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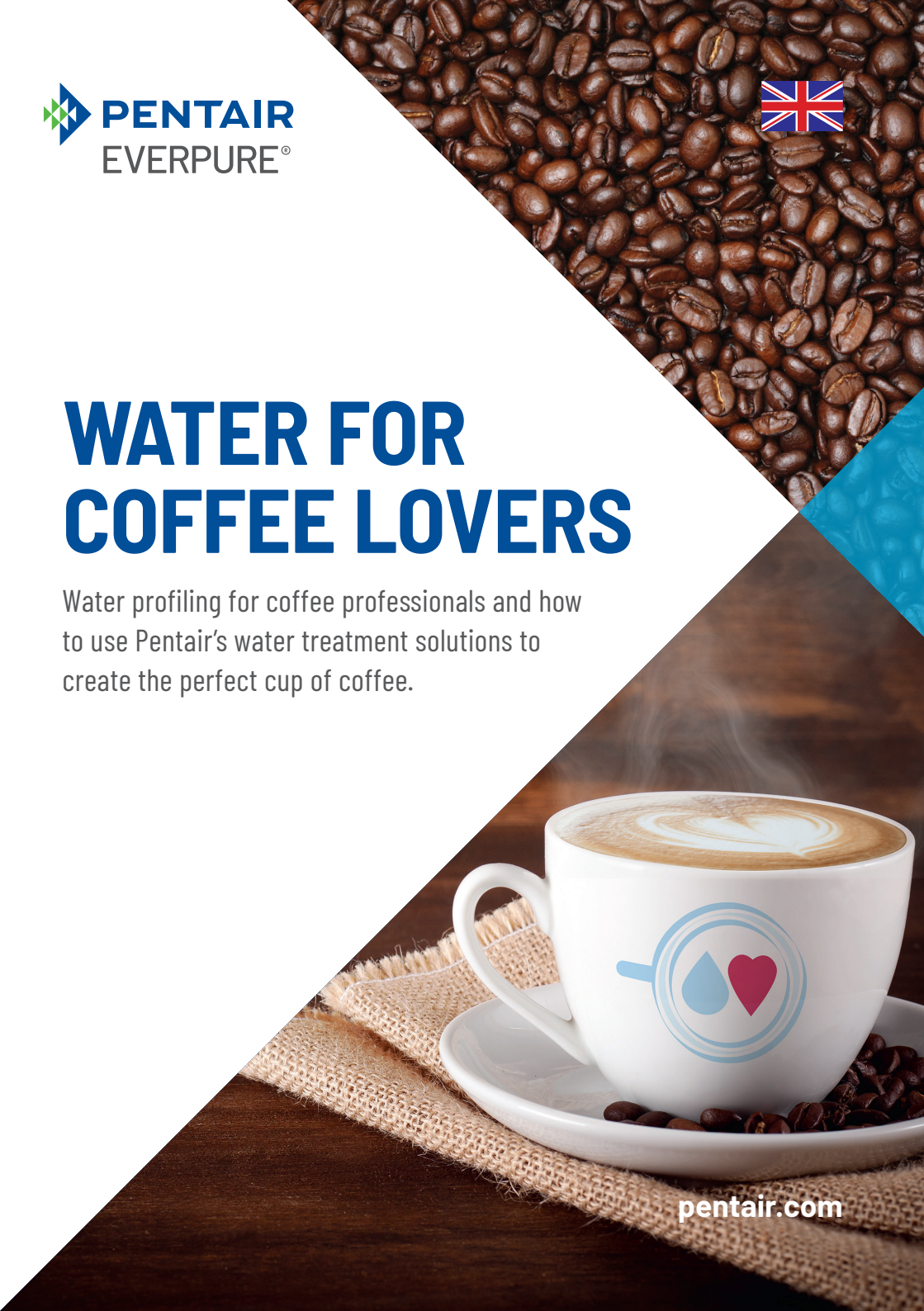
WATER FOR COFFEE LOVERS

Water profiling for coffee professionals and how to use Pentair's water treatment solutions to create the perfect cup of coffee.



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MAKING WATER WORK FOR YOU

We know that water is one of the most important ingredients in a cup of coffee. In this booklet we will cover water treatment for the perfect espresso, water profiling for coffee professionals and how to create the perfect cup of coffee.

Our aim is to give you a clear understanding of water; the issues you need to address, and the options you can consider to ensure the best coffee experience for your customer.

Brewed coffee is over 98% water, the remainder being compounds that are extracted from the coffee grounds. The quality of water used for brewing coffee can have a dramatic effect on the taste of the finished product and the performance of your coffee equipment.

