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Water is easy…RIGHT?

The technical requirements within the water industry are evolving rapidly, and the need for technical specialists across all sub-fields is becoming increasingly important. This is especially true at a time when there is a shortage of trained individuals, from technical specialists through to those working on the tools.

However, one area where terminology can often become blurred is the difference between **water conditioning** and **water treatment**. These terms are frequently used together, particularly in relation to biological growth, chemical reactions, scaling, corrosion, and temperature control. This article therefore aims to provide an overview of these areas and highlight key considerations that may assist future understanding, decision-making, and system design.

Best practice is often based on a **multi-barrier approach**, where several treatment methods are combined to manage different risks. This is particularly important in healthcare, industrial and high-dependency water systems where water quality, microbial control, asset protection and operational resilience are all critical.

Final selections must be system-specific and comply with all current applicable legislation, standards, and guidance.

Image extracted from - Fluid Dynamics International Ltd

So, what is the fundamental difference?

Water treatment refers to the broad process of improving water quality by removing, reducing, inactivating or controlling contaminants, impurities and undesirable components to make water suitable for a specific end use. This may include potable water, healthcare use, industrial processes, closed systems, medical applications, or process water.

Water treatment requirements should be determined through **risk assessment** and **tailored** to the specific application, rather than implying that a single universal standard of water quality applies in all circumstances. In simple terms, one peg never fits all.

Water treatment can include processes such as:

Main Group	Examples
Physical Removal	Filtration, sedimentation, media filtration, activated carbon filtration
Chemical Treatment / Disinfection	Coagulation and flocculation, chemical disinfection, sodium hypochlorite, hypochlorous acid, chlorine dioxide, ozone
Non-Chemical Disinfection	UV disinfection, copper-silver ionisation
Advanced Oxidation	Ozone, Advanced Oxidation Processes
Membrane Processes	Reverse Osmosis
Thermal Processes	Distillation
Ion Exchange	Ion exchange softening, demineralisation, selective ion removal, ACP Advanced Crystallisation Process or AOP Advanced Oxidisation Process

The purpose of these processes is generally to improve water quality by removing, reducing, or controlling substances and organisms that may present operational, aesthetic, or health-related risks. These may include bacteria, viruses, organic matter, suspended solids, dissolved minerals, metals, disinfection by-products, taste, odour, and other unwanted contaminants. The use of heavy metals may not be suitable for certain installations, such as those serving occupants with weakened immune systems.

Each option should be appropriately monitored, with a clear understanding of its limitations and effectiveness within the proposed building and associated system design.

Water conditioning, by contrast, is best understood as a subset of water treatment. It is focused primarily on modifying the characteristics or behaviour of water, rather than necessarily removing all contaminants.

Water conditioning is commonly associated with:

- Hardness control
- Scale prevention
- Corrosion control
- pH adjustment
- Softening through ion exchange
- Chemical dosing to alter water stability
- Physical or electronic devices intended to influence mineral behaviour
- Protection of pipework, fittings, calorifiers, boilers, heat exchangers and plant

The aim of water conditioning is usually to make the water more compatible with the system it serves. For example, reducing scale formation in hot water systems, improving heat transfer efficiency, protecting assets, reducing corrosion risk, or improving operational reliability. Electronic or physical scale-control devices do not remove hardness in the same way as ion-exchange softeners. Any performance claims should be supported by evidence, manufacturer data, and local water and system monitoring.

In simple terms:

Term	Main Purpose
Water treatment	Removes, reduces, inactivates or controls contaminants
Water conditioning	Modifies water characteristics, particularly hardness, scale and corrosion potential

Both are important, and in practice they often overlap. For example, softening is a conditioning process, but it is also a recognised form of treatment. Similarly, pH correction may be used to protect materials, but it can also influence disinfection performance, corrosion risk and biological control.

Selecting an Appropriate Treatment Method

There is no single “best” form of water treatment. The correct method depends on the water source, the system design, the intended use, regulatory requirements and the specific risks being managed.

