Boiler storage best practice

Protecting idle boilers

Overview

Boilers that are out-of-service face the very real possibility of corrosion on the internal surfaces. Most corrosion within properly treated boilers occurs during downtime. It is therefore desirable to protect this equipment while it is out of service.

Storage procedures are designed to allow boilers to be kept off-line for any period of time without damage. Regardless of the method employed, the boiler should be thoroughly cleaned and inspected prior to storage.

There are three primary techniques are available to protect the water side of idle boilers:

- Wet storage
- Dry storage
- Blowdown cascade

This document will discuss these procedures, presenting advantages and disadvantages associated with each method.

Wet storage

Wet storage is generally employed when boilers will be idle for brief periods and/or may require start-up with short notice. Chemicals are added to deaerated boiler feedwater in the boiler to protect metal surfaces from both oxygen and low pH attack. Chemical residuals are maintained at higher-than-normal levels to ensure maximum protection. Inorganic or organic chemicals may be used, usually depending upon existing inventory of products.

NOTE: Boilers with superheaters and / or reheaters: Special precautions are required for boilers with non-drainable superheaters and reheaters. All chemicals used for lay-up of non-drainable superheaters and reheaters must be volatile to prevent deposit formation in these components when the boiler is returned to service.

Superheaters should be backfilled with chemically treated demineralized quality water to minimize deposition or corrosion after firing. Preferably, volatile chemicals should also be used for laying up the economizer and boiler. If non-volatile inorganic chemicals are used in the boiler, it is essential that precautions be taken so that none of the boiler layup solution enters the superheater.

Where the boiler is completely filled with water instead of using a nitrogen blanket, it may be necessary to install an expansion vessel (filled with properly treated water) above the highest part of the boiler to accommodate volume changes caused by temperature changes in the boiler. The vessel should be fitted with a cover and a sight glass and connected to an available opening such as a vent line at the top of the boiler to create a hydrostatic head. The tank will provide a ready visual check of water level loss or inleakage during lay-up. This tank must be disconnected prior to start-up.

Examples include:	
Sodium hydroxide[1] to maintain	350 to 450 ppm P Alkalinity and
Sodium sulfite[1] to maintain	100 to 150 ppm SO_3 residual

[1] 3 lbs of NaOH and 1.5 lbs of Na_2SO_3 per 1,000 gallons holding capacity are normally adequate for the initial dosages.

Or:	
Neutralizing amine[2] to maintain	pH ≥ 10 and
Baker Hughes BPB 59396 Oxygen Scavenger to maintain	DEHA ≥ 75 ppm

[2] 2 lbs of neutralizing amine and 2.5 lbs of Baker Hughes BPB 59396 Oxygen Scavenger per 1,000 gallons holding capacity are normally adequate for the initial dosages.

NOTE: This latter combination may also be used with non-drainable superheaters to provide protection. Use only condensate or other solids-free water for this purpose.

For boilers with complex circuitry (non-drainable superheater): After the boiler, superheater, and reheater are filled with lay-up solution, all valves on connecting piping should be tightly closed and the equipment pressurized with 5 psig (34 kPag) nitrogen.

To protect the boiler by Wet Storage:

- Fill the boiler to the normal operating level with deaerated feedwater
- Add treatment described previously
- Boil the water gently for 1 hour to afford mixing (vents should be open; maintain a safe water level)
- Raise the boiler's water level with deaerated water to eliminate any free air space and close the boiler
- Provide a surge reservoir to supply treated water to compensate for level fluctuations within the boiler; alternatively, nitrogen blanketing (5 psi) may be employed
- Test the boiler water weekly and add treatment as required to maintain proper chemical residuals
- Circulate weekly before testing and after chemical addition using an external pump or by temporarily lowering the water level and heating the boiler for one hour; then refill the boiler to the proper water level

Depending upon the surrounding environment, freeze protection may be needed.

