



Introduction

Nature provides the most complete water treatment system known to man – the human body designed to drink naturally water in all its forms. Mankind in its constant search for “quality of life” improvements has compromised virtually every available natural water source.

Water extracted from underground sources is by and large “hard”. Such waters derived from chalk and limestone deposits are particularly “hard” due to carbonate hardness result of calcium and magnesium carbonates with carbon dioxide being the generic term “Alkalinity”.

Alkalinity is defined as the presence of bicarbonates, carbonates and hydroxides of calcium, magnesium, potassium and sodium of which calcium carbonate (CaCO_3) is the most common.

Water extracted from surface sources is by and large “soft” mainly derived from rainfall. However, rainfall is contaminated by the atmosphere – chimney and industry stack emissions for example while catchment areas provide vegetation breakdown, pesticide and fertilizer residue and animal contamination.

Water extracted from rivers also carries treated or maybe not so well treated outfall from sewage works.

All of these waters are delivered to the consumer somewhere in the UK. Such is the nature of the supply network that blends maybe present all, sometime or none of the time.

Residential water treatment in UK ranges from none too simple filters through to reverse osmosis with softeners being far the most common.

Softeners

Predominant for anything other than municipal scale is base exchange softening. This is an ion exchange process with base being the definition of cations. However, it is a selective process due to choice of regenerant in this case salt – Sodium Chloride (NaCl).

Simplified explanation is the ion exchange is “loaded” with sodium (Na^+) ions in regeneration, in service as hard water flows through the bed calcium (Ca^{++}) and magnesium (Mg^{++}) having a stronger electrical charge displace sodium thereby producing “soft water”

However, there is a large body of medical documentation and opinion beyond the remit of this discussion that holds such a sodium-enriched water is not healthy and especially so for babies and infants.

Reverse Osmosis (RO)

There are many misconceptions regarding this method of treating water for potable use however, it is the closest technique yet developed by mankind to nature’s method of semi-permeable membranes and osmotic forces.



As the name implies the process “reverses” osmotic pressure preventing molecules larger than water crossing the membrane effectively demineralising the source water.

Although not generally acknowledged there is significant evidence in that consuming demineralised water may not be healthy. Principle in this is natural osmosis. Physical wellbeing requires balance in the body fluids if there is imbalance the body will seek to redress hence “tingling” on the tongue or lack of taste when drinking demineralised water.

RO is a non-selective process in that any ionic impurity of greater molecular weight than water will not pass including the essential minerals including calcium, magnesium, sodium and potassium.

A further and often totally overlooked aspect of using RO to demineralise is the resulting pH is lowered due to the effect of the membrane producing carbon dioxide (CO₂) from alkalinity (HCO₃) with a detrimental “leaching” effect of copper, lead or other metals present in traditional plumbing systems.

Demineralised water therefore, can have the following adverse effects:

- Increased corrosion potential
- Dietary deficiency with the risk of ischaemic heart and cerebrovascular disease (WHO< 2005z; WHO, 2006: Cotruvo, 2006.
- WHO recommends 10 mg/l of Magnesium and 30 mg/l of Calcium for drinking water

Rehardening

Having demineralised the water by RO it is common to “rearden” using Calcite cartridges filled with crushed and screened calcium carbonate which is most effective in a 5 ~ 6.5pH environment. These cartridges provide a slow, controlled pH reaction and maximum contact due to screened conformity and controlled (by flux) reduction of the natural occurring mineral rock (exactly as nature when water percolates to the aquifer). Calcite erosion adds hardness in the form of calcium (Ca⁺⁺) raising pH reducing leaching risk and to some improving taste.

Of course rehardening with calcite alone only adds calcium. Other essential minerals removed by RO are not replenished. Available are “rehardening” cylinders with a combination of fill materials said to improve “taste” but these are more of a subjective nature.

Whichever type of rehardening cartridge is used periodic backwashing is essential in maintaining good condition to prevent compaction as the mineral depletes increasing pressure drop and decreasing flux. This procedure is very rarely practiced in residential systems.