

pH Control during Brewing

Why monitor pH? Measuring pH throughout the brewing process enables us to have better control of our beers, can improve flavour for example by reducing astringency, can increase extract efficiency and assist in reducing the potential for bacterial infection in our finished beers.

What should we aim for?

Typical pH values for Ales; lagers are usually a decimal point or two higher.

During Mashing 5.2 – 5.5

Total collected wort after sparging 5.2 – 5.4

Collected wort after boiling 5.0 – 5.2

Post fermentation 3.8 – 4.2 (*specialist beers such as Lambic or Berlin Weisse may be as low as 3.5 – 3.7*)

Typical Factors influencing Wort pH (pre fermentation)

- Mash Liquor
- Sparge Liquor
- Composition of Grist (crystal and roast malts will reduce pH values)
- Addition of mineral salts (Calcium Sulphate / Chloride will reduce pH values if added to the mash, sparge liquor or boil and Magnesium Sulphate if added to the boil.

Typical Factors influencing Beer pH (post fermentation)

- Yeast strain and pitching rate
- Amino acids and nutrients present in wort

Taking Measurements; Inexpensive pH meters are now widely available and are increasingly reliable and accurate with improving technology. They do need to be calibrated to 7.00 and 4.00 at regular intervals and ready to use calibrating solutions are available, however a cheaper option are capsules available on eBay at reasonable prices, you will need the 7.00 and 4.00 capsules which need to be dissolved in the specified amount of de-ionised or distilled water before use.

Possible effects when mash / sparge / wort pH is too high;

- Lower extract from malt
- Tannins may be extracted from the mash during sparging causing harshness / astringency.
- Undesirable bittering compounds extracted from the hops during boiling causing harshness / astringency in the finished beer.
- A slower start to fermentation which provides more opportunity for contamination via wort bacteria or wild yeasts.

Possible effects when mash / sparge / wort pH is too low;

- Poor / dull flavour from malts
- Low / inefficient extraction of hop bittering compounds

Applying a minor correction to pH when making a brew.

Example; we are brewing a 25L batch of Pale Ale using Tesco Ashbeck water which is very soft, containing only 25mg/L of HCO_3 . (carbonates) Our grist contains 95% pale malt plus 5% medium crystal malt. We've added 5g gypsum (or Murphy's DWB) to the grist prior to mashing plus another 5g mixed in to the sparge liquor (well agitated) and after completion of mashing and sparging we measure a sample of total collected wort before any hops are added. We note that the sample measures 5.5 and can therefore assume that after say a 75 minute boil this would be reduced to 5.4 without any further Calcium addition, however with a further 5 -7g of gypsum / DWB added to the boiling wort before hops are added a post boil pH of 5.3 may be achieved which isn't too far from our target. However we could make a small correction at this point by cautiously adding 2ml of Murphy's A/M/S (same as Brupaks C/R/S) via a measured pipette. This should lower the post boil pH value to 5.2 or a tad lower enabling us to hit our target of 5.0 – 5.2.

If we were to repeat this brew it would be better to take some measures which ensure that the pH remains correct throughout the various stages.

This could be achieved by;

- Increasing the proportion of crystal malt, however this would alter the character and overall balance of the beer.
- Doubling the gypsum / DWB addition to the grist and also to the sparge liquor.
- Consider adding between 1 – 2% acidulated malt to the grist which will not affect the flavour or overall balance of the beer.

Any of the three options above (or a combination) should enable the correct pH to be achieved without the need to add mineral acid (A/M/S) to make corrections later.

From my own experience using acidulated malt additions to assist correct pH is an easy and safe option as slight errors won't have any adverse effects, this is not the case if adding mineral acids where extreme care is needed.

If the pH mash / sparge / wort values are too low the cause may be excessive liquor treatment (if used) or too much added gypsum or D/W/B. Reducing or eliminating the mineral salt additions may solve the problem or reducing the liquor treatment.

Beer pH should not normally concern us and indeed many brewers who monitor their wort pH rarely bother to check post fermentation values. During fermentation pH falls by around a whole unit, for example a reading of 5.1 before fermentation should typically fall to around 3.8 – 4.2 once fermentation has been completed. We really only need to consider remedial action if the readings are consistently higher or lower than normal. Beers that finish below 3.7 will tend to have a sharp dry finish whilst those above 4.4 usually have a cloying mouthfeel and lose their refreshing qualities. Different yeast strains may give higher / lower individual readings within the broad range described above. This often accounts for the individual characteristics imparted and why one beer fermented with a particular yeast may taste a little drier for example than another.

Abnormally high beer pH may be indicative of under pitching yeast, stressed yeast, insufficient aeration or a lack of nutrients / amino acids. In most cases this problem can be rectified by ensuring proper pitching rates, healthy yeast and adding a small quantity of yeast nutrient, (such as Brupaks / Wyeast) this should be mixed in with the wort just before the yeast is pitched, alternatively this may be added to the copper a minute or two before flame-out, if using the latter method note that a slightly higher amount may be needed as some will be lost in trub from the hot break

Lower than normal beer pH may be caused by bacterial infection, wild yeast, an excess of yeast nutrients, and if persistent a review of sterilising procedures may be needed.

Remember that specialist beers than have Brett additions or are fermented with wild or "Farmhouse" yeasts will often have pH values that are lower than normal and characteristic of that particular style.

Other applications for pH measurement.

Those brewers who use **Star San** may find it useful to monitor their working solution (which can be repeatedly used) to ensure that it remains below pH 3.0. If the value reads higher a small addition of phosphoric acid may be added to bring the solution within range.

Storing Yeast Slurries for re-use; those brewers who perform this practice and store yeast in the fridge for future use should measure the pH immediately after harvesting and note it down. During storage further readings should be taken which should not rise by more than 1.0 units, if higher it is an indication that significant cell death has occurred and the slurry should be discarded.

A few points to note;

- pH is normally measured at 20C. Most modern meters have some sort of ATC (automatic temperature compensation) built in, however note that this may not extend beyond the range of 0 – 50C.
- No need to spend a fortune on a pH meter! The cheap ones (up to £15) are usually quite accurate enough for our purpose and should last up to two years with careful use.
- It isn't recommended to attempt to correct the mash pH whilst actually mashing, it's usually easier to check the total wort pH before boiling using the information above and consider what adjustments to make for future brews.
- pH control is by no means essential and many craft brewers produce excellent beers without it.