

Water Treatment

The role of water treatment in the
effective operation of steam systems

First for Steam and Energy Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

Contents

- 1.0 Executive Summary
- 2.0 Types of raw water contamination
 - 2.1 Dissolved solids
 - 2.2 Dissolved gases
 - 2.3 Suspended solids
 - 2.4 The pH value of water
- 3.0 How water impurities affect steam systems
 - 3.1 Corrosion can damage steam systems
 - 3.2 Deposits can reduce energy efficiency
 - 3.3 Foaming reduces system efficiency and can contaminate product
- 4.0 Treating raw water contamination
 - 4.1 Water softening and chemical dosing
 - 4.2 The water softener stage
 - 4.3 Dealkalisation
 - 4.4 Demineralisation
 - 4.4.1 Reverse osmosis
 - 4.5 Controlling dissolved gases in the boiler feedtank
 - 4.6 Chemical conditioning of the feedwater
- 5.0 Reverse Osmosis
- 6.0 Designing a water treatment programme
- 7.0 Spirax Sarco Steam System Conditioning
 - 7.1 Analysis and audit
 - 7.2 Steam System Conditioning Service Agreements

1.0 Executive Summary

In even a relatively small country like the UK, raw water quality varies considerably from region to region. If these variations are not catered for properly, organisations will see a dramatic impact on the efficacy of their steam system operations.

The type and level of impurities in water supplies from different utilities needs to be analysed carefully and considerable expertise needs to be applied to create the most effective water treatment regime for a particular system and its processes.

The advantages of applying a proper water treatment

programme are considerable, not only in protecting the boiler and wider steam system from corrosion and potentially high maintenance costs, but also improving energy efficiency, reducing carbon emissions, maximizing productivity, minimizing the use of treatment chemicals and lowering the total cost ownership of plant.

This white paper reviews the causes and types of impurities found in water, the impact they can have on steam systems and how they can be controlled through softening technologies, and chemical treatment or reverse osmosis.

2.0 Types of raw water contamination

During its fall to earth, rainwater picks up impurities such as carbonic acid, nitrogen and, in industrial areas, sulphur dioxide. The water then permeates through the upper layers of the earth to the water table, or flows over the surface of the earth dissolving and collecting additional impurities. The common impurities in raw water include dissolved solids and gases, suspended solids and scum-forming substances.

2.1 Dissolved solids

The main types of dissolved solid are calcium and magnesium bicarbonates that dissolve to form an alkaline solution, and calcium and magnesium salts in the form of sulphates and chlorides that precipitate out of solution and can create deposits. The alkalinity of the water is an important measure that must be controlled to avoid damaging deposits forming in the boiler.

Other dissolved solids, such as sodium salts, are more soluble than calcium and magnesium salts and will not generally form deposits on a boiler's surfaces.

2.2 Dissolved gases

Oxygen and carbon dioxide are readily dissolved by water. The most harmful is oxygen, which in even very small amounts can be very damaging by pitting metal surfaces. Lower temperature boiler feedwater will contain more dissolved oxygen than water at higher temperature.

Just as harmful is carbon dioxide, which is often present in the form of carbonic acid, causing the water's pH level to fall, leading to corrosion. In addition, the heating of carbonates and bicarbonates inside the boiler causes the release of carbon dioxide, which can cause corrosion in the condensate system, by the formation of carbonic acid.

2.3 Suspended solids

These are substances that exist in water as suspended particles. They are usually mineral or organic in origin and are not generally a problem as they can be filtered out. If they penetrate to the RO system severe blockages can occur in the membrane.

2.4 The pH value of water

Another measure of water properties is its pH value. This is not an impurity or constituent but a numerical measure of the potential hydrogen content of water - which correlates to its acidity or alkalinity.

Water, H_2O , has two types of ions - hydrogen ions (H^+) and hydroxyl ions (OH^-). Hydroxyl ions are only relevant for the boiler when the water pH is more than 9.7. As the pH rises the more hydroxyl ions become present.

British Standard BS2486:1997 recommends that boiler water is maintained between 10.5 and 12.0. Outside this range the rate of corrosion of steel rises significantly as shown in figure 1.

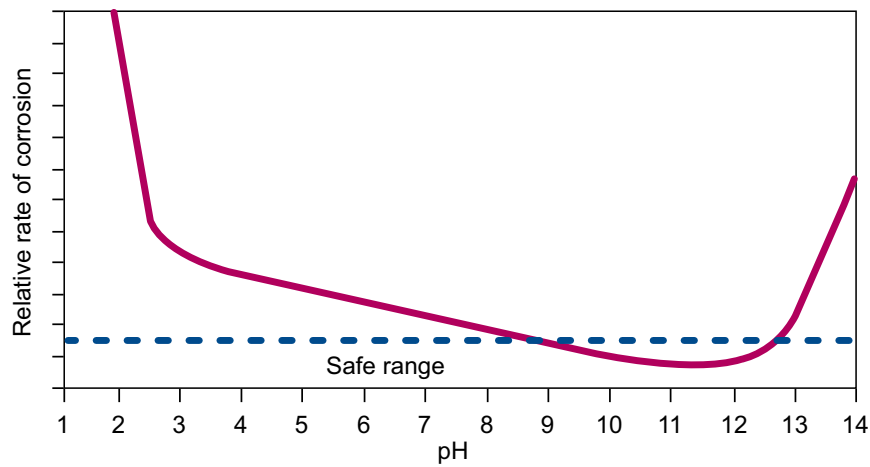


Figure 1: The effect of water pH on the corrosion rate of steel. BS2486 recommends boiler water is kept in the pH range 10.5 – 12.0.

