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Electro-magnetic systems explained

Jonny Seccombe, chairman of Lifescience Products, explains why the correct location of an electro-magnetic water conditioner is vitally important...

A recent article in HPM, 'Are we going soft on water treatment?' discussed the various options for treating hard water to prevent damaging scaling in water heaters, but it also revealed a lack of understanding of the functionality of some electro-magnetic systems.

Firstly, it is important to understand one of the unusual characteristics of limescale and why it causes such a problem. Unlike many other solids that precipitate from solutions and form a loose powder, such as salt, scale has to precipitate on to some other material, it won't just form on its own. That is why it causes so many problems. It attaches itself to surfaces and literally 'sticks around'.

If, on the other hand, you can create in the body of the water a nucleation seed that will attract the precipitating scale so that it forms in suspension rather than encrusting surfaces, the scale will form as a loose powder. The scale still occurs but it no longer 'sticks around', it just washes away in the flow of the water ceasing to cause a problem. Once formed on the nucleation seed, the scale is relatively inert and will not dissolve back into the water unless the acidity of the water is increased, which doesn't normally happen.

NUCLEATION SEEDS

Physical water conditioners seek to exploit this characteristic by generating nucleation seeds in the water for scale to bond onto. One very effective seed is zinc and many devices, such as magnetic and electrolytic systems, effectively dose zinc into the water by electrolysis - corrosion in other words. Once in the water, the zinc is permanently active so there is no loss of effectiveness over time. The common problem with zinc dosing devices, however, is the anode that is corroding can 'scale up' itself resulting in 'passivity', so the amount of zinc being dosed either reduces or stops altogether. Unless the anodes are replaced or cleaned on a regular basis the treatment is at best time limited.

Electro-magnetic systems, that are not zinc dosing, generally act on minerals already in the water, converting them into a form whereby they act as a nucleation seed. Iron on its own has been identified as an effective nucleation seed, albeit not as good as zinc, but studies suggest that if the iron molecule is modified by exposure to certain electro-magnetic impulses, it becomes far more effective at attracting scale. If the electro-magnetic influence is removed, which can happen over time and distance, the molecules can revert to their previous state, thus reducing their effectiveness to attract scale.

Another factor that has a very serious impact in larger plumbing systems and some water heater designs is the effect of pumps on the nucleation seeds. Tests have shown if a nucleation seed passes through a pump before it has collected any scale, its structure reverts back to its pre-treated state and the effectiveness can be reduced by a factor of five times. Therefore, the location of such units in the plumbing system plays a crucial role in determining their effectiveness to reduce scaling.

'TEMPORARY' TREATMENT

Not all electro-magnetic systems operate in the same way and some of them can overcome this problem of 'temporary' treatment. Most systems, especially those with a closed loop wire that runs from the controller, around the pipe a few times, and back into the controller, generate an electro-magnetic pulse locally to where the wires are installed. Similarly, most of the plumbed in systems treat the water only as it passes through the device. If a heater is nearby and the scale is generated soon after the nucleation seed has been created, the treatment is effective. If, on the other hand, the water is stored for some time before being heated or is pumped into the heater, the nucleation seeds decay and the effect can be significantly reduced.

Other types of electro-magnetic systems operate more like a radio transmitter. Typically, the wires come out of the controller, are wound around the pipe, and then stop. They act as radio antennae which induce a signal in the water that travels in both directions, upstream and downstream (see fig one). Not only does it provide permanent treatment for the water after it has passed through the antennae, even to a tank downstream, it also treats water upstream before it passes through the antennae, as well as water that is connected to the same plumbing system but doesn't even pass through the antennae at all. A plumber can sell one of these devices to his neighbour, make some money, and have his own house treated for free. Not something we encourage but technically possible.

Fig one: Water-King WK3 utilises pairs of open ended aerials to transmit signal both upstream and downstream

This ability to treat water upstream of the point of installation is especially useful in overcoming the problem of pumps that are close coupled to water heaters when the water is pumped from a storage tank to the heater. Water-King can be installed on the discharge side of these heaters (see fig two). The signal travels back into the heater where the scale is forming and it will also travel forward into the storage tank, treating it continuously irrespective of how long the water sits there before being drawn off.

The 'radio transmitter' type systems completely overcome the problems of short-term treatment, or 'memory effect' as it is sometimes known. Correctly, located they will effectively treat 'All the Water, All the Time'. Equally, they are not influenced by the need to maintain a zinc anode, where passivity becomes a problem.

In summary, the correct location of an electro-magnetic water conditioner is vitally important as is the need to understand exactly what type of electro-magnetic system you are actually dealing with.

Fig two: Heat exchangers can be treated through a back-signal by installing Water-King on the discharge side