MOLLUSK CONTROL WITH CHLORINE DIOXIDE

Chlorine dioxide (ClO2) is effective as both a disinfectant and an oxidant in water and wastewater treatment. Chlorine dioxide is a broad-spectrum microbiocide effective over a wide pH range. Its selective reactivity makes chlorine dioxide a powerful non-chlorinating oxidizing agent useful in many water treating applications for which chlorine and other oxidizing agents are unsuitable.

Application Description

Many industries are dependent on raw water from various lakes and rivers throughout the United States for cooling their process equipment. The recent invasion by various foreign mollusks (zebra mussels, Asiatic clams and others) into domestic inland waterways has led to the biofouling of water intake facilities at electric power generation stations and other industrial sites. If not controlled, these infestations can completely clog water intake facilities and lead to plant shutdowns.

Zebra mussels, the most prolific of the foreign mollusks, grow to about one inch in length, and a healthy female can produce up to 1.5 million veligers in a single season. The veliger is a free swimming larvae which hatches from the egg and remains suspended in the water column for one to three weeks, drifting with currents.

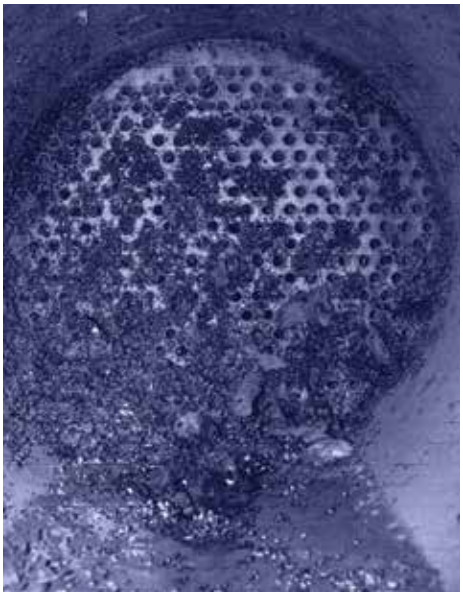
These fresh water mollusks are too small to be seen with the naked eye as juveniles. Becoming more visible as they mature, they develop the ability to attach to surfaces. As they collect in areas, they cause reductions in water flow by plugging inlet lines, process exchangers or surface condensers, and fire water systems. Newly settled zebra mussels reach such high densities (up to 700,000/ m2) and have such rapid post-settlement growth rates, that they rapidly form thick mats, restricting or blocking flow even in large diameter piping.

Treatment Alternatives

Removing the adults and eliminating the juveniles controls the Asian clams and zebra mussels. Common methods of control include mechanical and thermal treatment methods, as well as maintenance cleaning, special coatings, drying out the pipes, and chemical oxidizers and non-oxidizers. A number of companies have also introduced proprietary chemicals for control of these organisms.

Oxidizing biocides include chlorine gas, bleach, chlorine (or bleach) with bromide ion, chlorine dioxide, and potassium permanganate. Non-oxidizing biocides include various poisons, i.e., quaternary ammonium compounds or surface active agents to poison the mollusks. A few naturally occurring materials taken from plant extracts have also been used.

The suitability of any treatment program is dependent on the degree of contamination and the dynamics of the facility to be treated.



Mussels attached to Heat Exchanger

Mussels attached to Pump Shroud

Chlorine Dioxide

Chlorine dioxide generated from sodium chlorite may be used for mollusk control in commercial and industrial recirculating and one-pass cooling water systems. Chlorine dioxide has been found to be an effective control agent both for adult mollusks, to remove existing infestations, and their free-swimming larvae (veligers) to prevent settling and re-infestation. Unlike chlorine, chlorine dioxide does not react with organic materials to form trihalomethanes.

Chlorine dioxide dissolves in, but does not react with, water. It is less irritating to the clams than hypochlorous acid, formed by the reaction of chlorine with water. Clams are much more sensitive to chlorine dioxide than to chlorine. As a result, chlorine dioxide is effective at lower dosages than chlorine.

Chlorine dioxide can be applied by treating continuously over several days at a fairly low dosage or by treating at higher dosages for shorter periods of time. Another method is to treat routinely for short periods of time to control biofilm. Research has shown that mollusks will not attach unless a biofilm is present. Thus, prevention can be accomplished by routine removal of the biofilm.

Feed Requirements

The required dosages will vary with the system type, system conditions, the degree of water contamination present and the desired level of control. Depending on the extent of the infestation, chlorine dioxide chlorite may be applied either continuously or intermittently to achieve the necessary chlorine dioxide residual concentration.

Veliger Control: Maintain a continuous chlorine dioxide residual of 0.1 - 0.5 mg/L.

Intermittent Dose: Apply chlorine dioxide to obtain a chlorine dioxide residual concentration of 0.2 - 25 mg/L. Repeat as necessary to maintain control.

Continuous Dose: Maintain a chlorine dioxide residual concentration of up to 2 mg/L.

For once-through systems, or systems where treated water may enter a U.S. waterway, the concentration of residual chlorite ion should be monitored such that it does not exceed the requirements of the NPDES permit and is in compliance with local, state, and federal regulations.

For more information on dosage requirements specific to your application, contact your Evoqua Representative.

Method of Feed

Chlorine dioxide is a gas produced by activating sodium chlorite with an oxidizing agent or an acid source. Sodium chlorite is converted to chlorine dioxide through a chlorine dioxide generator and applied as a dilute solution. Chlorine dioxide solutions should be applied to the processing system at a point and in a manner which permits adequate mixing and uniform distribution. The feed point should be well below the water level to prevent volatilization of the chlorine dioxide.

Adult Zebra Mussel

Chlorine Dioxide Analysis

Residual chlorine dioxide concentrations must be determined by substantiated methods, which are specific for chlorine dioxide. Chlorine dioxide solutions can be analyzed by iodometric and amperometric titrations, and spectrophotometrically, with the standard DPD (N,N-diethyl-p-phenylenediamine) method. These methods are described in detail in Standard Methods for the Examination of Water and Wastewater[1].

4500-ClO_2 B	Iodometric Method
4500-ClO_2 D	DPD-Glycine Method
4500-ClO_2 E	Amperometric Method II

References

[1] Standard Methods for the Examination of Water and Wastewater, APHA, AWWA and WEF, Washington, D.C. (20th Ed., I998).

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