Commonly used treatment methods include:

- **Reverse Osmosis**: Can substantially reduce dissolved ions and microbial passage by removing dissolved solids, salts, metals, bacteria, and many, but not all, organic compounds. However, it should not be described as a standalone disinfectant. Its performance depends on membrane integrity, pretreatment, maintenance, and the hygiene of any post-RO storage and distribution system.

- **Ultraviolet Disinfection**: Inactivates bacteria and viruses without adding chemicals. It should be installed with filtration to minimise the risk of shadowing. UV provides no residual disinfectant, so downstream design, storage, and distribution controls remain important.
- **Activated Carbon Filtration**: Removes chlorine, organic compounds, taste and odour.
- **Ion Exchange**: Commonly used to remove hardness, calcium, magnesium and some dissolved ions.
- **Distillation** can produce high-purity water by evaporation and condensation, but storage and distribution can reintroduce contamination. It should not be implied that the final system remains sterile or microbiologically controlled without appropriate downstream controls.
- **Media Filtration**: Removes suspended solids, sediment and turbidity.
- **Chlorination Ozonation**: These are both oxidising disinfectants, but they behave differently. Chlorination can provide a residual in the distribution system, whereas ozone is highly effective but generally does not provide a lasting residual.
- **Advanced Oxidation Processes**: Used to treat difficult contaminants via enhanced oxidation in a titanium-lined chamber.

These are examples only; other treatment methods may be appropriate depending on the application.

Water Temperature, Hot Water Systems and Material Selection

When water is treated, conditioned and heated, **material selection becomes critical**. The interaction between water chemistry, temperature, disinfectants and system materials can significantly influence corrosion, scaling, biofilm formation and long-term system performance.

Hot water can accelerate chemical reactions and increase stress on materials. This makes it essential to consider not only the treatment method, but also the pipework, fittings, tanks, valves, calorifiers, heat exchangers, seals, gaskets, and other components that come into contact with the water.

In the UK, temperature control is a key part of risk management. HSE guidance states that cold water should be kept below 20°C where possible, hot water should be stored at a minimum of 60°C, and water should be distributed so that 50°C is reached at outlets within 1 minute. In healthcare premises, outlet temperatures to appliances of 55°C are commonly applied in accordance with risk assessment and relevant guidance.

Key concerns include:

Corrosion

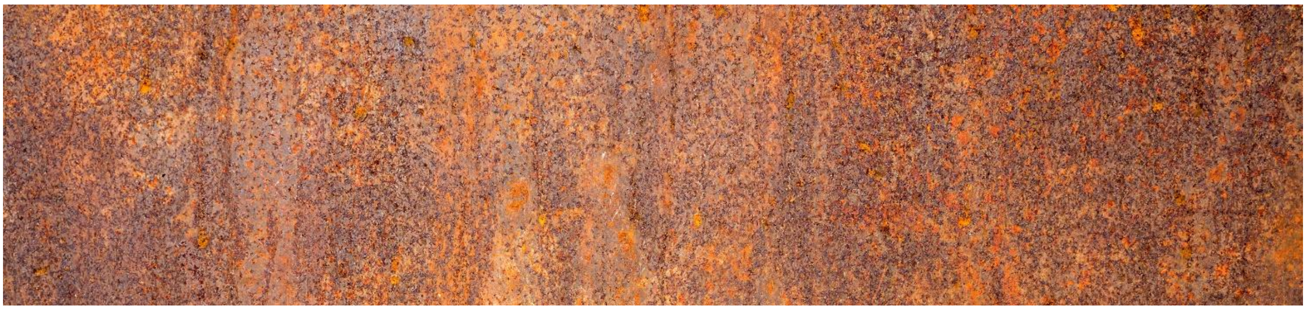
Hot water can accelerate corrosion, particularly in metallic systems. Copper, mild steel, galvanised steel, and stainless steel can all be affected, depending on the water chemistry.

The level of corrosive/galvanic risk depends on the combined effects of temperature, water chemistry, disinfectant regime, flow conditions, and material grade, rather than temperature alone.

