

Water Treatment

# Crafting the ideal water profile for your beer

Water makes up more than 90% of beer — but what exactly defines great brewing water? In this guide, you get our perspective on the ideal water profiles for various beer styles.

**GRUNDFOS** 

Possibility in every drop



# You know your beer, we know water

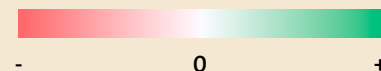
As water treatment specialists, we know that the right water profile is the foundation for brewing better beer.

Whether it is a crisp lager, a hop-forward IPA, or a non-alcoholic pilsner, consistency in water composition makes all the difference.

Brewing is not an exact science — our values are indicative and meant as a starting point for great beer. Cheers!

# Light and pale beers

Relative value indicator



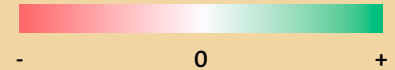
Beer Style	Ca <sup>2+</sup> (ppm)	Mg <sup>2+</sup> (ppm)	Na <sup>+</sup> (ppm)	Cl <sup>-</sup> (ppm)	SO <sub>4</sub> <sup>2-</sup> (ppm)	HCO <sub>3</sub> <sup>-</sup> (ppm)	SO <sub>4</sub> <sup>2-</sup> : Cl <sup>-</sup> Ratio	CaCO <sub>3</sub> RA ppm
Pilsner / Helles	40	8	10	50	50	30	1.0	-9
American Pale Ale	80	10	30	60	180	50	3.0	-22
West Coast IPA	120	10	30	60	250	50	4.2	-51
NEIPA (Hazy IPA)	120	10	30	195	75	50	0.4	-51
Wheat Beer	50	8	20	75	75	30	1.0	-16

Ca<sup>2+</sup> = Calcium | Mg<sup>2+</sup> = Magnesium | Na<sup>+</sup> = Sodium | Cl<sup>-</sup> = Chloride | SO<sub>4</sub><sup>2-</sup> = Sodium hydroxide  
HCO<sub>3</sub><sup>-</sup> = Hydrogen carbonate | CaCO<sub>3</sub> = Calcium carbonate | RA = Residual alkalinity

Beer Style	Notes / Adjustments
Pilsner / Helles	Neutral and balanced profile. Add $\text{Cl}^-$ for malt roundness; $\text{SO}_4^{2-}$ for sharper hop snap. Be careful with $\text{HCO}_3^-$ and pay attention to mash pH. The original Plzeň city water has lower concentrations, which some prefer, but from experience this profile works well in most cases.
American Pale Ale	Hop-forward. Increase $\text{SO}_4^{2-}$ for dryness and a hop character that pops; $\text{Cl}^-$ higher for more balance. Too low water mineralisation (e.g. pure RO water) will reduce the beer flavour. In a standard English pale ale, adjust chloride and sulphate to 100 ppm each to achieve a 1:1 $\text{SO}_4^{2-}:\text{Cl}^-$ ratio, better suited for the emphasis on malt and the use of more earthy/floral hops.
West Coast IPA	Very bitter and dry. Reduce $\text{SO}_4^{2-}$ or add $\text{Cl}^-$ if the bitterness is too harsh. Some like to push for $\text{SO}_4^{2-}:\text{Cl}^-$ ratios above 5, but that can be too extreme in terms of bitterness and will depend on taste and hop varieties. In traditional IPAs, a $\text{SO}_4^{2-}:\text{Cl}^-$ ratio of 2 with lower sulphate and slightly higher chloride accommodates a different hop profile and the use of darker malts. RA is very low; for amber and more traditional IPAs, positive RA values are used, so increase bicarbonate.
NEIPA (Hazy IPA)	Juicy and pillowy mouthfeel. If too sweet, raise $\text{SO}_4^{2-}$ slightly. For softness, boost $\text{Cl}^-$ . Most recommendations suggest twice as much chloride as sulphate; we use a little more, but that depends on preference. Aim for very low RA to balance the bitterness.
Wheat Beer	This is for a classical Hefeweizen. We aim for low mineral content to remove it from the taste profile, while keeping levels high enough to benefit from Ca and Mg. A $\text{SO}_4^{2-}:\text{Cl}^-$ ratio of 1.0 gives a balance that highlights esters from the yeast. Use low-alkalinity water, as the malt grist is pale. For a fruitier Belgian Wit, increase $\text{Cl}^-$ , while crisper, hoppier American wheat styles can use a $\text{SO}_4^{2-}:\text{Cl}^-$ ratio of 2.0.