Name	Chemical symbol	Common name	Effect
Calcium carbonate	CaCO_3	Chalk, limestone	Soft scale
Calcium bicarbonate	$\text{Ca}(\text{HCO}_3)_2$		Soft scale, corrosion
Calcium sulphate	CaSO_4	Gypsum, plaster of Paris	Hard scale
Calcium chloride	CaCl_2		Corrosion
Magnesium carbonate	MgCO_3		Soft scale
Magnesium sulphate	MgSO_4	Magnesite	Corrosion
Magnesium bicarbonate	$\text{Mg}(\text{HCO}_3)_2$	Epsom salts	Scale, corrosion
Sodium chloride	NaCl	Common salt	Electrolysis
Sodium carbonate	Na_2CO_3	Washing soda	Alkalinity
Sodium bicarbonate	NaHCO_3	Baking soda	Foaming
Sodium hydroxide	NaOH	Caustic soda	Alkalinity, embrittlement
Sodium sulphate	NaSO_2	Glauber salts	Alkalinity
Silicon dioxide	SiO_2	Silica	Hard scale

Table 1: The common impurities in water.

3.0 How water impurities affect steam systems

There are three main consequences of water impurities on a steam system – corrosion, deposits and foaming.

3.1 Corrosion can damage steam systems

If the boiler feedwater contains dissolved gases, particularly oxygen, corrosion of the boiler surfaces, piping and other steam system equipment is likely to occur. Carbonic acid can cause thinning of metal surfaces in contact with water, for example the bottom of pipework, while oxygen causes pitting of metal surfaces above the water, for example the top of pipework. If carbonic acid and oxygen are present in the water then the rate of corrosion rises by about 10%.

Caustic embrittlement or caustic cracking caused by excessive concentrations of sodium hydroxide can also lead to metal failure. Older, riveted boilers are more susceptible to this kind of attack; however, care is still needed on modern welded boilers at the tube ends.

3.2 Deposits can reduce energy efficiency

If the alkalinity of the feedwater is not controlled, then deposits on the heat transfer surfaces will build up. A layer of deposits is a barrier against effective heat transfer and can reduce the overall energy efficiency of boilers dramatically; forcing the boiler to burn more fuel to raise the same amount of steam. A deposit layer just one millimetre thick can reduce boiler efficiency by 10%.

In extreme cases, deposits can create local hot spots that can cause mechanical damage or even boiler failure.

If a build-up of deposits is identified, the boiler will need to be cleaned.

There are two approaches to getting rid of deposits. Stripping down the boiler and treating the affected surfaces with acid. This is a “quick fix” that enables the boiler to regain its full energy efficiency as soon as it resumes operations. But it also puts the boiler completely out of action for a prolonged period of time. This may be impractical for some boilers, or the cost of lost production during the downtime may be prohibitive. The acid treatment is also aggressive and can exacerbate any weaknesses in the equipment.

Online cleaning is a more gradual process over several months that dissolves the deposits, or softens and loosens them so that they drop to the bottom of the boiler. First it is important to identify the type of deposits present because different chemical dispersants will be needed for different deposits. In some rare cases, for example if silica contamination is present, online cleaning will be ineffective.

Online cleaning involves running the boiler at a higher alkalinity, with extra-low levels of dissolved solids and higher levels of chemical dispersants. The advantage is that the boiler can carry on generating steam throughout the process. But the extra boiler blowdown needed to keep dissolved solids at bay and to remove the additional sludge from the bottom of the boiler means losing energy, in addition to the extra money spent on treatment chemicals.

Typical deposits found in steam boilers

Deposits, whether iron oxide or hardness salts, will reduce the boiler's ability to transfer heat.

Calcium and magnesium carbonate deposits

The dissolved bicarbonates of calcium and magnesium break down at high temperature and pressure to give off carbon dioxide and form insoluble calcium and magnesium carbonates. Crystals of calcium carbonate are large and matted together with finely divided particles of other materials, so the scale looks dense and uniform.

Carbonate deposits can be identified easily by dropping in hydrochloric acid solution, bubbles of carbon dioxide will effervesce from the deposit and the deposit will dissolve.

Calcium sulphate deposits

This deposit is much harder than a carbonate deposit because the crystal structure is smaller. A sulphate deposit is brittle, does not pulverise easily and will not effervesce when dropped in hydrochloric acid solution.

