ECOSENSE
Bio-Decontamination Services

Microbial Decontamination

with ClorDiSys Chlorine Dioxide Gas

- Safest Fumigation Method
- Replaces VHP, Formaldehyde, and EtO
- No Residues
- Complete Decontamination of all Surfaces and Microscopic Crevices
- Fastest Cycle Times
- Effective Against all Viruses, Bacteria, Fungi and Spores
- EPA Registered Sterilant
- Guaranteed Dosage with Precise Concentration Monitoring
- Safe on Materials
- Capabilities Range from Treating Single Items to Large Spaces
- True Gas at Room Temperature
- On-Site Decontamination Services and Off-Site Contract Sterilization

Phone: 844-437-6688 **www.ecosensecompany.com** **info@ecosensecompany.com**

WHAT IS CHLORINE DIOXIDE?

Chlorine dioxide (CD) is a greenish-yellow gas with a chlorine-like odor recognized since the beginning of the 20th century for its disinfecting properties. It is widely used as an antimicrobial pesticide and an oxidizing agent in drinking water in addition to whitening paper for the pulp and paper industry.

Chemical Formula:	ClO_2
Molecular Weight:	67.45 g/mole
Melting Point:	-59°C
Boiling Point:	+11°C
Density:	2.4 times that of air

ClorDiSys uses chlorine dioxide gas for its broad efficacy against microorganisms. It is applied in a number of different applications and industries to provide a 6-log (99.9999%) sterilization level decontamination. The rapid sterilizing activity of CD is present at ambient temperature and across a wide range of gas concentrations.

Measured and Controlled

Due to its yellow-green color, chlorine dioxide gas can be measured using a photometer. A photometer measures the absorbance of the gas (darker color = higher concentrations) which allows for a highly accurate, repeatable, and reliable measurement to ensure tight process control.

True Gas at Room Temperature

Chlorine dioxide is a true gas at room temperatures which enables it to fill the space it is contained within evenly and completely, just like oxygen in air. This property is essential when trying to eradicate pathogens from an area, as the gas will get everywhere and not allow anything to "hide" from it.

Different from Chlorine

While "chlorine" is in its name, chlorine dioxide gas is VERY different. Chlorine dioxide's method of kill is oxidation, where chlorine kills through chlorination. Therefore, unlike chlorine, chlorine dioxide does not produce environmentally undesirable organic compounds and is safer on materials.

HOW DOES CHLORINE DIOXIDE WORK?

Chlorine dioxide acts as an oxidizing agent, which kills organisms by "stealing" electrons from cells, breaking their molecular bonds. The method and potency of chlorine dioxide gas prevents cells from mutating to a resistant form. This eliminates the need to rotate decontamination methods to prevent overuse and resistance. Additionally, because of the lower reactivity of chlorine dioxide, its antimicrobial action is retained longer in the presence of organic matter making it more effective than most other decontamination methods at killing within dust, dirt, and other organics.

IS CHLORINE DIOXIDE ENVIRONMENTALLY FRIENDLY?

Chlorine dioxide's properties make it an ideal choice to meet the challenges of today's environmentally conscious society. Chlorine dioxide gas is non-carcinogenic, leaves no residues or waste to treat or clean up, and does not deplete the ozone layer. It can be safely vented into the atmosphere in all parts of the world. It is used to treat drinking water and approved for organic crops on the USDA's National List of Allowed and Prohibited Substances. (7 CFR §205.601)

HOW DOES CHLORINE DIOXIDE REACT WITH WATER?

While chlorine dioxide has "chlorine" in its name, it is very different from chlorine. Chlorine reacts with water to form hydrochloric acid, but chlorine dioxide does not and maintains a neutral pH in water. Gaseous CD is the only decontaminating fumigant that penetrates water, decontaminating both the water and the surface beneath. If liquid is present, the sterilization efficacy of CD is not affected.

CHLORINE DIOXIDE GAS: THE SAFEST FUMIGANT

All decontamination agents are dangerous as this is their function. However, gaseous chlorine dioxide can be used safer than other fumigation methods due to its chemical properties and safety profile.

SAFETY WARNINGS (SELF ALERTING)

The best safety feature with CD is that it is self-alerting. CD 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 sensors is not as imperative as it is with VPHP. This makes CD safer since the user is self-alerted before unsafe levels are reached. With VPHP, there is no odor to provide a warning of exposure. This dangerous trait is why natural gas is given a sulfur-like odor additive, to act as an alert of exposure. VPHP users (and surrounding colleagues) become aware of a harmful exposure only when coughing and choking occurs, therefore relying on external sensors to prevent adverse health effects.

