH.

Altering Brewing Water Alkalinity

- **Permanent hardness** increases wort pH.
- Alkalinity (+)
- Hardness (-)
- Addition of calcium sulfate (-)
- Water acidification to neutralize alkalinity (-)
- Sodium carbonate addition (+)
- Ash addition (+)
- **Temporary hardness** decreases wort pH.
- Calcium/Magnesium content in dough-in & sparge water (-)
- Addition of gypsum (-)
- Highly alkaline water to slurry post-fermentation hop extract addition, e.g. with sodium carbonate, sodium bicarbonate or calcium carbonate (+)

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