# Dark and malty beers


Relative value indicator



Beer Style	Ca <sup>2+</sup> (ppm)	Mg <sup>2+</sup> (ppm)	Na <sup>+</sup> (ppm)	Cl <sup>-</sup> (ppm)	SO <sub>4</sub> <sup>2-</sup> (ppm)	HCO <sub>3</sub> <sup>-</sup> (ppm)	SO <sub>4</sub> <sup>2-</sup> : Cl <sup>-</sup> Ratio	CaCO <sub>3</sub> RA ppm
Brown Ale	80	10	30	100	90	90	0.9	11
Porter	90	10	50	100	60	180	0.6	77
Stout (Dry)	60	8	20	60	120	25	2.0	-27
Stout (Sweet / Milk)	90	10	60	140	60	180	0.4	77
Amber Ale / Märzen	90	10	30	100	100	100	1.0	12

Ca<sup>2+</sup> = Calcium | Mg<sup>2+</sup> = Magnesium | Na<sup>+</sup> = Sodium | Cl<sup>-</sup> = Chloride | SO<sub>4</sub><sup>2-</sup> = Sodium hydroxide  
HCO<sub>3</sub><sup>-</sup> = Hydrogen carbonate | CaCO<sub>3</sub> = Calcium carbonate | RA = Residual alkalinity

Beer Style	Notes / Adjustments
<b>Brown Ale</b>	A balanced profile. For extra roast smoothness, caramel and toffee, boost $\text{Cl}^-$ . Add $\text{SO}_4^{2-}$ if a crisper finish is desired. Aim for positive residual alkalinity to counter the acidity of darker malts and enhance the beer's maltiness. Depending on the amount of dark/roasted malt in the grain bill, increase bicarbonate accordingly.
<b>Porter</b>	Intended for a roast-forward but smooth taste. We use high $\text{HCO}_3^-$ to account for malt acidity and to shift the roasted flavour from ashy to chocolate/coffee. $\text{Cl}^-$ is higher than $\text{SO}_4^{2-}$ to promote roundness and soft bitterness. Some famous stout/porter breweries aim for higher calcium and a slightly positive RA. $\text{Cl}^-$ can be increased for roundness.
<b>Stout (Dry)</b>	Dry Irish stout, "Guinness-like". Low alkalinity helps achieve a beer with a dry, crisp and slightly acidic taste. We use a $\text{SO}_4^{2-}:\text{Cl}^-$ ratio of 2 to accentuate bitterness and dryness, counterbalancing the tendency of chloride to give roundness/body. Many use a 1:1 ratio successfully.
<b>Stout (Sweet / Milk)</b>	Creamy and sweet. Chloride amplifies the sweetness and creaminess of lactose; adding more can be risky. Sulphate gives the beer some structure to complement the effect of chloride/lactose, but we don't want too much, as it will sharpen bitterness. Alkalinity is needed to compensate for the acidity of the grain bill.
<b>Amber Ale / Märzen</b>	No fixed rules here. Push $\text{Cl}^-$ for malt sweetness; $\text{SO}_4^{2-}$ for a crisp finish. We favour a balanced profile slightly high in minerals (roughly double that of Bru'n Water Amber Full). Residual alkalinity should follow colour, and if a lighter amber is preferred, the bicarbonate value should be reduced.