SHORTER CYCLE TIMES

Chlorine dioxide is the fastest acting decontaminating gas or vapor. Various decontamination methods' cycle times range from 3½ hours to over 12 hours to decontaminate a 2500 ft^3 room (70.8 m^3). With normal aeration exhaust rates, a CD cycle would be about 3½ hours, formaldehyde would be about 12½ hours, and VPHP could be 10+ hours. VPHP has longer cycles because of the extended aeration times due to the nature of vapor condensation and absorption issues that do not apply with a true gas. Formaldehyde has long cycles because of long exposure times and the neutralization time. This means a potentially unsafe condition exists for a far shorter time when using chlorine dioxide.

LOWER CONCENTRATION LEVELS

Chlorine dioxide is typically used at lower concentrations for room decontamination. VPHP concentrations are typically 750-1500 ppm. Formaldehyde concentration is typically 10,000 ppm. CD concentration is typically only 360 ppm. Use concentrations for all agents are much higher than safe levels, however if something goes wrong, the higher concentration of formaldehyde and VPHP poses a greater risk.

EQUIPMENT LOCATED OUTSIDE THE TARGET CHAMBER

The ClorDiSys CD generating equipment is located outside the decontamination target chamber. If equipment is inside the chamber and an issue occurs, the user may have to enter with a decontamination agent present in order to shut it down. Since our CD generation equipment is located outside the chamber, if an issue occurs, the equipment can easily be shutdown by hitting the stop button located on the generator or simply pulling the plug.

QUICKER EMERGENCY AERATION

In case of an emergency during a decontamination, chlorine dioxide gas is quicker to aerate down to the 8-hour TWA compared to hydrogen peroxide based methods and formaldehyde, so the environment returns to a safe condition faster. If something goes wrong during the CD cycle, aeration can be started and in 30-45 minutes there will be no CD left (below the 0.1ppm TWA). If something goes wrong during a VPHP cycle, catalytic conversion starts and this typically takes 12 hours. If direct aeration is utilized, this also takes hours to remove the VPHP from the room. (See "Shorter Cycle Times" above.)

CARCINOGENICITY

Formaldehyde is "known to be a human carcinogen" as described by the US National Toxicology Program. The ACGIH designates VPHP as an A3, Confirmed Animal Carcinogen with Unknown Relevance to Humans. Chlorine dioxide gas is not considered to be carcinogenic, and the ACGIH does not list CD as a carcinogen of any kind. CD gas is used to treat fruits, vegetables, poultry, and other foods as well as drinking water.

COMPLETE DECONTAMINATION

Chlorine dioxide and formaldehyde are gasses that reach and penetrate all surfaces and crevices, unlike vapors which have trouble guaranteeing complete coverage and penetration. As the only decontaminating agent able to penetrate water, CD gas decontaminates the water and the surface beneath it. If the decontaminating agent cannot reach ALL of the dangerous organisms, at the proper concentration, for the prescribed amount of time, then a complete decontamination will not occur and worker safety is compromised. CD gas is able to be accurately measured in realtime using a UV-vis spectrophotometer, allowing for the correct concentration and exposure levels to be met every time, making it very reliable.

