

# The chemistry of treating water in closed systems

Simply adding chemicals to water in a closed system can do more harm than good. Understanding the chemistry is all-important, as **Peter Bowles** of Airmec explains.

**T**here is a lot more to water treatment than occasionally dosing with chemicals. Do you know what type of water you are using? Hardness and softness in water present very different problems. In a nutshell — hard water can lead to scaling, soft water can be corrosive. So solving one problem can aggravate another one. Getting the initial analysis and treatment plan right is vital.

Any facilities manager will want to avoid the costs implicit in reduced thermal efficiency. However, getting the chemical mix and dosage or the inspection and flush-through regime wrong will not improve the situation, and could well make matters worse by introducing damage that shortens the life of the whole system.

Nevertheless treating water in closed heating and cooling systems is essential. A system that is harbouring a build-up of corrosion and sludge will have to work harder to distribute water and heat. Blockages and sludge will impede the water flow, and energy-using components like the system pump will have to work harder to overcome the obstruction, and may have a shorter life as a result.

A 1 mm layer of carbonate scale build up on the heat exchanger can reduce heat transfer by up to 10%. The efficiency losses from other chemical scales are dramatically higher, especially phosphates, sulphates and silicas.

The risk is present whether you are running a new or refurbished system, with a condensing or high efficiency boiler, or a much older



installation. Stainless steel systems are not risk free, nor are those where the physical barrier of a plate heat exchanger sits between the boiler and the secondary components of the system. Microbiological fouling (bio-fouling), corrosion and scale can all result in energy wastage, poor system performance and damage to plant and components.

## The chemistry

The main aim of water treatment is obviously to prevent or minimise fouling, scaling and corrosion in the first place; as a rule continuous conditioning rather than occasional treatment is the best option. So the first step to specifying the best treatment and flush-through regime is to understand the chemistry of what is going on in your system — or at least make sure you choose a partner who does.

Good water analysis includes checks for hardness, conductivity, pH, chlorides, iron, copper and aluminium.

**“Treating water in closed heating and cooling systems is essential”**

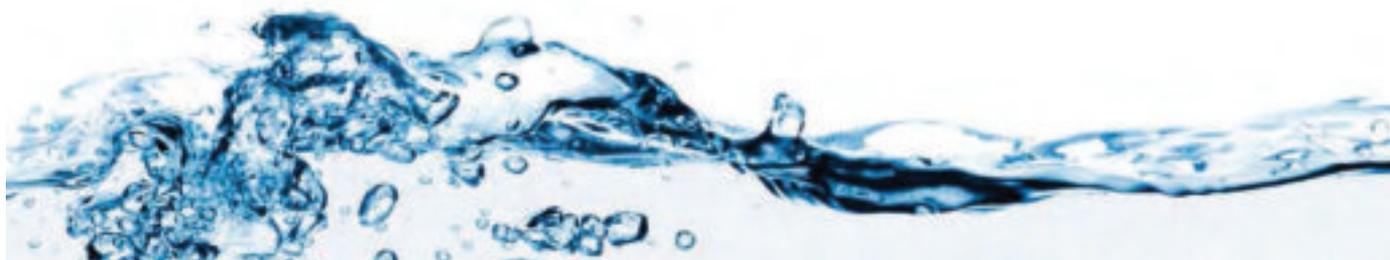
Here is a brief introduction to the key issues.

Hardness in water is caused by a high proportion of magnesium and calcium bicarbonates which can precipitate as scale to clog the system and impede efficient heat transfer. The ‘knee jerk’ reaction is to add water softeners, often expensively and not always with proper reference to the level of local water hardness or the specific usage of the system.

There is just no reason or excuse for a shotgun approach to dosing as the data and statistical tools to avoid doing so are freely and readily available. At Airmec we determine whether the water will precipitate, dissolve, or be in equilibrium with calcium carbonate using the Langelier saturation index (first developed in 1936 and well-proven over the years) and the Ryznar stability index (RSI), which was developed from actual observations of corrosion rates and film formation in steel mains.

Of course, and not everyone bothers to do this, it is important to consider how water will behave chemically when it is in use within the system, not just when it comes out of the mains. All this information needs to be cross-referenced with how and how often the system is used and what volumes of water are being pumped. It is not a job for amateurs.

For instance even the softest water can form scale if the concentration of salts is increased by evaporation. So if your system is subject to high levels of evaporation, the issue of soft water



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you started with may not actually be the biggest risk to your system, and vice versa.

