DANAMARK watercare

GUIDING WATERCARE INNOVATION

Understanding WaterCare:

A Discussion on the benefits of Reverse Osmosis verses Water Softening

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Reverse Osmosis verses Water Softening – When to choose one over the other?

This is one of those questions that has no simple answer. It's like asking how long is a piece of string? We will attempt to provide an impartial answer here, drawing from the input of various sources and water quality experts.

We have no bias one way or the other and believe that both treatment technologies are competent in solving scale build up. They may be applied individually however in some cases, when paired up together, they are very complimentary.

First things first, what is scale & where does it come from?

Scale is anything and everything solid that is deposited onto surfaces that come in contact with water. The most important and common type is lime scale, but it also includes hydroxide scale, silica scale, phosphate scale, plus ordinary dirt, rust, etc. that settles as sediment and gets incorporated into scale

Different kinds of scale

Lime scale is limestone that is first dissolved from the ground and then precipitated later in water using equipment. Lime scale is predominantly calcium carbonate (CaCO3), but in many places magnesium carbonate may account for up to 1/3 of the total.

The changes that cause lime scale to precipitate are:
pH increase (a pH of 8 is ten times more scale forming than a pH of 7)
Temperature change – freezing or heating
Any increase in concentration of hardness, TDS or alkalinity

Hydroxide scale is a fluffy, cloud-like "floc" that forms around ions of certain metals at high pH and then settles into a gooey sludge that sometimes acts like cement. Examples are iron hydroxide floc and aluminum hydroxide floc.

Silica scale is essentially glass, and it forms wherever soluble silica levels above 15 ppm encounter a heat transfer surface, such as a coffee brewer.

Phosphate scale occurs only if polyphosphate treatment is flawed. If the dosage is excessive, calcium polyphosphate may precipitate. In other words, by overfeeding polyphosphate, you actually make the scaling problem worse.

Scale is different everywhere – know what type you have to determine the right treatment

The appearance of scale varies and depends on the impurities that are present in the water. For example, pure limescale is pure white, but sediment and turbidity (dirt, rust and mud) may colour it.

Common contaminants have the following properties:

RED	Rust
BLUE/GREEN	Copper
WHITE or PALE YELLOW	Oxidized sulfur
BROWNISH/BLACK	Manganese, Iron

Water Softening

A water softener is a unit that removes hardness from water by simply replacing the calcium and magnesium with sodium ions.

Sodium ions are much more soluble, and hence they do not form scale. The softener holds a bed of small resins that contain sodium ions on its surface. When hard water is fed to it, sodium replaces calcium and magnesium until all the resins are exhausted. At this point, the sodium needs to be regenerated.

Sodium chloride (salt) is added to the softener at every regeneration cycle to form a strong brine that reverses the ion exchange process and regenerates the resin bed with sodium. Calcium and magnesium are expelled to the brine, which is flushed down the drain. The cycle is repeated automatically to remove hardness from another batch of hard water.

Because sodium is added to softened water, some people mistakenly think that it poses a health risk, especially for individuals on dietary restrictions. The fact is we take almost all of our mineral supply from food and the amount of sodium in water is too small to be considered.

For those parts of the country where the water is very hard (over 15 grains) and threshold polyphosphate feeding is not sufficient enough to control scale, water softeners may be used. We recommend “blending” soft water with filtered water, in order to reduce the hardness of the water, without eliminating it.

Reducing hardness to approx. 3 - 5 grains is the optimum level of hardness for coffee and espresso. Anything lower produces bitter, over extracted coffee. In addition, water that is too soft has too little conductivity, which makes coffee brewers, with probes, difficult to operate due to the inability to read water levels.

For those situations where it is difficult to blend soft and filtered water, it is desirable to filter the water prior to softening. This results in peak performance from the filters and clean water to the softener. Softening is good if you need large volumes of water and if the presence of sodium and chloride ions is not a problem.

Reverse Osmosis (RO)

Reverse Osmosis (RO) is widely used in both industrial, commercial and residential water filtration. RO filtration is so fine even dissolved salts are removed from water, to end up with essentially pure H_2O that is free of bacteria, viruses and organic compounds.

In order to explain RO technology, we first have to consider the natural process of osmosis. In nature, osmosis occurs when a semi permeable membrane separates a dilute solution and a concentrated solution. This membrane only allows water to pass through it while retaining everything else. Water will naturally flow from the dilute solution to the concentrated one until an equilibrium point is reached where both sides have the same concentration.

In RO, the reserve process is performed, hence the name. Pressure is applied to the concentrated solution in order to force water through a custom-designed semi permeable membrane. Salts, organic compounds and microorganisms are retained while pure water is filtered out. The spent concentrated solution – called reject – is usually drained out.

