

# CSI ClorDiSys Solutions, Inc.™

“The Chlorine Dioxide People”

Providing you with gaseous chlorine dioxide solutions for your decontamination needs

## Chlorine Dioxide vs. “Vapor” Hydrogen Peroxide

Chlorine Dioxide (CD) and formaldehyde are the only effective decontaminating agents that are used for the decontamination of buildings, rooms, isolators and bio-safety cabinets that are “true” gases. Hydrogen peroxide is a liquid at room temperature and requires boiling or vaporization to generate the vapor. The boiling point for 35% hydrogen peroxide is 109°C while room temperature is only 21-22°C. A vapor is basically a super heated fluid that, when introduced into a room, wants to return to its original form, a liquid, as condensation. If the target chamber is a long distance from the generator (more than a few feet), heat tracing or insulation of hosing is required to REDUCE condensation in the hoses.

Gaseous CD does not require tight control of Dew Point temperatures as is required with VHP (ie. difficult to obtain uniform condensation or lack of condensation in a real world application). Gaseous CD has Quicker Aeration due to minimal absorption and lack of condensation. Additionally, CD systems from CSI can include integrated, accurate, and repeatable CD concentration measurement and control. This means that while only an *injection rate* is selected with VHP and the chamber concentration assumed, an *actual chamber concentration* is chosen and attained with CD. This greatly simplifies validation efforts and assures efficacy and repeatability.

**Scalability:** One single ClorDiSys CD generator can decontaminate spaces from 1 to over 60,000 cubic feet as compared to multiple Hydrogen Peroxide generators (1 generator for every 1500 cubic feet). Using VHP injection rates need to be modified for room size and configuration with CD the injection rate does not change at all.

Room size cu ft (area in sq ft)	Amount of CD Generators required	Amount of VHP generators required
1000 cu ft (100 sq ft)	1	1
1500 cu ft (150 sq ft)	1	1
2000 cu ft (200 sq ft)	1	1-2*
5000 cu ft (500 sq ft)	1	2-3*
10000 cu ft (1000 sq ft)	1	6-7*
15000 cu ft (1500 sq ft)	1	10
20000 cu ft (2000 sq ft)	1	13-14*
30000 cu ft (3000 sq ft)	1	20

\* Lower number generator used if room is empty room geometry is simple (no closets or lab benches which block the flow of vapors).

**Material Compatibility:** Hydrogen Peroxide is 1.9 times more corrosive than CD based on its higher oxidation potential.

**Efficacy:** CD is 250% more efficient than Hydrogen Peroxide due to CD’s higher oxidation capacity based on CD seeking 5 free electrons vs. 2.<sup>1</sup>

**Quicker Cycles:** To further highlight the benefits of CD, the following documents example cycle times for both CD and VHP.

Isolator Decontamination	Volume	Cycle Time
Steris VHP	≈ 25 ft <sup>3</sup>	3-6 hours <sup>2</sup>
Bioquell Clarus	≈ 25 ft <sup>3</sup>	3-3.5 hours <sup>2</sup>
Chlorine Dioxide	31 ft <sup>3</sup>	1.3 hours <sup>3</sup>

Room Decontamination	Volume	Cycle Time
Steris VHP	300 ft <sup>3</sup>	7.5 hours <sup>4</sup>
Steris VHP	760 ft <sup>3</sup>	4.25 hours+overnight aeration <sup>5</sup>
Bioquell Clarus	2500 ft <sup>3</sup>	10-11 hours <sup>6</sup>
Chlorine Dioxide	2700 ft <sup>3</sup>	3.5 hours <sup>7</sup>

CSI ClorDiSys Solutions, Inc.

P.O. Box 549, Lebanon, NJ 08833-0549 Tel:(908) 236-4100 Fax:(908) 236-2222

[www.clordisys.com](http://www.clordisys.com)

Additional benefits can be seen in the following table:

