

COOLING TOWER MANUAL



Chapter 7

LIQUID EFFLUENT POLLUTION CONTROL

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7.1 SCOPE

The use of cooling towers to dissipate process heat to the atmosphere has been common in many industries for years. Recent water quality regulations concerning the thermal properties of plant effluents are making the use of cooling towers attractive for industries which have used once-through cooling in the past. While the effluents from cooling tower systems can meet water quality regulations concerning the maximum allowable discharge temperature (Ref. 1), cooling tower blowdown must be examined closely in light of the strict pollution control regulations now in effect. This examination must start with an understanding of applicable state and federal pollution control requirements. Next, water treatments necessary to protect the cooling system from corrosion, scaling and biological fouling must be examined to determine what objectionable chemicals they will add to cooling tower blowdown. Finally, methods to remove or detoxify the harmful components in cooling tower blowdown water must be identified. A knowledge of these three factors is necessary to control pollution resulting from cooling tower blowdown. This chapter is intended to serve as a guide in obtaining the required knowledge.

7.2 DEFINITIONS

None

7.3 REGULATIONS

The discharge or disposal of cooling tower blowdown is an aspect of tower operation which has recently been complicated by new water pollution regulations (Ref. 2, 3, 4). In 1972, the Congress passed the Federal Water Pollution Control Act Amendment. This act superseded previous pollution control regulations and established comprehensive guidelines for water quality and pollution control. The guidelines were intended to provide a framework within which the various regional and state pollution control agencies could operate; but the act also gives the Environmental Protection Agency (EPA) the power to enforce the Federal guidelines if the states fail to fulfill their obligations.

The objective of the 1972 Act was to eliminate the discharge of pollutants into navigable waters by 1985. To meet this objective, the Act specifies that by July 1, 1977, pollutants in industrial discharges must be reduced to levels attainable

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using the "best practicable" technology. By July 1, 1983, discharges of pollutants must be reduced to levels consistent with the "best available" technology. Contract studies are being conducted for the EPA on twenty industrial groups to determine the types and amounts of pollutants emitted by the various groups. These studies will be used to determine the "best practicable" emission levels for each group. The levels which will be set for use of the "best available" technology will be based on further studies of the industrial groups and on research into pollution control methods. Further information concerning the methods the EPA is using to set pollution emission levels and on the results of the contract studies can be obtained by contacting the appropriate regional EPA offices.

One very important aspect of the 1972 law is that it established a new permit system for industrial discharges and sets penalties for violation of the law. Under this system, any person (individual, partnership, corporation, or other organization) wishing to discharge effluents into a body of water must obtain a permit from the state or states involved through the state's EPA-approved permit system. Further, a Federal license must be obtained. The application for the Federal license must be accompanied by a certification from the state that all pollution control regulations are being satisfied. More information on the permit system may be obtained by contacting the state pollution control agencies or the regional EPA offices.

The guidelines which the EPA sets for acceptable water quality and pollution control will serve as minimum requirements for the regional and state pollution control agencies; therefore, more stringent requirements may be set in certain locations. The applicable local standards must be met in order to obtain state certification. Information on state standards can be obtained by contacting the state pollution control agency involved.

7.4 SOURCE AND TYPE OF POTENTIAL LIQUID CONTAMINANT

7.4.1 Corrosion Prevention

7.4.1.1 Chromates

Many recirculating water systems which use cooling towers for removing excess heat from process cooling water contain dissimilar metals. Dissimilar metals in contact cause galvanic action which aggravates the problem of corrosion control. Various chromate salts are among the

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most effective corrosion inhibitors available so they are widely used in recirculating water. Corrosion rates can be reduced 95% or more by the use of chromates in proper concentrations.

One potential problem with chromate use is that some systems require rather high concentrations of chromate to avoid pitting, and high concentrations may make the use of this material too costly. Another problem with chromate use is that most effluent standards currently restrict the concentration of hexavalent chromium to 0.05 ppm and trivalent chromium to 1.0 ppm in the stream. In order to meet the appropriate requirement, rather expensive facilities would be required to reduce the concentration of toxic chromium from cooling tower blowdown. Additional information about the use of chromates for inhibiting corrosion may be found in several sources (Ref. 1, 2, 3).

