Brewer's Friend iPhone Apps

Brewing With Total Confidence

Welcome Guest!
Login | Sign Up

- Home
  - Home Page
  - Blog
  - Forum
  - FAQs
- Tools
  - Calculators
  - Brew Day Sheets
  - Charts
  - Water Profiles
  - New Recipe
- Search
  - Beer Recipes
  - Site Wide Search
- Browse
  - Recipes
  - Fermentables
  - Hops
  - Yeast
  - Other Ingredients
  - Beer Styles
  - Members
- My Brewing
  - My Dashboard
  - My Brew Sessions
  - My Recipes
  - My Shopping List
  - My Inventory
  - My Notes
  - My Water Calcs
  - My Brewing Report
  - My Profile
- Beer Recipes

- New Beer Recipe
- Import BeerXML
- Search Recipes

Navigation Menu...

Mash Chemistry and Brewing Water Calculator
Brewing Water Treatment with Confidence (**v1.5**) *[release history]*

Whether you are a brewer looking for a tool that allows you to calculate a resulting water profile based on a source water profile and salt additions or a brewing water expert who wants to figure out the amount of slaked lime needed for optimal alkalinity precipitation, this tool has you covered. It is designed to be simple and intuitive to use yet sufficiently accurate in its implementation of the underlying chemistry.

Jump to documentation

Water Volumes: ?

Unit Preference: US (gal/pound) SI (liter/kg)

Summary: Show Overall Water Summary in Each Section

Total water volume: 60 l — The total water volume to be treated may be larger than mash and sparge water combined.

Mash water: 30 l

Sparge water: 22.5 l

Use different water sources for mash and sparge

Blend Waters

▲ Hide Source Water: ?

Water report: Full

Calcium: 0 mg/l

Magnesium: 0 mg/l

Sodium: 0 mg/l

Chloride: 0 mg/l

Sulfate: 0 mg/l

Alkalinity As: Bicarbonate Alkalinity

Alkalinity: 16.8 dH

pH: 7.4

Update Calculations ▼ show report

▲ Hide Water Target Selection: ?

Target Water: Balanced Profile

Description: This basic water profile is suitable for beers ranging from dark golden to deep amber in color. The gerally low ion content should not interfere with the taste of the beer.

Ca^{+2}	Mg^{+2}	Na^{+}	Cl^{-}	SO_4^{-2}	HCO	
80	5	25	75	80	10(	mg/l

Update Calculations

	Ca^{+2}	Mg^{+2}	Na^{+}	Cl^{-}	SO_4^{-2}	HCO
Actual	84.3	13.1	24.2	70.5	70.6	400.165 ▲
Delta	4.3	8.1	-0.8	-4.5	-9.4	300.2

▲ Hide Salt Additions: ?

Salts: Salts Added to Mash Only

Salts can be entered as g or mg/l. The latter assumes total volume when mash and sparge are same waters and it assumes mash volume when they are different waters.

Gypsum: 2 g $CaSO_4 \cdot 2H_2O$

~0.5 tsp

Epsom salt:	8 ~1.7 tsp	g	$MgSO_4 \cdot 7H_2O$
Table salt:	3 ~0.5 tsp	g	NaCl
Calcium chloride:	5 ~1.1 tsp	g	$CaCl_2 \cdot 2H_2O$
Magnesium chloride:		g	$MgCl_2 \cdot 6H_2O$
Chalk:	15 ~3.9 tsp	g	$CaCO_3$
Baking Soda:	1 ~0.2 tsp	g	$NaHCO_3$
Slaked Lime:		g	$Ca(OH)_2$
Lye:		g	NaOH

Update Calculations

▼ Show Boiling and Lime Softening: ?

▲ Hide Acid Additions: ?

Acid: ☐ Acid Added to Mash Only.

☐ Specify acid by target mash pH

Acid Type: Lactic acid

Acid Strength: 80 %

Acid Amount: 0 ml/l 0.0 ml or ~0.0 tsp

Acidulated Malt *: .35 kg

* in addition to any acidulated malt specified in the malt bill

Update Calculations

▼ Show Mash Water Report Before Dough-In: ?

▼ Show Sparge / Kettle Salt Additions: ?

▲ Hide Sparge Water Acidification: ?

