

## Boiler Layup Procedures For Systems with Non-Demineralized Makeup

Boilers that are out of service for even short periods of time face the very real possibility of corrosion on the internal surfaces. There are two types of boiler layup: Wet Layup - the procedure that is used when the boiler will be out of service for shorter periods of time and may need to be brought back into service within several hours' prior notice. Dry Layup - the procedure that is generally used in boilers that are to be out of service for extended periods of time ( $\geq 30$  Days), or in situations where the boilers are subject to the possibility of freezing, thus precluding the possibility of wet layup. Prior to any long-term storage, the boiler should be thoroughly cleaned and inspected. See Technical Bulletin TB-1 "Taking Boilers Off Line". Note: There are also special procedures for Superheater Layup - if superheaters are present, see Superheater Layup Procedure (below).

The procedures that follow are designed to allow boilers to be kept off line for any period of time with reduced risk of damage.

### Wet Layup Procedure

The following wet layup procedure is appropriate for use in boiler systems where high purity makeup water IS NOT required.

1. Fill the boiler to its normal operating level, with softened, deaerated feedwater. Never fill the boiler with non-deaerated water.
2. Add enough catalyzed sodium sulfite to achieve a residual of at least 100 to 300 ppm as  $\text{SO}_3$  (158-473 as  $\text{Na}_2\text{SO}_3$ ).
  - a. This will require the addition of approximately 1.5 to 4 lbs active sodium sulfite per 1,000 gal of water in the boiler (i.e. 1.6-4.2 lbs Hytherm 225 PBB / R-9-C or 37-100 oz. R-26L).
  - b. Feed sufficient caustic soda to establish a pH of 11-12, or a hydrate alkalinity (2P-M) of 300 to 500 ppm as  $\text{CaCO}_3$ . The quantity of caustic required will depend on the alkalinity of the fill water. Typically, about 6-10 lbs (60-100 oz.) of Hytherm 150/LB-18/Alkali 50 is required per 1,000 gal of water in the boiler.
3. In the event that external circulation is not available, lightly fire the boiler, using an auxiliary fuel such as natural gas, in order to establish sufficient circulation to ensure proper mixing of the chemicals throughout the boiler.
4. After circulating, and before the unit has completely cooled and some steam pressure still remains, the boiler should be completely filled with deaerated feedwater.
  - a. An alternative to complete flooding is to place the boiler under a 5 to 10 psig Nitrogen Blanket to prevent air inleakage. CAUTION: When nitrogen blanketing is employed, safety placards should be posted and an appropriate reentry procedure established (there is danger from both asphyxiation and pressure).

5. Tightly close all connections and apply a small positive pressure to the boiler in order to compensate for the vacuum that develops as the unit cools to room temperature. This can be achieved via the feedwater pump.
  - a. As an alternative to applying a back pressure, it is possible to maintain a positive head or reservoir to serve the same purpose. This is done by connecting a clean 55-gal drum to the vent line or other available fitting at the top of the boiler. As the boiler is filled, the drum collects the overflow. Then, as a vacuum develops because of cooling, the water in the drum enters the boiler to keep it full. Additional water added to keep the drum filled should be treated with catalyzed sodium sulfite (i.e. 1 oz R-9-C or Hytherm 225 PBB powders or 2.2 oz R-26L per 50 gal of water) and caustic (i.e. 3 oz Hytherm 150/LB-18 per 50 gal of water).
6. Wet storage of a boiler should not exceed 30 days whenever possible. During longer periods of wet storage, the boiler should be circulated, or fired twice per month to bring the water temperature to 160°F before cooling.
7. The boiler should be tested weekly as long as the unit is in storage. Sulfite and caustic soda should be fed as required to maintain the recommended chemical residuals. Whenever more chemical is added, circulate the boiler water for a short time by means of an external pump or by lightly firing up to 160°F.
8. In preparation for returning the boiler to service, drain the boiler to the normal operating levels and bring the unit back on-line in the normal manner.
9. Increase the rate of continuous blowdown during the first 24 to 48 hours of operation.
10. Initiate the feed of regular boiler water treatment chemicals as soon as the boiler is placed into service.

