WATERWIDE

Viv

Special points of interest:

- **Oxygen solubility in water is inversely proportional with temperature. This means that cold water has the potential to dissolve more oxygen than hot water. This is why having the feed water temperature as high as possible on a boiler plant is so important.**
- **Many steam boilers undergo annual inspection over the summer months, as part of Waterwide's technical commitment to its clients we take regular photographs of the inside of the boiler shell to monitor the condition of the boiler on an ongoing basis.**

BOILER WATER TREATMENT

A boiler is like an industrial pressure cooker. A sealed cylinder containing water is heated up by burning gas or oil. Steam is driven off through a regulating valve in the boiler and used to heat up a process or application on the site. As steam is pure water vapour, the boiler content is maintained and replenished with more water called **feed water.** The steam once used in the application is either lost or is condensed and returned to the boiler plant. This is called **condensate** and has no solids dissolved in it. Even in the most efficient plant however, it is not possible to recover all the steam as condensate thus the condensate has to be added to in order to maintain the boiler water level. This water is called **make up**.

Make up water is usually pre-treated to remove some of the scale forming ions. To do this a **base exchange softener** is usually used. This takes calcium and magnesium out of the water and replaces it with non scale forming sodium ions. This softened make up water and condensate return make up the boiler feed water.

There are several problems which can occur within a boiler system. The major problems are; scale and sludge deposition, corrosion and boiler water carryover. If left untreated these problems can in extreme cases cause steam boilers to explode and it is for this reason that standards have arisen on how to treat and maintain boiler systems.

WATERWIDE works to BS2486 which specifies the chemical conditions required to be maintained in the boiler water to avoid scale and corrosion and to ensure that the steam produced is pure and dry.

- Scale and sludge deposition are the result of the precipitation of compounds that are no longer soluble. Calcium carbonate (chalk or limestone) is one of the most common of these compounds. When water dissolves calcium carbonate, calcium bicarbonate is formed. When this solution is exposed to heat, as in a boiler, the calcium carbonate re-precipitates out and forms a scale within the boiler. Much of the calcium carbonate is removed from the make up water by the base-exchange softener but some hardness may remain. The water should be regularly tested as boilers cannot tolerate large amounts of scale (BS2486). Other compounds may remain dissolved even under high temperatures and pressures, eg. calcium sulphate, until the point of saturation when they precipitate out as suspended solids. These solids can bake onto heat transfer surfaces and affect efficiency. The solids can be conditioned with the use of **phosphate** and **polymers** which create an amorphous sludge which can be removed through blowdown.
- There are many types of corrosion that can occur in a boiler. Two common types are oxygen corrosion and carbon dioxide corrosion. All natural water contains oxygen. This dissolved oxygen can cause oxygen pitting but can be removed using an **oxygen scavenger** which absorbs the oxygen from the water. The gas carbon dioxide can also be dissolved in water and can be neutralised using **Amines** (carbon dioxide corrosion is covered in detail overleaf).
- Boiler water carryover is where water droplets are carried over into the steam, line thus creating wet steam. Wet steam has less energy and introduces impurities into the condensate return and thus the boiler feed water. Carryover can occur when the boiler pressure reduces or when the water in a boiler foams. It is important, therefore, that boiler pressure is maintained and that foaming is minimised. Foaming can be caused by a high alkalinity in the boiler water (a boiler should maintain alkalinity between >350ppm P alkalinity and <1250ppm total alkalinity - BS2486). High alkalinity is caused primarily by a high level of dissolved solids. Controlling dissolved solids should serve to maintain alkalinity within the BS2486 guidelines.

WATERWIDE supply boiler water treatment chemicals for use as part of a boiler's ongoing treatment regime. If you require further details, please contact us via any of the means overleaf.

MONEY DOWN THE DRAIN

The question of efficiency in a steam raising boiler plant can be viewed from a variety of angles. Ultimately however, it all comes down to cost.

Improvement in efficiencies on this type of plant can be categorised into three main groups;

- Proper water treatment to minimise scale deposition
- Minimising boiler water blowdown
- Installing heat recovery equipment

The adjacent article describes chemical treatments required for a boiler plant.

Minimising blowdown and using waste heat recovery systems are also very important ways of making savings.

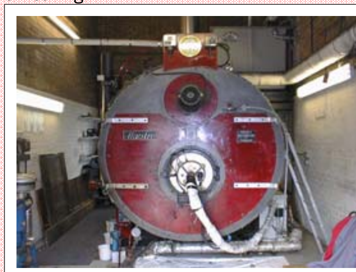
To help justify the installation of a heat recovery system which in turn will lead to reduced blowdown, the following example may be of use; Take a boiler plant running at 100 psi with a feed water temperature of 50 C.

