CHEMTEX
INTERNATIONAL CHEMTEX CORPORATION

Technical Topics

Sulfate Reducing Bacteria

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During recent years, there has been a significant increase in the incidence of corrosion caused by Sulfate Reducing Bacteria (SRB). This type of corrosion has caused major damage to cooling water systems. The effects of this type of corrosion can be found in cooling tower sumps, recirculating lines and condenser water boxes.

Reasons for this increase include the change from chromate based programs to modern corrosion inhibitors along with the change to more alkaline based programs. Chromates were known to have a bacteriostat effect which helped prevent growth of SRB.

Indications of SRB include a reddish or yellowish nodule on metal surfaces that when broken exhibits black corrosion by-products. When the complete nodule is removed, a bright silver pit is found. Corrosion by-products are non-magnetic. Severe localized pitting is evident. If hydrochloric acid is added to the black deposit, hydrogen sulfide will be released giving off a "rotten" egg odor.

The two most common species of these bacteria are Desulfovibrio desulfuricans and Desulfotomaculum nigrificans. These organisms favor an anaerobic (oxygen free) environment. This does not mean that sulfate reducers will not grow in oxygen rich cooling waters. SRB can thrive under deposits where no oxygen is present even though aerobic conditions exist in the main body of water. Problems with SRB will occur more readily in systems with concurrent fouling problems. Excessive amounts of dirt, algae, oils and other bacteria will provide ideal conditions for growth. SRB will co-exist with Iron Reducing Bacteria creating massive problems. Even small amounts of oils and grease will provide nutrients for growth. Stagnant water and low flow conditions will increase the chance of SRB growth.

SRB's obtain their energy from the anaerobic reduction of sulfates. Sulfates are available in most waters due to outside contamination. This bacteria contains an enzyme, (hydrogenase) that enables it to use elemental hydrogen generated at the cathodic site to reduce sulfate to hydrogen sulfide. It therefore acts as a cathodic depolarizing agent. The corrosion of iron by this process is very rapid and unlike ordinary rusting, is not self-limiting.

Once SRB's begin to grow in a system, it becomes very difficult to eliminate. A prevention program is much more effective than trying to clean a fouled system. Keep excessive dirt from settling in basins with the use of dispersants and side stream filtration. Prevent cooling water contamination by oils and grease. Even the smallest amounts may cause problems. Make sure contamination is not coming from the surrounding area. Check for bathroom and kitchen exhaust vents. Make sure incinerator stacks and diesel exhaust are not entering the tower. Keeps the system flowing. Prevent stagnant water.

Control of this type of bacteria can be accomplished with good housekeeping and proper biocide treatment. Bacterial control can be accomplished by using bromine, chlorine, DBNPA, MBT, carbamates or isothiazalone. These biocides will all control SRB in bulk water. When the bacteria becomes encapsulated, control then becomes a problem. Many of the above listed biocides will not penetrate the protective capsules. Some are even deactivated by the sulfide released by the bacteria.

The addition of a bio-dispersant and penetrant will help the biocides enter the bacteria cells, providing a much better chance of kill. Research and field experience has shown that a glutaraldehyde based biocide has been very effective in eradicating this bacteria.

If contamination does occur, a special clean out program should be designed for each system. All aspects of the water treatment program need to be examined. Complete control of this bacteria is necessary to prevent recontamination.