Silica deposits

This deposit is very hard, resembling porcelain. The crystals of silica are extremely small, forming a very dense impervious scale. This scale is glossy in appearance, extremely brittle, very difficult to pulverise and not soluble in hydrochloric acid solution.

Silicate scales can be formed in all boilers. Maintenance of a ratio of silica content to caustic (OH) alkalinity of less than 0.4 : 1 can prevent this.

Iron deposits

Iron deposits from corrosion products are very dark in colour and can be magnetic. They are soluble in cold strong acid, giving a dark brown solution.

3.3 Foaming reduces system efficiency and can contaminate product

Foaming may occur if the alkalinity of the water is too high, the boiler's TDS levels are too high, there is excessive contamination in the condensate return, the dosage of polymers is too great, or increased boiler concentrations. Foam forms in the space between the water surface inside the boiler and the steam off-take. This creates carryover in which the foam is carried out of the boiler and into the steam distribution system itself.

Foaming can cause numerous problems including:

- Water trickling down from the steam connection of the gauge glass, making it difficult to see the water level accurately
- Level probes, floats and differential pressure cells may not accurately determine the boiler water

level, which could cause the boiler to run dry

- Alarms may be sounded, and the burner(s) may even 'lockout'. This will require manual resetting of the boiler control panel before supply can be re-established.

If the impurities in the boiler feedwater are not dealt with properly, carryover of boiler water into the steam system can occur. This may lead to problems elsewhere in the steam system, such as:

- Contamination of control valve surfaces, degrading their operation and reducing their capacity
- Contamination of process plant, increasing thermal resistance and reducing heat transfer effectiveness
- Blocking of steam traps, leading to plant waterlogging and reduced productivity.

Correct boiler operation to control carryover

Carryover can be controlled by a water treatment programme that may include the addition of anti-foaming agents to the boiler water to break down the foam bubbles. However, carryover can also be caused by incorrect boiler operation, such as:

- Operating the boiler with an excessively high water level
- Operating the boiler below its design pressure, which increases the volume and velocity of the steam released from the water surface
- Operating the boiler with an excessive total dissolved solids (TDS) level
- Excessive steam demand.

Smooth boiler operation is important. With a boiler under constant load and within its design parameters, the amount of entrained moisture carried over with steam should be less than 2%. However, if load changes are rapid and large, the pressure in the boiler can drop considerably, creating turbulent conditions as the contents of the boiler flash to steam. The reduction in pressure also increases the specific volume of the steam with larger bubbles that create more foaming.

If the steam system creates substantial demand changes during normal operation then other measures should be taken, such as:

- Replacing on/off boiler water level controls with modulating controls
- Implementing 'surplussing controls' to prevent the boiler pressure from dropping too far
- Installing a steam accumulator
- 'Feed-forward' controls to bring the boiler up to maximum operating pressure before the load is applied
- 'Slow-opening' controls that bring plant on-line over a pre-determined period
- Install RO to reduce alkalinity & foaming

4.0 Treating raw water contamination

Raw water with all its impurities needs to be treated before being fed to the boiler in order to avoid corrosion and poor steam system performance as described in the previous section. This feedwater treatment should be external to the boiler. The major water treatment processes include:

- Water softening supplemented by chemical treatment in which various chemicals are added to the boiler feedwater in order to reduce the effect of deposits, corrosion and chemical attack within the system.
- Reverse osmosis - a process in which the water to be treated is forced through a semi-permeable membrane to strip out nearly all the contaminants, leaving behind a concentrated solution of impurities, which is rejected to waste.
- Carbon filtration – if the water is heavily chlorinated, carbon filtration may also be required either between the water softener and the Reverse Osmosis plant or before the water softener itself. This is necessary to remove chlorine from the water, which otherwise could be highly corrosive.

4.1 Water softening and chemical dosing

Chemicals added to the boiler feedwater should adhere to a strict chemical treatment programme. BS 2486: 1997 and BS EN 12953 –10 2003 are examples of UK and European Practices providing guidance on water treatment. Deviation from such practices can result in excessive chemicals entering the steam system, which in turn can result in severe fluctuations in the quality / purity of steam entering the process. Conversely, insufficient chemical dosing can result in excessive corrosion and scale within the steam and condensate system.

It's also important to take into consideration the fact that brine waste from softeners can be significant and can contaminate effluent.

4.2 The water softener stage

The water supply is first softened, with ion exchange being the most common form of water treatment for shell boilers producing saturated steam. Ion exchange uses an insoluble resin made of beads of 0.5 to 1.0 mm diameter. The resin beads are porous and hydrophilic - that is, they absorb water.

