



ClorDiSys

Solutions For All Your Gaseous Chlorine Dioxide Needs

The Chlorine Dioxide People

Chlorine Dioxide Gas: The Safest Fumigant

This paper highlights some of the reasons why gaseous chlorine dioxide (CD Gas) is the safest of all the gas or vapor decontamination agents. To be clear, all decontamination agents are deadly. This is their function.

Safety Warnings (Self Alerting): The best safety feature with CD Gas is that it is self-alerting. CD Gas has an odor threshold at or below the 8 hour Time Weighted Average (TWA), so the user is self alerted to exposure at a low level and the reliance on external equipment is not as imperative as with Vapor-Phase Hydrogen Peroxide (VPHP). This alone makes CD Gas safer since the user and nearby personnel are self-alerted before unsafe levels are achieved. With VPHP, there is no odor to provide a warning of exposure. The user becomes aware of a harmful exposure only when respiratory symptoms present themselves. The user cannot detect VPHP until the safe levels are exceeded and *must* rely on external equipment to alert of possible exposure. This makes it extremely important to place personal safety detection devices all around the area when using VPHP. With CD Gas, the reliance upon external equipment is less critical as the self-alerting odor can reduce the overall risk.

Shorter Cycle Times: Chlorine dioxide gas has a shorter cycle time than other high level decontamination methods, lowering the risk profile for the process itself. Decontaminating a 10" x 20" room would take approximately 3.5 hours from start to end when it is safe to reenter the room. Formaldehyde and VPHP decontaminations would take approximately 8-16 hours to decontaminate the same size room in most cases. VPHP cycles require additional time to remove the vapor from the room at the end of the cycle as the vapor condenses onto surfaces and does not evaporate quickly. Catalytic conversion to remove VPHP can take upwards of 12 hours, while direct aeration through the HVAC system can take approximately 6+ hours. Formaldehyde has a longer kill time and a longer removal time as residues can be left behind by the process which requires additional cleaning. A longer cycle time represents a greater risk as the room contains an unsafe environment throughout the decontamination process. CD Gas is able to reduce the risk by completing its decontamination cycle in a much shorter time while still delivering a complete, 6-log decontamination of the room.

Lower Concentration Levels: Chlorine dioxide is typically used at lower concentrations for room decontamination than VPHP and formaldehyde. CD Gas concentration is typically 360 ppm for room decontamination. VPHP concentrations are typically 750-1500 ppm. Formaldehyde concentration is typically 8,000 ppm. While all concentrations are dangerous, the higher concentration of formaldehyde and VPHP poses a greater risk due to the higher concentrations in the room.

Equipment Located Outside the Room/Chamber: The CD Gas generating equipment is located outside the room or chamber being decontaminated. If equipment is inside the room and some issue occurs, the possibility exists where the user may have to enter during unsafe conditions in order to shut the equipment down. Since CD Gas generation equipment is located outside the room, the equipment can easily be shutdown by hitting the stop button located on the generator or even by pulling the plug.

Quicker Emergency Aeration: Chlorine dioxide is quicker to aerate down to the 8-hour TWA compared to VPHP and formaldehyde. In case of emergency, the room being decontaminated returns to a safe condition quicker when CD Gas is used. A room being decontaminated with CD Gas can be fully aerated in 30-45 minutes when it would be safe to enter. A room being decontaminated with VPHP can be made safe in 6-18 hours depending on whether catalytic conversion or direct venting is being used to remove the hydrogen peroxide. The reason for the long aeration times with VPHP is that it is a vapor that condenses onto and absorbs into surfaces and materials during the decontamination which then requires evaporation or desorption. A room being decontaminated by formaldehyde can be made safe in between 60-120 minutes not counting residual cleanup times. Even though the TWA for CD Gas is 0.1 ppm vs. 1.0 ppm for VPHP, CD Gas concentrations are able to get down to the safe levels much quicker than VPHP. Similarly, if there is leakage from the room or chamber being decontaminated, the leak will be removed and exhausted quicker with CD Gas than VPHP or formaldehyde.

Non-carcinogenic: Chlorine dioxide gas is not classified as a carcinogen by any health organization. Chlorine dioxide is used to treat drinking water in over 800 municipalities within the USA and is widely used in Europe as well. Chlorine dioxide is also used to rinse many fruits, vegetables, and poultry and is on the National Organic Program's List of Approved and Prohibited Substances as an approved substance for use in organic foods.

Formaldehyde is classified as a known carcinogen by most of the leading health organizations worldwide.

Hydrogen Peroxide is classified as a "confirmed animal carcinogen with unknown relevance to humans" by the American Conference of Governmental Industrial Hygienists (ACGIH).

Complete Decontamination: One of the most important safety factors for decontamination methods are their ability to completely decontaminate the space they are introduced into. Chlorine dioxide and formaldehyde are gasses which reach and penetrate all areas throughout the room/chamber including cracks, crevices and other hard to reach areas. Vapors have difficulty reaching these areas due to poor diffusive properties and condensation issues. If the decontaminating agent cannot reach ALL of the dangerous organisms in the space, at the proper concentration, for the prescribed amount of time, then a complete decontamination will not occur and worker safety is compromised.

Summary: There are many reasons chlorine dioxide gas provides a better safety profile when compared to VPHP and formaldehyde. The cycles are shorter limiting the "unsafe" time when the decontaminating agent is present. It is far quicker to aeration to its TWA level if an emergency does occur. The actual concentration levels are significantly lower. And, most importantly, CD Gas is self-alerting with an odor threshold at or below the 8 hour Time Weighted Average (TWA) so the user is self alerted to exposure at a low level, which is not the case with VPHP.

	Chlorine Dioxide Gas	Vapor Phase Hydrogen Peroxide	Formaldehyde
8 hr TWA (time weighted average)	0.1 ppm	1.0 ppm	0.75 ppm
Odor Detection	YES At 8 hour safety level	NO	YES
Carcinogen	NO	NO	YES
Able to be Vented to Environment	YES	YES	NO
Cycle Times (Risk of Exposure) 2500 ft ³ room	3-4 hours	6-18 hours	12+ hours
Typical Concentrations	360 ppm	750 ppm	8000 ppm
Good Penetration and Distribution	YES (gas)	NO (Vapor)	YES (gas)
Ability to Penetrate Water	Yes (gas)	NO (vapor)	YES (gas)
Equipment Location	Outside Room	Bioquell Inside / Steris Outside	Inside Room
Aeration Time 2500 ft ³ room	30-60 minutes	Typically Overnight	1 hour + cleanup