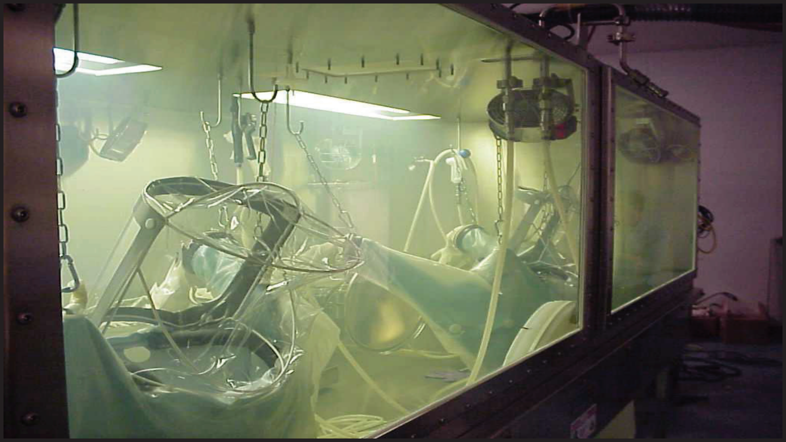
CHLORINE DIOXIDE GAS APPLICATIONS









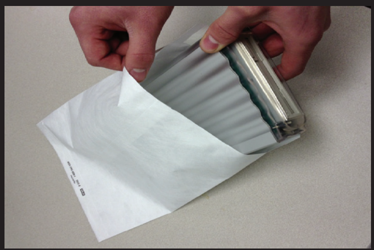










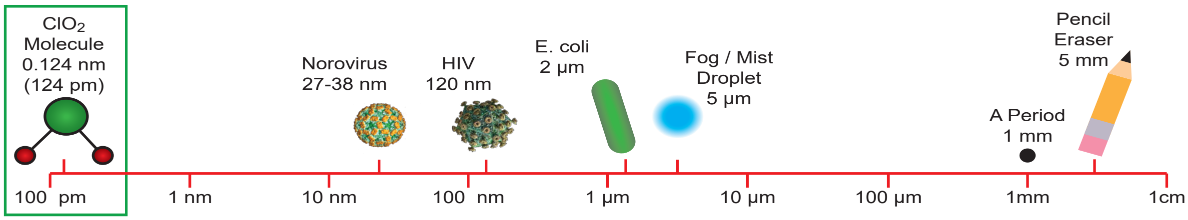



Chlorine dioxide gas can be utilized for a multitude of applications in a variety of industries. Chlorine dioxide gas is not affected by environmental factors and is not subject to dew-point or condensation issues making it a versatile decontamination agent effective in all types of environments.

METHOD COMPARISON: EFFICACY

Being a true gas, chlorine dioxide observes natural gas laws meaning that by nature, it will uniformly fill any space where it is introduced. Hydrogen peroxide vapor on the other hand, is not a true gas and will start to condense back into its liquid state at temperatures below 228°F (109°C), negatively affecting its distribution and penetration abilities. This "Vapor vs. Gas" differentiation leads to many of the differences between the two methods.

MOLECULAR SIZE MATTERS



	CHLORINE DIOXIDE GAS	VAPOR PHASE HYDROGEN PEROXIDE	PEROXIDE/PERACETIC ACID FOGGING
DISTRIBUTION Contact is essential. Poor distribution leads to poor decontamination.	Follows natural gas laws to achieve complete and uniform distribution throughout space.	Hydrogen peroxide vapor is poor at passive diffusion because of hydrogen bonding characteristics.[1]	Since it's heavier than air, it has difficulty getting under or behind objects.
PENETRATION Cracks, crevices, gaps, and pipe threads are commonly found in rooms/chambers.	Able to penetrate into cracks, crevices, and some organic materials.	Unable to penetrate well due to tendency to condense on surfaces, and unable to penetrate gaps of 5mm (0.196")[2].	Unable to penetrate well due to its typical size of 5-15 microns versus 1-2 microns for the organisms.
RELATIVE HUMIDITY Increased humidity levels are essential in all spore reduction. However, the higher the Rh, the greater the risk of damaging electronics.	Typical range is between 60-75%.	Initial levels vary but final levels typically exceed 85%.	Initial levels vary but final levels typically exceed 85%.
CONCENTRATION MONITORING	Integrated, validated photometric sensor which measures concentration accurately in real-time.	Chemical sensor may be integrated at extra cost. Inaccurate concentration monitoring due to condensation and non-uniform distribution within space.	The solution concentration can be verified, but the treatment concentration cannot due to condensation and non-uniform distribution within space.
EPA REGISTRATION Product labels must be read for approved applications.	YES	YES	YES/NO

1. Orlowski, Martin. Redifining Decontamination Safety. ALN Magazine, March 2011.
2. Steris Case Study M1941, Industry Review: Room Decontamination with Hydrogen Peroxide Vapor. Publication ID #M1941EN.2002-09 Rev. C, Steris, 2000.

Chlorine Dioxide Gas vs. Vapor Phase Hydrogen Peroxide

Chlorine dioxide gas offers a much more flexible process than hydrogen peroxide, allowing it to work more reliably across various applications and conditions.