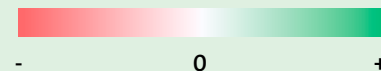


**0.5%**  
**ABV**

# **Water for brewing low or non-alcoholic beer**

# Low and no alcohol beers

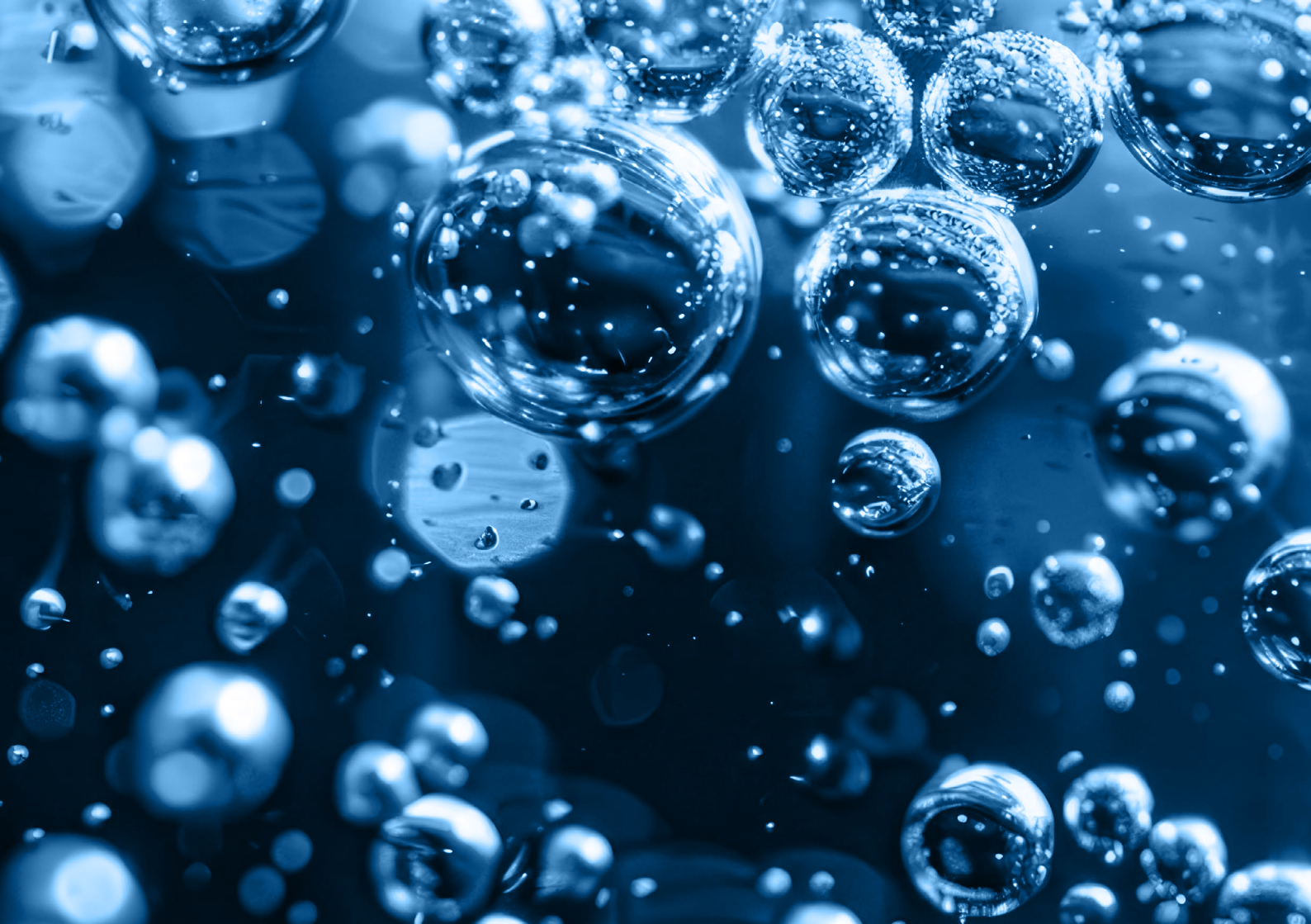
Relative value indicator



Beer Style	Ca <sup>2+</sup> (ppm)	Mg <sup>2+</sup> (ppm)	Na <sup>+</sup> (ppm)	Cl <sup>-</sup> (ppm)	SO <sub>4</sub> <sup>2-</sup> (ppm)	HCO <sub>3</sub> <sup>-</sup> (ppm)	SO <sub>4</sub> <sup>2-</sup> : Cl <sup>-</sup> Ratio	CaCO <sub>3</sub> RA ppm
Pale Lager / Pale Ale	75	10	25	100	80	<50	0.8	-18
Wheat Beer	60	8	30	120	60	30	0.5	-23
IPA	120	10	30	100	200	50	2.0	-51
NEIPA	125	10	30	200	75	50	0.4	-54

