

## Correct boiler water treatment ensures a long service life for your boiler

*Oxygen in the boiler water is the Number One enemy of the boiler plant, closely followed by seawater and oil. Aalborg Industries recommends multi-chemical water treatment*

### Various treatment options

A variety of boiler water treatments are effective to deal with the ultimately hazardous problems of scaling, corrosion or sludge in a boiler plant. The remedy depends of the type of boiler plant and problem.

The options range from multi-chemical treatment to single-treatment/one-shot products and from manual to automatic water treatment systems. Reduced manning levels create a demand for easier methods and procedures because engine room staff has less time to undertake traditional water analysis and treatment.

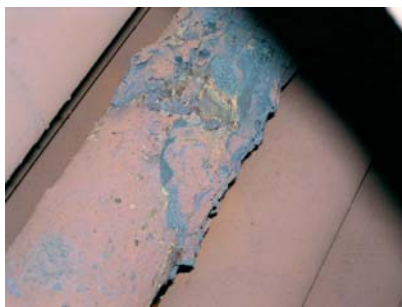
### Easy - but not fail proof

Fairly simple methods of boiler water analysis involving combined treatment chemicals are available. Such systems are often referred to as single-treatment or "one-shot" systems and are based on two simple tests: the pH value and the conductivity of the boiler water. One-shot systems generally require a supply of high quality make-up water and an optimized condensate and feed water system (far from common on all plants). Unfortunately, the advantages are minor in comparison with the results when such support conditions are not satisfied. In many

cases, serious corrosion damage is subsequently found in the boiler.

### Boiler corrosion and oxygen

One of the most common reasons for boiler corrosion remains the action of dissolved oxygen in the make-up water and feedwater. In many procedures, excessive oxygen content is unfortunately merely treated as a secondary factor based on "good" experience and/or results measured on an optimized plant during a test trial.



*Severe corrosion of boiler convection tubes on the water side*

When Aalborg Industries evaluates a case of boiler corrosion, our policy is to either measure and control the oxygen content in the boiler water or to measure and control the amount of oxygen-binding component.

### Multi-chemical water treatment

Aalborg Industries recommends the use of a multi-chemical boiler

water treatment system incorporating an oxygen-binding component which can be controlled separately, based on the analysis of remaining dissolved oxygen or the amount of component in excess. The multi-chemical treatment system has the further merit of better individual control with reduced chemical usage.



*Corroded boiler furnace dome and convection tubes*

Good boiler water treatment is dependent not just on the chemicals but also on the daily maintenance of the condensate and feedwater systems, as well as the boiler itself. It is important that the condensate returns in its full amount and that, if possible, the hot well temperature is kept at 85-95°C for deoxygenizing (see "Aalborg Solutions" No. 2) and that the boiler is regularly skimmed and blown down. The crew must still ensure skilled and efficient monitoring and maintenance of the complete system.

A feedwater deaerator, whether pressurized or under vacuum, is generally better than traditional open hot wells. Deaerators underwrite closed installations into which only a small amount of air/oxygen penetrates.

Additionally, it is possible for a larger amount of the heat to be returned to the system instead of cooling the condensate in a cooler before it enters an open hot well.

In terms of boiler water treatment, the best water condition is obtained if the majority of the condensate can be led directly to a deaerator since the pressure, temperature and mechanical design give better possibilities for water deaeration.

### AWT - Automatic water treatment systems

Automatic water treatment (AWT) systems can take care of many of the daily tasks and reduce the crew's work load. Furthermore, most systems can log water conditions at frequent intervals, enabling records to be stored on floppy disks for subsequent easy assess.

#### Recommended boiler water characteristics for boilers working at pressures up to 20 bar

Appearance	clear and free of mud
Chloride content	<100 ppm Cl
"P" alkalinity	100-150 ppm CaCO <sub>3</sub>
Total alkalinity	<2 x "P" alkalinity
pH at 25°C	10.5-11.5
Hydrazine excess	0.2-0.5 ppm N <sub>2</sub> H <sub>4</sub>
Phosphate excess	20-50 ppm PO <sub>4</sub>
Specific gravity (20°C)	<1.003 kg/m <sup>3</sup>
Conductivity (25°C)	<2000 micromhos
Oil content	nil

#### Feedwater characteristics recommended for boilers

Appearance	clear and free of mud
Hardness	0-0.5 ppm CaCO <sub>3</sub>
Chloride content	<15 ppm
pH at 25°C	8.5-9.5
Oil content	nil

A multi-chemical treatment method should be adopted with an AWT system, and the system should incorporate an oxygen probe for measuring and controlling the amount of dissolved oxygen in the boiler water. Aalborg Industries anticipates increasing adoption of AWT systems driven - despite installation costs - by the short-term and long-term benefits to operators.



Severe pitting and scaling in downcomer tube

### Seawater and oil contamination

Attention is drawn to the damage caused by contamination from seawater and oil. Both promote heat transfer resistance on the water side of the boiler, causing the steel structure facing the flame and flue gas to be heated beyond its design point. Structural damage/rupture will occur when the contamination becomes sufficiently high, resulting in a leaking boiler.

### Prevention better than cure

Aalborg Industries thus always recommends the provision of salinity alarms/shut-downs and oil-detecting systems in the feedwater arrangements. Many ships are, however, still delivered without such safeguards even though their costs are very small compared with the expense of a damage repair.

### Condensate and feedwater system layout

Owners and yards should consider the layout of the condensate and feedwater system at the newbuilding design stage with attention to the following aspects:

- The proposed type of boiler water treatment
- Number and location of chemical injection points
- Manual or automatic water treatment
- Installation point for salinity and oil-detection equipment
- Design of cascade tank
- Hot well or deaerator system
- Temperature control of the hot well

The tables in the left column indicate Aalborg Industries' recommended characteristics for boiler water and feed water for its own auxiliary boilers.

Sodium sulphite can be used instead of hydrazine; the allowed excess in that case being 30-60 ppm. When other types of oxygen-binding agents are applied, Aalborg Industries recommends that their excess should be measured to confirm that no oxygen is dissolved in the boiler water. A value of <0.02 ppm is advised if the content of dissolved oxygen is measured directly.



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