CYCLE DEVELOPMENT	CHLORINE DIOXIDE (CD)	VAPOR PHASE HYDROGEN PEROXIDE (VPHP)
ROOM VOLUME	Volume does not affect CD cycle development. Volumes up to 70,000 ft^3 (1982 m^3) are achievable with one generator.	Volume DOES affect cycle development. VPHP generators have volume capacities between 8,000 and 12,000 ft^3 (226.5-339.9 m^3) with realistic capacities around 2,000 ft^3 (56.6 m^3).
ROOM SHAPE	Room shapes do not affect the cycle for CD. As a true gas at room temperatures, chlorine dioxide naturally disperses everywhere.	Room shape DOES affect cycle development as VPHP is injected in a line-of-sight fashion. Whatever cannot "be seen" by the generator cannot be contacted directly by VPHP and may not receive sufficient concentration to achieve full decontamination.
SHADOW AREAS/ LOADING WITHIN A SPACE	The amount of equipment and its location within a space does not affect a CD cycle. Gasses get everywhere.	The amount of equipment and its location within a space DOES affect a VPHP cycle. Equipment and items in the room can act as barriers to the VPHP distribution, blocking the line-of-sight between other surfaces and the generator. As such, cycles must be developed and validated whenever the amount, or location of equipment, changes to ensure proper decontamination.
TEMPERATURE	CD exists as a gas at temperatures above 52° F (11° C). As a true gas, CD gets great distribution naturally and automatically. No affect on cycle development. At use concentrations, chlorine dioxide remains a gas to much lower temperatures.	Temperature DOES affect the cycle as hydrogen peroxide has a boiling point of 228° F (109° C). At temperatures below this, hydrogen peroxide starts condensing back to the liquid state. This limits its movement causing non-uniform distribution and concentration with some areas not getting enough VPHP to achieve full decontamination, since colder areas and surfaces scavenge VPHP from warmer surfaces and areas. This property clouds the success and repeatability of cycles.
STARTING RELATIVE HUMIDITY LEVEL **NOTE:** All decontamination methods need elevated Rh for spore log kill	Starting Rh level does not affect the cycle. Humidity is added independently from CD gas.	Starting humidity DOES affect the VPHP cycle. Humidity is added to an environment along with VPHP as it is generated by vaporizing a hydrogen peroxide/water mixture. With humidity levels affecting dew points and condensation of VPHP, the initial Rh level can significantly impact the decontamination process, as higher Rh levels will cause faster condensation and further limit its distribution.
INJECTION RATE	Cycles always use the same injection rate. No affect on cycle development.	Room geometry, room volume, and the amount of equipment within the room DOES affect the injection rate used in a cycle. The proper injection rate needs to be determined through testing and validation runs which must be performed for each room and every time the amount and location of equipment changes.
WET SURFACES	CD can penetrate water and decontaminate it and the surface beneath it. No affect on cycle development.	The presence of wet surfaces DOES affect VPHP cycles. VPHP dilutes and breaks down in water and is unable to decontaminate it or the surface beneath.

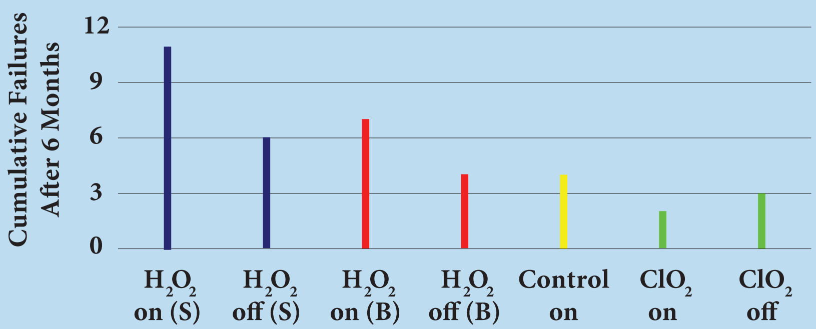
MATERIAL COMPATIBILITY

Chlorine dioxide is an oxidizer, as is hydrogen peroxide, ozone, bleach, and many other decontaminating agents. However, CD gas is the gentlest on materials among those options, due to it's lower oxidation potential. A higher oxidation potential means it's a stronger oxidizer and more corrosive. Chlorine dioxide has an oxidation potential of 0.95V, which is lower than other commonly used decontaminating agents.

Biocidal Agent	Oxidation/Corrosion Potential (V)
Ozone	2.07
Peracetic Acid	1.81
Hydrogen Peroxide	1.78
Sodium Hypochlorite	1.49
Chlorine Dioxide	0.95

While scientifically less corrosive, chlorine dioxide gas has a bad reputation due to the link with chlorine as well as the other chlorine dioxide products that lack the purity that our process uses. Other methods of generating chlorine dioxide mix an acid and a base which forms a chlorine dioxide solution which is then off-gassed to fumigate a space. That generation method produces two acidic components, acidified sodium chlorite and chlorous acid, alongside chlorine dioxide which makes these methods more corrosive. Our method of generating pure chlorine dioxide gas is accomplished by passing a low concentration chlorine gas through a proprietary sodium chlorite cartridge to convert the chlorine gas into pure chlorine dioxide gas. This allows our process to be safe when decontaminating stainless steel, galvanized metals, anodized aluminum, epoxy surfaces, electronics, and the most common materials of construction. Typically, if water will not corrode an item, neither will our CD.

The US EPA shows that hydrogen peroxide is more corrosive than chlorine dioxide gas



Ref: Emily Snyder, "Indoor and Outdoor Decontamination" Presentation at the EPA Region 9 / ORD Homeland Security Research Workshop, July 14, 2011 San Francisco, CA.