Ca<sup>2+</sup> = Calcium | Mg<sup>2+</sup> = Magnesium | Na<sup>+</sup> = Sodium | Cl<sup>-</sup> = Chloride | SO<sub>4</sub><sup>2-</sup> = Sodium hydroxide  
HCO<sub>3</sub><sup>-</sup> = Hydrogen carbonate | CaCO<sub>3</sub> = Calcium carbonate | RA = Residual alkalinity

Beer Style	Notes / Adjustments
<b>Pale Lager / Pale Ale</b>	We use $\text{Cl}^-$ to compensate for the loss of body from ethanol. If partial fermentation is used, chloride will help smooth out the wort sweetness. Some like to increase sulphate, especially for pale ales, to bring more focus to bitterness.
<b>Wheat Beer</b>	To promote yeast-derived esters, arrested fermentation is often used for low-alcohol wheat beers. We keep the profile high in chloride to balance the residual sweetness, sulphate low to restrain bitterness and alkalinity low to avoid buffering acidity.
<b>IPA</b>	Compared to alcoholic IPA, the sulphate amount is reduced to prevent the bitterness from feeling harsh, and we opt for a more balanced $\text{SO}_4^{2-}:\text{Cl}^-$ ratio of 2 to keep the beer hop-forward without feeling too thin.
<b>NEIPA</b>	NEIPAs are less dependent on alcohol for flavour, and therefore we use the same water profile for this non-alcoholic version, with just a slightly elevated chloride level to compensate somewhat for the missing alcohol. Some brewers prefer a slightly lower mineral content.



# **Common water treatment units for breweries**



# Activated carbon filtration

## What it is

Hot-water sanitisable stainless steel vessel containing activated carbon.

## When to use

- When operating on municipal water containing free chlorine.
- Free chlorine must be removed to avoid off-flavours and unwanted oxidation.

## Key considerations

- Activated carbon is an excellent place for microorganisms to proliferate. Making the filter hot-water sanitisable ensures that safe drinking-water quality can always be maintained.

# Dealkalisation

## What it is

Ion exchange technology selectively reduces residual alkalinity from water by replacing bicarbonate and carbonate ions with chloride ions.

## When to use

- If you have high-alkalinity source water, dealkalisation can help achieve the targeted mash/sparge pH while keeping the water treatment setup simple.

## Key considerations

- Requires the use of strong acid for regeneration.



# Softening



## What it is

Chemical-free ion exchange technology to selectively remove hardness (Ca and Mg) from water.

## When to use

- If you have high hardness leading to scaling in your brew system, or if you need to adjust Ca relative to  $\text{Cl}^-$  and/or  $\text{SO}_4^{2-}$ .
- Softened water can be used for both cooling tower and boiler make-up, as well as for CIP and bottle rinse.
- As pretreatment before reverse osmosis to prolong the lifespan of the membranes.

## Key considerations

- Never use thoughtlessly to produce brew water. Ca and Mg are essential for brew water and must be present.
- Will generate wastewater with a high concentration of sodium and chloride.

# Reverse osmosis

## What it is

Membrane-based technology that retains more than 99.8 % of the salts in the water, as well as removing pyrogenic substances and microorganisms, resulting in water with a very low mineral content.

## When to use

- If you are brewing multiple beer styles and want the flexibility to build a whole range of water profiles.
- If you are brewing in different locations, you can ensure a consistent product across all sites.
- If you want one central water treatment system that can deliver water to the entire brewery.
- If you want to recycle water or use rainwater in your brewery.

## Key considerations

- Will typically waste 10-25 % of the incoming water if no extra measures are taken.
- By using high-recovery RO-PLUS technology, you can achieve up to 90 % water recovery — significantly reducing the waste stream.





THE  
MARLOW  
BREWERY

REBELLION  
BEER  
CO.

**“ Water quality is absolutely critical to the flavour and consistency of Rebellion’s beers. The Grundfos RO and softening systems give us complete confidence in our water profile day in, day out and have proven very reliable from both a performance and support perspective.**

Michael Finn  
Engineering Manager at Rebellion Brewery UK