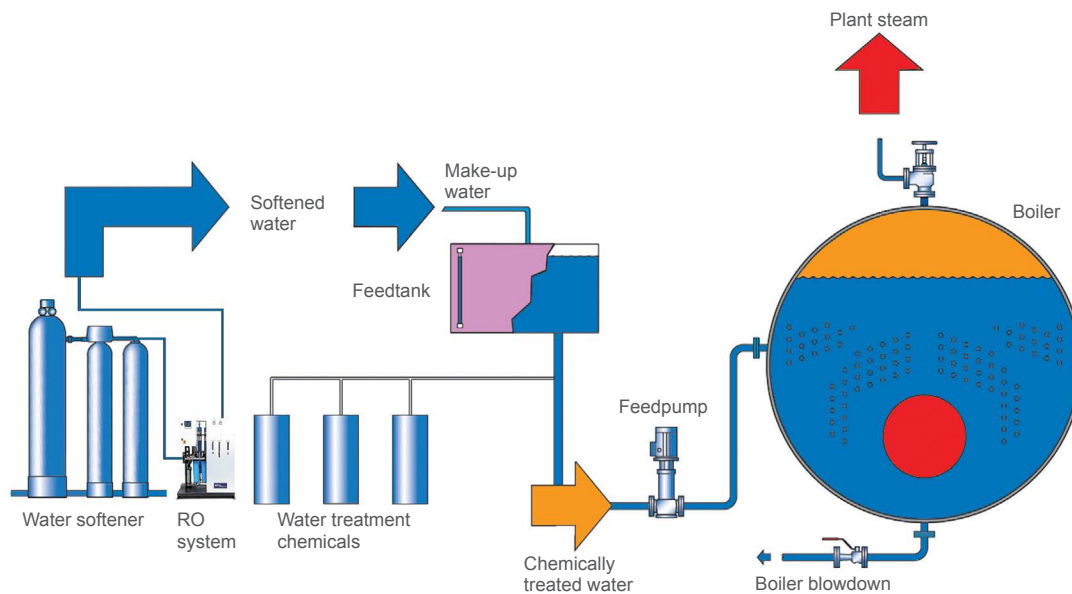


Figure 2: Overview of the chemical treatment of boiler feedwater.

Base exchange softening is the simplest form of ion exchange and also the most widely used. The resin is initially activated (or charged) by passing a brine solution through it, which leaves the resin rich in sodium ions. The water to be softened is then pumped through the resin bed and ion exchange occurs. Harmful, scale-forming calcium and magnesium ions in the water are substituted by the sodium ions from the resin, leaving the flowing water rich in sodium salts which do not form scale in the boiler. The resin has a finite exchange capacity and needs to be regularly recharged with a brine solution.

Softeners are relatively cheap to operate and can produce treated water reliably for many years. They can be used successfully even in high alkaline (temporary) hardness areas provided that at least 50% of condensate is returned. Where there is little or no condensate return, a more sophisticated type of ion exchange is preferable.

4.3 Dealkalisation

The disadvantage of base exchange softening is that there is no reduction in the water's TDS and alkalinity. This is overcome by a dealkaliser that first removes 90-95% of the alkalinity. A dealkaliser is seldom used without a base exchange softener.

Before the adoption of RO, a dealkalisation plant was used to remove alkalinity from water and reduce the impact from alkalinity breaking down to carbon dioxide in the boiler.

4.4 Demineralisation

Demineralisation is typically only used with high pressure boilers of more than 30 bar, such as those in power stations and so is not relevant to most industrial applications. The process removes virtually all the salts by passing raw water through both exchange resins.

4.4.1 Reverse Osmosis

Osmosis is a process that uses a semipermeable membrane allowing ions to move from a concentrated solution to a less concentrated solution. This process stops as osmotic pressure increases.

RO uses high pressure to overcome the osmotic pressure and artificially reverse the process. Salts are now concentrated on the outside of the membrane and sent to waste. Pure water is forced by pressure through the semipermeable membrane to the centre of the membrane ready for use. The pure water, or 'permeate', will have had 98-99% of its salts removed.

4.5 Controlling dissolved gases in the boiler feedtank

Water from the softener or RO plant is fed to the boiler feedtank where it needs to be kept at a high enough temperature to minimise the content of dissolved oxygen and other gases. The correlation between the water temperature and its oxygen content is shown in Figure 3.

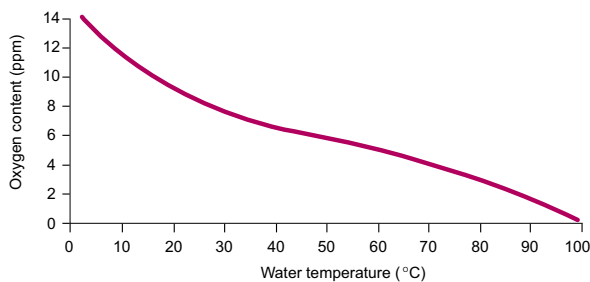


Figure 3: Heating the feed water lowers its oxygen content, reducing the corrosion potential, saving chemical and energy costs.

If a high proportion of make-up water is used, heating the feedwater can substantially reduce the amount of oxygen scavenging chemicals, such as sodium sulphite, required. Furthermore, reducing these chemicals added to the boiler feedwater lowers the amount of bottom blowdown needed, saving energy.