Acid Type: select

Acid Strength: %

Acidify Sparge Water: Acidify Sparge Water

Update Calculations

Amount of acid needed to hit sparge water pH of 5.4:

▲ Hide Grist Info: ?

grist pH properties are based on none given Beer color malt bill

malt name	weight	type		
Weizenmalz	3.75 kg	base malt	4	Lovibond
Pilsnermalz	1.88 kg	base malt	1.8	Lovibond
Wienermalz	1.88 kg	base malt	3.4	Lovibond
Sauermalz	0 kg	acidulated malt		Lovibond
	kg	base malt		Lovibond

	kg	base malt		Lovibond
	kg	base malt		Lovibond
	kg	base malt		Lovibond
	kg	base malt		Lovibond
	kg	base malt		Lovibond

Update Calculations

Grist DI water pH: 5.68
Grist pH buffer: 34 $mEq \cdot kg^{-1} \cdot pH^{-1}$

Mash Report: ?

Mash pH *: 5.88

Mash thickness: 3.99 l/kg
pH Delta from Water: 0.21

effective water residual alkalinity: 280.10 ppm as $CaCO_3$
effective strength of weak acids: 192.45 ppm as $CaCO_3$
* mash prediction is for mash sample cooled to 25 C / 77 F

Overall Water Report: ?

Ca^{+2}	Mg^{+2}	Na^{+}	Cl^{-}	SO_4^{-2}	Alkalinity	Residual Alkalinity
mg/l	mg/l	mg/l	mg/l	mg/l	ppm as $CaCO_3$	ppm as $CaCO_3$
84.3	13.1	24.2	70.5	70.6	356.8	288.9

Range Check

SO_4^{2-}/Cl^- ratio: 1.0 Balanced
Total lactic acid as equivalent acidulated malt in grist: 4.7 %

Save / Reload:

Title:

Description:

Save: Save / Update Save As New Record

Reload: Reload
Enter an existing Record ID and click the 'Reload' button to recall it.

Click here to list all your saved records.
Also available under My Brewing -> My Water Calcs (requires login).

Documentation

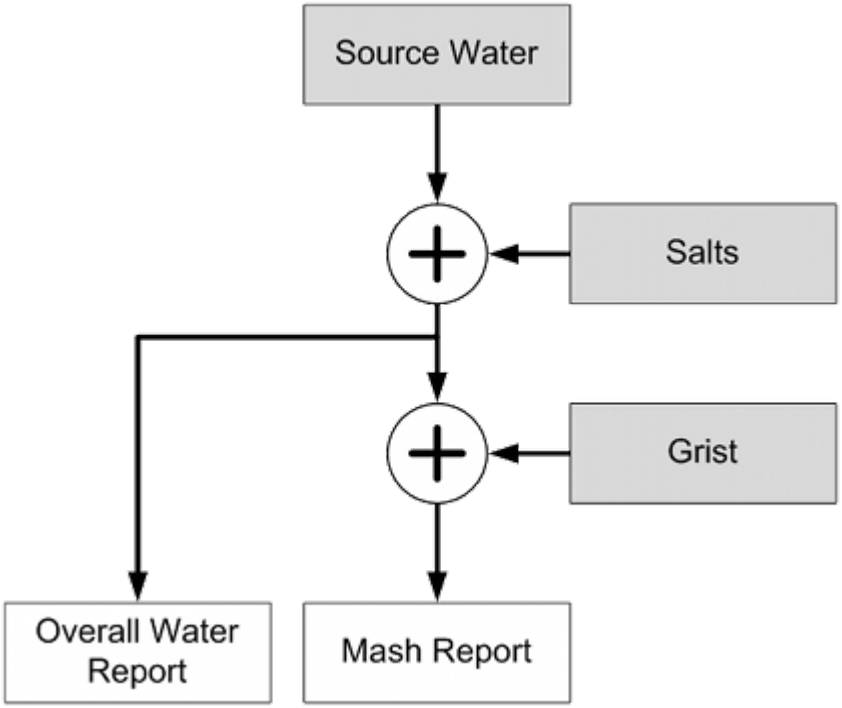
Overview

The calculator's layout is meant to be intuitive and follows the usual steps in brewing water treatment:

- determine the needed water volumes
- define the source water profile
- add salts and or hydroxides
- add acid if necessary
- define the pH properties of the grist
- get a mash pH prediction

- get a report of the resulting water profile
- compare the resulting profile to a target profile

All of these steps are done in different sections. To keep it simple only the most basic section are open on start-up. These sections allow for simple water treatment according to this flow chart



A more detailes flow chart of all the calculator's capabilities is avalable at the end: Full Water Treatment Flow Chart

What follows here is a detailed description of how to use and interprete each section. It should be noted that this is not a guide to brewing water and mash chemistry. The user should have a basic understanding of brewing water chemistry.

