



PROPER BOILER LAY-UP PROCEDURES

Prevention of corrosion in a boiler in standby condition is more difficult than in an operating boiler. This brief report has been prepared to summarize the methods that may be followed to prevent or minimize deterioration of the internal surfaces of boilers from corrosion during inoperative periods.

Two sets of conditions must be met:

1. The boiler must be held in readiness to operate at any time on short notice. This may be designated as intermittent standby.
2. The boiler will be continuously inoperative for an indefinite period of weeks or months. This is prolonged standby.

INTERMITTENT STANDBY

In general, the water level maintained in the boiler under these circumstances corresponds closely to that of operation, and by banked fires, or in the case of powdered coal, oil, or gas fuel, intermittent and/or reduced firing, the temperature is held closely to that of steaming temperature. Circulation, however, is very slight.

During operation the boiler water is uniformly maintained alkaline, and by its' rapid circulation segregation of and water containing oxygen is prevented. During the standby period, however, some loss of water occurs--slight leakage through blowdown valve, slight steaming--which is replaced by feedwater. If the feedwater is sufficiently oxygen-free and of suitable alkalinity or pH value, conditions leading to corrosion will not be developed. If this is not the case, however, delayed intermingling of boiler water and feedwater, and segregation of the latter may develop at some of the boiler surfaces conditions of low alkalinity and dissolved oxygen concentrations which are conducive to corrosion. In cases of considerable length of standby condition and of appreciable makeup of feedwater to replace losses, the boiler water alkalinity may disappear entirely, and general corrosion occur.

No single rule can be given to assure correctness of conditions in the boiler water. The regular boiler water tests should be made as carefully on the boilers in this service as on the operating boiler. In the case of multidrum bent-tube boiler, it would be advantageous if the samples could be drawn from the rear drum during intermittent service. If the alkalinity falls too low, it can be augmented by introducing a small amount of an alkali solution (preferably a dilute solution of caustic) directly into the boiler at the point of

feedwater entry, with a force hand pump, or in other convenient manners. In cases where appreciable quantities of oxygen are dissolved in the feedwater that is introduced, sodium sulfite (Na_2SO_3) may be pumped into the boiler either separately, or along with the alkali solution referred to above, to react with and remove the dissolved oxygen. In most cases, sufficient sodium sulfite would be fed to maintain a reservoir of at least 100 ppm sodium sulfite (Na_2SO_3).

If corrosion in certain sections is proof of segregation of the feedwater, the mode of feedwater delivery to the boiler sometimes can be arranged to assure its mingling with the boiler water. Requirement of makeup water occasioned by leakage can be minimized by stoppage of the leaks. If several boilers are maintained in intermittent standby condition, they should be alternated in turn in operating service wherever possible, thus obviating serially the irregularities of conditions that may develop from the standby condition.

The rules that are appropriate in this case, therefore, are quite largely those that apply to operating boilers, and their application must be as fully or more carefully performed.

PROLONGED STANDBY

Two general procedures are available:

1. The boiler may be emptied and dried out, and kept dry.
2. The boiler may be filled completely with water.

DRAINING AND DRYING

This method gives excellent protection from corrosion to the metal surfaces so long as no moisture is present. At times the boiler is left open for free circulation of air after drying; at times quicklime or silica gel is placed in trays in the boiler and it is closed up for drying. In either case, water leakage over, or sweating of, the surfaces must be guarded against, since such water saturated with oxygen and in contact with the surfaces promotes rapid corrosion. So long as the surfaces remain dry, no corrosion of any extent will occur.

Similar moisture-free will protect superheaters of the drainable type. On the other hand, collection of condensate in the lower bends of a non-drainable superheater will promote rapid attack, even though the boiler proper remains in good condition. To dry the superheater initially, blowing warm air through the individual tubes or elements is suggested. To insure complete drying and elimination of subsequent condensation, a series of small heater, either gas or electric, should be installed in the furnace at the lower extremity of the superheater bank and equally spaced across its width. Maintenance of such a heating arrangement will insure internal and external dryness of the superheater tubes. This represents the most positive means of minimizing standby corrosion in the superheater whether the boiler proper is left open to the atmosphere or is sealed with trays of quicklime inside. It should be pointed out that the use of quicklime requires that

the chemical be inspected about monthly intervals to make certain that is not caked and spent.

If experience indicates that external sweating of the boiler tubes is a problem, additional heaters should be installed in the furnace at strategic locations to maintain temperatures above the dew point in all parts of the furnace as well as in the superheater section.

BOILER-FILLED WITH WATER

In this method, protection can be obtained if first, the correct chemical conditions are maintained with the water with which the boilers are filled; second, mixing of the water in the boilers is satisfactory so that correct conditions remain throughout the boiler; and third, the boiler are completely filled with treated water so that no wet surfaces are in contact with air.

Enough caustic soda should be added to the water in idle boilers to produce therein a sodium hydroxide (NaOH) concentration of about 400 to 600 ppm and also enough sodium sulfite should be added to the water to establish a reservoir of sodium sulfite (Na₂SO₃) of about 100 ppm.

The purpose of the sodium sulfite in the boiler water is to remove oxygen therefrom, which it does by combining with the oxygen to form sodium sulfate. Thus in adding the sulfite to the water a certain amount will be consumed and, as pointed out above, enough should be used to build up a reservoir of about 100 ppm of the unoxidized material.

Mixing of the water in the boiler must be thorough so that correct chemical conditions will exist in every section of the boiler. Mixing is sometimes accomplished by circulating water from one section of the boiler to another with a pump. If a pump satisfactory for this purpose is available, it can also be used to fill the boiler and the chemical solution can be trickled into the water at the suction wide of the pump as the boiler is being filled. This procedure practically insures thorough mixing of the chemicals with the water.

If a circulating pump is not available, mixing can be accomplished by light steaming. In some cases where operating boilers are to be taken out of service to stand idle for some time, the correct concentration of alkalinity and sodium sulfite can be built up in the boiler water before the boilers are taken off the line.

No matter how mixing is accomplished, samples drawn from various sections of the boiler should be tested periodically to determine where or not the concentrations of alkalinity and sodium sulfite are satisfactory.

If possible, deaerated water should be used to fill the boiler. However, if deaerated water is not available, other water can be used.

In completely filling boilers, the superheaters as well should be filled. Also, all blowoff, non-return, and feed valve should be tight to minimize leakage of water out of or into the boiler.

A convenient method for keeping boilers full of water is to connect to some available connection on top of the boilers, or on the outlet superheater headers, a small tank-this tank being located above the boilers and filled with water containing the proper amount of alkalinity and sodium sulfite. With this arrangement, if water leaks from the boilers it will be replaced by water from the tank and if the tank is kept filled the boilers will always be full. On the other hand, if leakage of water into the boilers occurs, the tank will overflow and this will be an indication that leakage is occurring.

If you have to leave boilers in standby condition for any length of time, you will take care of them by one of the methods set forth in this brief report, you will find that you will have protected them from corrosion during this period of standby condition.