7.4.1.2 Polyphosphates

Phosphates, especially the polyphosphates are also widely used for corrosion control in recirculating cooling water systems (Ref. 5, 6, 7, 8, 9, 10, 11, 12). One advantage of phosphate is its ability to reduce tuberculation by removing corrosion products and thus reducing friction losses. One author reported that tests performed at Monsanto Chemical Company showed the inhibition provided by the metallic phosphates was equivalent to the effectiveness of the chromate treatment (Ref. 13).

However, phosphates are not recommended for systems with high calcium content because of calcium phosphate precipitation. Also, higher phosphate concentrations are limited because they cause precipitation of calcium phosphate. The reversion of polyphosphate to orthophosphate, which increases at high system temperatures, is another factor which limits the use of phosphate in recirculating cooling water treatment (Ref. 5). Also one source (Ref. 5), indicates that metal

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loss is much greater with phosphate than with chromate and that more pitting occurs with phosphate than with chromate. There is apparently some difference between these materials and those reported in Reference 13. Further information about the test conditions would be required to reconcile this difference.

While it is not certain that severe restrictions will be placed on the level of phosphates in the blowdown of cooling towers, the discharge of phosphates has been receiving considerable attention.

7.4.1.3 Phosphate Dianodic

This method makes use of polyphosphate in combination with chromate within a controlled pH range, and reduces or eliminates the pitting that occurs when the individual components are used separately (Ref. 5). The major advantage of the Dianodic treatment is reduction of pitting. Metal loss is also reduced as effectively as it is with chromate.

Previous statements regarding chromate and phosphate effluent standards are applicable to discharges utilizing this type treatment.

Additional information about the use of phosphates as corrosion inhibitors may be found in the literature (Ref. 5, 6).

7.4.1.4 Zinc

Zinc Dianodic corrosion inhibitors can be used very effectively in recirculating water systems where the calcium content of the makeup water is high or the reversion of polyphosphate to the orthophosphate form is high. Improved corrosion protection is obtained by superimposing zinc on the phosphate-chromate combinations. Limitations to use of the Phosphate Dianodic inhibitors occur where the calcium content of the makeup water is high or the reversion of polyphosphate to orthophosphate is high. The broad coverage provided by the

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Zinc Dianodic inhibitors overcome these limitations of the Phosphate Dianodic inhibitors. Both the Zinc Dianodic and the Phosphate Dianodic treatment protect both copper and steel (Ref. 5).

However, the chromate components of the Zinc Dianodic inhibitor will become a contaminant in the blowdown of cooling towers where it is used. Regulations on the discharge of zinc are less restrictive in many areas than for chromium but it appears that there will be more restrictive constraints on the discharge of this ion. There is a possibility of restrictions on the discharge of the phosphate components as noted in the polyphosphates section.

Additional information about the use of Zinc Dianodic combinations as corrosion inhibitors may be found in the literature (Ref. 5, 6).

7.4.1.5 Fluoride Dianodic

The Fluoride Dianodic treatment was developed to handle water contaminated with aluminum. Aluminum is sometimes used as a coagulant to aid in removing suspended solids from turbid water. However, if aluminum floc is not removed by filtration, carry-over of the floc may occur and cause fouling of heat exchangers with aluminum deposits. The fouling deposits are most commonly aluminum hydroxide and aluminum phosphate. The fluoride ion from the Fluoride Dianodic treatment preferentially complexes the aluminum ion. The resulting soluble complex acts dianodically with chromate and aids in preventing both fouling and corrosion (Ref. 5).

The regulations on the discharge of water containing the chromate, phosphate and fluoride components of this treatment should be determined from the appropriate state and Federal agencies.

7.4.1.6 Organic Base

One source (Ref. 5) indicates that organic base corrosion inhibitors developed in recent years

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