

## Whitepaper

BINDER PURE AQUA SERVICE is a water treatment system that prevents scale buildup, thereby ensuring efficient long-term functioning of BINDER equipment. Scale buildup is not a health hazard but contributes to reducing performance, increasing energy costs and may ultimately lead to malfunctioning of valuable equipment.

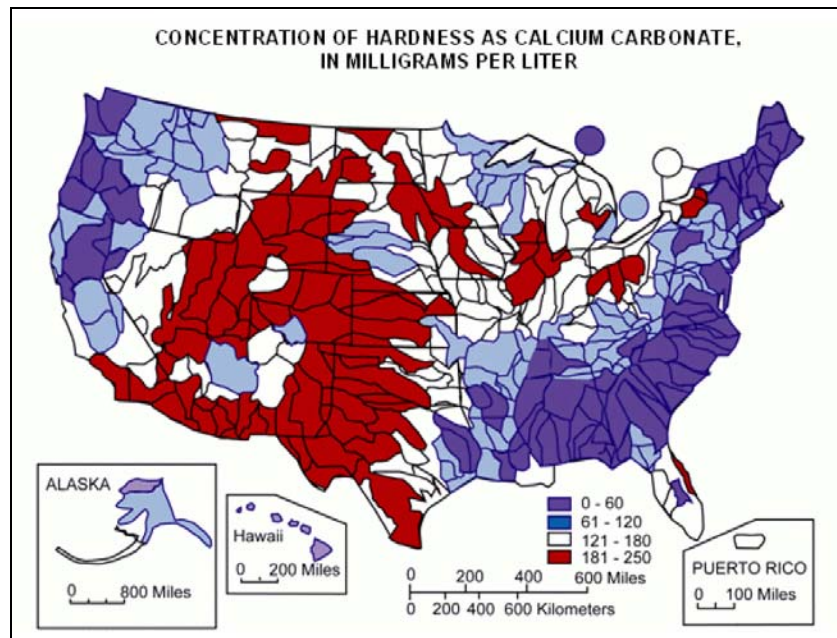
Scale reduces the thermal efficiency of heating and humidification systems by increasing the time it takes to achieve the set values. The U.S. Department of Energy reports that just a ¼” of scale deposits will increase your energy bill by 40%. In fact, British Water say that even a 1.6mm coating of limescale on a heating element can make it up to 12% less effective.

In order to properly respond to this situation a classification of water hardness has been defined in the US and accepted by governmental agencies and industries.

Soft Water	0 to 60 mg CaCO <sub>3</sub> /L
Moderately Hard Water	61 to 120 mg CaCO <sub>3</sub> /L
Hard Water	121 to 180 mg CaCO <sub>3</sub> /L
Very Hard Water	181 to 250 mg CaCO <sub>3</sub> /L
Hardest Water	251 to 2846 mg CaCO <sub>3</sub> /L

Reference: Hardness classification according to Durfor and Becker (1964)

According to the United States Geological Survey, 89.3% of the United States is affected by hard water. Softest waters were in parts of New England, the South Atlantic-Gulf States, the Pacific Northwest, and Hawaii. Moderately hard waters were common in many rivers of Alaska and Tennessee, in the Great Lakes region, and the Pacific Northwest. Hard and very hard waters were found in some streams in most of the regions throughout the country. Hardest waters (greater than 1,000 mg/L) were measured in streams in Texas, New Mexico, Kansas, Arizona, and southern California.



Reference:

Mean hardness as calcium carbonate at National Stream Quality Accounting Network NASQAN water-monitoring sites during the 1975 water year. Colours represent stream flow from the hydrologic-unit area. Map edited by USEPA, 2005. Modified from Briggs and other in 1977.

Water hardness is a traditional measure of the capacity of water to react with soap. Water hardness is caused by dissolved polyvalent metallic ions. In fresh waters, the principal hardness-causing ions are calcium and magnesium; strontium, iron, barium and manganese ions also contribute.<sup>(1)</sup> Hardness can be measured by the reaction of polyvalent metallic ions in a water sample with a chelating agent such as ethylenediaminetetra-acetic acid (EDTA) and is commonly expressed as an equivalent concentration of calcium carbonate.<sup>(1,2)</sup> Hardness can also be estimated by determining the concentrations of the individual components of hardness and expressing their sum in terms of an equivalent quantity of calcium carbonate.

Although hardness is caused by cations, it is often discussed in terms of carbonate (temporary) and non-carbonate (permanent) hardness. Carbonate hardness refers to the amount of carbonates and bicarbonates that can be removed or precipitated from solution by boiling. This type of hardness is responsible for the deposition of scale in hot water pipes and tea kettles. Non-carbonate hardness is caused by the association of the hardness-causing cations with sulphates, chlorides and nitrates. It is also referred to as "permanent hardness" because it cannot be removed by boiling.



PURE AQUA SERVICE is a water softener based system especially adapted to the specific requirements of environmental test equipment. One PURE AQUA SERVICE cartridge processes approx. 2.000 L of hard water (120 to 180mg/L). Increasing water hardness reduces the service life. See table below.

Water hardness (freshwater)	Cartridge sufficient for processing the following quantity of water
178.5 mg/l (ppm) = 12.5 English (Clark) degrees = 10.4° grains per U.S. gallon = 1.785 mmol/l	approx. 2000 l
356 mg/l (ppm) = 25 English (Clark) degrees = 20.8° grains per U.S. gallon = 3.57 mmol/l	approx. 1000 l
712 mg/l (ppm) = 50 English (Clark) degrees = 41.6° grains per U.S. gallon = 7.14 mmol/l	approx. 500 l

Reference: Mounting Instructions BINDER PURE AQUA SERVICE water treatment system, Version 12/2010 Art. no. 7001-0159

The water treatment system BINDER PURE AQUA SERVICE (Art. no. 8012-0625) consists of:

- Disposable cartridge (Art. No. 6001-0077)
- Measuring equipment mounted to T-piece, with power supply unit 110V-240V and socket adapter
- Mounting instructions (Art. No. 7001-0159)
- 3m metal water hose with screwings, for processed water, and 2 gaskets
- Water drain for pressure compensation when replacing the cartridge



PURE AQUA SERVICE is not for drinking water, neither for analytical nor for medical purposes. The cartridges are not meant to be recharged but are replaced after their rated service life.

References:

1. U.S. Environmental Protection Agency. Quality criteria for water. Office of Water and Hazardous Materials Rep. EPA-440/9-76-023, Washington, DC, July (1976).
2. Sekerka, I. and Lechner, J.F. Simultaneous determination of total non-carbonate and carbonate water hardness by direct potentiometry. Talanta, 22: 459 (1975).
3. Environment Canada. Surface water quality in Canada -- an overview. Water Quality Branch, Inland Waters Directorate (1977).
4. Sawyer, C.N. and McCarty, P.L. Chemistry for sanitary engineers. 2nd edition. McGraw-Hill Series in Sanitary Science and Water Resources Engineering, McGraw-Hill, Toronto (1967).
5. Thomas, J.F.J. Industrial water resources of Canada. Water Survey Rep. No. 1. Scope, procedure, and interpretation of survey studies. Queen's Printer, Ottawa (1953).

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