Cold water from the water treatment plant makes up any losses in the system. The pre-treatment plant is typically a softener or RO plant that feeds the hotwell. The softener or RO plant is actuated from level probes located in the hotwell, giving an 'on / off' control signal. In this way, make-up water flow controls the hotwell water balance. The boiler feed pumps take water from the hotwell to top up the boiler as steam is produced.

4.6 Chemical conditioning of the feedwater

Before entering the boiler, water from the feedtank is treated by adding chemicals in metered amounts. The chemical treatment required depends on the operating conditions of the steam system, including water hardness and impurities, the volume of condensate

returned to the feedtank and the boiler design and operating parameters. Figure 4 shows the best points in the steam system to apply chemical treatments.

Inevitably, some impurities will pass through the main water softener treatment system, so this chemical conditioning stage aims to ensure the water going into the boiler is at the right quality. The objectives of the chemical treatment include:

- Preventing scale formation from the low remaining levels of hardness. Sodium phosphate is normally used for this, and causes the hardness to precipitate to the bottom of the boiler where it can be blown down. If reverse osmosis is used then no phosphate is required and polymers can be used instead.
- To maintain the correct chemical balance in the boiler water - to prevent corrosion it needs to be alkaline and not acidic. Typically, feed water pH should be maintained between 8.5 and 9.5, while boiler water pH should be kept between 10.5 and 12.0. In addition, alkalinity levels in the boiler can be controlled by the addition of sodium hydroxide.
- To condition any suspended solids by introducing a polymer to disperse them.
- To provide anti-foaming protection.
- To remove traces of dissolved gases, including oxygen, carbon dioxide and other gases that may create corrosion. This is achieved by introducing oxygen scavenging chemicals, such as catalysed sodium sulphite, and condensate corrosion inhibitors, such as neutralising amines, to deal with the corrosive effects of carbon dioxide in steam
- Sludge conditioners are used to prevent solids from depositing on metal surfaces and keep them in suspension
- Synthetic polymers can also be introduced at this stage to prevent silica from combining under high pressure and temperature with metal heating surfaces to cause hot spots. Maintaining a ratio of silica content to caustic (OH) alkalinity of less than 0.4:1 can prevent this.

Chemical	Purpose
Sodium hexametaphosphate	Antiscalant and sludge conditioner
Sodium hydroxide	Corrosion inhibitor
Sodium metabisulfite	Oxygen scavenger
Sodium metasilicate	Sludge dispersant
Sodium phosphate (mono-, di-, tri-)	Antiscalant and sludge conditioner
Sodium polyacrylate	Sludge dispersant
Sodium polymethacrylate	Sludge dispersant
NN-diethylhydroxylamine	Condensate corrosion inhibition
Tannin powder	Oxygen scavenger
Sulphonated copolymer	Sludge dispersant
PBTC	Sludge dispersant
Methylene phosphoric acid	Sludge dispersant
Diphosphoric acid	Sludge conditioner
NTA (4Na)	Sludge dispersant
Cobalt sulphate	Oxygen scavenger catalyst
Cyclohexylamine	Condensate corrosion inhibition
Morpholine	Condensate corrosion inhibition
Diethylaminoethanol	Condensate corrosion inhibition

Table 2: Typical water treatment chemicals. These chemicals are usually supplied under proprietary names.

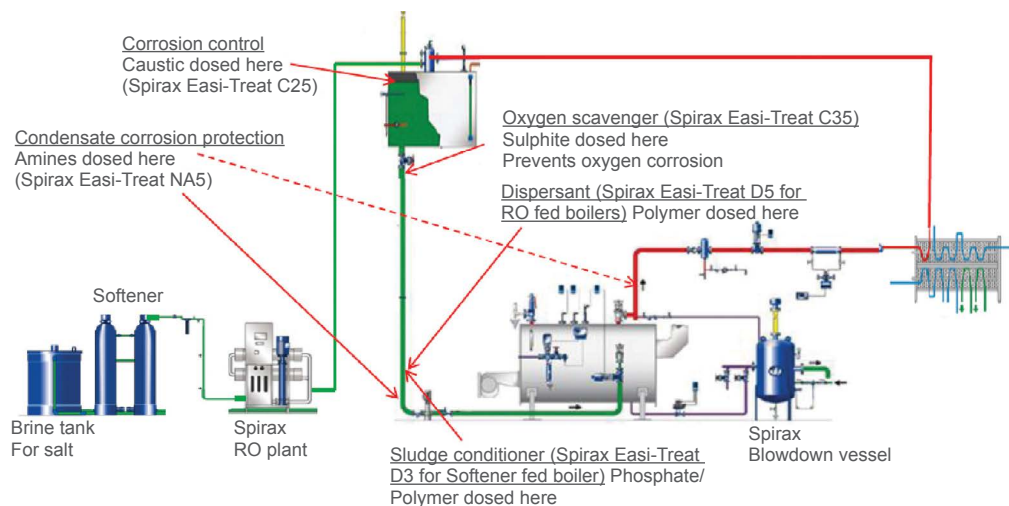


Figure 4: The correct points of dosage of water treatment chemicals.

