



AN ADVECO GUIDE FOR
COMMERCIAL WATER HEATING

A close-up photograph of a water heater tank's interior. The heating elements are heavily encrusted with a thick, white, crystalline limescale deposit. The deposit is flaking and peeling, revealing the dark metal underneath. The background shows the red and black components of the tank's internal structure.

Limescale Protection In Electric DHW Systems

www.adveco.co

LIMESCALE PROTECTION IN COMMERCIAL ELECTRIC DHW SYSTEMS

This paper considers the advantages of a move to electric and the correct application of electric immersions for DHW systems within commercial buildings.

It explores the detrimental issue of rapid limescale generation caused by use of direct electric immersion as a primary heat source.

The use of water softener and scale inhibitors will be considered, and Adveco will propose the use of an electric boiler in an indirect 'sealed loop'. This approach minimises scale generation, vastly improving reliability and drastically reducing maintenance demands, with operational and maintenance savings quickly offsetting any additional capital costs.



Immersion Heater & Electric Boiler

A comparative guide for commercial hot water systems

When to use an electric boiler

- High demand
- Hard water
- Where modulation (soft start and load matching) would be beneficial

Advantages of a electric boiler

- Safer due to multiple levels of built in protection and separation from DHW
- No scale
- Remote location from cylinder, reduces cylinder clearance requirements
- Controls built in

When to use an immersion

- Low scale scenarios
- As backup
- Low demand applications (domestic)

Advantages of an immersion

- Installation time
- Cost

The Transition To Electric

As the electricity grid becomes cleaner, commercial hot water systems in the UK are transitioning towards electric-only designs as the potential for long-term carbon savings grows.

While an optimised electric based system includes heat pump technology, electrical resistive heating remains a necessary component of many systems to deliver the high-grade heat required for domestic hot water applications. Typically, the resistive heating is provided 'directly' to the hot water cylinder via an electrical immersion heater. However, significant advantages can be realised using an indirect electric boiler system.

The Advantages of Electric

- Lower carbon emissions in line with government calls for net zero
- Addresses regulatory changes on new gas connections
- Removes NO_x for improved IAQ and occupant comfort
- Modern, future-proof option that embraces incorporation of heat pumps
- A simple to install, cost-effective, and familiar technology

A Dated Technology



Scale collected in the bundle of an immersion heater

Electric immersion heaters are not a new technology. They have been used for many years as backup heat sources in commercial boiler-fed indirect cylinders, a low-demand application for which they are perfectly suitable.

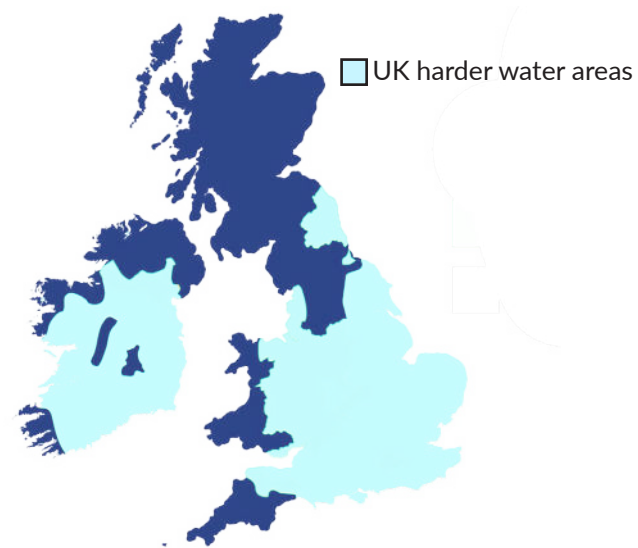
With new net zero driving a preference for electric-only hot water systems, delivering reliability is an essential business demand. However, direct immersion heating is not reliable as a primary heat source in hard water areas for commercial applications.

Scale of the Problem

Approximately 65% of the UK mains water is classed as 'hard' due to the presence of calcium. A naturally occurring mineral, calcium is safe to ingest so levels in drinking water are unregulated. In the cold water supply it is held as solute in the water and rarely leaves traces on the pipes and fittings.

When 'hard' water is heated the calcium precipitates out of the solvent as calcium carbonate, clumping together and attaching to the hottest surfaces as limescale. Within a water heater, limescale will typically form on the heat exchanger or heating element.

Variation in heat exchanger types impact the formation of scale. A direct electric immersion heater aggravates the formation of scale due to the temperature and intensity of the heating element, whereas a heat exchange coil or tube typically exhibits a much lower surface temperature and comparatively less scale formation.



Immersion heaters have been known to fail in hard water areas in as little as six months

These larger heat exchangers also have a greater capacity to expand and contract, causing scale to flake off as it forms, avoiding detriment to the heat exchanger. Electric immersion heaters with close, tight bundles of rods also expand and contract, but some scale cannot fall clear, becoming trapped in the rods and damaging the element.

