CHEMTEX
INTERNATIONAL CHEMTEX CORPORATION

Technical Topics

Basic Microbiological Control for Open Recirculating Cooling Systems

TT-010-0588

The basic objectives of a successful cooling water treatment program are increased process efficiency, increased production output and maximized equipment service life. For a cooling water treatment program to achieve maximum effectiveness, it must address the problem areas of corrosion, deposition and microbiological contamination. Open recirculating cooling water systems are continuously infected with microorganisms. These microorganisms multiply rapidly in warm cooling waters and can lead to fouled heat exchangers, system metal loss due to microbiologically induced corrosion, degradation of cooling tower wood, and clogged screens and filters. Reduced flow rates, a reduction in heat exchanger capacity and the accumulation of microbiological growths on tower decks and tower fill are all signals of a severe microbiological problem.

An effective microbiocide program to control the growth of microorganisms involves three steps:

1. The identification of the types and concentrations of microorganisms present in the cooling system.

2. The selection of proper biocides based upon system design, discharge restrictions, and types of microorganisms.

3. Proper application, dosage and control of the selected biocides.

Microorganisms found in open recirculating cooling water systems will generally fall into one of three categories: Fungi, Algae, or Bacteria. These organisms can enter a cooling system in a variety of ways. Some will enter the system through the make-up water supply. Others will be scrubbed from the atmosphere during normal operation. Still others may enter the system as a result of the accumulation of organic matter such as insects or grass clippings.

Once inside a system, the propagation of these microorganisms depends upon a variety of factors.

The system must contain enough nutrients to sustain microbiological growth.

1. The system must have the correct ratios of oxygen and carbon dioxide to support microbiological life.

2. Tower location is an important factor. Sunlight can significantly increase to a rate at which microorganisms propagate.

3. The system temperature must be within certain ranges for different types of microorganisms. Microorganisms that produce slime tend to flourish between 40° and 150°F.

TYPES OF ORGANISMS

BACTERIA: Bacteria represent the largest group of troublesome organisms present in open recirculating cooling water systems.

Slime forming bacteria produce a dense, sticky mass which can cause fouling of system heat exchangers. Water flows can be impeded resulting in the loss of heat transfer. Additional microbiological growth is promoted when system water flow is reduced. Spore forming bacteria are difficult to control if a complete kill is required. The organism becomes inert if its environment becomes hostile to it. The organism begins to propagate once the environment becomes suitable again. Most processes are not affected by spore formers when the organism is in the spore form.

Sulfate reducing bacteria generate sulfides from sulfates and can cause serious localized corrosion if not controlled. This organism converts water soluble sulfur compounds to hydrogen sulfide which is acidic. This process usually occurs at the center of large red-black deposits and results in deep pitting under the deposit.

Iron reducing bacteria are found in waters with a high ferrous iron content. The ferrous iron is con-

verted to insoluble ferric hydroxide. This leads to tuberculation attack which results in increased flow resistance and restricted carrying capacity.

FUNGI: Fungi are most often found on the wooden structures of cooling towers such as the fill or the support members. Fungal attack of the wood usually means a permanent loss of the strength of the wood structure.

ALGAE: Algae require sunlight to grow so they are found in the open, exposed areas of the cooling tower. Algae grow in dense, fibrous mats that can plug the distribution trays or piping. Algal growths also provide an ideal growth area for anaerobic bacteria.

The objective of an effective microbiocide program is to expose the microbial population to a sufficient dose of biocide for a long enough time to achieve the desired effect.

Biocides may be fed continuously through the use of automatic feed equipment. More often they are fed on an intermittent basis because of economic considerations or effluent restrictions. An effective biocide program will include the use of two biocides of differing types which are fed in an alternating manner.