

HALOX Products Fact Sheet

Microbiological Control in Small to Intermediate Cooling Systems Using Chlorine Dioxide (ClO₂)

Introduction

In the United States, there are approximately one million cooling towers. Of these, about 25% are large industrial towers which operate on chlorine gas because of cost considerations. The other 75% use other biocides, because safety and handling concerns outweigh cost. Halox addresses the needs of the small to intermediate cooling towers. They range in size from 500 tons to 10,000 tons.



Cooling Towers Treatment Chemicals

Treatment of cooling water systems has two basic objectives: to protect and extend the life of the cooling system and to insure good heat transfer. Any fouling of the heat exchanger surface decreases the heat transfer efficiency. Corrosion destroys heat exchanger surfaces and causes leaks. The following three components comprise a cooling water treatment program. 1) microbiological control, 2) scale and deposit control, 3) corrosion control. This document deals primarily with microbiological control.

Microbiocides

Where there is water there is the opportunity for harmful microorganisms to grow. Cooling systems, therefore, are prone to bacterial contamination and slimy biofilm. Microbiocides used to disinfect small to intermediate cooling towers are divided into two general groups: non-oxidizing and oxidizing biocides.

Non-oxidizing biocides have several drawbacks. They are toxic to humans and animals. They are dangerous to store and handle. Disposal of cooling water containing non-oxidizers can be difficult and costly due to the toxicity of the chemical species. They must be added in large amounts to assure effectivity but they can cause health problems and they are expensive.

Oxidizing biocides include chlorine, bromine, and chlorine dioxide (ClO₂). Chlorine and bromine react rapidly with microbiological species and chemicals in the water. A rapid reaction with microbiological species means a quick and effective kill. A rapid reaction with chemicals such as scale and corrosion inhibitors means consumption of the product for other than microbiological control. Since chemical reactions are usually the first to take place, only the residual of the product remaining after the chemical reaction is completed is available for microbiological control.

Chlorine and bromine have other limitations. They exhibit poor biofilm control. They do not retain their biocidal efficiency over wide pH ranges. They are relatively unstable. Chlorine has the potential to form trihalomethanes (THMs) which are suspected carcinogens. When chlorine and bromine react with chemicals such as ammonia, nitrogen, and corrosion and scale inhibitors they form objectionable byproducts while reducing their effectivity.

Chlorine dioxide

Chlorine dioxide (ClO₂) is a highly effective, environmentally-friendly biocide. It is a selective oxidant that attacks planktonic and sessile bacteria, disinfects surfaces, and rapidly reduces biofilms. ClO₂ is a stable, dissolved gas that is a strong bactericide and virucide at concentrations as low as 0.1 ppm. With minimal contact time, it is highly effective against pathogenic organisms such as Legionella, amoebal cysts, Giardia cysts, E. Coli, and Cryptosporidium. ClO₂ reduces biofilms so bacterial regrowth is significantly impeded.

ClO₂ does not ionize to form weak acids (as chlorine and bromine do) in aqueous solutions. This allows ClO₂ to be effective over a wide pH range.

ClO₂ does not react with organic materials to form THMs. ClO₂ is neither consumed by nor reactive with ammonia and nitrogen compounds and with most treatment chemicals (corrosion and scale inhibitors) present in cooling water systems. ClO₂ is approved and recommended by the U. S. Environmental Protection Agency as an environmentally friendly drinking water additive to replace chlorine.

Legionella Control In Cooling Towers

Legionnaires' Disease is caused by the bacterium Legionella pneumophila. An estimated 10 to 15 thousand persons contract Legionnaires' Disease in the United States each year; 5 to 15% of these cases prove to be fatal. A number of these cases have been linked to cooling towers where Legionnaires' Disease is usually found in biofilm throughout the entire water distribution system. ClO₂ has proved to be the cost-effective method for short-term and long-term water disinfection for Legionella in cooling towers.

When to use chlorine dioxide

ClO₂ is more stable than other oxidizing biocides and compatible with most water treatment chemistry. There are specific circumstances where ClO₂ provides superior, more cost-effective performance than chlorine or bromine in cooling towers. ClO₂ should be considered when requirements include:

- maintaining biocidal activity at higher pH values where bromine and chlorine are ineffective.
- extremely high biofilm removal rates to increase time for organisms to recover and re-infect
- biofilm removal sufficient to ensure effective heat exchange efficiency.
- low reaction with organics and no reaction with ammonia to ensure maximum product availability
- environmentally benign by-products in the cooling tower discharge ensure microbiological control even in environmentally sensitive areas.
- performance not affected by pH, ammonia, or organic levels; no chlorinated organic compounds

Halox Chlorine Dioxide Generators

Because U.S. Federal law prohibits the transportation of ClO₂, chlorine dioxide is generated on-site at the point-of-use. Halox SRE electrochemical systems use electricity in the unit's cassette(s) to generate a small amount of acid to convert a single precursor, sodium chlorite, into ClO₂ and NaCl. There is no acid to handle, no chlorine and no bleach. Halox generators produce up to 100 g/hr (5.5 lb/day) of ClO₂.

Halox Accu-Cide chemical generators safely mix dilute sodium chlorite and acid to generate chlorine dioxide. No chlorine and no bleach are used. Accu-Cide generators are available in wall-mount or skid-mount configurations and produce up to 10 lb (4.5 kg) of ClO₂ per day.

When operated according to Halox guidelines, this Halox equipment generates a safe, dilute solution at a controlled, measurable rate that contains up to 550 ppm of chlorine dioxide. For specific sizing concentrations, please contact Halox Technical Service. Immediately after generation, the ClO₂ solution is fed directly to the water being treated. This self-contained system is safe to use and simple to operate.



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