Water Volumes

Use this section to enter the water amount to be treated. Unless salts and acid are added to mash water only all water treatment applies to the total water volume. The total water volume might be larger than the combined mash and sparge water volume. This is useful for water treatment which requires removal of sediment (alkalinity precipitation through boiling or slaked lime, for example).

The mash water volume will be used for the mash pH prediction while the sparge water volume is used for sparge water treatment.

It is also possible to select a different water source for sparge water. This can be useful for brewers who want to mash with their tap water and sparge with reverse osmosis water. If ”Use different Water for mash and sparge“ is checked a source water dialog

for sparge water is shown. In this case any non sparge water specific treatment will only apply to the mash water

The source water can also be blended with a different water source. If “Blend Waters” is checked a field for the blending water amount is shown and a source water dialog for Water B opens up. The amount of blending water can be specified as % of water volume or absolute volume in l, qt or gal. By default the blended water volume is the total water volume. If ”Use different Water for mash and sparge“ is checked only the mash water volume is considered for blending. There is no support for blending different water sources to be used only as sparge water

Jump to Water Volumes section

Source Water

For users with a Brewer's Friend account, water profiles can be configured here. Even trial accounts benefit from this functionality.

By default only one source water dialog is shown, but up to 3 dialogs can be displayed: Mash Water A, Mash Water B and Sparge Water. A source water dialog accepts either a full water report or simple GH & KH measurements.

In a full water report all 6 major brewing ions can be entered. Calcium and Magnesim can be entered as ppm (same as mg/l) or hardness (ppm as $CaCO_3$ or dH). Sulfate can be entered as ppm or ppm as S (ppm as Sulfate). The latter is how sulfate is reported on a Ward labs report.

Bicarbonate can be specified as either alkalinity or bicarbonate.

By default a pH of 8 is assumed but if water pH is known it can and should also be entered. An accurate source water pH slightly improves mash pH prediction.

If water report is only entered as GH&KH (general hardness and alkalinity, the latter is known as Karbonathärte in German, hence the abrevation KH) an assumption about the relative amounts of calcium and magnesium is made and the sodium, chloride and sulfate ions are left as zero. Bicarbonate will be calculated from alkalinity and pH. Knowledge of calcium, magnesium and alkalinity is sufficient for predicting mash pH

Once “Update Calculations” is clicked a basic water report for the source water is given and can be expanded. For those interested an advanced water report is also available. Note that the information shown in the source water reports only pertains to the source water that was specified. The treated water before dough-in can be seen in the “Mash Water Report Before Dough-In” section. The following is shown in any basic water report:

- **3 cations** (calcium, magnesium and sodium)
- **4 anions** (chloride, sulfate, bicarbonate and carbonate)

- **ion balance** is the difference between the sum of cations and the sum on anions. If the ion balance is significantly above or below 0 it is possible that not all ions were specified correctly and the user should check the water report. If the water was entered as GH&KH it is usual for the ion balance to be off since that test does not test for 3 of the 6 major ions.

The advanced water report shows

- **general harness (GH):** a measure of the calcium and magnesium present in the water
- **temporary hardness (GH_t)** represents the calcium and magnesium that can be associated with bicarbonate and carbonate ions. Water with high temporary hardness responds well to alkalinity reduction through boiling.
- **permanent hardness (GH_p)** is the difference between general and temporary hardness
- **pH** of the water
- **Alkalinity** is the acid eqivalents it takes to lower the water's pH to 4.3. In brewing it is a measure of the water's ability to raise mash pH. The water calculator implements alkalinity based on its definition and as a result distilled water with a pH of 7 has an Alkalinity of 2.5 ppm as $CaCO_3$ since that is how much acid is takes to lower its pH to 4.3
- **RA** or Residual alkalinity is the water's alkalinity that has not been neutralized by the acidity created by the reaction between water's calcium and magnesium and the malt's phosphates. Kolbach defined residual alkalinity as Alkalinity - calcium hardness / 3.5 - magnesium hardness / 7
- **p_{CO2}** is the CO_2 partial pressure that corresponds to the CO_2 dissolved in the water at 25 C (77 F). Surface waters tend to have a CO_2 pressure close to atmospheric CO_2 pressure (0.00035 atm) while well water can have a significantly higher CO_2 pressure than that. Waters with higher CO_2 content also tend to have a high temporary hardness
- **$CaCO_3$ (undissolved)**, the undissolved calcium carbonate content, will always be 0 for source water analysis but may be non zero for the treated mash water

Jump to Source Water section

Water Target Report

The Water Target Report Allows the users to compare the overall water with a particular water profile. The preloaded selection contains a number of historic and commonly used profiles but the user can also enter an individual profile. For users with

a Brewer's Friend account, water profiles can be configured here. Even trial accounts benefit from this functionality.

