Scale is deposits of primarily insoluble calcium and magnesium carbonates that form on the surface of water pipes, water boilers and kettles under certain conditions. Water is classified as being either "soft" or "hard" depending on the level of calcium and magnesium.

Typically, surface water from lakes and rivers are low in calcium and hence are considered "soft." On the other hand, groundwater is rich in minerals like calcium and magnesium carbonates and has a high potential to form scale. Hence it is considered "hard".

The prairies provinces, particularly Manitoba and Saskatchewan, have the highest level of hardness in their water due to the high concentration of dissolved minerals in groundwater. On the other hand, the west coast has unusually soft water that is fed from snowmelt and mountain lakes.

Foodservice operators and beverage vendors are well aware of the effects of scale on their water handling equipment. Hard water causes the formation of scale deposits in water-heating appliances. Over time, the flow of water is restricted, and the efficiency of heating equipment drops due to the insulating effect that scale deposits have. The reduction in efficiency increases energy usage, which translates to increasing operating costs. In addition, hard water reduces the ability of soap to lather, which leads to increased consumption of dishwashing and laundry detergents.

Hardness Measurement

The potential to form scale can be determined by measuring total hardness. Total hardness is a measure of the concentration of calcium and magnesium ions in a water sample. Concentrations can be described in a number of ways, yet the most common method of describing scale is either in parts per million (ppm) or in grains per gallon (gpg).

Hardness Levels

The following chart provides a general range of hardness levels and the corresponding concentrations of total hardness in ppm and gpg. (Source: Health Canada)

Hardness Level	Total Hardness in parts per million	Total hardness in grains per gallon
Soft Water	0 to 60 ppm	0.0 to 3.5 gpg
Medium Hard	60 to 120 ppm	3.5 to 7.0 gpg
Hard Water	120 to 180 ppm	7.0 to 10.5 gpg
Very Hard	Above 180 ppm	Above 10.5 gpg

It's all in the Chemistry

The formation of scale strongly depends on the chemistry of water. There are three main factors that influence the formation of scale: concentration, temperature and pH. Each is briefly described below:

- ✓ **Concentration:** The higher the concentration of calcium and magnesium ions (total hardness), the higher the potential is for scale deposition.
- ✓ **Temperature:** calcium and magnesium carbonates are usually dissolved in water in room temperature. As water temperature increases, the solubility of calcium and magnesium carbonates drops, and deposits start forming. This explains why scale is most commonly found in water kettles and boilers.
- ✓ **pH:** refers to the concentration of hydrogen ions [H^+] in water. Neutral water has a pH value of 7. pH levels above 7 indicate alkaline water, while pH levels below 7 indicate acidic water. The potential for scale formation increases when the pH level is above 7. However, slightly acidic water has less potential for scale formation.

Scale Control Technologies

The key to controlling scale is by either removing the calcium and magnesium ions from water or altering the scaling mechanism to prevent scale crystals from growing.

Removing scale-forming ions almost always involves ion-exchange, a process whereby calcium and magnesium ions are replaced with positive ions that do not form scale. Sodium chloride (table salt) is the most popular substance used in ion-exchange water softeners.

Water softening is an established practice in the water industry that has been around for many decades. The process is useful for treating large quantities of hard water. A typical application for water softeners is Point-of-Entry (POE) units for commercial and residential applications. Other ion-exchange processes use hydrogen ions to replace calcium and magnesium ions in water.

Another method of dealing with scale is the use of polyphosphate additives. These additives prevent scale crystals from growing and forming hard deposits. Polyphosphate additives are available in slow-dissolving cartridges that feed controlled amounts to water.

Which scale control technology to use?

In order to select the best water treatment system for your application, it is important to first understand water quality. Testing water samples for total hardness provides an indication as to which scale control technology is the most suitable.

Generally, for hard to very hard water, ion exchange systems are more effective, especially for large flow applications such as car washing systems, whole restaurants feed water and laundry machines. For moderately hard water and low flow applications, polyphosphate-based cartridges may be the best option.

Water Test Kits

There are various water test kits available, and they vary in their sophistication. Check out our H2O Express Water Test Kit, part no. 180-80193 on our website.