The converse also applies because, probably counter-intuitively, hard water becomes softer as it heats up. While you would normally expect water to be able to hold onto more ions in solution as it warms up, and this is indeed the case for most substances, the complete opposite happens for the magnesium and calcium bicarbonates that cause water hardness. As water heats up within the system, they precipitate and drop out as scale. Temporary water hardness is completely lost at 51°C, and most systems will of course be operating at much higher temperatures than that.

This begs the question of whether and how intensively to treat for water hardness or softness. By the way, measuring levels of evaporation has the knock-on advantage of enabling

you to negotiate with your water services supplier to reduce the effluent costs you pay.

#### Safe scale removal

If systems are treated inefficiently, without due consideration to the type of water, then a scale will form. The blanket use of strong acids to remove this thermal insulator can lead to damage within the equipment by dissolving the component metals. Again, there is no excuse or reason for this as a professional water-treatment chemist will analyse the scale to identify the most appropriate inhibited mild acid. The removal of the scale will then optimise efficiency of the heat-exchange process and, hence, reduce energy costs, without adding to the risk of costly physical or mechanical failure.

*Peter Bowles is Airmec's water-treatment specialist.*

## The diversity of Marflow Hydronics' Xterminator

Marflow Hydronics reports that its Xterminator valve set is increasingly being used with a variety of different terminal devices, showing it to be a highly diverse product.

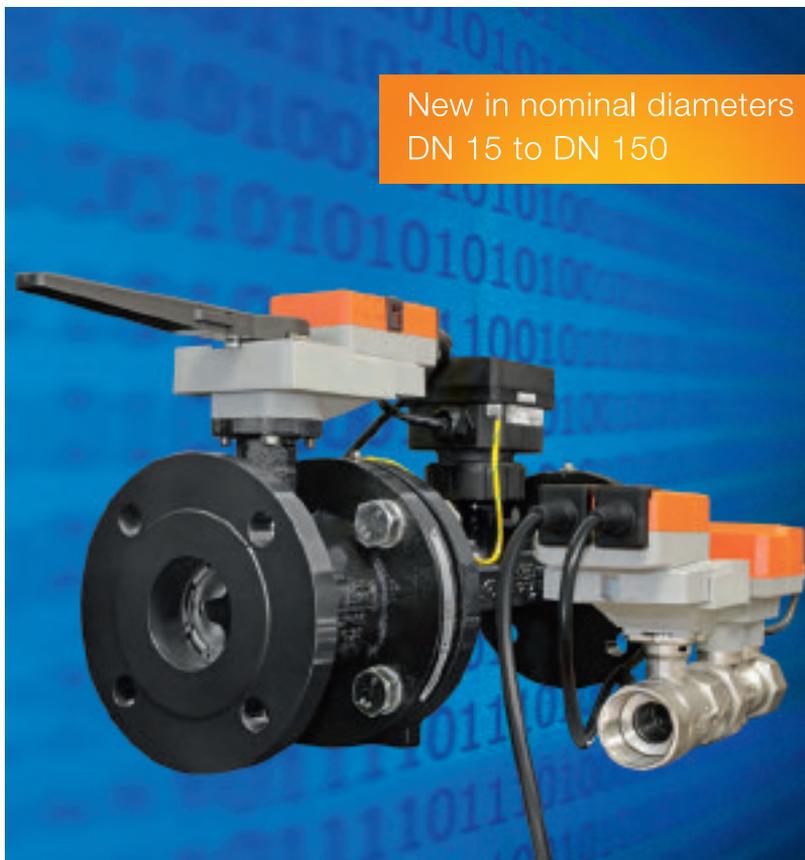
Over the past few years, the Xterminator valve set has been mostly credited as a great solution to work with fan-coil units.

However, customers are increasingly using the product with a larger range of terminal devices, just as it was designed for, demonstrating its true flexibility.

The Xterminator is a range of engineered terminal unit connection sets which incorporates a suite of valves and fittings to balance and control any terminal device, such as chilled beams, fan convectors, air-handling units and trench heating, as well as fan-coil units.

Nick Martin, technical manager, says, 'We have three types of Xterminator in our prefabricated product portfolio, and they've been designed so that they can work with any terminal device. There's often a misconception that they only complement fan-coil units, but the recent growth in the variation of applications that we've been helping customers with demonstrates the product's great diversity.'

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