Read about all the target profiles on our summary page.

Once calculations are run the differences are shown. Up/down arrows appear and the difference is shown in red when the difference is less than -10 or greater than 10 mg/l

Ion Range Report:

- Within recommended generalized brewing range.
- Low, but not necessarily an issue.
- Above recommended brewing range, but not harmful.
- Harmful, do not brew at this level!
- A low or high ion concentration is not necessarily a bad thing, such as the case of Pilsen water, where the target is practically diluted water, or the case of Burton on Trent where the sulfates are elevated.
- If the calculator reports a harmful level, this means it is definitely harmful to the flavor of the beer, and quite possibly harmful to human health!

It should be noted that historic water profiles are not necessarily the best water to brew a classic style from that city since it is not known if the brewers did any water treatment. A prime example is Munich water which is well suited for Munich Dunkel but the wrong water for Munich Helles.

Jump to Target Water section

Salt Additions

Use this section to specify salt and hydroxide (lime and lye) additions to the water. The additions will be considered for the total water volume (“Salt Added to Mash Only” and “Different waters for Mash and Sparge “ both cleared) or only for the mash water volume (either “Salt Added to Mash Only” or “Different waters for Mash and Sparge “ checked).

Each salt or hydroxide can be entered as g or mg/l and once “Update Calculations” is clicked an approximate tsp amount is shown to the right. There is no tsp amount for Magnesium Chloride since it is commonly available as fairly large flakes. If salts are entered as mg/l the gram amount of salt is also shown. This is based on the applicable volume

Chalk ($CaCO_3$) that is added to the water or is precipitated from the water and not removed by decanting will only contribute 1/2 of its alkalinity potential and calcium. This matches experimental results with chalk and its effect on mash pH. The alkalinity and calcium from undissolved chalk is used in the mash pH calculation and in the Overall Water Report.

The hydroxides slaked lime (pickling lime) and less frequently lye (sodium hydroxide) can either be used to raise mash pH or precipitate alkalinity. This behavior depends on the "Precipitate CaCO3" check box in the "Boiling and Lime Softening" section. By default this checkbox is cleared and the addition of hydroxides will raise mash pH.

Jump to Salt Additions section

Boiling and Lime Softening

This is a section for advanced water treatment.

Boil water : when checked the calculator takes the water after salt additions and removes CO_2 from the water until the CO_2 pressure matches atmospheric CO_2 partial pressure. During this process calcium carbonate ($CaCO_3$) is precipitated according to the water's calcium and carbonate content and the solubility product of these ions

Precipitate $CaCO_3$: When checked the water calculator takes the post salt addition water and precipitates calcium and carbonate as $CaCO_3$ until the solubility condition for these two ions is met. In contrast to boiling it does not let any of the water's CO_2 escape. This feature is intended to be used to precipitate calcium carbonate after slaked lime has been added to the water. It can also be used to check if a given water is super saturated with calcium carbonate

Decant water: when checked all undissolved calcium carbonate (chalk) will be removed from the water. By default this box gets checked when "Boil Water" or "Precipitate $CaCO_3$" are checked. But the user can un-check this box if that's the intend.

Recommended slaked lime addition reports the amount of slaked lime that should be needed to convert all the water's CO_2, carbonic acid and bicarbonate to carbonate. This provides guidance for choosing the slaked lime amount that needs to be added for alkalinity precipitation with slaked lime. Note that this is based on the water's ion composition after salts and hydroxides have been added. When slaked lime has already been added to the water the amount displayed will be less. Due to the chemistry involved the amount shown plus the amount of slaked lime already added is not necessarily the same amount shown when no slaked lime has been added

Boil message alerts the user that alkalinity precipitation through boiling was limited by the amount of available calcium. In the interest of a more complete calcium carbonate precipitation and a sufficient amount of residual calcium in the brewing water calcium salts like Calcium Chloride or Gypsum should be added.