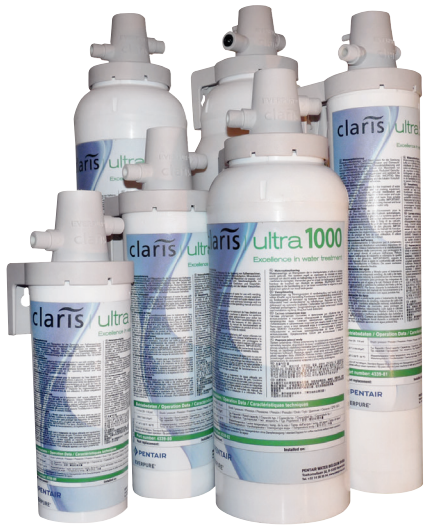
We want to identify and highlight the important objective and subjective issues that revolve around taste and equipment protection, enabling you to make informed decisions about your water treatment options.

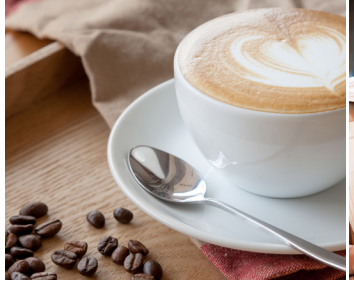
We'll start with an objective summary of water and how it affects brewing equipment.

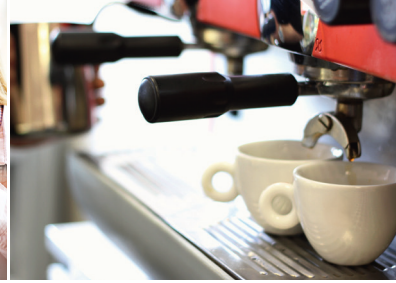
FACT: Hard water will form scale inside coffee equipment, reducing equipment efficiency, causing costly failures and in a commercial enterprise ultimately loss of revenue.

But it's not just Hard water that can cause equipment damage. Water is considered to be the "universal solvent". The purer the water, the more capable it is of damaging equipment by promoting corrosion. This is also true for water with a natural or artificially low pH. Additionally, many water sources contain mineral salts that can be corrosive as well as scale forming.

WATER FOR COFFEE LOVERS







WATER.

WHAT IS IT AND HOW DOES IT RELATE TO COFFEE AND COFFEE EQUIPMENT?

It is well documented that pure water is a chemical substance with formula H^2O: one molecule of water has two hydrogen atoms covalently bonded to a single oxygen atom, and in its purest state has a pH of 7 or neutral. Water is very rarely found in its pure state; so what's in your tap water will impact the coffee you brew and your coffee equipment. Some of the relevant information has already been widely debated within the barista community, other issues have not previously received as much attention. We will cover the key topics and their influence on coffee. We can also draw on existing knowledge from the wider beverage and brewing industry where water chemistry has long been understood.

TOTAL DISSOLVED SOLIDS

- Total Dissolved Solids (often abbreviated TDS) is basically anything in the water that isn't Hydrogen (H) or Oxygen (O). These can be dissolved or suspended (colloidal) particles. In general TDS are not considered to be associated with health issues, high TDS water would normally indicate a high water hardness.
- Minerals dissolved in water can be split into two categories, positively charged ions (Cations) and negatively charged ions (Anions).
- The SCAA recommends that TDS levels are between 75 ppm and 250 ppm so as not to adversely affect coffee extraction and taste.

TDS. THE CATIONS

CALCIUM & MAGNESIUM

Often called the hardness minerals. Calcium and less so Magnesium are generally the most abundant of the cation minerals in water. Calcium can form insoluble salts which create the "scale" issues affecting equipment performance.

Whilst it is accepted that a good cup of coffee needs some of these hardness minerals, there is evidence to suggest that calcium is preferable to magnesium, further backed up by references from the beer industry that magnesium salts can add an unwanted astringent bitterness.

SODIUM & POTASSIUM

Sodium is usually more abundant in water than potassium. At low levels they can add a welcoming sweetness to the beverage, whilst at high levels sodium salts can taste... salty.

Sodium salts are usually highly soluble so unlike calcium won't cause scale issues, but it is believed that Sodium Chloride can swell coffee grounds effecting extraction times and rates.

Due to its links with potential health issues, the amount of Sodium allowed in drinking water is limited to 200 mg/litre.

The SCAA recommendations are for sodium content ideally to be around 10 mg/litre.

IRON & COPPER

Even in relatively small amounts metals such as Iron and Copper add a metallic taste to a beverage.

Both can be present in the water supply but increased copper levels can occur due to corrosion in building pipework and / or brewing equipment.

TDS. THE ANIONS

CARBONATES, BICARBONATES AND HYDROXIDES

Also known as the alkalinity ions. Carbonates form salts with insoluble hardness metals, causing scaling of equipment.

As alkalines they also have a great effect on the pH of the water.

The SCAA recommends a desired alkalinity level around 40 mg/litre as CalciumCarbonate (CaCO3).

