No chemicals, simply chemistry.

eleXion

Chemical Free Water Treatment

- A Guide for New and Existing Systems

www.elexion.uk

EleXion has a strong belief that effective hydronic corrosion protection should not cost the earth, not just in terms of finances, but also when considering our greatest asset…. the environment.

With the drive towards Net Zero, carbon reductions and our impact on the environment, we are helping our clients protect their assets, ensuring efficiencies remain high, keeping operating and maintenance costs low, in a sustainable way, minimising our impact on the environment.

Chemical additives have long been at the forefront of UK guidance for the HVAC industry in an ongoing struggle to prevent corrosion within our sealed heating and cooling systems.

Our guidelines look at how metals react when they come into contact with water, salts/minerals, and oxygen. We do not look to “inhibit” or suppress the issues, instead we deal with the root cause of the corrosion, doing so strictly without the use of chemical additives.

Using both our experience and that of our manufacturing partners, we are able to offer our clients proven methods and products from two of Germany’s leading experts in the field of chemical free water treatment.

With a combined experience exceeding 50 years in the prevention of corrosion, eleXion alongside our partners are now setting the standard in the UK for chemical free closed loop water treatment.

Not only are our solutions sustainable and environmentally friendly, encompassing natural metal passivation processes, but also offer superior protection over traditional methods, far exceeding the BSRIA B29 requirements when utilising CF CPC, without the use of harsh chemicals.

Proven, tried and tested chemical free water treatment.

EleXion were invited to provide technical advice to BSRIA during the review and updating of the BG50 documentation. Electrochemistry is now included within this guidance and recognised by BSRIA alongside the use of demineralised water as an accepted alternative to more traditional, less environmentally friendly chemical based processes.

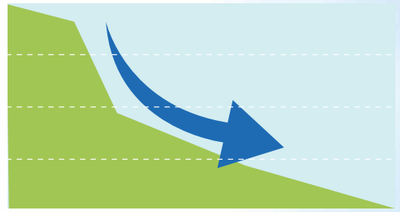
This guide covers problematic older systems as well as new systems and is in accordance with Europe’s most stringent guides and our experience in closed loop water treatment.

Referenced Guidelines:

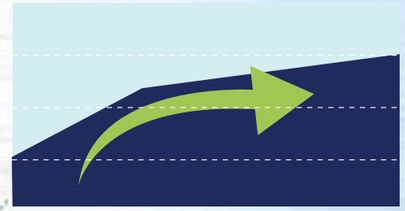
German VDI 2035
German guideline AWGF District Heat Networks
Danish District Heating Association
Swiss SWKI BT 102-01
Austrian ÖNORM H5195-1
BSRIA BG29
BSRIA BG50
CIBSE Heat Networks Code of Practice CP1 2020

Heat Networks Consultant · CPD CIBSE APPROVED UNTIL 2025 · BESA AFFILIATE · CIBSE PATRONS

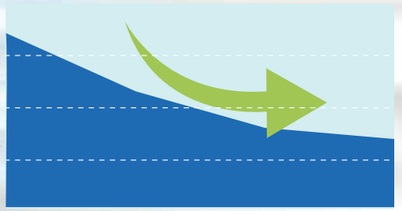
As simple as…



Dissolved oxygen O_2mg/L



pH value



Electrical conductivity µS/cm

We target 3 key areas, the root causes of corrosion which helps protect system components and maintain high levels of efficiency. Sustainable, simple and effective corrosion protection.

NO chemical cocktails and NO complicated formulas, eleXion simply use 100% trusted natural chemistry to provide ongoing corrosion protection. Offering sustainable and environmentally friendly system solutions, which give constant and reliable protection.

Chemical free guidance

Water from the mains supply often contains undesirable minerals, salts, bacteria, and has a low pH which are not suitable for filling modern heating/cooling systems.

Hard water can severely impact the performance and life expectancy of modern systems, with it being noted that up to 1mm of scale can result in a reduction of efficiency of up to 10%.

The VDI 2035 (table below and right) Swiss SWKI BT 102-01 and Austrian Ö NORM H5195-1, all state that the sum of total hardness should not exceed certain levels with a view to preventing the effects caused by limescale within the system.

Total Heating output in kW	Total hardness in °dH		
	Specific system volume in l/kW (Based on smallest individual heating output)		
	≤ 20	>20 – 40 ≤	40 <
≤50 kW specific water content generator ≥ 0.3 l/kW	None	≤ 16.8	≤ 0.3
≤50 kW specific water content generator > 0.3 l/kW and systems with electrical heating elements	≤16.8	≤ 8.4	
>50 – 200 ≤ kW	≤ 11.2	≤ 5.6	
>200 – 600 ≤ kW	≤ 8.4	≤ 0.3	
>600kW	≤ 0.3		

Each mineral within mains water carries a small charge, either negative or positive and this is what gives water what is known as “electrical conductivity.” It has long been accepted that water with a high electrical conductivity provides an accelerated path for corrosion to take place as well as the potential for scale to form which will impact the efficiency and reliability of the system and its components.