Jump to Boiling and Lime Softening section

Acid additions

This section allows the addition of an acid of choice to either all water (“Acids added to mash only” cleared) or only the mash water (“ Acids added to mash only” set). Sparge water acidification is done in a different section. Due to the fact that acids are added to the water after salts are added they will also be added to only the mash water if “Salt Added to Mash Only” was set.

The user selects an acid type, which populates a default for the acid strength, and then enters the amount to be added. Among the selection of acids is also CRS (Carbonate Reducing Solution) which is a mix of hydrochloric and sulfuric acids. This mix, also sold as AMS[3], is popular among UK home brewers. A strength of 100% refers to the strength of this acid in the bottle.

When “Specify acid by target mash pH” is checked the user is able to specify a target mash pH and the necessary amount of the selected acid is calculated, displayed and applied to the mash. Note that this only works for mash acid additions (not for additions to all water). It will also not work if the current mash pH is lower than the target mash pH or no grist is specified.

This section also allows the specification of acidulated malt. Since acidulated malt is not added directly to the water before dough-in it only affects the calculated mash pH and not the water parameters shown in the “Mash Water Before Dough-In” section. All acid malt amounts specified here are in addition to any acid malt that may be specified in the malt bill option in the grist section. Acid malt is assumed to be Weyermann® Sauermalz which contains about 3% lactic acid by weight.

Jump to Acid Additions section

Mash Water Report Before Dough-In

This is a simple report of the mash water composition. It considers all additions that have been made to the mash water alone or all brewing water. This is not the water report a user should compare against a target water profile or evaluate for intended brewing water composition. For this the “Overall Water Report” should be used.

See the Source Water section for a description of the water parameters that are reported.

Jump to Mash Water Report section

Sparge/Kettle Salt Additions

This is a section where the user can specify any salt additions that should be considered for the Overall Water Report but which don’t affect the mash water. As a result these are salt additions for the sparge water or salts added directly to the kettle. Since chalk, baking soda, slaked lime and lye can raise the sparge pH they are not

recommended additions for sparge water or kettle.

Jump to Sparge/Kettle Salt Addition section

Sparge Water Acidifiction

In order to eliminate or reduce the sparge water's ability to raise wort pH during sparging some brewers lower their sparge water's pH to ~5.4. The amount needed can be calculated in this section by selecting an acid.

If the user actually wants to acidify the sparge water with the given amount of acid, the "Acidify Sparge Water" box should be checked.

Jump to Sparge Water Acidification section

Grist info

In order to make a mash pH prediction the calculator needs input for grist properties. If they are not given or the grist weight is set to 0 any mash related report will be "n/a".

The user is able to enter grist properties either as beer color or malt bill. For beer color based predictions the following input is needed:

- **Grist weight:** the total weight of the grist
- **Beer color:** The beer color in SRM
- **% roasted color:** approximate ratio between color derived from roasted malts and total beer color. An estimation as 0%, 25%, 75% or 100% is sufficient

The color based grist pH prediction is based on Kai Troester's work outlined here: Beer Color to Mash pH V2.0

For malt bill based predictions the following is needed for each malt

- **weight** of the malt
- **malt type,** which can be "base malt", "crystal malt", "roasted malt", "acidulated malt", "DI water pH" or "acidity". The difference between crystal and roasted malts is that crystal malts malts have a hard kernel while roasted malts are generally much darker and have a brittle kernel."DI water pH" can be used for base malts if the distilled water mash pH is known. "acidity" can be used for specialty malts if their titratable acidity to a pH of 5.7 is known. These are the two parameters that are estimated if only the malt's color and type are known
- **Color** rating of the malt in Lovibond. The malt's color, along with its type, will be

used to predict its pH parameters based on work published by Kai Troester [1]

Once the calculations were run the grist section also reports two mash pH related grist parameters:

- **Grist DI water pH** is the predicted mash pH when the grist is mashed with distilled water
- **Grist pH Buffer** is the amount of acid equivalents needed to move 1 kg of the grist by 1 pH unit

Jump to Grist Info section

Mash Report

This section shows the predicted mash pH and a few other results that might be of interest.

