



Aalborg Solutions

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Scaling in boiler/feedwater systems

Daily maintenance of a boiler plant must address the potential of scaling, corrosion and sludge in all sections of the boiler plant and include preventative measures. This newsletter deals with scaling.

Various treatment options

There are considerable economic advantages to maintaining your auxiliary boiler plant well by providing good quality boiler/feedwater treatment. There are several chemical water treatment programmes available that address both physical condition of the feedwater, heating and venting of the hot well and pressurized deaeration, but also counter the harmful effects of dissolved gases, particularly oxygen.

Water treatment goals

The primary goals of a controlled water treatment programme are:

- to maintain clean scale-free water-side heat transfer surfaces in steam generating systems
- to prevent metal loss due to corrosion
- to ensure efficient production of steam in boiler systems without priming, foaming or carry-over contamination
- to prevent the formation of deposits in steam/condensate systems
- to minimize heat loss from the system due to excessive blow down from boilers
- to keep all power generating and auxiliary equipment and associated water and steam systems at their most efficient levels and thus minimize costs.

Aalborg Industries emphasizes the importance of full chemical treatment (see Aalborg Solutions No. 5) to secure a trouble-free, cost-effective operation of low-pressure boiler/feedwater systems. All sections of the system must be protected by the treatment which must be continuous.

Main problems in boiler water

The main water-related problems of a boiler/feedwater system leading to equipment failure and increased operating costs are: *scaling, corrosion and sludge*. Each may contribute to the severity of the others. In addition, if one or more of the problems remain unchecked in one part of the system, other parts like the host section may be adversely affected as well.

Scaling in boilers

Scaling is the formation of a crystalline interlocked layer of mineral substances on heat transfer surfaces. Severe scaling normally occurs only within the boiler. Its mechanism is the exceeding of solubility limits of mineral substances due to elevated temperature and solids concentration at the tube/water interfaces.

Typically, in low-pressure boilers, the scale formed is mainly a carbonate/sulphate complex of cal-

cium and magnesium embracing calcium carbonate and magnesium sulphate. If unchecked, scaling causes progressive lowering of the boiler efficiency by heat retardation (it acts as an insulator). Eventually, scale build-up will cause the tubes to overheat and rupture.

Scale can also cause accelerated corrosion. Semi-porous or discontinuous scale provides the physical environment for "crevice" or differential concentration corrosion.



Boiler scaling on boiler tubes in composite boiler

Preventative measures

The first anti-scaling preventative measure is to supply good quality distilled (demineralised) water as make-up feedwater. The purer (mineral-free) the feedwater is, the weaker the driving mechanism to form scale. Even the purest make-up water contains some minerals, however, and others are added by seawater seepage across condensers and coolers.

Scale-forming minerals which do enter the boiler can be rendered harmless by internal chemical treatment. A long-established technique is to detach the "hardness" cations, magnesium and calcium, from the scale-forming minerals and replace them with sodium ions.

Sodium phosphate and hydroxide are fed to the boiler water. The insoluble compounds calcium phosphate and magnesium hydroxide are preferentially formed in the bulk water under boiler conditions, precipitating as non scale-forming

fluid sludges. The sodium cations are exchanged to combine with the carbonate, sulphate and chloride anions to form highly soluble compounds.

In another scale prevention technique - threshold scale inhibition - a polymer is fed to the boiler water. As the scale-forming minerals are forced out of solution, the polymer attaches to the scale crystals and keeps them in suspension. The described technique is successful in conditioning seawater distiller brine where concentration and temperature values differ from those in boiler water. But threshold scale inhibition is deficient as a scale preventative measure when used alone in a marine low-pressure boiler/feedwater system.

See *Aalborg Solutions No. 7* which deals with corrosion and sludge in boiler/feedwater systems.



Boiler scaling of tube plate and tubes



Boiler scale on water side



Aalborg Solutions is published by the Aalborg Industries After Sales and deals with operation of steam and heating equipment. Ideas and suggestions for topics are most welcome.

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