OBJECTIVES OF WATER CONDITIONING

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Aside from its usual universal use for drinking and sanitary purposes, water is used in industry chiefly in five distinct ways:

To generate steam for power or heating
To cool process equipment or materials
To clean or otherwise to process materials
To transport materials
To become part of a product

In all of these fields of use, water tends to cause trouble, by: **forming deposits which interfere with the transfer of heat or impair the quality of products and/or damaging the metals, wood and other materials of construction used to contain or transport or use the water**.

Water conditioning has as broad objectives, therefore, the prevention of deposits and the control of corrosion. In any specific case, additional objectives may be important, such as, the control of foaming in a steam boiler or a cleaning bath.

Another broad objective of increasing importance is the reconditioning of waste water after industrial use so that it may be employed again in the same plant or released in a condition suitable for use by others.

To be successful, water conditioning must make water behave and must do so at an over-all cost substantially less than that incurred by allowing the water to misbehave.

The specific treatment chemicals and water conditioning processes to be controlled in your plant under the instructions in this primer are set forth on the following pages. Every system is different and these peculiarities must be studied by trained individuals in order to provide you with a personalized influent to effluent water treatment program.

SAMPLING THE BOILER WATER

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The container into which the sample is drawn must be clean and should be rinsed with the boiler water once or twice before the sample is collected. In phosphate conditioning the sample must <u>not</u> be drawn in a tinned or galvanized container, or reactions will occur.

The sample should represent the most concentrated circulating boiler water in the boiler. If the boiler is supplied with special sampling connections, samples should be drawn from these points. If not, either such special connections should be installed or care taken that the sample be as representative of this condition as possible.

Sampling will depend on blow down and chemical feed schedules. With continuous blow down and continuous chemical feed, samples will represent average conditions of the boiler water, chemical feed and blow down rates. If not, sampling can be altered as required on the basis of the tests.

With the methods of feed and blow down, samples should be collected as part of a sequence of operations. When chemical feed is intermittent and blow down is continuous, the recommended sequence is:

1. **Sample**
2. **Test**
3. **Blow down**
4. **Feed or adjust feed of chemicals**

If it is necessary to draw the sample from the water column blow down line, you **must** blow the water column and gauge glass thoroughly to remove condensate and provide a representative boiler water sample. It is essential to use a sample cooler when taking a sample from this point or from any sample point. The sample may be drawn from other convenient points so long as it is representative of the circulating boiler water. A cooling coil, which prevents sample flashing, is desirable at all operating pressures and essential at higher pressures.

Cool the boiler water sample to room temperature or lower. If the sample is to stand for any appreciable time before testing, transfer to a clean bottle or flask and stopper. Do not disturb any sludge in the sample that settles. Water vapor will liberate from a sample that has not cooled and an erroneous reading (artificially high) will allow, which will concentrate the boiler water components and erroneous test results. A sample cooler is required in order to take a proper sample. The coil type sample cooler should be installed to take the sample for every water testing point that is over 100 degrees F.

SOFTENING BY SODIUM-CYCLE BASE EXCHANGE

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A zeolite softener is designed and operated much like a conventional sand filter, except that it contains not sand but a bed of base exchange material. The exchange material may be mineral “greensand", specially processed coal, or one of several synthetic resins. these base exchange materials differ from one another in physical and chemical respects, but all of them soften water in the same way.

When water containing calcium and magnesium hardness passes through a zeolite softener, the calcium and magnesium simply attach to the particles of exchange material and are replaced by an equivalent amount of ionic sodium. After a time in service, the exchange bed becomes exhausted (loses its ability to remove hardness from the water) and must be regenerated with salt (sodium chloride). During the regeneration or brining operation, sodium is reattached onto the particles of exchange material. This restores the capacity for removing hardness while calcium and magnesium accumulated during the previous softening run are discharged to waste in the spent brine.

SOFTENER OPERATION

SERVICE RUN

The frequency with which a zeolite softener must be regenerated depends upon

- the kind and amount of exchange material used,
- the cleanliness and compactness of the bed,
- the hardness of the raw water
- and the amount of salt used for regeneration.

Near the end of a softening run, as the bed approaches exhaustion, hardness in the effluent water starts to rise rather sharply. Ideally, an exchange bed should be regenerated when the effluent hardness rises to some specified value (usually about 5 ppm as calcium carbonate) as determined by hardness tests.

Many zeolite softeners are regenerated (sometimes automatically) after the passage of some specified volume of water. In such cases, it is necessary to make periodic checks of effluent hardness just prior to regeneration to make sure that the unit is not being regenerated too soon nor being run beyond the point of hardness breakthrough.

BACKWASH
Immediately after a unit is taken out of service for regeneration, water is passed through it in reverse direction for several minutes. This back washing operation scours dirt off the particles of exchange material, reclassifies them and eliminates channeling or packing of the bed. Back washing a bed is sometimes desirable between regeneration if the interval between regeneration becomes abnormally long because of low flow rate or low hardness in the raw water. In most zeolite softeners, the rate of backwash is controlled automatically, while the duration of the backwash operation is specified by the equipment manufacturer.

REGENERATION (brining)
During the regeneration or brining operation, a definite volume of salt solution is passed through the exchange bed. The time involved is roughly that required to introduce the brine and to displace one volume of water in the tank.

RINSE
Excess brine must be rinsed from the exchange bed before the unit can be returned to service. Failure to rinse a bed sufficiently may contaminate the feed water system with dangerous amounts of chloride, calcium and magnesium. Such contamination can cause severe foaming in boilers and may completely disrupt the control over boiler water conditions in general.

It is customary to rinse zeolite softeners either for a definite length of time or on the basis of a specified amount of rinse water. Rinsing requirements should be checked periodically by chloride tests made on the effluent rinse water. As a general rule, a softener unit is ready to be put back into service when the chloride content of the effluent water is 10-20 ppm above that of the raw water.

MAINTAINING SODIUM ZEOLITE RESIN

Zeolite beds may become badly fouled with accumulated dirt, particles of rust, or organic growths. This can result in reduced softening capacity, excessive pressure drop across the exchanger, wasteful salt consumption, and generally unsatisfactory performance. Most accumulations of objectionable foreign matter can be eliminated by the use of a suitable detergent and disinfectant. The water treatment service engineer can recommend suitable treatment to keep zeolite beds clean and in good operating condition.