Dry storage

Dry Storage is generally used in boilers that are to be out-of-service for long periods of time (usually greater than 6 months) or that are subject to the possibility of freezing. Dry Storage is generally preferred over wet storage but does not allow the boiler to be brought online rapidly.

The procedure is as follows:

- Remove all water from the boiler. The boiler should be thoroughly dried by circulating warm or hot air; compressed air can be used to blow water from horizontal tubes. This can be accomplished by stoves or, in some units, a small wood fire. Special attention is required for non-drainable superheaters. Apply heat to the boiler at low rates, if needed, to evaporate all residual moisture.
- A chemical desiccant is placed in each drum so that air circulation below the container is possible. Install one of the following desiccants in trays located within each drum:

Desiccant	lbs of desiccant / 1,000 gal of holding capacity
Calcium oxide (Quicklime)	8
Silica gel	10
Activated alumina	15

- As soon as the desiccant is in place, close all boiler openings and tightly blank all connections. Tightly seal the drums to prevent air in-leakage.
- An inspection of the desiccant and an evaluation of its continued ability to absorb moisture should be made every 2 months. Replace the desiccant as needed. It the desiccant becomes exhausted:
  - A crust will form on the calcium oxide
  - Silica gel becomes "gummy"
  - Activated alumina gets mushy

As a supplement to the desiccant, a 5 psig positive pressure nitrogen blanket may be employed to prevent air in-leakage. This can extend the interval between required inspections.

Another Dry Storage option is the BOILER LIZARD™ from Cortec. Cortec's BOILER LIZARD combines Vapor phase Corrosion Inhibitor™ (VpCI) powder in a polyvinyl alcohol (PVA) water-soluble bag. The powder formulation is free of phosphates, heavy metals, nitrites and free amines. Designed for dry lay-up of boilers, the BOILER LIZARD powder protects metals in enclosed spaces. The VpCIs vaporize and adsorb on all metal surfaces, reaching all recessed areas and interior cavities.

- Normal application rate is one bag per each 1,000 gallons of system capacity
- Provides continuous corrosion protection during dry lay-up period
- Protects ferrous metals and aluminum
- Provides protection in the vapor phase (void), liquid phase and the interface
- Up to 12 months protection
- Vapor phase inhibiting action protects inaccessible and recessed surfaces
- Requires little or no surface preparation for routine shutdown maintenance
- VpCI layer does not need to be removed prior to equipment start-up
- Eliminates need for other forms of protection including nitrogen blankets, silica gel and hydrazine

Blowdown cascade

Blowdown cascade is applicable when an operating boiler is located near to the boiler which is to be protected. Blowdown from the operating boiler is routed through the bottom of the idle boiler to an outlet at the top.
This method:

- Provides a low maintenance option in that it requires no circulation, testing or opening for inspections
- Allows almost immediate start-up since treated boiler water is already in the boiler
- Transfers heat from the blowdown to the idle boiler, which reduces the potential for condensation of moisture on fireside metal surfaces

Alternatively, blowdown flash tank bottoms can be routed through the idle boiler if pressure is adequate.

Live steam boiler layup

Taking live steam from an active boiler is another method of protecting an idle boiler. It maintains temperature and pressure of the idle boiler, and provides adequate protection against corrosion, both on the steam side and the fireside. Live steam should be added either to the economizer inlet, the steam drum or the superheater outlet. From there it should be exhausted at all extremities of the boiler including the bottom blowdown line in the mud drum, the superheater and the economizer if present.

Care must be taken that this practice should only be used if the superheaters are drainable, to remove accumulated condensate. Additional steam traps can be added to the lower headers or directly to the bottom blowdown line to maintain pressure and relieve condensate from the system. A thorough review of the boiler configuration is needed to apply this procedure to insure complete distribution of steam and evacuation of condensate.

References

"Consensus for the Lay-Up of Boilers, Turbines, Turbine Condensers, and Auxiliary Equipment", volume 66; The American Society of Mechanical Engineers; Three Park Avenue N; New York , New York 10016

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