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Chlorine Dioxide – The Disinfectant of Choice

Most manufacturing industries including power, steel, chemical, auto and F&B face difficulties in ensuring that their disinfection needs are effectively met. Chlorine is most commonly used on the basis of its reasonable cost and easy availability in many forms rather than its suitability to meet disinfection goals. Chlorine dioxide is now fast becoming a disinfectant of choice considering its improved disinfectant capability besides its ability to penetrate and destroy biofilms.

The disinfection capability of many chlorine compounds especially in cooling towers depends on a host of factors including cooling system design, injection points, retention etc. In spite of following all design and application suggestions, chlorine compounds are unable to destroy biofilms (sessile organisms).

The formation of biofilm on cooling tower walls or heat exchanger systems affects the plant's performance. Conventional disinfectants are not effective enough on biofilms and this leads to a direct impact on plant efficiencies and costs. Apart from their relative ineffectiveness, these conventional disinfectants also generate disinfection by-products (DBPs) that can further complicate the system's performance.

Research carried out by the Building Services Research and Information Association (BSRIA) on chlorine dioxide treatment of domestic water systems concluded that, concentrations of chlorine dioxide as low as 0.1 ppm can eradicate biofilms. The United Nations World Health Organisation (WHO) has confirmed chlorine dioxide as one of the best disinfectants; it has also been approved by several health ministries, as it has a broad-spectrum, high efficiency and is non-toxic. Therefore, it is the best alternative to other disinfectants.

Major advantages of using chlorine dioxide for disinfection include:

- High water solubility (up to 8 grams per litre at normal temperature and pressure)
- No trihalomethanes (THMs) are formed
- Low formation of DBPs (chlorites)
- Effective at low concentrations
- More effective against viruses than chlorine or ozone
- Corrosive effects of chlorine dioxide are minimal
- Simple to maintain & effective
- Rapid microbial killing action
- Maintains biocidal activity up to pH 11
- Better tolerance to organics than chlorine or bromine

- Does not react with organics to form eco-toxic and bio-accumulative by-products
- Environmentally safe
- Excellent odour neutraliser
- Effective fogging and fumigation material

Case Study

A brewery industry experienced severe accumulation of biofouling in the cooling tower. The recirculation rate of the cooling tower was 2500 m^3/h and the hold up volume was 500 cu. m. It was observed that gradually the fouling and corrosion of the cooling tower were having a direct impact on the treatment and heat transfer, causing a decrease in efficiency and increase in power consumption.

Conventional Use of Sodium Hypochlorite

Sodium hypochlorite is the most commonly used oxidising biocide. It is inexpensive, toxic to most micro-organisms and reacts quickly. However, in the system, organic matter reducing agents and chemicals containing reactive nitrogen impair its effectiveness. The use of sodium hypochlorite corrodes metals and attacks the wood of the cooling tower when applied in excess, making it difficult to maintain a pH of 7 – 8.

In spite of increasing the dosage to 100 ppm (daily basis) on the hold up volume, it neither penetrated the thick slimy mass of microbial growth nor restricted its growth and activities.

Use of Chlorine Dioxide instead of Sodium Hypochlorite

Chlorine dioxide was applied directly into the suction of the cooling system's recirculating pumps. The dosage of chlorine dioxide used was as little as 0.3 ppm, twice a day for an hour each, and was effective over a broad pH range. Chlorine dioxide did not form any chlorinated organic by-product. Therefore, it was very effective on the biofilm and for algae control. It also reduced the requirement for microbial control chemicals in the cooling tower. As a result, heat transfer efficiency improved and power consumption was low.

Cost Comparison of Chlorine Dioxide with Sodium Hypochlorite

A comparison of chlorine dioxide and sodium hypochlorite should be conducted from the perspective of long-term performance rather than mere cost. Often, to retain effectiveness, users tend to increase the dosage of sodium hypochlorite, resulting in enormous increase in cost while still not equalling the effectiveness of chlorine dioxide. (Chlorine dioxide becomes more competitive in systems that operate at high pH.) The higher the contamination level the more economically viable chlorine dioxide becomes. For a contaminated system, the amount required is as low as 1/20th that of sodium hypochlorite.

This makes the cost benefit ratio of chlorine dioxide excellent compared to sodium hypochlorite.

For further enquiries on Chlorine Dioxide,

Call: 022 3047 2024

Ion Exchange (India) Ltd., Ion House, Dr. E. Moses Road, Mahalaxmi, Mumbai-400 011, India. Phone: +91-22-3989 0909/3047 2024
Fax: +91-22-2493 8737 E-mail: hocro@ionexchange.co.in Website: www.ionindia.com
Phone 3989 0909 in Chennai, Delhi, Kolkata, Mumbai; prefix 022 from other cities.

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