CHLORIDES

Sodium chlorides can give a salty taste to coffee. Chlorides are also the nemesis of Stainless Steel, and at high levels can break down the protective coating causing pitting corrosion.

The effects of corrosion on stainless steel are subject to many variables, so it is always best to check with your equipment manufacturer for their recommended Chloride limits. Some manufacturers suggest a threshold of 30 mg/litres others quote limits as high as 100 mg/litres.

SULPHATES

Calcium Sulphate in water will cause a hard white scale. Fortunately Calcium Sulphate is slightly more soluble than Calcium Carbonate and Sulphate levels are usually far lower than those of Carbonates, so Sulphate scale is not generally a problem.

pH

pH is the measure of acidity or alkalinity. If there are more H's than OH's than Carbonates the water will be acidic and vice versa the water will be alkaline.

That's not the end of the story. Water likes to dissolve gases such as Carbon Dioxide (CO2) which would create mild Carbonic Acid. High levels of dissolved Carbon Dioxide will make the water more acidic.

pH 7 is neutral, SCAA recommendations are that levels of between pH 6.5 and pH 7.5 are best for coffee.

HARDNESS

The definition of Total Hardness is the sum of the Calcium and Magnesium ions in the water. In reality most water hardness is predominately Calcium hardness.

Certain salts of these metals are insoluble and the main cause of limescale. Hardness also affects the rate of extraction of brewed coffee. To achieve a balanced brew the SCAA recommend a hardness of between 17 mg/litre and 85 mg/litre when measured as CaCO3.

Brewed coffee is over 98% water, the remainder being compounds that are extracted from the coffee grounds.

TOTAL HARDNESS IS MADE UP OF TWO COMPONENTS:

Permanent Hardness is the amount of hardness minerals that can't be removed through the boiling of water.

Temporary Hardness also known as Carbonate Hardness, is the measure of hardness minerals that can be removed by boiling. This will be predominately Calcium Carbonate.

DISINFECTANTS

With the noticeable exception of Denmark, the municipal water sources in most countries are treated with disinfectant to prevent contamination from bacteria and viruses which otherwise could be harmful to health.

Chlorine is the most commonly used disinfectant but in the USA, UK, Sweden and Finland there is a growing practice to use Chloramine, a compound of chlorine and ammonia.

Chlorine and chloramine not only impair the coffee taste by oxidizing essential oils, but can also be corrosive to metal parts and damaging to "O" rings and seals.

For good coffee chlorine and chloramine should be removed from the water along with any other off tastes and odours.

DIRT PARTICLES

Even though you might not be able to see them, water contains lots of small dirt particles. These particles can act like sandpaper and be damaging to equipment valves and seals. The particles can also accumulate to block the small valve openings in modern brewing equipment.

WATER TREATMENT TECHNOLOGIES

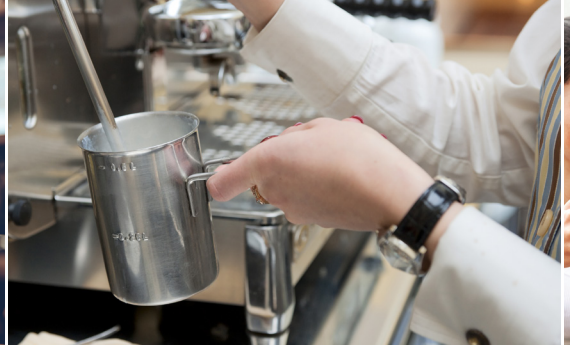
Now you understand what's in your water, we have to look at the common technologies used to treat it.

These technologies may be used individually or combined within a single system or unit.

SEDIMENT FILTER

In its most basic form a sediment filter is a screen to filter out dirt particles. At the other end of the spectrum it can be a membrane filter capable of removing viruses and bacteria from the water. Choosing a filter with a micron rating ≤ 5.0 microns should ensure that your water is free from damaging dirt particles.

NOTE: Some filters employ a blending bypass. Don't treat the bypass water for sediment removal.

CARBON ADSORPTION

Carbon filters are extremely efficient at removing chlorine, off tastes and odours from the water supply. Carbon can be incorporated into a filter in a granular form or in a more solid form such as a carbon block also incorporating sediment reduction capabilities.

NOTE: Some filters employ a blending bypass. Don't treat the bypass water for chlorine reduction.

Whilst carbon is efficient at removing chlorine many carbon filters are not efficient at removing chloramines. Should you be in an area where chloramine is a problem it may require investing in a filter containing specialized carbon filtration that will remove chloramines.

SOFTENING TECHNOLOGIES

Strongly Acidic Cation Resins

SALT SOFTENERS

The vessels of these water treatment units contain small plastic beads (resin) charged with sodium ions. In all water conditions the resin will exchange their sodium ions for calcium and magnesium ions in the water, effectively removing hardness from the water. As sodium ions are heavier than calcium or magnesium the TDS will increase slightly, whilst pH and Alkalinity will effectively remain constant.

