



WATER VALLEY FOR WATER TREATMENT CHEMICALS AND SOLUTIONS

Chilled Water System

Introduction

In closed recirculating systems, heat is transferred to the cooling water from the hot process, then it is transferred out of the cooling water by conduction in another piece of heat transfer equipment.

No water is evaporated or concentrated. A system is considered closed when it is designed to be filled with water once, shut off, and then run continuously for long periods of time without any significant amount of make-up water added. In closed cooling water systems, the heat is usually dissipated by an auxiliary open cooling loop or forced air that passes over tubes containing the closed system water (as in a car radiator).

Common operating problems Corrosion, Scale, Fouling and Microbial growth are the four major problems in all types of recirculating water systems. All of these types of problems are of importance in closed recirculating systems because corrosion is significantly affected by fouling and microbial activity.

Scaling interferes with heat transfer of the process and can lead to process-side problems. Without any provision for the removal of corrosion products in system blow down, the closed system is particularly subject

➤ cleaning of network piping system for chilled water system

A – Chemical Cleaning

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PROCEDURE :

1. Arrange by-pass connections for chillers as well as cooling towers, air handling, and fan coil units.
2. Flush the system with fresh water till the water becomes free from suspended solids.
3. Add the following and circulate for 48 Hours:

System	Quantity required of (P2P-V) in KG
Chillers	- KG

4. Flush the system with fresh water - to drain - till the water is free from suspended solids and the total dissolved solids (T.D.S.) as well as the pH of system water equals values of fresh water. Flushing to drain should take place from as many points as possible
6. Remove all by-pass connections + circulate water in the system for 5 hours
7. If any suspended solids occur in the system's water, flush with fresh water - to drain - till the water is free from suspended solids and level of iron dissolved goes down to less than 0.3 ppm as Fe^{++} .

8) add our TN-20 v to protect the system from any corrosion caused by dissolved oxygen and preserve the system



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Closed Loop Systems: Chemical Treatment Alternatives

The water in a closed cooling system is continuously recirculated. Unless the system has a leak, the makeup requirements are minimal. This is characteristic of most chilled water systems and hot water heating loops.

Several chemical treatment methods have been developed for closed loop systems. The selection of one treatment method over another is determined by the water quality, the type of freeze protection used, if any, the system metallurgy, and any environmental or safety issues that must be considered.

INITIAL CLEANING

If the closed loop system is new, it should be chemically cleaned prior to the start of the treatment program. Chemical cleaning removes oil, mill scale, dirt, welding fluxes and other contaminants that can interfere with the performance of the treatment program. Chemical cleaning is also recommended for older systems that have suffered from corrosion. Cleaning insures that the chemical corrosion inhibitors can establish a proper film on the metal surface.

CHEMICAL TREATMENT OPTIONS

After the system is clean, one of the following treatment programs can be applied.

Sodium chromate has been used for years in closed water systems. Alkaline sodium chromate is an oxidizing agent that functions by forming a dense gamma oxide film on mild steel. A minimum of 300 ppm as sodium chromate is required for system protection. High temperature hot water systems require higher dosages of from 2000 to 2500 ppm.



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Chromate concentrations above 300 ppm are thought to attack some pump seals. Also, as an oxidizing agent, chromate is incompatible with glycol-based antifreezes.

The discharge of chromate to the environment has been severely restricted by the EPA. Chromate is also known to cause dermatitis in workers who come into prolonged contact with this compound.

Borate-nitrite

formulations provide equivalent corrosion protection to that offered by chromates. The sodium tetraborate creates a buffer in the system that stabilizes the pH between 9.0 and 9.5.

A minimum of 200 to 500 ppm of sodium nitrite is required for corrosion protection of mild steel. A 1000 ppm residual as sodium nitrite is recommended in high temperature hot water systems. For those waters that are high in chlorides and sulfates, 1500 ppm of sodium nitrite is required. A general recommendation for inhibitor levels is 800 to 1200 ppm as sodium nitrite. Nitrites function as reducing agents in closed systems.