5.0 Reverse Osmosis

Reverse Osmosis (RO) provides an alternative to traditional chemical-based water treatments. It removes virtually all salts from the incoming water supply (it may sometimes require some anti-scalent chemicals) and it doesn't need to be regenerated like conventional ion exchange resins.

RO relies on semi-permeable membranes, which have pores so fine that only water molecules are small enough to pass through them. In nature, similar membranes are responsible for regulating the water and nutrient levels in living cells. In industrial applications, pumps apply pressure to the raw water side and force pure water through a synthetic membrane, leaving salts and other contaminating molecules behind. Probably the easiest way to visualise RO is as a filtration system.

If no softener is used in front of the RO, water with a high level of natural salts can be treated using minimal anti-scaling chemicals or without chemicals, but with regular de-scaling using a buffered acid. So it's often considered a safer option in sensitive systems, such as medical, food or pharmaceutical applications. RO is

generally cost-effective and often delivers sufficient savings to achieve a payback of between 12 and 18 months.

An RO plant can deliver energy and water savings because it reduces significantly the need for boiler blowdown by decreasing the quantity of TDS in the boiler. RO also reduces the need for boiler treatment chemicals, while reduced scale formation helps minimise ongoing maintenance costs.

In addition, RO avoids many of the issues that need to be tackled with water softeners, such as carbon dioxide corrosion, chloride-induced corrosion, high TDS, and carbonates and bicarbonates that pass through softeners which may cause corrosion.

All these benefits need to be weighed against the upfront capital investment and operating costs of RO.

The wide range of available membranes means that RO is straightforward to adapt for different raw water sources and different mineral contents. The rejection rate of salts from the raw water is usually between 98% and 99% depending on the membrane and feed water quality.

Water treatment for clean steam applications

Clean steam is typically raised from purified water in a dedicated clean steam generator. It overcomes the potential risks of contamination from plant steam and should be considered for quality-critical processes, which are at risk from the typical contaminants found in plant steam.

Clean steam generators should only be operated if the feedwater is of appropriate quality. Raw water is not adequate and will require some pre-treatment, which is governed by the nature and concentration of raw water contaminants. Reverse osmosis (RO), deionised/demineralised (DI) and continuous electro-deionised (CEDI) water are possible feedwater alternatives. The feedwater used for generating clean steam will not be chemically treated since most of the particulates, inorganics and dissolved solids etc are removed at the pre-treatment stage.

Although clean steam generators often use plant steam as a heat source, it is important to remember that the quality (dryness) of the plant steam is still important in order to maintain good heat transfer, hence maximising efficiencies.

6.0 Designing a water treatment programme

There is no standard treatment for water that all steam system operators can apply. This is because of variations in the quality of the water being supplied by water utilities, as well as variations in the steam application itself. To enable a water treatment programme to be created for a steam system, the impurities in the water supply must first be analysed.

Water supplies and steam systems are extremely dynamic and their chemistry can vary day by day. The quality of raw water is obviously an important factor when choosing a water treatment plant. Although TDS levels will affect the performance of the boiler operation, other issues, such as total alkalinity or silica content can sometimes be more important and then dominate the selection process for water treatment equipment.

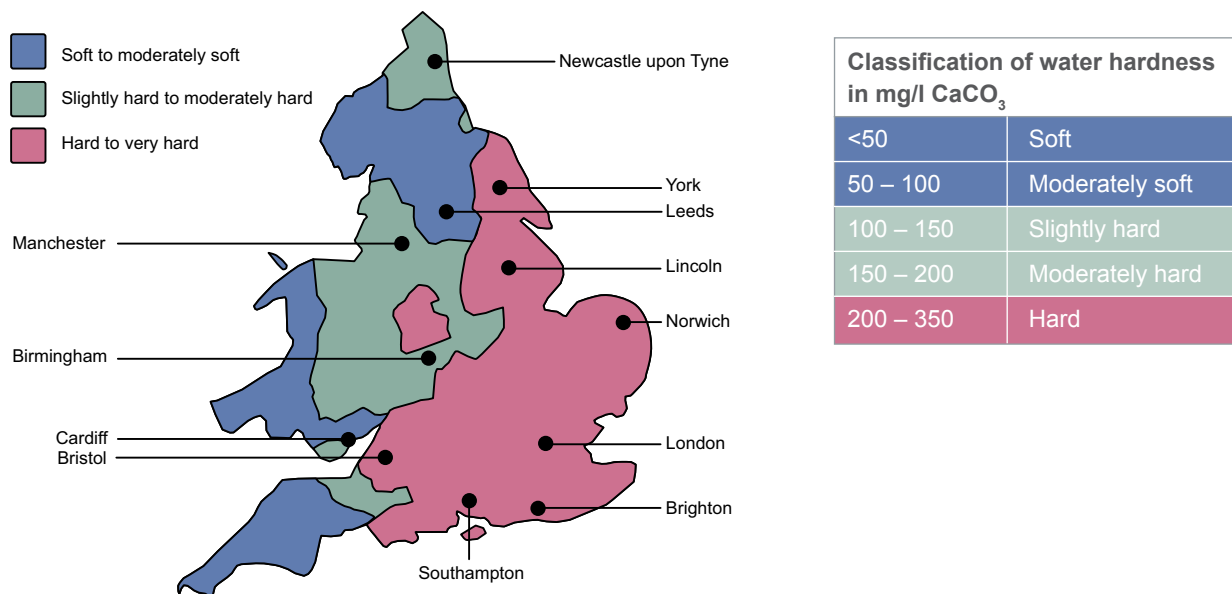


Figure 5: Water quality can vary tremendously from one region to another depending on the sources of water and local minerals.