Advantages to the barista are that their equipment will no longer be at risk of scaling. The disadvantages are increased sodium and TDS levels which may impact coffee quality.

These softening systems can often be regenerated at end of life either manually or automatically.

URBAN MYTH: The use of Sodium softening is illegal for drinking water. Not technically true although in most countries it is recommended that Sodium softening is not used for drinking water. The elevated Sodium levels may mean that the water is no longer "potable" according to local water regulations.

Weak Acidic Cation Resins

DE CARBONISATION

The vessels of these water treatment units contain small plastic beads (resin) charged with hydrogen ions. The resin will exchange their hydrogen ions for calcium and magnesium ions associated with the carbonates. Calcium levels are now reduced so the water hardness and TDS will also reduce. With the carbonates effectively removed and the water now laden with hydrogen the pH will drop dramatically, typically as low as pH 4.5.

To help counteract this low pH most systems of this kind incorporate a blending bypass to limit the softening effect of the resin. When properly set the pH on a new system is likely to be in the region of pH 5.5 - 6.0.

Bypasses can be either fixed or operator adjustable. They can be a simple hole allowing the water to pass through and can be sensitive to variations in water pressure or flow rates. Alternatively they can be highly engineered designs which provide a consistent performance for all water conditions.

NOTE: Where a filter incorporates a bypass, check the level of filtration offered to the bypassed water.

SCALE CONTROL

Scale Inhibitors

PHOSPHATES

Scale inhibitors are often phosphate salts dosed into the water. There are many forms of phosphate each having their own particular characteristics.

URBAN MYTH: There is speculation regarding the safety of consuming phosphates.

PHOSPHATE IN BLACK COFFEE: 50 mg/litre
PHOSPHATE IN A CAPPUCCINO: 250 mg/litre
PHOSPHATE IN A TYPICAL COLA BEVERAGE: 700 mg/litre

When Phosphates are used in water treatment, they interfere with the formation of some chemical compounds such as Calcium Carbonate that are insoluble in water. They do not soften the water, merely inhibit or slow down the formation of these scale forming compounds. Phosphates can also be utilized in helping to prevent equipment corrosion.

MINERAL REDUCTION

REVERSE OSMOSIS

A reverse osmosis system is based around a semi permeable membrane which only allows the smallest molecules (Hydrogen and Oxygen ions) to pass through. The remaining ions are washed away to drain.

When specifying a Reverse Osmosis system a number of factors should be considered.

Some RO systems have a relatively low water production rate. To ensure sufficient water is available for peak demands an external storage tank is often recommended. If the water pressure supplying the membrane is low, the system may need a water boost pump.

Traditional RO systems can waste a lot of water, increasing utility costs. High Efficiency systems are now available offering high water recovery rates.

Reverse Osmosis system are typically available in three different styles

- REVERSE OSMOSIS: WATER ONLY
  These systems often produce a water that is devoid of the minerals you require to make a good coffee. The water is also likely to be aggressive to coffee equipment.
- REVERSE OSMOSIS: WITH BLENDING
  These systems allow blending of a proportion of filtered tap water to achieve the desired TDS levels. The complexity of the blending system used will dictate the stability of the treated water.
- REVERSE OSMOSIS: WITH CALCIUM DOSING
  The treated RO water is passed through a bed of calcium which then dissolves back into the water to achieve a balanced, re mineralized water quality. A number of coffee equipment manufacturers are starting to show a preference for this type of system for use in areas of high chlorides, to prevent any bypass blending of the chlorides back into the water.

SUMMARY

Now you know what's in water and how it can impact coffee taste and coffee brewing equipment. You also have an insight into the common treatment methods currently available and how they will affect your water. So what should you do next...

- *Obtain an analysis of what's in your local water. This can be obtained freely from your municipalities water supplier, and will probably be an average of their readings for your water source over the last 12 months. If the supply source changes so can the water quality.*

  Self-test the main contaminants with easy to use and relatively cheap test equipment. This will also allow you to keep an eye on your water quality and allow for seasonal fluctuations.

  Invest in a full water analysis from your tap. This will highlight any issues for your individual premises.
- *Decide on what you want your brew water to look like. TDS levels ? Hardness ?*
- *Select your preferred Filtration and water treatment partner. Your supplier should offer the full spectrum of technologies.*
- *Work with your Filtration supplier to specify a system that meets the needs of your business and falls within your budget for capital expenditure and operational costs. Ensure you choose a system that doesn't just meet your needs now, but has the capacity or can be easily expanded to meet increased demand as your business grows.*

WATER FOR COFFEE LOVERS

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WBC SPONSOR OFFICIAL WATER FILTRATION

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ISSUE: October 2020