

TECHNICAL BULLETIN



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CHLORINE DIOXIDE

SANITIZING AGENT

MATERIAL & FUNCTION

Chlorine dioxide (ClO₂) is a synthetic yellowish-green gas with chlorine like odour. ClO₂ is unstable as a gas and will undergo decomposition into chlorine gas (Cl₂), oxygen gas (O₂) and heat. However, ClO₂ is stable and soluble in an aqueous solution. For example, solutions of approximately 1% ClO₂ (10 g/L) may safely be stored if the solution is protected from light and kept chilled. In solution, ClO₂ exists as a true gas.

The instability of ClO₂ has an important consequence. It negates the possibility of creating and transporting cylinders or rail cars of the gas. Instead ClO₂ must be [produced and used at the same location](#).

However, despite the care and [safety considerations](#) which must be taken when using ClO₂, the potential advantages of using this chemical greatly outweigh the possible disadvantage of on site production. When produced and handled properly, ClO₂ is an extremely effective and powerful biocide, disinfectant agent and oxidizer. Used extensively in the Pulp and Paper Industry, [new applications](#) for ClO₂ in other areas such as municipal water treatment, are increasingly being investigated.

USES

ClO₂ is used principally as a primary disinfectant for surface waters (such as stagnant ponds) with odor and taste problems. It is an effective biocide at concentrations as low as 0.1 ppm and over a wide pH range. ClO₂ penetrates the bacteria cell wall and reacts with vital amino acids in the cytoplasm of the cell to kill the organism. The by-product of this reaction is chlorite. Of importance is that toxicological studies have shown that ClO₂'s disinfection by-product, chlorite, poses no significant adverse risk to human health.

Chlorine dioxide is used extensively as a bleaching agent in the pulp and paper industry. In fact, in order to minimize the environmental effects of the bleaching process, ClO₂ is rapidly becoming the chemical of choice. Chlorine dioxide is also being used as a disinfectant agent in the food industry for fruit and vegetable washing, flume water disinfection, meat and poultry disinfection, food process equipment sanitizing water and for odor control. ClO₂ has been extensively used by fish processors to extend the shelf life of Tuna. ClO₂ has been added to live fish tanks at the rate of 1:800 and the fish have been immediately immersed in this solution after capture.

In industrial processes, ClO₂ is used in industrial water treatment (cooling systems/towers), ammonia plants, pulp mills (slime control, paper machines), oil fields, scrubbing systems/odor control, textile bleaching and the electronic industry. Chlorine dioxide is also being applied to medical wastes.

As prominently reported in the US National Media, chlorine dioxide gas is also very effective in remediating environments which have been contaminated with Anthrax spores.

It should first be noted that both chlorine and chlorine dioxide are powerful and effective disinfectant agents. Chlorine has been and continues to be a very effective disinfectant which is responsible for making and keeping drinking water safe for people around the world. In the instances in which the drinking water source is surface water, which contains organic materials, ClO₂ offers the following benefits. First, ClO₂ functions via an oxidative rather than chlorinating reaction. This virtually eliminates the formation of chlorinated organic compounds which are suspected to increase cancer risk. Second, ClO₂ is generated on site, thereby eliminating the need for site storage of chlorine

and/or transportation thereof.

Is Chlorine Dioxide a commodity chemical (i.e. can I purchase it directly from a chemical supplier)?

Pure chlorine dioxide cannot be purchased in solid, liquid or gaseous form. In fact, because ClO₂ is such a highly effective and reactive chemical, transportation of ClO₂ is not permitted. Chlorine dioxide must be produced and used at the point of application.

How is Chlorine Dioxide made?

Chlorine dioxide may be prepared chemically from either sodium chlorite or sodium chlorate or generated electrochemically.

Can Chlorine Dioxide be stored safely?

Solutions of approximately 1% ClO₂ (10 g/L) may safely be stored at 5°C for several months, with little change in concentration, provided that the solution has no gas space and is protected from light. Solutions of 10% chlorine dioxide are easily detonated by sunlight, heat and carbon monoxide.