Using a method known as demineralisation via ion exchange, we can combat the effects of water with high conductivity, minerals and salts, providing a better class of conditioned water for our systems which removes the possibility of scale formation and reduces the risk of corrosion from taking place.

Xi+ is our in-house special mix ion exchange resin designed to condition the fill water and/or existing circulating water to the parameters detailed in this guideline which is also in accordance with VDI 2035.

Our resin not only removes salts and minerals from the fill/circulating water, the special blend of anion and cation beads provides a significantly better exchange capacity of acids and aggressive salts over many standard resins available. As these acids are removed along with carbon dioxide, the pH of the fill water already starts to increase which provides the ideal environment for passive layers to form on the metals surface.

Xi+ enables the basic requirements of VDI 2035 to be achieved at point of fill

VDI 2035 LOW SALIINE	System water	Unit
Total hardness	Dependant on system size	mg/l
Conductivity	>10 - < 100	µS/cm
pH	8.2 – 10	pH

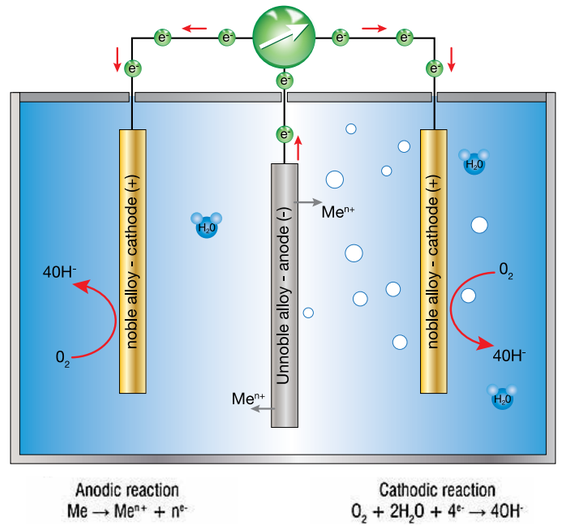
Along with the electrical conductivity of the circulating water VDI 2035 stipulates that dissolved oxygen should be removed from the system as well as maintaining the pH to set levels to aid in the natural passivation of the system metals.

pH control can be achieved at the same time as removing dissolved oxygen from the system when utilising electrochemistry.

Electrochemistry can also be referred to as continual corrosion control as it continuously removes dissolved oxygen from the circulation water. It is well known and accepted that oxygen is the driving force for corrosion, it enters the system during initial filling, top ups and also through system materials such as gaskets, hoses, crimp fittings etc.

Regulation of the pH value, consumption of oxygen/ carbon dioxide, separation of circulating particles and air bubbles can all be achieved by utilising electrochemistry.

The process is recognised by VDI 2035, AWGF and BSRIA BG50 as a suitable corrosion protection regime without the need for chemical additives, it is also actively recommended by the Swiss SWKI BT 102-01.



Elexion provided technical guidance and prepared this image for BSRIA for the revised BG50 documentation

Electrochemistry provides 100% natural and sustainable system protection, without the need of chemicals.

No electrical power supplies, no complex system components or servicing routines are required when implementing electrochemistry.

As easy as...

Existing systems looking to convert on a gradual basis to the chemical free standard, which are not suffering from constant or severe water quality or system issues.

Install

Install elector reaction tank and ioniX refill devices on the system.

The elector tank will assist in the clean-up of the system by collecting floating debris in the base of the tank. The mild alkaline environment created in the reaction tank can pick up oils, small particles, films and kill bacteria as the system water passes into the chamber.

The tank will condition the overall system water by removing dissolved oxygen and regulating the pH to ideal ranges.

ioniX refill devices will be installed to the outlet of the pressurisation unit and/or manual quick fill point on the system. When top up water is required it will pass through Xi+ ion exchange resin before entering the system, putting the water in a non-corrosive state, and increasing the pH by removing minerals, salts, and carbon dioxide.

Clean

As part of the gradual rejuvenation phase, the elector reaction tank will require regular inspections, potentially up to the first year of operation. The client may also need to clean system strainers as part of this process, although this will be driven by the condition of the system water prior to works commencing.

The elector reaction tank will require draining to remove debris and allow the system to then be topped up with demineralised water via the ioniX filling unit. This process not only removes the debris but also works towards removing inactive chemical additives from the system and reducing the electrical conductivity of the system water. On a monthly basis the condition of the system water should show considerable improvements with water samples supporting visible improvements.

The anode can be cleaned manually be simply removing from the device and cleaning with a wire brush and then reinserting within the tank.