From steam tables, it can be deduced that at 100 psi, the calorific value of the steam produced will be 2764 kj/kg.

At 50 C under atmospheric pressure, the feed water will have an energy valve of just 207 kj/kg.

Increasing the feed temperature to 80 C will increase the energy value of the feed water to 336 kj/kg. (The difference between 50 C and 80 C being 129kj/kg).

Dividing this difference by the 2764 kj/kg in the steam and multiplying out as a % shows a saving in the amount of energy (fuel) needed to produce any given amount of steam. This example equates to a 4.6% saving .



This figure is somewhat over simplified, assuming several variables are constant and that the boiler is running at 100% efficiency. It does however, demonstrate the benefit of using waste heat recovery to raise the feed water temperature.

Increasing the feed temperature reduces the amount of dissolved oxygen present. This in turn reduces the requirement for oxygen scavenger which reduces the TDS loading. This then reduces the amount of blowdown required and hence in turn reduces the energy wastage associated with putting hot water to drain.

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CODE OF CONDUCT ASSOCIATION

Inexpensive Water Softener Monitoring

Water softeners are used both in domestic and industrial situations. The use of a water softener is to remove calcium and magnesium scale forming ions and exchange them for non scaling sodium ions. Hence water softeners are sometimes referred to as base exchange units.

Soft water can be easily tested for with the use of a simple colour change tablet. A small sample of water is taken and one tablet introduced. If the water turns green, then the water is soft. If the water turns red, then the water is hard.

As a consequence of this red/ green result, the tablets used in the test are sometimes referred to as Yes / No tablets or Stop / Go tablets for obvious reasons.

WATERWIDE can supply a complete test for evaluating hardness, which will also allow a moderate degree of definition on how hard (or soft) a water is. Similarly, we can provide replacement test tablets for most type of Yes/No—Stop/Go kits.

If you have any questions or comments regarding water related topics, please telephone, fax or e-mail

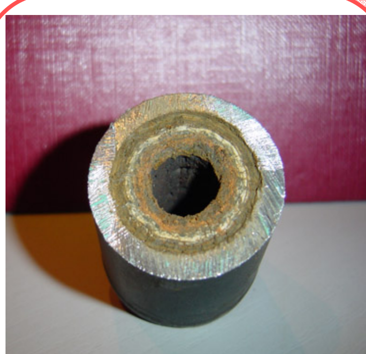
Iron in the Condensate Return

Returning condensate to a hot well on a steam raising boiler plant is seen as one of the most efficient ways of minimizing energy losses from such a plant.

Good quality condensate from good quality steam condenses providing high quality hot make up to the feed tank. This minimizes the requirement of fresh, often cold soft water supply.

Being hot, also minimizes the amount of dissolved oxygen present in the feed water thus in turn, minimizing the amount of oxygen scavenger required to remove traces of oxygen from the feed water. This then (in the case of sulphite type oxygen scavengers) helps to minimize the loading of the TDS of the boiler and maximize the alkalinity.

Good quality condensate can result in its own problems. The pH will typically be very low, ~ <7.0. This is due to the presence of carbon dioxide in the steam forming a dilute carbonic acid in the condensing condensate. Acidic condensate readily picks up iron from pipe work and fittings resulting in a feed water to the hot well which often contains a few ppm of dissolved iron. This may not be readily noticed at the time but on entering the boiler by way of the feed water, the alkalinity of the boiler will quickly precipitate the dissolved iron as a hydrated iron oxide in the boiler shell. This can be noted from the bright red/brown cloudy colouration of the boiler water. It will quickly cover the heat transfer surfaces resulting in an adherent iron oxide scale which can seriously affect heat transfer and increase the potential for under deposit corrosion within the boiler.



A cross-section of a condensate line - The red/brown rings are iron oxide deposits and the white ring is calcium scale deposited from carryover.

To remedy this, condensate line inhibitors are often used to either elevate the pH or physically lay down a barrier on the internals of the pipe work to minimize the affect of the acidic condensate. Some plants however cannot risk the use of such treatments. Hospitals, Textile industries and food factories are typical of this group. Such establishments have to look at alternative means of minimizing corrosion in their condensate lines.

Two main options are available;

- Stainless steel return lines in place of mild steel will help alleviate the problem of iron in the condensate.
- Installation of a dealkalisation/degassing plant will remove the carbonates and bicarbonates from the make up water which in turn will prevent them from breaking down forming carbon dioxide in the first place

Either way is costly but is certainly cheaper than descaling or retubing a failed boiler, with all the down time, lost productivity and aggravation caused.