Where limescale forms and remains on the heat transfer surface, because it is non-conductive, the surface becomes insulated leading to overheating of the element or heat exchanger. Over time this will cause it to rupture if the heat cannot be dissipated.

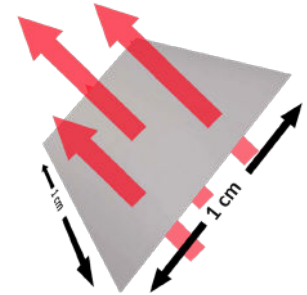
Combatting Limescale

It is common for protection from limescale formation to be provided by a vigorous cleaning regime. This option carries both a cost and system downtime that is not acceptable for many commercial buildings.

For electric immersion hot water systems scale formation should be a major concern...

For this reason, an approach which minimises formation of scale, reducing the need for cleaning, is more advantageous.

Heat Intensity represents the amount of energy passing through a cm^2 of the heat exchanger surface area



Ways To Minimise Scale

1

Water Softener

2

Scale Inhibitor

3

Alternative heat exchanger

Water Softener

A water softener replaces calcium ions from the water supply with sodium ions preventing formation of limescale. This is the best way of dealing with limescale and provides a benefit not only for the water heater but for the whole system.

However, water softeners require regular maintenance, filling them with salt, which if neglected cancels all benefits. Some studies also question the suitability of softened water for drinking. For most water heating systems it is advised not to fully soften all of the water but, to minimise corrosion risk, to blend softened and mains water to achieve a hardness of 100ppm (CaCO_3).

Scale Inhibitors

Scale inhibitors are designed to alter the ionic structure of the water so the scale is less likely to precipitate out of the water. There are several methods, but they only create a temporary effect. Over time the water returns to its natural state.

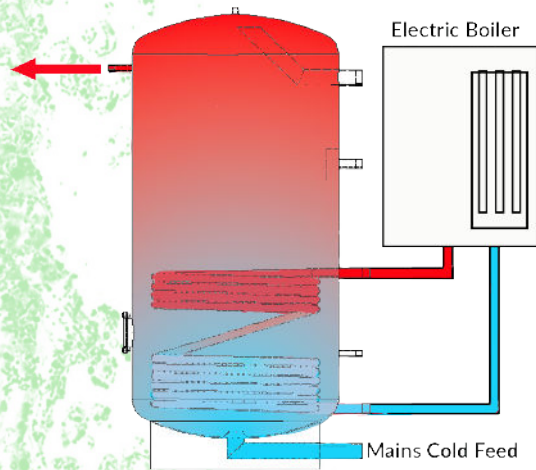
As a low-maintenance product, inhibitors are often selected to protect hot water systems as a 'fit and forget' technology. This is a common mistake. Whilst inhibitors do reduce scale formation and the required amount of water heater maintenance, they do not replace the maintenance regime, nor provide enough protection to ignore possible scale formation.

For many sites neither a water softener or a scale inhibitor provides a satisfactory response, whether because of space, maintenance, downtime, or cost. A better option for these sites would be to replace the immersion heaters with a low limescale forming hot water system.

Alternative Heat Exchange

The Case For Using An Electric Boiler

An electric boiler, such as the Advenco ARDENT, heats water using immersion heaters located in a small tank within the boiler housing rather than directly installed into a hot water tank. This creates a sealed 'primary' loop to an indirect coil in the cylinder, eliminating the common problems of direct electric heating.



The electric boiler heats the same water continuously so there is only a small, finite amount of scale in the system which will not damage the elements. The heat exchanger in the cylinder is a large coil operating at a relatively low (80°C) temperature.

Extensive experience with indirect coil use in the UK has shown that scale is not usually a significant problem in these systems. The electric boiler operates at the same efficiency as an electric immersion heater (100%) and so the only overall difference in system efficiency is the minimal pump electrical consumption and a negligible amount of heat loss in the pipework.



An electric boiler hot water system will take up a little more space than an all-in-one electric cylinder, but it has more versatility and requires less clearance for the cylinder. Similarly priced to an immersion heater, an electric boiler system can cost slightly more due to the small amount of additional installation work. But with the cylinder forming significantly less scale, vastly improving reliability and drastically reducing maintenance demands, operational and maintenance savings will quickly offset any additional capital costs.

The electric boiler additionally offers a level of redundancy that is not achieved with a single immersion heater. Scale formation is significantly reduced to a level that scale control can be adopted or not, depending on other building fittings and equipment that may benefit from it.

ADVECO



Adveco Ltd. Unit 7 & 8 Armstrong Mall, Southwood Business Park,
Farnborough, Hampshire GU14 0NR

T | 01252 551 540 E | enquiries@adveco.co

LIMESCALE PROTECTION IN ELECTRIC DHW SYSTEMS

www.adveco.co