The US EPA performed a study comparing the material compatibility of chlorine dioxide gas and two hydrogen peroxide vapor systems on computers. CD Gas had the least failures, while hydrogen peroxide was shown to have more failures, especially when the computer fans were turned on (signified by the "on" columns in the graph). The fans brought higher concentrations of moisture and hydrogen peroxide into the computer itself which caused more damage than when the fans were off.

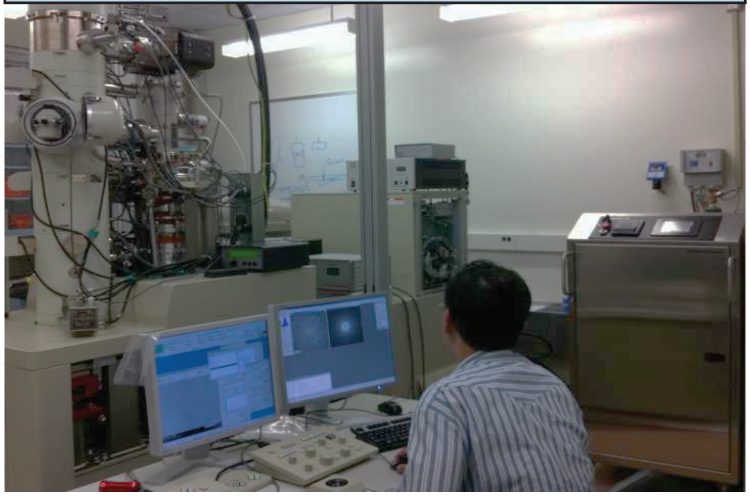
DRY STERILIZATION

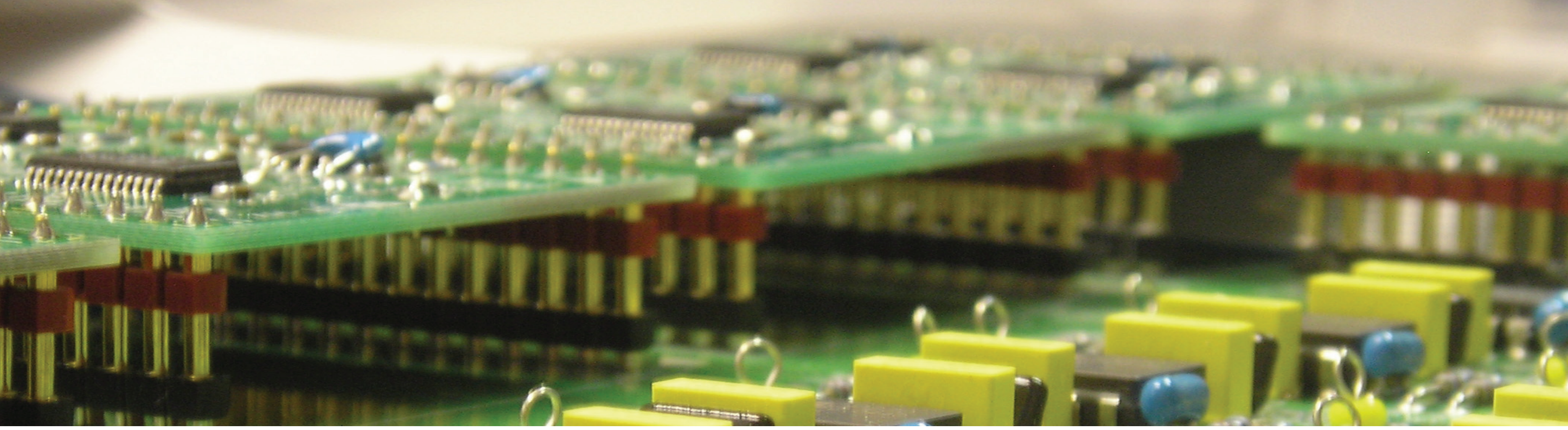
Our chlorine dioxide gas is generated through a completely dry process, leaving no concern over liquid-sensitive materials or components being affected.

RESIDUE FREE

Our CD Gas does not leave a residue on equipment and surfaces after a decontamination. Once the gas has been removed, the area is safe and does not require additional cleanup.

CD has been used to decontaminate interior components of a $3 Million Transmission Electron Microscope with no adverse effect.





OUR GENERATION METHOD

Not all chlorine dioxide products are equal. Our CD gas generators produce a pure chlorine dioxide gas without the acidic byproducts typical of other chlorine dioxide products.

OXIDATION POTENTIAL

Pure chlorine dioxide has a lower oxidation/corrosion potential than ozone, peracetic acid, hydrogen peroxide, and bleach. This means chlorine dioxide is safer on materials than those chemicals.

IF YOU DON'T TRUST US, TEST US!

We offer material compatibility testing for items that you are concerned about.