Area	Total hardness	Total alkalinity	Total dissolved solids (TDS)
Leeds	22	22	46
York	248	248	310
Birmingham	100	100	230
London	372	372	422

Table 3: Water variation within the UK. All impurities expressed in mg/l calcium carbonate equivalents.

Deciding on the type of chemical regime and water treatment system is a matter for a skilled water treatment specialist. Most boiler owners recognise that they do not possess the in-depth knowledge and skills in house to optimise their water treatment and steam system conditioning regimes. If they opt to bring in specialist help, the contract should specify no more than a month between visits.

Even so, it may be prudent to carry out in-house checks between visits from the experts, and the specialist company should provide whatever support the end user needs to make those checks possible. For example, Spirax Sarco not only provides testing kits and water treatment engineers, but also makes sure that steam plant owners have all the training they need to use them properly. The recommendation on most sites is to carry

out testing several times a week, so any changes in the system chemistry can be identified and dealt with immediately.

The benefits of a correctly designed water treatment programme include:

- Faster steam system warm-up times
- Reduced downtime
- Fewer product rejects because steam reaches the point of use in the correct condition
- Maximising heat transfer throughout the steam system
- Minimising chemical, water and energy use
- Reducing energy waste and carbon emissions
- Lower fuel bills through improved energy efficiency
- Compliance with water treatment guidelines (EN 12953/BS2486)

Dealing with phosphate dosing by utilities

Water companies started adding phosphate to the water supply in order to meet the limits on lead imposed by the 1998 European Drinking Water Directive. The Directive gave EU Member States 10 years to ensure that drinking water supplies have lead levels that do not exceed 25 microgrammes per litre of water. An even tougher limit of just 10 microgrammes per litre will come into force by December 2013.

When the legislation arrived on the scene in 1998, the water to some 8 million British households was still travelling through lead pipes, some of which belonged to the water companies and others to home owners. Although the water companies and householders will have replaced many of these old pipes by now, it's doubtful whether lead will be totally eliminated from the supply in the foreseeable future. So it looks like phosphate dosing is here to stay.

The phosphate situation varies across the UK. For example, soft water tends to dissolve the most lead, so suppliers in soft water areas will typically be relying on phosphate dosing more heavily than suppliers in hard water areas. But wherever a site is based, steam system operators should be aware that they could have an issue with phosphate unless they or their water treatment contractor keep on top of the situation.

If the presence of phosphate is recognised in the water supply, the right treatment can prevent it precipitating and becoming a problem. Phosphate causes scaling when it reacts with calcium or magnesium in the boiler water, depositing scale onto the boiler tubes. Typically this happens when the boiler water becomes too hard, perhaps as a result of incorrect water pre-treatment or a poorly performing water softener.

Avoiding this situation involves constantly and consistently managing the alkalinity of the water in the boiler, adding chemical dispersants and ensuring that the level of dissolved solids is kept in check through regular boiler blowdown.

7.0 Spirax Sarco Steam System Conditioning

Spirax Sarco provides a comprehensive Steam System Conditioning service that can help increase the efficiency of systems, reduce energy consumption, lower maintenance costs and reduce the level of plant downtime arising from the management of water and steam quality.

Unlike traditional suppliers of water treatment chemicals who focus on the boiler, Spirax Sarco takes an end-to-end approach to the steam and condensate system. This is based on the realisation that a 'clean' boiler is only part of the picture and water treatment must optimise the overall efficiency of the entire system.

7.1 Analysis and audit

The service starts with an initial assessment of the boiler house and system to establish whether a full conditioning audit is appropriate. If so, the audit is tailored to site requirements and gives recommendations for establishing an effective steam system conditioning strategy.

The audit includes:

Water and process mapping

Mapping identifies how the water and steam quality changes as it progresses through the plant. This enables probable impact on the operation of the steam and condensate system, as well as the process, to be assessed.

Fingerprinting

Fingerprinting compares deposit analysis with water quality to establish the root cause of scaling and corrosion in the steam and condensate system.

Environmental compliance

Reducing the environmental impact and associated costs, while ensuring environmental compliance.

Defined cost savings, payback and cost of ownership

An executive summary focuses on defined cost savings, added value projects and cost of ownership. The main report also provides a review of the plant operations and design.

7.2 Steam System Conditioning Service Agreements

Once the auditing is complete, Spirax Sarco offers comprehensive service agreements for managing the conditioning strategy to conserve water and energy, reduce chemical use and plant downtime.

