

APPENDIX "F"

Treatment & Control of Feed & Boiler Feed Water

INTRODUCTION:

In other than exceptional circumstances, a natural water is not suitable for boiler feeding unless it is suitably treated, since the use of an untreated water can cause foaming and priming, corrosion of the metal, and restriction of the water spaces due to scale deposition. Serious scaling may result in ultimate failures of generating tubes and distortion of the tube plates with subsequent leakage at tube joints. It also reduces the heat transfer and consequently the efficiency of the unit.

Because of the very great differences in the composition of natural water from various sources and localities, it is quite impossible to prescribe any standard form of treatment. It must normally be based on the composition of the water supply available and, where there are alternative supplies, it is usually advantageous to use the supply which is most easily treated.

The notes which follow are not intended to be instructions, but merely a guide to the treatment and control, and the boiler user is advised to adopt the service and guidance of a specialist company supplying water treatment chemicals.

TYPE OF TREATMENT:

Generally speaking, natural water can be divided into two classifications:-

- (I) Water of Low Hardness, which contains hardness salts of calcium and magnesium in amounts up to about 150 parts per million.
- (II) Hard Water, which may contain hardness salts in quantities up to 500 parts per million or more.

In the case of soft water, defined in Group (I), "internal treatment" will generally be satisfactory, but, as different water requires different chemicals, the specific treatment for a given installation can only be determined properly by an examination of the water supply. "Internal Treatment" comprises the addition of chemicals to the water entering the boiler and, in this case, the reactions occur in the boiler, hardness salts being precipitated as sludge which has to be removed by blowing down.

A properly balanced treatment will convert all the hardness salts into a soft, easy-flowing sludge and render the boiler water alkaline to phenolphthalein, a condition which is necessary as a protective against "on load" corrosion.

Hard water defined by Group (II) presents a more difficult problem because internal treatment may produce so much sludge in the boiler as to make its control difficult. Suspended sludge may promote foaming in the boiler and carry-over of boiler water into the steam mains and, where possible, the water should be softened before it is fed to the boilers. Choice of the process will depend on the composition of the raw water supply. In many cases, where boilers are installed in factories or institutions, etc., where the water for process or domestic supplies has to be softened, it is very probable that the treated water will be suitable for boiler feeding after the application of an internal treatment, as described for soft water in Group (I). Therefore, these notes concentrate on "internal" treatment. Internal treatment, chemicals or mixtures usually employed invariably contain some or all of the following chemicals, the purpose of which is described:

APPENDIX "F"

Sodium Phosphate - which precipitates calcium and magnesium hardness salts as soft calcium and magnesium phosphate.

Sodium Aluminate - used as a coagulant.

Tannins - which render the precipitates free-flowing and, by surface action on the boiler metal, act as a protection against corrosion. They also have the property of absorbing oxygen from the boiler water.

Starch - used in some cases as alternative to tannin or with tannin. It is a coagulant and has the property that it can absorb slight traces of oil which may get into the boiler water.

Alkali - usually caustic soda ash, the purpose of which is to impart alkalinity to the boiler water.

Sodium Sulphate - used when a water deficient in naturally occurring sodium sulphate, in order to provide a sodium sulphate/caustic soda minimum ratio of 2.5 for protection against caustic cracking.

CONTROL OF TREATMENT AND BOILER WATER CONDITIONS:

The normal treatment will be the continuous addition of the chemicals to the feed water in sufficient quantity to precipitate the hardness salts in the boiler water.

Correct treatment will ensure that the feed is always alkaline with a pH between 8.5 and 9.5. The quantity of chemicals to be added will be determined by simple test on the boiler water and, briefly, these tests are:

Hardness - The hardness should always be zero. Presence of hardness is an indication of scale-forming conditions and the chemical dose should be sufficient to ensure its absence.

Phosphate - The phosphate residual in the boiler water should be not normally less than 50 and not more than 100 parts per million, expressed as tri-sodium phosphate. It is the most important test for the adequacy or otherwise of the treatment, as, in the presence of a phosphate residual to the degree specified, hardness in the boiler water cannot exist.

Alkalinity - The total alkalinity of the boiler water, expressed as calcium carbonate, should not be less than 15-20% of the total dissolved solids concentration.

Total Dissolved Solids - The total dissolved solids in the boiler water, resulting from the concentration of the dissolved solids in the feedwater, plus the addition due to the treatment chemicals, should not be allowed to exceed 2,000 to 4,000 parts per million. This figure is, however, influenced by several factors, eg., water level, changes in load, and the amount and physical condition of the suspended matter in the boiler water. Experience will indicate whether it can be increased or whether it must be decreased.

Method of carrying out the tests and recommendations for the necessary apparatus will generally be provided by the supplier of the water treatment chemicals.

Blowing Down - The frequency of blowing down which is necessary to maintain the boiler reasonably clear of deposited sludge and within the concentration specified for the total dissolved solids in the boiler water will be governed by the composition of the raw water and the amount of chemicals added. Power boilers should be blown at least once per day and preferably lesser amounts twice or three times per day. To ensure the removal of the maximum amount of sludge, the blowdown valve should be opened momentarily several times with a short pause between operations, so that the disturbance in the vicinity of the blowdown outlet can die down and further sludge move into position ready to be flushed out at the next operation.

If the dissolved solids content in the feed water is high, it may be advisable to have a continuous blowdown, but, as this is not so effective in the removal of sludge, the regular operation of the intermittent blowdown cannot be eliminated.

It is also most important that the feed water regulators be blown down at least once per day to ensure that the float chambers are clear of sludge.

Heating boilers should seldom be blown down and then only on the advice of a water treatment consultant.

Sodium Sulphate/Caustic Soda Ratio:

As scale deposits, which are likely to occur in the boiler if water treatment is faulty, may cause cracking of the tube plates with possible consequent leakage at tube seats, it is good precaution to maintain the advised sodium sulphate/caustic soda ratio of 2.5 as a protection against possible intergranular cracking of the tube plate in stressed areas.

If included in the chemical mixture, it will be in correct proportion to the alkali to provide the necessary sodium sulphate/caustic soda ratio and under these conditions tests will not be required for routine control.

Idle Boilers:

If at any time a boiler is off load for more than a few days, precautions should be taken to protect it against corrosion during such periods. For an extended length of time, the boiler should be emptied, hosed out to remove sludge and then dried thoroughly. Trays of quick lime should then be placed in the drum, after which the drum should be closed up.

Alternatively, if a boiler is to be held ready for immediate use, it should be emptied and cleaned and then be filled completely with feed water which has been made alkaline by the addition of caustic soda and to which sodium sulphite to the extent of 100-150 parts per million has been added as an oxygen absorbent. Air cocks should be closed and the water tested from time to time for caustic soda and sodium sulphite residual.