Factors influencing corrosion include:

- pH
- Alkalinity
- Chloride levels
- Dissolved oxygen
- Temperature
- Flow velocity
- Stagnation
- Disinfectant residuals
- Galvanic interaction between different metals

Stainless steel is often considered highly corrosion-resistant, but it is not immune. Common grades include **304, 316, 316L and duplex 2205**, each providing different levels of corrosion resistance depending on the water chemistry and operating conditions. In general, **304** is often used in general-purpose applications, while **316 and 316L** offer improved resistance to chloride-related corrosion, and **duplex 2205** may be selected for more aggressive or high-demand environments. Performance is influenced by **grade selection, surface finish, chloride concentration, temperature, oxidising disinfectants, fabrication details and maintenance regime**, with elevated chlorides and higher temperatures increasing the risk of pitting corrosion or stress corrosion cracking. For this reason, stainless steel should always be selected on a **system-specific basis**, and manufacturer limits should be confirmed before use in continuous high-disinfectant or high-temperature applications.

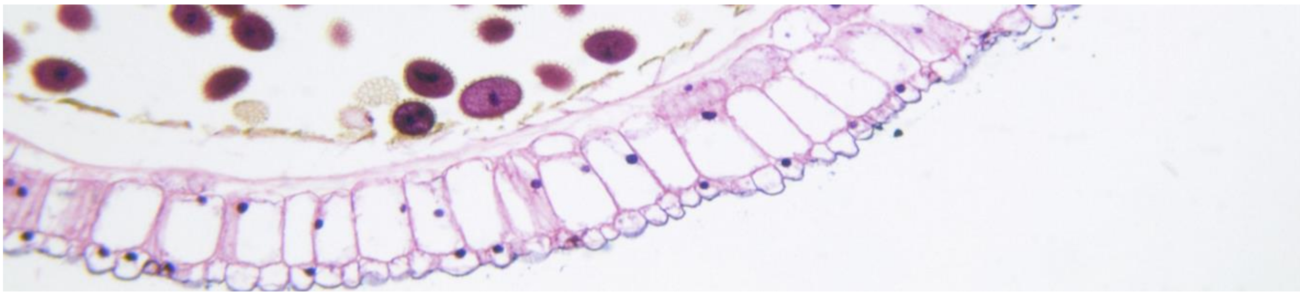


Scaling

Hard water can lead to calcium carbonate and magnesium scale formation, particularly in heated systems. This can reduce heat transfer efficiency, increase energy consumption, restrict flow, damage components, shorten asset life, increase maintenance burden, and create surfaces where biofilm can become established. In hot water systems, these effects can also compromise microbial control and overall operational performance.

Scale is especially problematic in:

- Calorifiers
- Boilers
- Plate heat exchangers
- Thermostatic mixing valves
- Showers
- Spray outlets
- Hot water return systems



Chemical Compatibility

Treatment chemicals must be compatible with the system materials. Chlorine, chlorine dioxide, ozone, acids, alkalis, and other oxidising agents can affect metals, plastics, elastomers, and seal materials. Disinfectant choice and dose should be checked against pipe, fitting, tank, elastomer, and component approvals, as chlorine dioxide, chlorine, and ozone may each have different material and by-product considerations. Chemical suppliers and product manufacturers should be asked to confirm compatibility in writing, especially for elastomers, flexible hoses, plastics, and specialist components.

- Poor compatibility may lead to:
- Premature failure of seals or gaskets
- Pipe degradation
- Leaching
- Cracking
- Loss of mechanical strength
- Increased corrosion risk

This is particularly relevant where elevated disinfectant levels or continuous dosing regimens are used.

Image extracted from The truth about water conditioners

Thermal Expansion and Mechanical Stress

Hot water systems undergo repeated heating and cooling cycles. This causes expansion and contraction, which can lead to stress, fatigue, joint movement and leakage if the system is not correctly designed and installed.