*Ecosense will expose your items/equipment to chlorine dioxide gas and return to you for observation and testing. Testing is limited to small batches less S/H. For large items or extended testing, please call.

CONTRACT STERILIZATION SERVICES

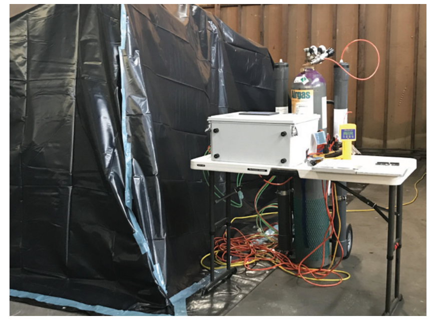
Ecosense offers Contract Sterilization Services where we can decontaminate your items, equipment, supplies, and products at our facility, then ship them back to to your facility or onward to a 3rd party facility. Ecosense uses chlorine dioxide gas for sterilization of components instead of gamma irradiation, ethylene oxide gas, or electron beam methods. Turnaround time is traditionally 24 to 72 hours, dependant upon the particular application and special requests. Upon completion, a Certification Sheet is issued describing the process and showing the sterilization cycle data.

COMMON APPLICATIONS

- Sterilization of components before entering a clean facility
- Equipment contaminated with amplicons, beta lactams, or mold
- Computers, printers, keyboards, and routers
- Electronics (RFID tags, monitoring instruments, microscopes)
- Supplies (Shoes, safety glasses, clothing)
- Sterilization of sterile products manufactured in a non-sterile facility
- Medical items
- HEPA or Sterilizing Filters

CONTRACT STERILIZATION OPTIONS

Let us help sterilize your products, supplies and equipment at the Ecosense facility. We can sterilize small batch items in our decontamination chamber or can easily accomodate large equipment by constructing a custom size fumigation tent

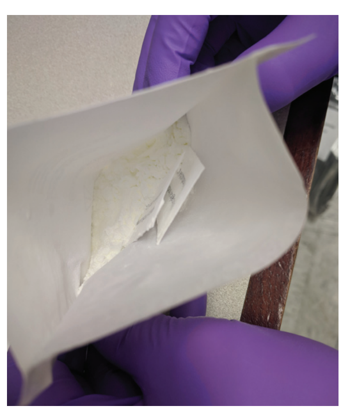


“TRUE” STERILIZATION OF MEDICAL DEVICES

Chlorine dioxide gas (CD) is able to provide true sterilization, similar to EtO for medical devices. While EtO is a very effective sterilant, CD has many benefits over EtO for a variety of applications. Both are gasses which have the ability to reach all of the individual organisms to provide 6-log sporicidal kill. The CD concentration can easily be measured with a built-in UV-VIS spectrophotometer ensuring the efficacy of every cycle and allowing for parametric release.

Chlorine dioxide is the method usually recommended when devices have imbedded batteries which are not affected by CD. CD does not get absorbed into materials like EtO does, so an aeration time of under 30 minutes is typical.

CD is also not listed as a carcinogen. In almost all locations, it can simply be exhausted to the environment rather than needing to be scrubbed with hazardous solutions. It is non-flammable and non-explosive at use concentrations, so it does not require expensive damage limiting construction.



INDUSTRY PROVEN APPLICATIONS INCLUDE:

- implantable contact lenses
- artificial limbs
- suture products
- bones and bone powders
- surgical kits
- endoscopes
- small electronic devices

DECONTAMINATION SERVICES

Decontamination Services can be utilized for a variety of applications from tented pieces of equipment and small chambers up to entire facilities. Ecosense has the capability to decontaminate areas over 4,000,000 ft^3 (113,267 m^3). **Services can be arranged for contamination response or preventive control needs.** They can be scheduled as needed or contracted for routine prevention, scheduled maintenance, and shutdown periods.

Chlorine dioxide gas is able to reach and kill all organisms wherever they are hiding. **CD gas naturally fills the area it is introduced into evenly and completely, and penetrates deeper into crevices than pathogens can hide because its molecule size is smaller than the smallest viruses and bacteria, resulting in complete kill.** This allows a better decontamination than traditional sanitation methods such as sprays, mists, fogs, foams, and vapors.

Only gaseous decontaminating agents are **truly effective in areas that are difficult to reach such as floor drains, HVAC grills, beneath furniture and components, inside of cabinets, hinges, pipe threads, instruments**, and other difficult to reach areas. CD is non-carcinogenic, does not require neutralization, leaves no residues, and provides an extremely fast method for decontamination.

SERVICE CONTRACTS ARE AVAILABLE FOR MONTHLY, BI-MONTHLY, QUARTERLY, OR YEARLY OCCURRENCES.