Health Department of Western Australia (March 2000)

Chlorine dioxide is permitted to be used as a processing aid during the washing and peeling of foods in the course of manufacturing foods provided that the final food contains not more than 1.0 parts per million (ppm) available chlorine or the equivalent concentration of available chlorine dioxide.

Chlorine dioxide is permitted to be used in packaged water and in water that is used as an ingredient in other foods conditional on the available chlorine level not exceeding a maximum residual concentration of 5 ppm available chlorine or the equivalent concentration of available chlorine dioxide.

The Health Department of Western Australia also permits the use of aqueous chlorine dioxide in the following applications:

1. As a terminal sanitising rinse for food contact surfaces at a maximum concentration of 1000 ppm available chlorine or the equivalent concentration of available chlorine dioxide.
2. For disinfection of surfaces such as wall, floors and ceilings at a maximum of 500 ppm available chlorine or the equivalent concentration of available chlorine dioxide, and
3. For the control of mould and mildew on surfaces such as wall, floors and ceilings at a maximum of 1000 ppm available chlorine or the equivalent concentration of available chlorine dioxide.

Chlorine dioxide is considered to be a processing aid rather than a food additive and therefore does not require to be declared on the list of ingredients.

APPLICATION

From Sodium Chlorite and acid.



In order not to generate explosive concentrations of chlorine dioxide, a solution of 4% Sodium Chlorite is supplied. This solution of chlorine dioxide is intended for further dilution.

The application concentration of chlorine dioxide is typically in the 1 to 50 ppm level. Drinking water polishing levels may be in the 0.5 ppm range, whereas in vegetable washing where higher levels of organic contamination are present, higher levels of say 5 ppm will be required.

The actual use level depends on the reactive organic material present, but normally a target of 0.5 ppm as available chlorine at the end of the process is satisfactory. As a guide, the maximum allowable level for drinking water treatment is 0.5 ppm in Great Britain, and min = 0.05 mg/L max = 0.2 mg/L for Germany. A Maximum Contaminant Level (MCL) of 0.8 ppm Chlorine dioxide is proposed in the USA.

The acid used to generate chlorine dioxide may be selected as appropriate from hydrochloric acid, phosphoric acid, acetic acid, lactic acid (eg teat treatment), and citric acid. The food acids (acetic, lactic and citric acid) are preferred for food treatment although some loss of chlorine dioxide will occur due to reaction with chlorine dioxide. Carbon dioxide and oxalic acid may be formed in the process. A four fold molar ratio of lactic acid to sodium chlorite (5.3:1 by weight) has been found satisfactory in practice. The mineral acids (Hydrochloric and phosphoric acid) do not react with chlorine dioxide but the pH is less easily controlled.

Recommended Mixing ratios:

1L of 4% Sodium Chlorite requires: the following wt of acid:

Hydrochloric acid 32% 4 g

Phosphoric acid 85% 4g

Acetic acid 90% 9.5 g

Lactic acid 100% 13 g

citric acid monohydrate 21g

1L of the acidified sodium chlorite solution in 100L water gives approx 200 ppm of chlorine dioxide

GENERAL DATA

CAUTION

Avoid contact with skin and eyes and avoid breathing vapour or spray mist.

Ensure NO SMOKING or NAKED FLAME during application of sealer and provide ADEQUATE VENTILATION. Wear safety gear if in an enclosed space. See the msds for further detail.

PACKAGING

Sodium chlorite: 50 kg.

Sodium chlorite solution: 20L, 200L cubes

Citric acid: 25 kg bags

Acetic acid: 15L, 200L

IMPORTANT NOTICE TO CUSTOMER

*Since the use of this product is beyond the control of either seller or manufacturer, their only obligation shall be to replace any quantity of product, which is proven defective. They cannot assume any risk or liability in excess of the purchase price of the product itself, which does not include labour or any consequential damages resulting from the use of this product. Determining the suitability of this product for any intended use shall be solely the responsibility of the user. **ALWAYS TEST FIRST.***