



## Understanding the Mash pH

### 15.4 Using Salts for Brewing Water Adjustment

Brewing water can be adjusted (to a degree) by the addition of brewing salts. Unfortunately, the addition of salts to water is not a matter of  $2 + 2 = 4$ , it tends to be 3.9 or 4.1, depending. Water chemistry can be complicated; the rules contain exceptions and thresholds where other rules and exceptions take over.

Fortunately for most practical applications, you do not have to be that rigorous. You can add needed ions to your water with easily obtainable salts. To calculate how much to add, use the nomograph or another water chart to figure out what concentration is desired and then subtract your water's ion concentration to determine the difference. Next, consult Table 16 to see how much of an ion a particular salt can be expected to add. Don't forget to multiply the difference in concentration by the total volume of water you are working with.

Let's look back at the nomograph example where we determined that we needed 145 ppm of additional Calcium ion. Let's say that 4 gallons of water are used in the mash.

Choose a salt to use to add the needed calcium. Let's use gypsum.

From Table 16, gypsum adds 61.5 ppm of Ca per gram of gypsum added to 1 gallon of water.

Divide the 145 ppm by 61.5 to determine the number of grams of gypsum needed per gallon to make the desired concentration.  $145/61.5 = 2.4$  grams

Next, multiply the number of grams per gallon by the number of gallons in the mash (4).  $2.4 \times 4 = 9.6$  grams, which can be rounded to 10 grams.

Unless you have a gram scale handy, you will want to convert that to teaspoons which is more convenient. There are 4 grams of gypsum per teaspoon, which gives us  $10/4 = 2.5$  teaspoons of gypsum to be added to the mash.

Lastly, you need to realize how much sulfate this addition has made. 2.5 grams per gallon equals 368 ppm of sulfate added to the mash, which is a lot. In this case, it would probably be a good idea to use calcium chloride for half of the addition.

The following table provides information on the use and results of each salt's addition. Brewing salts should be used sparingly to make up for gross deficiencies or overabundance of ions. The concentrations given in Table 16 below are for 1 gram dissolved in 1 gallon of distilled water. Dissolution of 1 gram of a salt in your water will result in a different value due to your water's specific mineral content and pH. However, the results should be reasonably close. Please refer to Appendix F - Recommended Reading, for better discussions of water chemistry and brewing water adjustment than I can provide here.

Table 16 - Salts for Water Adjustment

Brewing Salt and Common Name	Concentration at 1 gram/gallon	Grams per level teaspoon	Effects	Comments
Calcium Carbonate (CaCO <sub>3</sub> ) a.k.a. Chalk	105 ppm Ca <sup>+2</sup> 158 ppm CO <sub>3</sub> <sup>-2</sup>	1.8	Raises pH	Because of its limited solubility it is only effective when added directly to the mash. Use for making dark beers in areas of soft water. Use nomograph and monitor the mash pH with pH test papers to determine how much to add.
Calcium Sulfate (CaSO <sub>4</sub> *2 H <sub>2</sub> O) a.k.a. Gypsum	61.5 ppm Ca <sup>+2</sup> 147.4 ppm SO <sub>4</sub> <sup>-2</sup>	4.0	Lowers pH	Useful for adding calcium if the water is low in sulfate. Can be used to add sulfate "crispness" to the hop bitterness.
Calcium Chloride (CaCl <sub>2</sub> *2H <sub>2</sub> O)	72 ppm Ca <sup>+2</sup> 127 ppm Cl <sup>-1</sup>	3.4	Lowers pH	Useful for adding Calcium if the water is low in chlorides.
Magnesium Sulfate (MgSO <sub>4</sub> *7H <sub>2</sub> O) a.k.a. Epsom Salt	26 ppm Mg <sup>+2</sup> 103 ppm SO <sub>4</sub> <sup>-2</sup>	4.5	Lowers pH by a small amount	Can be used to add sulfate "crispness" to the hop bitterness.
Sodium Bicarbonate (NaHCO <sub>3</sub> ) a.k.a. Baking Soda	75 ppm Na <sup>+1</sup> 191 ppm HCO <sub>3</sub>	4.4	Raises pH by adding alkalinity.	If your pH is too low and/or has low residual alkalinity, then you can add alkalinity. See procedure for calcium carbonate.

My final advice on the matter is that if you want to brew a pale beer and have water that is very high in carbonates and low in calcium, then your best bet is to use bottled water\* from the store or to dilute your water with distilled water and add gypsum or calcium chloride to make up the calcium deficit. Watch your sulfate and chloride counts though. Mineral dilution with water is not as straightforward as it is with wort dilution, due to the various ion buffering effects, but it will be reasonably close. Good Luck!

Taken directly from; How To Brew by John Palmer  
<http://www.howtobrew.com/section3/chapter15-4.html>