DECONTAMINATION SERVICE CASE STUDIES

DEVELOPMENT OF RESPONSE PLAN AND PROTOCOL FOR MMV or MOLDS

To minimize downtime if a facility becomes contaminated with molds, MMV, or other unwanted organisms, preplanned decontamination protocols can be put into place. Ecosense can work with your Operations, Engineering, and QA Personnel to develop a response plan and document it in a protocol. Advantages include: plan arranged prior to the actual crisis when resources are available; time savings with a simple phone call initiating action response; and cost savings with a pre-negotiated treatment cost.

RENOVATION

A 35,000 ft^3 facility was being completely renovated to update everything from its ventilation system to its equipment and casework. Prior to moving back into the facility, the area was decontaminated in order to provide a guaranteed sterile environment for research. Decontamination took one day and included all rooms, hallways, and supporting ductwork. The floors above and below the facility were occupied throughout the decon with no chlorine dioxide gas detected and no adverse effects seen.

OCCUPIED SPACES SURROUNDED BY ROOMS BEING GASSED

A facility had three occupied rooms within its vivarium; a holding room and its adjoining procedure and necropsy rooms. These rooms were surrounded by contaminated holding and procedure rooms being gassed with chlorine dioxide. The occupied rooms were monitored for leakage throughout the decontamination. During the process, no leaks were observed in any of the areas, and all biological indicators were killed.

DUCTWORK

In some cases, facilities are interested in just decontaminating their ductwork and not the accompanying rooms. An eight room HIV lab was built with an undersized HVAC system and was looking to replace it with a correctly sized unit. There was concern as to whether or not the exhaust ductwork was contaminated from the research performed within the lab, so a decontamination was scheduled. A recirculation loop was setup in order to ensure that the gas was migrating throughout the entire length of ductwork. Biological indicators were placed in the ductwork and the recirculation loop in order to prove efficacy. All biological indicators were dead upon completion.

Decontaminating the Difficult

BSL-3 LAB

A BSL-3 influenza laboratory undergoes a yearly decontamination using chlorine dioxide gas during a facility shutdown. All equipment is left within the space during the decon, as the gas will reach and contact all surfaces within the lab. Results are shown through the placement of 40 biological indicators as various locations throughout the lab. Some locations include closed drawers, inside and behind Biological Safety Cabinets, underneath tabletop equipment, as well as easy locations such as floors, ceilings and walls.

AMPLICONS

Chlorine dioxide gas was validated by PCR equipment manufacturers and is proven effective against amplicons. CD gas can inactivate them in rooms or on equipment, so there is no risk of cross contamination causing misreads on subsequent analysis. As a true gas, it will reach all areas of your room and equipment surfaces including the inside of most equipment. Equipment can also be sent to Ecosense for treatment. After inactivation, analysis equipment can be used for testing with no risk of contamination or false readings.

HEPA HOUSING

While HEPA filters can block the flow of liquid/vapor based decontamination methods, gasses like chlorine dioxide are able to travel through the HEPA filter with no problem, making the decontamination quick and easy. A BSL3 facility routinely decontaminates their HEPA housing with CD gas. In order to monitor and control the process, a recirculation loop is setup and the gas is injected at the entrance to the HEPA Housing and monitored at the exit to make sure the entire housing reaches the proper dosage.

BETA-LACTAMS

Chlorine dioxide gas is proven effective against Beta-Lactams and validated to inactivate them on equipment or in rooms, so there is no risk of allergic exposure. The validation consisted of testing to achieve a 3-log inactivation of eight different Beta-Lactams. After inactivation, equipment and buildings can be used for non-Beta-Lactam products.

FACILITY DISINFECTION POST MAINTENANCE SHUTDOWN

Yearly planned maintenance shutdowns create dirty environments since foreign equipment, tools, and people enter the clean areas. Previously, this 300,000 ft^3 facility underwent three cycles of detergent cleaning and water rinse followed by three treatments with Spor-Klenz. This required over a dozen personnel with mops and buckets over multiple shifts and a minimum of a week's worth of time. The process was costly (consumables alone cost approximately $100,000) and had inherent failures in the process since it was a laborious manual process. The facility switched to chlorine dioixide gas decontamination. The result was a disinfection cost of under $100,000; a time savings cost of three days, and efficacy improved to a complete 6-log sporidical kill.

TRANSPORT VEHICLES

Multiple facilities use chlorine dioxide gas to decontaminate their trucks, vans, and shipping containers. Transport vehicles can be decontaminated in between deliveries to prevent cross-contamination. With CD gas, this process takes just three to four hours from start to finish. Another facility uses shipping containers to decontaminate equipment from their facility as an external decontamination chamber.