	<b>“Vapor” Hydrogen Peroxide</b>	<b>Chlorine Dioxide</b>
<b>Safety</b>	<ul style="list-style-type: none"> <li>Not Carcinogenic</li> <li>Mucus membrane irritant</li> <li>No decontamination needed upon exiting facility</li> <li>People entering area need to be in self contained breathing apparatus (SCBA)</li> </ul>	<ul style="list-style-type: none"> <li>Not Carcinogenic</li> <li>Mucus membrane irritant</li> <li>No decontamination needed upon exiting facility</li> <li>People entering area need to be in self contained breathing apparatus (SCBA)</li> </ul>
<b>Current uses</b>	<ul style="list-style-type: none"> <li>Pharmaceutical and Medical Device Equipment and Components</li> <li>Medical Device Sterilization</li> <li>Hospital</li> </ul>	<ul style="list-style-type: none"> <li>Bio-remediation (Anthrax- Hart Building, Trenton Post Office, AMI building)</li> <li>Pharmaceutical and Medical Device Equipment and Components</li> <li>Medical Device Sterilization</li> <li>Removal of biofilms</li> <li>Water treatment</li> <li>Food sanitization (Meats and Produce)</li> <li>Drinking water</li> </ul>
<b>Regulatory status</b>	<ul style="list-style-type: none"> <li>Only Steris Vaprox is EPA registered for sterilization/decontamination</li> </ul>	<ul style="list-style-type: none"> <li>ClorDiSys Solutions, Inc. is EPA registered for sterilization/decontamination (Including rooms)</li> </ul>
<b>Biocidal Activity</b>	<ul style="list-style-type: none"> <li>Broad Spectrum <ul style="list-style-type: none"> <li>Requires Low humidity</li> </ul> </li> <li>Good sporicidal activity</li> </ul>	<ul style="list-style-type: none"> <li>Broad Spectrum <ul style="list-style-type: none"> <li>Higher humidity (&gt;65%)</li> </ul> </li> <li>Good sporicidal activity</li> </ul>
<b>Mode of action</b>	<ul style="list-style-type: none"> <li>Oxidation (oxidation potential of 1.78)</li> <li>Oxidation Capacity of only 2e-</li> </ul>	<ul style="list-style-type: none"> <li>Oxidation (oxidation potential of 0.95)</li> <li>Oxidation Capacity of 5e-</li> <li>Free radical monomer</li> <li>Does not Chlorinate</li> </ul>
<b>Functional Conditions</b>	<ul style="list-style-type: none"> <li>Use concentrations &gt; 2.0 – 5 mg/L</li> <li>Need very low humidity levels prior to starting cycle</li> <li>Concentration based on loss in mass</li> <li>Ideal temp &gt; 35°C (to reduce condensation)</li> <li>Boiling/Vaporization of liquid</li> <li>Typical cycle time 10 hours (2500 ft<sup>3</sup> chamber)</li> </ul>	<ul style="list-style-type: none"> <li>Use concentrations used typically 0.2 - 5 mg/L</li> <li>Need &gt; 65% RH (hydration critical to sporicidal properties)</li> <li>Effective at ambient temperatures (15-40°C)</li> <li>In situ generation</li> <li>Typical cycle time 3.5 hours (2700 ft<sup>3</sup> chamber)</li> </ul>
<b>Advantages / Disadvantages</b>	<ul style="list-style-type: none"> <li>Broad Spectrum</li> <li>Good sporicidal activity</li> <li>Does not have effect on wide range of plastics</li> <li>Does not have effect on stainless steel surfaces</li> <li>Vapors have poor penetrating ability</li> <li>Vapors have poor distribution ability</li> <li>1 generator for every 1500 cu ft</li> <li>Cannot monitor hydrogen peroxide concentration in real time</li> <li>Oxidation Capacity of only 2e-</li> <li>More corrosive effects due to higher oxidation potential</li> <li>Need higher operating temperatures in chamber to reduce hydrogen peroxide condensation</li> <li>Cannot take into account loss of vapor concentration due to condensation</li> <li>Long cycle times</li> <li>If generator is a long distance from chamber (&gt;5ft) insulation and heat tracing of hoses required to reduce condensation</li> <li>Can be corrosive to uncoated ferrous metals at higher concentrations</li> <li>Galvanized steel (duct work) and aluminum catalytically breaks down hydrogen peroxide</li> <li>Does not obtain kill on cement block</li> </ul>	<ul style="list-style-type: none"> <li>Broad Spectrum</li> <li>Good sporicidal activity</li> <li>Chlorine Dioxide is a true gas (Boiling point 11°C)</li> <li>Gas concentration is continuously monitored during process</li> <li>More efficient due to Oxidation Capacity of 5e-</li> <li>No neutralization of the gas is needed</li> <li>Can vent to atmosphere or scrub</li> <li>Gas penetrates dead legs and hard to reach places</li> <li>Broad spectrum biocidal properties</li> <li>Used to sanitize equipment in food industry</li> <li>EPA approved sterilant</li> <li>Novartis validated filling line using Chlorine Dioxide</li> <li>Does not Chlorinate environment and equipment</li> <li>Does not have effect on wide range of plastics</li> <li>Does not have effect on stainless steel surfaces</li> <li>Does not have effect on anodized aluminum</li> <li>Can be corrosive to uncoated ferrous metals at higher concentrations</li> </ul>

**References:**

- Wintner, Barry, Contino, Anthony, and O'Neill, Gary. Chlorine Dioxide, Part 1: A Versatile, High-Value Sterilant for the Biopharmaceutical Industry. Bioprocess International, Dec' 2005
- Caputo, Ross A. and Fisher, Jim. Comparing and Contrasting Barrier Isolator Decontamination Systems. Pharmaceutical Technology, November 2004.
- Czarneski, Mark A. and Lorcheim, Paul. Isolator Decontamination Using Chlorine Dioxide Gas. Pharmaceutical Technology, Volume 29, No 4, April, 2005
- Steris Case Study M1456, VHP Case Study #1 – Hydrogen Peroxide Gas Decontamination of A Material Pass-Through (MPT) Room, Publication ID #M1456(8/99), Steris, August, 1999.
- Steris Case Study M1455, Case Study #3 - VHP 1000 Decontamination of a 760 ft3 room Containing Blood and Urine Analyzers, Publicaiton ID#M1455/990810 (8/99), Steris August 1999.
- Room Decontamination Presentation to Council on Private Sector Initiatives, Washington, DC, by Henry Vance PE of Alpha Engineering, February 11, 2002
- Lorcheim, Paul. Decontamination using Gaseous Chlorine Dioxide, A case study of automatic decontamination of an animal room explores the effectiveness of this sterilization system. Animal Lab News, Vol. 3, No. 4, p25-28, July/August 2004.

**CSI ClorDiSys Solutions, Inc.**

P.O. Box 549, Lebanon, NJ 08833-0549 Tel:(908) 236-4100 Fax:(908) 236-2222  
[www.clordisys.com](http://www.clordisys.com)