## Superheater Layup Procedure

Drainable superheaters can be considered as part of the boiler as far as treatment procedures are concerned, and are flooded in the same manner as described in Wet Layup Procedure.

Non-drainable superheaters and reheaters require the following special precautions:

1. Before the boiler is flooded, block off the superheater section so that it is isolated from the boiler.
2. Back-fill the superheater section only with high-purity water, condensate or equivalent.
3. Add one of the following passivating oxygen scavenger products to the boiler storage water:
  - a. R-12LU (catalyzed hydroquinone) to maintain a residual of 2,000 to 3,000 ppm as product. This will require an addition of 2.0 to 3.0 gallons of R-12LU per 1,000 gallons of water in the boiler.
  - b. R-53LU (catalyzed Diethylhydroxylamine – DEHA) to maintain a residual of 200 ppm as DEHA or 888 ppm as product. This will require approximately 0.9 gallons of R-53LU per 1,000 gallons of water in the boiler.
  - c. R-1304LU (carbohydrazide) to maintain a residual of 200 ppm as Carbohydrazide or 3300 ppm as product. This will require approximately 3.2 gallons of R-1304LU per 1,000 gallons of water in the boiler.
4. Adjust boiler storage water pH to 9.5-10.0 with a neutralizing amine. This requires approximately 0.5 -2.5 lbs of active amine per 1,000 gallons of water in the boiler (i.e. 41-202 oz. of A-5 or 21-104 oz. Conden-Saf 4750).
5. Circulate the water in the superheater section to ensure thorough mixing of chemicals.
6. For start-up, follow the manufacturer's instructions for firing rate and procedures for boiling water out of the superheater tubes.

## Dry Layup Procedure

1. The boiler should be drained, cleaned and thoroughly dried. Drying is accomplished by circulating warm or hot air throughout the unit. This can be provided by the use of stoves, blowers or compressed air. Special attention is required for low areas where water may collect and/or non-drainable superheaters.
2. A vapor phase corrosion inhibitor or chemical desiccant is placed in the boiler (each drum for desiccants) so that air circulation below the container is possible. The more commonly used materials and rules-of-thumb requirements include:
  - a. Cortec Boiler Lizard™: @ 1 bag (3.3#)/1,000 gallons of boiler holding capacity. Use of this vapor phase corrosion inhibitor will result in up to 12 months protection.
  - b. Quicklime: @ 6 to 10 lbs/1,000 lbs/hr rated capacity, or @ 6 lbs per 100 ft<sup>3</sup> of volume
  - c. Silica gel: @ 10-12 lbs/1,000 gal boiler holding capacity, or @ 8-10 lbs/100 ft<sup>3</sup> of volume
  - d. Activated alumina: @ 8 lbs/100 ft<sup>3</sup> of volume
3. As soon as the inhibitor/desiccant is in place, close all boiler openings and tightly blank all connections.
4. An inspection of the desiccant and an evaluation of its continued ability to absorb moisture should be made every 2 to 3 months. Boilers treated with vapor phase corrosion inhibitor should not be re-opened for inspection.
5. In preparation for returning the boiler to service, remove all desiccant materials from the boiler and bring the unit back on-line in the normal manner.
6. Initiate the feed of regular boiler water treatment chemicals as soon as the boiler is placed into service.

## Layup of Auxiliary Equipment

Proper storage of feedwater heaters and deaerators is also essential. The watersides of feedwater heaters should be filled with treated demineralized water containing catalyzed sulfite (at least 100 to 300 ppm as SO<sub>3</sub>) and enough neutralizing amine or caustic soda to keep the pH at least 9-10. A nitrogen blanket using moderate pressure can be used to ensure complete oxygen removal and protection. Note: Heat exchange equipment containing copper alloys should not be in direct contact with storage water containing amines or ammonia. The shell side of feed-water heaters is stored either dry or wet depending on the valve arrangement. A nitrogen blanket should be maintained on the system with either storage method.

Deaerators should be nitrogen blanketed as soon as the pressure drops to 5-10 psig. All drain lines and steam extraction lines should be closed and treated water circulated through the deaerator and storage tank. Regular, weekly checks for sulfite residual and pH should be carried out as for boiler wet layup and more chemicals added as needed.