Protect

Once the system water conditions have improved, the levels of corrosion reduced and the reliability of the system back to an acceptable standard, the system can then be returned to a normal service routine. The anodes should be inspected once to twice a year and the reaction chamber drained when doing so.

The anodes within the reaction tank and resin within the filling units should be replaced when required to maintain the system water quality and remains within the target parameters required to meet the VDI 2035 standards.

Existing systems looking for rapid results for switch to chemical free standard because of constant or severe water quality or system issues.

Install

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Clean

Dependant on system design, materials and chemicals used, plus condition of the system water, it may be preferable to dilute with fresh mains water. Lowering the chemical concentration will reduce resin required to condition the circulation water, the impact of chemical additives can pollute the resin meaning the life expectancy is reduced and that the volume required to reach the required limits could be increased. Dilution can be undertaken by a simple dynamic flush to reduce the concentration.

Removal of chemical additives via inline conditioning via ion exchange resin Is possible if the above is not practical to complete onsite, it should be noted that the resin quantity will likely be increased during this method.

The system water is now ready to be conditioned by inline treatment where the existing system water passes through our ioniX mobile filling station on a side stream basis where it connects to the flushing bypass supplied with the elector tank, or other suitable points on the system.

The ioniX filling station can be connected in series with mobile eleXion high efficiency pumped filters or on larger systems multiple eleXion high efficiency pumped filters can be temporarily installed on other parts of the system to help aid the initial clean-up of floating debris and films.

Once the system water has been conditioned to <100 µS/cm the ioniX unit can be removed. The filters should remain on the system until circulation particles have been removed and that a water sample shows the correct required levels.

Protect

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New systems, ready for pre-commissioning clean utilising CPC process as per BSRIA BG29 and complying with chemical free guidance

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Clean

Once the new system has been completed it should be filled with preconditioned Di water from a mobile ioniX filling unit. For larger systems requiring higher filling rates, other options are available. System components such as fan coil units should be put into bypass mode. The system water will enter the system with the minerals and salts extracted to the desired levels stated in VDI 2035 low saline operation. The water will also be conditioned to ensure it is free from bacteria.

eleXion high efficiency pumped mobile filters should then be attached to temporary parts of the system on a side stream basis. Multiple filters can be added either in parallel or separate parts of the system to aid in filtering the debris/films.

Once the system has been filled, vented and pressure tested the system should then operate under the velocities as stated in BSRIA BG29. This can be achieved by using existing system pumps or temporary pumps provided to ensure velocities are met.

The eleXion high efficiency pumped filter will then operate to remove installation debris, initial corrosion particle and films. The internal differential switch in the filter will deactivate the pump and raise an alarm when the filters become blocked. Filter cartridges should start at 30µm, filtering down to 0.5µm.

Once the system water parameters reach the desired levels components such as FCUs can be brought online ready for flushing.

Protect

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eleXion recommended target parameters

We recommend the following system parameter targets:

eleXion target requirements	System water	Unit
Total hardness	Dependant on system size	mg/l
Conductivity	>10 - <200*	µS/cm
O2	<0.1	mg/l
pH	8.2 – 10	pH
Chloride	<30	mg/l
Sulphates	<50	mg/l
Nitrates	<50	mg/l
Total iron	<1	mg/l
Dissolved iron	<0.5	mg/l
Total copper	<0.5	mg/l
Total Aluminium	<1	mg/l
SRB	0	cfu/ml
NRB	0	cfu/ml
Pseudomonads	<1000cfu/ml at 30˚C**	cfu/ml
TVC	< 10,000 cru/ml at 30 °C and no increasing trend	cfu/ml

* VDI 2035 low saline operation recommends electrical conductivity of less than 100 µS/cm.
When using an elector reaction chamber, it is acceptable to be less than 200 µS/cm and still be protected.
** VDI 2035 states “Water-carrying systems are not sterile and will therefore always contain micro-organisms (for example, bacteria, algae, fungi)”. There is no advice given in terms or parameters however, it is referenced that “In practice biofilm formation and MIC can only be reduced by reducing the supply of nutrients to the micro-organisms” Our European partners would usually only test for bacteria if it is visual during a system analysis or corrosion has taken place where all other stated parameters have been achieved. The figure shown in the table above is as stated in BG29. When implementing chemical free we aim to create an environment by reducing the supply of nutrients and where bacteria levels can be maintained

UK sites now benefiting from chemical free water treatment

EleXion have worked on a diverse range of projects including universities, schools, hotels, offices, Biomass farms and communal heating schemes, providing corrosion protection for sealed LTHW and chilled water systems

Fabrick, Halifax

University of York

Hampton Grange, Bromley

Fully customisable range of buffer vessels available

Visit our website for futher details

Up to 10-year warranty

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