As a result, they are compatible with glycol-based antifreezes. Nitrites are an excellent food source for bacteria. Nitrite-reducing bacteria are a potential problem in closed systems. When nitrite reducers are present, the nitrite level in the system drops without a corresponding decline in the specific conductance. A reduction in both the nitrite level and the conductance suggests that water is being lost from the system.

The remedy for nitrite-reducing bacteria is to treat the system with 50 to 100 ppm of quaternary ammonium biocide such as N-alkyl dimethyl benzyl ammonium chloride (12.5%). Oxidizing biocides such as chlorine should not be used as they oxidize nitrites and glycols.

Borate-nitrite-silicate inhibitors offer all of the advantages and disadvantages of the borate-nitrite products. The added silicate, however, offers better protection for aluminum. Silicates are commonly used in commercial antifreeze formulations because of the increased use of aluminum in automobile radiators.



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Molybdate

is used alone or in combination with other inhibitors in closed water systems. Generally, a minimum of 100 to 200 ppm of molybdate as MoO_4 is required for corrosion protection. Higher dosages are required in more aggressive waters. The pH of the system should be maintained above 7.5. Enhanced protection of yellow metals is achieved by blending molybdate with tolytriazole. Often molybdate is used in conjunction with nitrite to afford better protection at lower molybdate concentrations.

Molybdates do not tend to support the growth of bacteria. Because it is a weak oxidant, molybdate can be used in systems containing glycol. Molybdate is generally accepted as being less toxic than chromate. However, the EPA continues to review its environmental impact. This may lead to more stringent limitations on the use and discharge of molybdate inhibitors.

Sodium sulfite-caustic soda

programs have been used successfully in many closed systems. The sulfite residual should be maintained between 30 to 60 ppm with sufficient caustic soda added to adjust the pH to within 9.3 to 9.5. This is an effective approach when properly applied. It is less expensive than other options and presents few disposal problems.

This treatment method is compatible with glycol antifreezes. If the closed system suffers from air in leakage, the sulfite will be consumed at a rapid rate.

Continued addition of more sulfite will cause the dissolved solids to increase significantly.

The use of caustic soda for pH adjustment causes the water to be poorly buffered. Overfeed of caustic will increase the pH above the desired 9.0 to 9.5 range. Draining the system or treatment with sulfuric acid is then required to lower the pH to within the desired range.



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Polyphosphate

is used in closed systems that require a food-grade treatment program. Polyphosphate reacts on steel surfaces to form an iron-phosphate inhibitor film. This film is fragile, however, and does not persist in the absence of a chemical residual. Polyphosphate also sequesters dissolved iron.

Typical dosages are 3 to 10 ppm as PO_4 . Polyphosphate hydrolyzes into orthophosphate. Orthophosphate, in turn, reacts with calcium hardness to form insoluble calcium phosphate sludge. As a result, polyphosphate is best applied in systems containing less than 50 ppm calcium hardness.

MONITORING THE INHIBITORS PERFORMANCE

Monitoring the performance of the corrosion inhibitor is a key part of the water management program. Various test methods are available to check on the closed system treatment performance.

Water samples should be taken periodically to check the inhibitor residual in the system. A check of the iron and copper content of the sample will provide a clue as to the effectiveness of the corrosion inhibitor. Typically, iron as Fe_2O_3 should be less than 0.01 ppm and copper should be less than 0.5 ppm.

Corrosion coupons are the most common way to evaluate the effectiveness of a corrosion inhibitor program. The results in mils per year (mpy) should be less than 0.50 for steel coupons and less than 0.20 for copper and brass.

Millipore filter studies provide information on the amount and type of corrosion by-products in the system. A 0.45 micron filter is used to trap solids on the filter paper. The color of the filter is compared against known standards or the solids are quantitatively analyzed in the lab.

Instantaneous corrosion measurements

provide immediate information on the corrosion rate without having to wait 30, 60 or 90 days as required with the coupon method.



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By-pass piping can be installed in a segment of the system to permit visual inspection of the piping without disturbing the rest of the system.

SUMMARY

Closed loop corrosion protection is an important part of a complete water treatment program. Several chemical treatment options are available, but several factors should be considered prior in selecting the right inhibitor program. These include water quality, materials of construction, freeze protection requirements, safety and environmental issues.