- **Mash pH:** the predicted mash pH. Even though 2 decimal points are reported a brewer should expect an accuracy of about +/- 0.1 pH units. A commonly accepted mash pH target is the range between 5.3 and 5.6.
- **Mash thickness** can be used to spot incorrect malt weight amounts or water volumes by seeing an unecpectedly high or low mash thickness
- **pH delta caused by water and its treatment** shows how much the mash pH changes from the grist's DI water mash pH
- **effective water residual alkalinity:** depending on the current mash pH the pH changing effect of the water's bicarbonate and carbonate content can vary slightly. This is a result of the more realistic implementation of the water's carbonic acid system. This is only displayed for educational purposes.
- **Effective strength of weak acids:** weak acids that were used for water and mash treatment (like phosphoric or lactic acid) exhibit a change in their effectiveness depending on the final mash pH. This is only displayed for educational purposes.

Jump to Mash Report section

Overall Water Report

This is the final and most important water report. It considers all water treatments done to both mash and sparge water. It effectively mixes the mash and sparge water and displays the result. This water report should be used to judge the effective ion concentration of the major water ions. It also checks if these ions are at acceptable or

even harmful levels.

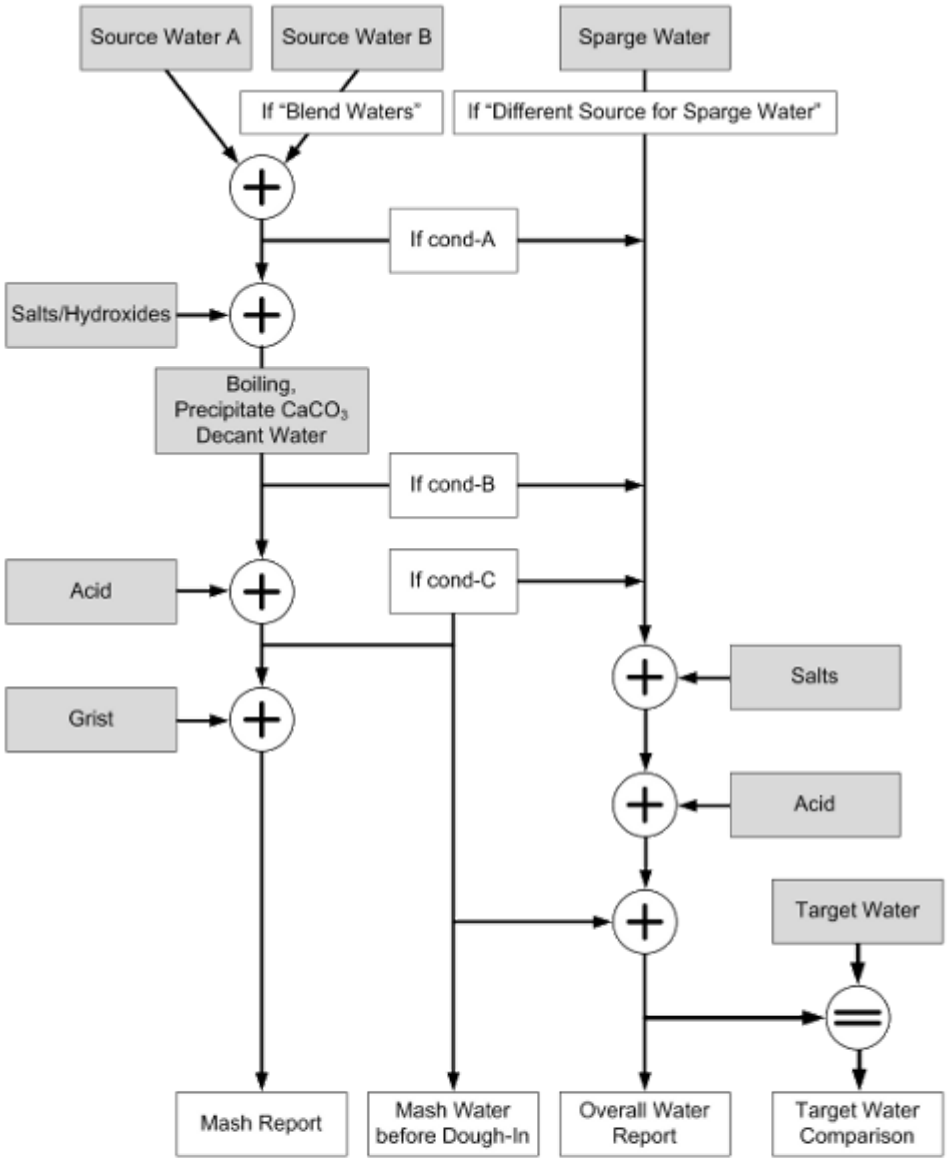
In addition to reporting the ions it also reports the SO_4^{2-}/Cl^- ratio, an indication of the beer's perceived bitterness as published by John Palmer [2]. Only at a combined Cl^- + SO_4^{2-} level greater than 100 ppm should this ratio be seen as meaningful.