Service agreements can include:

Water conditioning

Design and implementation of a chemical and analytical programme to BS 2486, providing scale and corrosion control and support services. Selection, installation and servicing of dosing equipment, pre-treatment plant and control systems.

Plant integrity check

The plant integrity check ensures that both efficient heat transfer surfaces and safe waterside conditions have been maintained. It also audits the effectiveness of the chemical program and plant operations.

Routine fingerprinting and steam quality testing

To investigate scale, corrosion and steam quality issues to maintain plant efficiency and longevity.

Boiler house log book

Provision of boiler house log book detailing chemical treatment programme, report escalation procedures, operation and safety information and agreed key performance indicators.

Training

Steam system conditioning awareness training for boiler operators, in accordance with BS 2486, helps to ensure safe and compliant administration of site involvement in the conditioning programme.

Service agreement review

Annual business review of the service agreement, achieved cost savings and future added value projects to ensure continuous improvement.

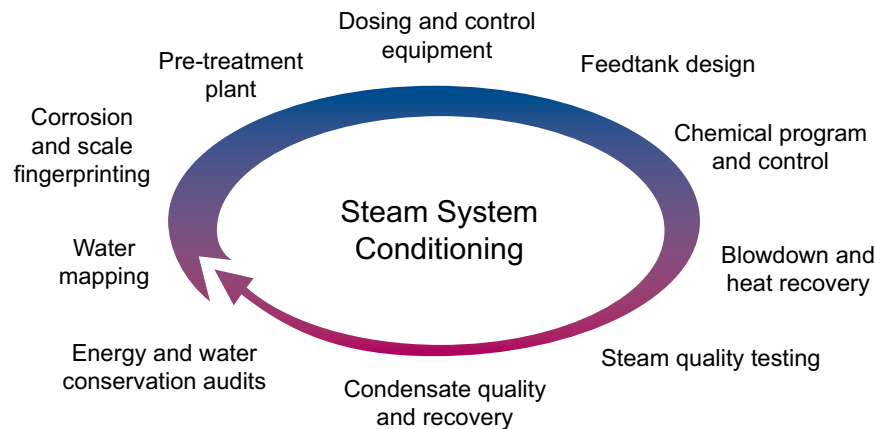


Figure 6: Spirax Sarco Steam System Conditioning covers all aspects of the control of water and steam quality.

1. Pre-treatment plant includes water softeners, reverse osmosis plant, deaerators, and salt saturators. Spirax Sarco also provides conditioning and cleaning chemicals as well as installation and commissioning services and service agreements.
2. Dosing and control equipment covers chemical dosing pumps, bulk storage chemical tanks, boiler interfaced chemical dosing and service agreements.
3. Feedtank design encompasses a portfolio of feedtanks and ancillaries such as deaerator heads and data logging.
4. Chemical Program & Control provides oxygen scavengers to eliminate oxygen corrosion; sludge dispersants and conditioners to prevent scale in the boiler; precipitants (phosphate) to prevent scale; alkalinity builder (caustic) to prevent boiler corrosion; condensate treatment to prevent condensate corrosion, as well as test kits, boiler house logbooks and training.
5. Blowdown & Heat Recovery delivers a wide range of products and service agreements to recover heat from waste streams
6. Steam Quality Testing for clean steam, dryness fraction, condensable gases and condensate water analysis
7. Condensate Quality & Recovery covers comprehensive products, as well as corrosion monitoring, inline monitoring, data logging and trend monitoring
8. Energy & Water Conservation Audits for recycling and reuse, heat recovery return on investment and feasibility study, advice on Carbon Trust initiatives and efficiency monitoring
9. Water Mapping looks at the water quality impact throughout the steam system
10. Corrosion & Scale Fingerprinting covers scale & corrosion analysis, water analysis, chemical program with cross-matching water analysis and chemical program with deposit analysis for identification of route cause

Spirax Sarco water treatment programme revitalizes research centre steam system

Spirax Sarco provides water treatment services to an international centre for research in the UK, including servicing its automatic TDS blowdown controls and softening equipment. Spirax Sarco engineers regularly visit the site to monitor and adjust the system.

Spirax Sarco has overhauled the water treatment regime at the centre, halting a corrosive period that had seen the boiler feedtank replaced twice in four years. Other costly repairs to pipework, valves, humidifiers and other steam plant components have also been eradicated.

Using steam for humidification, washing and sterilization, the centre previously suffered regular breakdowns, blocked valves, hot water supply interruptions and even water coming through the humidification system.

Spirax Sarco found the problems stemmed from the previous water treatment procedure. By analysing the water quality as it passed through the steam system, Spirax Sarco was able to recommend an improved mix of treatment chemicals and processes that has reduced corrosion in the boiler.

Since Spirax Sarco's involvement, unplanned maintenance work on the steam system has been eliminated, and the centre now enjoys better quality steam and consistently heated water. It is also using less water treatment chemicals, saving further costs.



First for Steam and Energy Solutions

EXPERTISE | SOLUTIONS | SUSTAINABILITY

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