Material choice must therefore consider:

- Temperature rating
- Pressure rating
- Expansion control
- Jointing method
- Support spacing
- Flexibility
- Long-term durability

Microbial Growth and Biofilm

Material selection can also influence microbial risk. Some materials, particularly certain plastics, rubbers, and flexible hoses, may support biofilm formation if they are not properly specified, installed, and maintained. To reduce risk, unnecessary flexible hoses and dead legs should be avoided, and materials should be selected to suit the intended water quality and operating temperature.

In healthcare and other high-risk environments, this is especially important where systems may be vulnerable to colonisation by organisms such as **Legionella**, **Pseudomonas aeruginosa**, and other opportunistic waterborne pathogens. The healthcare-specific framework is set out in **NHS HTM 04-01**, which should be read alongside Health and Safety Executive - Legionnaires' disease. The control of legionella bacteria in water systems Approved Code of Practice and guidance **HSE L8** Fourth Edition and Health and Safety Executive's (HSE) technical guidance for controlling *Legionella* bacteria in hot and cold water systems **HSG274 Part 2**. System design, temperature control, flow, turnover, disinfection strategy, and maintenance all play a role in reducing microbial risk.

Common Material Choices

Material	Strengths	Key Considerations	Typical Applications	Limitations
Copper	Good thermal performance, widely used for hot water, durable	Can corrode in aggressive water; affected by pH, velocity and disinfectants	Potable hot water, cold water, some closed systems	Can suffer from pitting, erosion-corrosion or dezincification-related issues depending on water chemistry; not ideal in highly aggressive waters
PEX	Flexible, corrosion-resistant, easier installation	Temperature and pressure limits; potential compatibility issues with disinfectants	Potable cold water, potable hot water, underfloor heating, some low-temperature distribution systems	Not suitable for all high-temperature or chemically aggressive applications; UV sensitivity and fitting quality are important
Stainless Steel	Strong and corrosion-resistant in suitable conditions	Sensitive to chlorides and high temperatures; more expensive	Potable hot water, cold water, closed systems, some process applications	Grade selection is critical; chloride exposure, disinfectants and stagnation can increase corrosion risk
PVC	Corrosion-resistant and suitable for cold water applications	Not generally suitable for hot water	Cold water distribution, drainage, some process services	Limited temperature capability; not typically used for potable hot water
CPVC	Suitable for some hot and cold water applications	Temperature, pressure and chemical compatibility must be checked	Potable hot water, cold water, some light-duty process applications	Must be checked for temperature, pressure and disinfectant compatibility; not suitable for every system type
Mild / Galvanised Steel	Historically common in some systems	Higher corrosion and deposition risk; generally, less favoured for potable hot water systems	Legacy systems, some closed systems, non-potable or industrial applications	Prone to corrosion, scaling and reduced water quality over time; generally poor choice for modern potable hot water systems

All materials in contact with potable water should be approved and suitable for the intended application, temperature, pressure, and chemical exposure. In the UK, WRAS approval helps demonstrate compliance with the Water Supply (Water Fittings) Regulations for plumbing products and materials, while DWI Regulation 31 approval is a separate approval route mainly for substances and products used by public water suppliers before the point of delivery to premises. Material selection should always be based on the intended application, water quality, operating temperature, disinfectant regime, and system type, as suitability can differ significantly between potable hot water, cold water, closed systems, and process applications. If this is to be published externally, the relevant approval and regulatory framework should be named for the intended audience and supported with references.

Summary

Water treatment and water conditioning are closely linked, but they are not the same. Water treatment is the broader discipline, focused on removing, reducing, inactivating, or controlling contaminants to make water suitable for its intended use. Water conditioning is more specific, concentrating on modifying water behaviour in relation to hardness, scale, corrosion, and system compatibility.

In practice, particularly in hot water and healthcare environments, effective water management depends on a balanced understanding of water chemistry, microbiological risk, temperature control, system design, material compatibility, disinfection strategy, maintenance requirements, and regulatory compliance. Good water management is therefore not just about treating the water, but about understanding how the water, the system, the materials, and the operating conditions interact over time.

Selection should ultimately be based on a documented water risk assessment and maintained through design, installation, to monitoring, review and to ‘*As Built Environment*’.