CSI ClorDiSys Solutions, Inc.™

"The Chlorine Dioxide People"

Providing you with gaseous chlorine dioxide solutions for your food decontamination needs

Concerned about food or tank decontamination?

- Automate the decontamination process.
- Reduce human exposure to disinfecting agents.
- Reduce overall decontamination time.
- Eliminate decontaminating agent storage.

Concerned about your current decontamination process? Our chlorine dioxide system generates a true gas that ensures complete coverage.

- Vapor systems rely on uniform temperature on all room surfaces.
- Spray methods rely on complete coverage or direct contact.
- Formaldehyde requires neutralization and wiping of residues.
- Manual wiping does not ensure complete coverage, is labor intensive and time consuming.
- Aqueous methods of food decontamination don't get as complete coverage.
- Aqueous methods for tanks require large amounts of the decontaminating agent and storage tanks.
- Methyl Bromide use is becoming more restricted.

Cloridox - GMP

The Cloridox and Minidox systems completely control the cycle which will thoroughly decontaminate food storage areas, processing equipment, storage tanks, and processing vessels. The process can be used for decontaminating berries, fruits, vegetables, seeds and other food products as well as used for the sterilization of bottles and packaging.

The typical chlorine dioxide cycle consists of humidifying the room or chamber, injecting gas and holding, then finally exhausting. No manual wiping or further steps are required. In addition, variations in temperature or condensation do not affect the efficacy of chlorine dioxide gas thus simplifying validation efforts.

Another product, Exterm tablets, generate a high level decontamination solution for wiping down food preparation surfaces to disinfect and sanitize.

What is Chlorine Dioxide?

Chlorine dioxide (CD) is a greenish-yellow gas and is a single-electron-transfer oxidizing agent with a chlorine-like odor. CD has been recognized since the beginning of the century for its disinfecting properties; these properties have led to the widespread use of CD in the treatment of drinking water. Beyond this and numerous other aqueous applications, the sporicidal properties of *gaseous* CD were demonstrated in 1986. Subsequent to these initial studies, it has been shown that gaseous CD is a rapid and effective sterilant active against bacteria, yeasts, molds, and viruses. The rapid sterilizing activity of CD is present at ambient temperature and at relatively low gas concentration, 1 to 30 mg/L.

Although Chlorine Dioxide has "chlorine" in its name, its chemistry is radically different from that of chlorine. When reacting with other substances, it is weaker and more selective. For example, it does not react with ammonia or most organic compounds. Chlorine Dioxide oxygenates products rather than chlorinating them. Therefore, unlike chlorine, Chlorine Dioxide does not produce environmentally undesirable organic compounds containing chlorine.

Chlorine Dioxide is widely used as an antimicrobial and as an oxidizing agent in drinking water, poultry process water, swimming pools, and mouthwash preparations. It is used to sanitize fruit and vegetables and also equipment for food and beverage processing. It is used to decontaminate animal facilities. It is also employed in the health care industries to decontaminate rooms, pass-throughs, isolators and also as a sterilant for product and component sterilization. What's more, as an oxidizing agent, it is extensively used to bleach, deodorize, and detoxify a wide variety of materials, including cellulose, paper-pulp, flour, leather, fats and oils, and textiles.

NOTE: Approximately 900,000 tons are used daily.

Process Advantages:

- Biocidal at low concentration and ambient temperature
- Short Cycles
- It is a true gas that distributes rapidly
- No manual wiping required
- Process tolerates temperature fluctuations and gradients
- No liquids
- Process effectiveness independent of dew point and condensation
- No neutralization required
- Efficacious under vacuum or at atmospheric pressure
- Extremely low residuals
- Rapid aeration (low-use concentration and minimal adsorption)
- No mixing of solutions

CD Antimicrobial Spectrum of Activity:

Vegetative Bacteria:
- Staphylococcus aureus
- Pseudomonas aeruginosa
- Salmonella cholerasuis
- Mycobacterium smegmatis

(* CD Indicator Organism)

Bacterial Spores:
- Bacillus subtilis *
- Bacillus stearothermophilus
- Bacillus pumilus
- Clostridium sporogenes

Food Bacteria:
- Listeria monocytogenes
- Bacillus thuringiensis
- Escherichia coli (E. coli)

Fungi:
- Aspergillus niger
- Trychophyton mentagrophytes
- Candida albicans

Viruses:
- Polio Type II (non-lipid)
- Herpes simplex Type I (lipid)
- Parvo Virus

D-Value vs. CD Concentration:

CD Concentration (mg/L)	D-Value (minutes)
10	0.75
20	0.27
30	0.12

Antimicrobial Properties / Mode of Action:

CD acts as an oxidizing agent and reacts with several cellular constituents, including the cell membrane of microbes. By "stealing" electrons from them (oxidation), it breaks their molecular bonds, resulting in the death of the organism by the break up of the cell. Since CD alters the proteins involved in the structure of microorganisms, the enzymatic function is broken, causing very rapid bacterial kills. The oxidative attack on many proteins simultaneously is behind the potency of CD and explains why the cells of microorganisms are unable to mutate to a resistant form.

Log Reductions of L. monocytogenes on uninjured and injured green pepper surfaces after 3-mg/liter CD gas and solution treatments for 10 min at 20^{o} C and water washing.

Green pepper	3-mg/liter CD gas	3-mg/liter CD solution	Water washing
Uninjured Surfaces	7.39 ± 0.28	3.67 ± 0.10	1.35 ± 0.10
Injured Surfaces	3.60 ± 0.28	0.44 ± 0.12	0.39 ± 0.04

Table from: Journal of Food Protection, Vol. 64, No. 11, 2001, Pages 1730-1738, “Reduction of Listeria monocytogenes on Green Peppers by Gaseous and Aqueous Chlorine Dioxide and Water Washing and it Growth at 7^{o}C”, Y. Han, R. H. Linton, S.S. Nielsen and P.E. Nelson

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