MULTI-STORY RESEARCH FACILITY

A new, four floor, 370,000 ft^3 facility consisted of laboratories, animal holding rooms, procedure rooms, autoclaves, meeting rooms, office areas, cold rooms, storage rooms, and other areas. All four floors of the facility were decontaminated at the same time using chlorine dioxide gas. Equipment was operated from a single location outside of the barrier on the third floor with tubing transporting the chlorine dioxide gas up to 200 ft away on the other floors. All equipment was in place prior to the decontamination such that it did not need to be autoclaved into the facility.

BIOLOGICAL EFFICACY OF CHLORINE DIOXIDE

ClorDiSys' Chlorine Dioxide Gas is registered with the United States Environmental Protection Agency as a sterilizer. The U.S. EPA defines a sterilizer as able "to destroy or eliminate all forms of microbial life including fungi, viruses, and all forms of bacteria and their spores."

Below is a table of some of the more commonly seen organisms that chlorine dioxide has been proven to eliminate. **To date, no organism tested against CD Gas has proved resistant.**

PRODUCT: CSI CD CARTRIDGE	**EPA REGISTRATION #**: 80802-1

BACTERIA	VIRUSES	ALGAE, FUNGI, MOLD, & YEAST
Blakeslea trispora[28]	Adenovirus Type 40[6]	
Bordetella bronchiseptica[8]	Calicivirus[42]	Alternaria alternata[26]
Brucella suis[30]	Canine Parvovirus[8]	Aspergillus spp.[12,28]
Burkholderia spp.[36]	Coronavirus[3]	Botrytis species[3]
Campylobacter jejuni[39]	Feline Calici Virus[3]	Candida spp.[5, 28]
Clostridium botulinum[32]	Foot and Mouth disease[8]	Chaetomium globosum[7]
Clostridium dificile[44]	Hantavirus[8]	Cladosporium cladosporioides[7]
Corynebacterium bovis[8]	Hepatitis A, B & C Virus[3,8]	Debaryomyces etchellsii[28]
Coxiella burneti (Q-fever)[35]	Human coronavirus[8]	Eurotium spp.[5]
E. coli spp.[1,3,13]	Human Immunodeficiency Virus[3]	Fusarium solani[3]
Erwinia carotovora (soft rot)[21]	Human Rotavirus type 2 (HRV)[15]	Lodderomyces elongisporus[28]
Franscicella tularensis[30]	Influenza A[22]	Mucor spp.[28]
Fusarium sambucinum (dry rot)[21]	Minute Virus of Mouse (MVM-i)[8]	Penicillium spp.[3,5,7,28]
Helicobacter pylori[8]	Mouse Hepatitis Virus spp.[8]	Phormidium boneri[3]
Helminthosporium solani (silver scurf)[21]	Mouse Parvovirus type 1 (MPV-1)[8]	Pichia pastoris[3]
Klebsiella pneumonia[3]	Murine Parainfluenza Virus Type 1 (Sendai)[8]	Poitrasia circinans[28]
Lactobacillus spp.[1,5]	Newcastle Disease Virus[8]	Rhizopus oryzae[28]
Legionella spp.[38,42]	Norwalk Virus[8]	Roridin A[33]
Leuconostoc spp.[1,5]	Poliovirus[20]	Saccharomyces cerevisiae[3]
Listeria spp.[1,19]	Rotavirus[3]	Stachybotrys chartarum[7]
Methicillin-resistant Staphylococcus aureus[3]	Severe Acute Respiratory Syndrome (SARS)[43]	Verrucarin A[33]
Multi-Drug Resistant Salmonella typhimurium[3]	Sialodscryoadenitis Virus[8]	**PROTOZOA**
Mycobacterium spp.[8,42]	Simian rotavirus SA-11[15]	Chironomid larvae[27]
Pediococcus acidilactici PH3[1]	Theiler's Mouse Encephalomyelitis Virus[8]	Cryptosporidium[34]
Pseudomonas aeruginosa[3,8]	Vaccinia Virus[10]	Cryptosporidium parvum Oocysts[9]
Salmonella spp.[1,2,4,8,13]	**BACTERIAL SPORES**	Cyclospora cayetanensis Oocysts[41]
Shigella[38]		Giardia[34]
Staphylococcus spp.[1,23]	Alicyclobacillus acidoterrestris[17]	**OTHER**
Tuberculosis[3]	Bacillus spp.[10,11,12,14,30,31]	Beta Lactams[29]
Vancomycin-resistant Enterococcus faecalis[3]	Clostridium. sporogenes ATCC 19404[12]	Amplicons[46]
Vibrio spp.[37]	Geobacillus stearothermophilus spp.[11,31]	Volatile organic compounds (VOCs)[47]
Yersinia spp.[30,31,40]	Bacillus thuringiensis[18]	Biofilms[45]

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