Total lactic acid as equivalent acidulated malt tallies up all lactic acid that has been used in mash and sparge and reports is as an equivalent of acidulated malt in the grist. It is recommend that brewers keep this level under 5% to avoid a flavor impact from the excessive lactate present in the final beer.

Jump to Overall Water section

Full Water Treatment Flow Chart

The following flow chart illustrates the full set of the calculator’s water treatment capabilities. The different conditions refer to check box settings as shown at the bottom of the diagram.



Cond-A: not "Different Source for Sparge Water"
and "Salts Added to Mash Only"

Cond-B: not "Different Source for Sparge Water"
and not "Salts Added to Mash Only"
and "Acid Added to Mash Only"

Cond-C: not "Different Source for Sparge Water"
and not "Salts Added to Mash Only"
and not "Acid Added to Mash Only"

[1] Kai Troester, Effect of Water and Grist on Mash pH, 2009

[2] John Palmer, Residual Alkalinity Spreadsheet avaiable in Chapter 15 of How To Brew, 2011

[3] Murphy's & Son, Homebrew Product Information - AMS

Brewing Water Treatment with Confidence (**v1.5**) *[release history]*

Legal Disclaimer: The Brewer's Friend Water Chemistry Calculator is for entertainment purposes and should not be used for professional brewing. Brew salts, acids, and bases should be handled with care, proper safety equipment, and a full understanding of their properties. No warranty or guarantee of accuracy is provided on the information provided by this calculator.

Categories

- Announcements (32)
- Beer Styles (12)
- Book Reviews (16)
- Brewing (47)
- Economics of Brewing (8)
- Equipment (50)
- Fun (26)
- Hops Growing (22)
- Ingredients (9)
- Kegging and CO2 (12)
- Lagering (5)
- Recipes (23)
- Uncategorized (5)
- Wine (4)
- Yeast Cultures (17)
- **Random Post**
- Archives

Calculators

- **Complete Recipe Builder**
- ABV Calculator - Alcohol
- SRM Calculator - Color
- IBU Calculator - Bitterness
- All Grain OG/FG
- Brewhouse Efficiency
- Water Chemistry - Basic
- Water Chemistry - Advanced
- Mash Calculator
- Quick Infusion Calculator
- Extract OG/FG
- Dilution & Boil Off Calculator
- Hydrometer Temperature

- Refractometer Calculator
- Brix Conversion Calculator
- Chaptalization Calculator
- Bottling Calculator
- Priming Sugar Calculator
- Keg PSI Calculator
- Gyle & Krausen Calculator
- Wine Calculators
- Yeast Pitch and Starter

Templates and Helper Sheets

- All Grain Recipe Template
- All Grain Brew Day Checklist
- Partial Mash Recipe Template
- Partial Mash Brew Day Checklist
- Extract Recipe Template
- Extract Brew Day Checklist

Recent Posts

- Congrats to all the Winners!
- This Weeks Newest Features on Brewer's Friend
- Brewer's Friend Supporting Membership and More Giveaway!
- Add Photos to your Brewer'sFriend Recipes!
- BrewPrint.com and BrewersFriend.com have Merged!
- Yeast Pitch Calculator for iOS 7 launched
- Q&A session with brewing author Stan Hieronymus
- Controlling Fermentation Temperature with a Fermentation Chamber
- September 2013 Release Live – Inventory and shopping list updates
- Book Review – For the Love of Hops

Handy Data Sheets

- Yeast Stats
- Hops Alpha Acids
- Other Ingredients
- Beer Styles - ABV Chart
- Beer Styles - IBU Chart
- Beer Styles - OG/FG Chart
- Beer Styles - SRM Chart

Brewer's Friend

- Pages
  - Home
  - Blog
  - Forum
  - FAQ
- Tools
  - Recipe Builder
  - Brew Day Sheets
  - Brewing Calculators
  - My Dashboard
- Search
  - Site Search
  - Beer Recipes
- More
  - Contact
  - About
  - Pricing / Features
  - Partner Program
  - Advertise