In a typical install, RO is used in combination with sediment & carbon filtration. This prefiltration step is necessary in order to remove silt, sand, chlorine and other chemicals that may shorten the life of the RO membrane. Water is then pressurized and passed through the RO membrane to produce almost pure water.

Some systems add a secondary carbon filter and a UV lamp to remove any trace chemicals and kill any micro-organisms that might escape filtration by the RO unit. In addition, a water softener is an important pre-requisite to RO.

The irony of RO is that after all this effort to remove so much, we often have to add TDS (total dissolved solids) back in to the ingredient water, in order to achieve the proper extraction as RO water has little to no conductivity. Without adequate mineral content, there will not be adequate extraction. Ironically enough, high TDS and low TDS both inhibit proper extraction. Adding TDS back is achieved by the addition of a calcite feeder. This is an inexpensive feeder to purchase and maintain.

RO works well in applications where you need smaller volumes of high quality water. RO should remove about 98% of the incoming minerals from the water. The original investment for RO equipment is higher than softeners and the cost per gallon of water is more. You have to remember that it takes water to make water with RO which means you could be throwing away 3-4 gallons of water to make one gallon of RO. Then also figure in the sewer charge to get rid of that water and the power requirements to run the RO pumps.

RO is preferable if the incoming TDS of the water is over 500 ppm and hardness is over 10 gpg. But this can vary on the application.

The pro's and con's of each technology in a foodservice environment

For Food service applications, if hardness is more than 15 – 20gpg, a softener is recommended along with RO for Point of use equipment. Without the Softener, the RO will not last very long. Cost and space are also factors when choosing. Softeners take up large amounts of space and require frequent maintenance (salt, cleaning, etc.) which are not very expensive. RO takes up much less space but is more expensive to maintain (including water wastage).

COFFEE:
Where scale is an issue, 'blended' RO water, with filtered water, is suitable for coffee and hot beverages. Note: since cold water is denser than hot water, it travels through the RO membrane very slowly , therefore there is less production. Blending some hot water into the RO feed water helps. (or insulate the pipes) The ideal temperature for RO feed water is 70F to 75F.

STEAM:
In a flash steamer the best solution is either RO or DI(demineralization). If the volume of the flash steamer is low, DI could be the way to go. The initial equipment cost is low but cartridge costs can get expensive. DI cartridges have a capacity to remove only a set amount of TDS so take the TDS of the water and divide it into the capacity of the DI cartridge and that will tell you how much water you can treat before it is exhausted. If the volume of water needed is high then RO is the answer.

Softening adds sodium and chlorides into the water which will be left behind when the water is turned to steam. The residual chlorides will attack the metal components of the flash steamer.

WAREWASHING:
Softeners are commonly used due to the volume of water used and the need to eliminate spotting and streaking on silverware and plates.

FOUNTAIN:
Soft water should not be fed to fountain pop dispensers; soft water affects carbonation and produces flat drinks. It is unusual in foodservice to use softened or RO water in this application; fine filtration is typically suitable.

TEA:
Cloudiness of tea is directly proportional to the amount of hardness in water. Hard water produces tea with a more bitter taste and weaker flavour than soft water. Soft water produces clear tea, even when chilled with ice. Soft water does not affect taste until the concentration of NaCl (sodium chloride) reaches a threshold of 600 to 1000 ppm.

RO water used to brew tea produces a slightly stronger colour and taste.

WATER CONSUMPTION CONSIDERATIONS FOR RO:
Different brands of RO systems have varying production rates, but a general rule of thumb is anywhere from 7 to 1 to 5 to 1, i.e. for every 5 gallons of water going thru an RO system, 1 gallon of product water is produced. So you need to remember that you need water to make water here. Another critical factor is water temperature, the colder the water, the more dense, the less production, so a 200 gallon per day (gpd) system may only produce 130 gallons per day.

To illustrate the impact this could have on a typical coffee application, using a 200 gpd system, producing approx. 130 gallons per day:

RO capacity	130 gpd
Waste factor	7 to 1
Waste factor	780 gallons (6 gallons x 130 gallons) per day
Days open	365
Waste	284,700 gallons (365 x 780) Multiplied by the number of restaurants…
Avg. cost of water?	Multiplied by the number of restaurants and waste…?

Note: Everpure has engineered a new RO system that produces 4 gallons of product water for every 5 gallons treated, which is very innovative and addresses this age old problem with RO. (Model MRS-EnViro 600).

In hard water areas, we would recommend a small water softener to protect the RO membrane. In the case of the Everpure MRS-EnViro 600 system, we have the ability to blend in filtered water with the RO water to increase capacity and add some conductivity back into the ingredient water.