

## WATER HARDNESS CALCULATION.

This calculation determines the permanent total hardness CaCO<sub>3</sub>.

Total permanent water hardness is calculated with the following formula:

TOTAL PERMANENT HARDNESS = CALCIUM HARDNESS + MAGNESIUM HARDNESS

The calcium and magnesium hardness is the concentration of calcium and magnesium ions expressed as equivalent of calcium carbonate. The molar mass of CaCO<sub>3</sub>, Ca<sup>2+</sup> and Mg<sup>2+</sup> are respectively 100,1 g/mol, 40,1 g/mol and 24,3 g/mol. The ratio of the molar masses are:

$$\frac{M_{CaCO_3}}{M_{Ca}} = \frac{100,1}{40,1} = 2,5 \qquad \frac{M_{CaCO_3}}{M_{Mg}} = \frac{100,1}{24,3} = 4,1$$

So total permanent water hardness expressed as equivalent of CaCO<sub>3</sub> can be calculated with the following formula:

$$[CaCO_3] = 2,5 \cdot [Ca^{2+}] + 4,1 \cdot [Mg^{2+}]$$

See attached guide for water hardness CaCO<sub>3</sub> classification and more detail regarding WATER HARDNESS, causing lime scale, or classed as scale forming, with corrosive abilities ito of the LSI index.

HARD WATER is over saturated with calcium carbonate and TOO SOFT WATER is under-saturated with calcium carbonate. TOO HARD or TOO SOFT, both have an aesthetic effect on piping & electrical equipment.

### **Problems with hard water – Lime Scale Build Up and Scale Contamination.**

Hard water is defined as water from a source, mainly well, or borehole water with \*tested levels of dissolved & suspended magnesium and calcium ions, noted as CaCO<sub>3</sub> hardness, ranging from soft, low value mg/l or ppm to very high values in mg/l or ppm. See table below. \* A source water sample is tested at a laboratory for CaCO<sub>3</sub> hardness.

CLASSIFICATION	Hardness in mg/l or ppm
SOFT	0 - 60
MODERATLY HARD	61 - 120
HARD	121 - 180
VERY HARD	>180

The minimum test to be done and analytical report required, [a full spectrum chemical analysis is not required, but suggested], to #calculate the water softening di-ionizing system size & media loading is;

- Ca as calcium
- Mg as magnesium
- Na as sodium salts
- Fe as iron
- Mn as manganese
- CaC03 hardness