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. With this classification from the EPA, it can be thought that Chlorine Dioxide Gas will eliminate all viruses, bacteria, fungi, and their spores. Testing has been done using Chlorine Dioxide on a multitude of specific organisms, and that information is found below. It is not a complete list of organisms in which Chlorine Dioxide Gas is effective against, only a sample of organisms in which Chlorine Dioxide has been successfully tested against. To date, no organism tested against Chlorine Dioxide Gas has proved resistant.

Again CSI's gaseous chlorine dioxide is registered with the EPA as a sterilant.

Product: CSI CD CARTRIDGE
EPA Reg#: 80802-1
Registrant: CLORDISYS SOLUTIONS, INC
Approval Date: 02/25//2005
Active Ingredients: Sodium chlorite 72.8%

With the US-EPA there are various levels of kill and registration. For example List G is the norovirus (Norwalk like Virus). CSI's system is registered under List A (Sterilizers). Since chlorine dioxide is demonstrated effective as a sterilant and our product is registered as a higher level of kill, Sterilizers/Sporicides it is then established that we are effective against viruses. Simply stated registration as a sterilant means we kill everything, bacteria, fungi, spores and viruses. In addition by list G it can seen that chlorine dioxide is specifically effective against noroviruses.

EPA registered products effective against Methicillin Resistant *Staphylococcus aureus* (MRSA), Vancomycin Resistant *Enterococcus faecalis* or *faecium* (VRE), human *Norovirus* (Norwalk like Virus), as well as products used for medical waste treatments in healthcare/ medical facilities are also included. The lists are organized alphabetically by product names and by numerical order of their EPA Registration numbers (EPA Reg#).

Only primary product names from the primary registrants are included in the lists. All EPA's registered pesticides must have an EPA registration number (EPA Reg#). Alternative brand names have the same EPA Reg# as the primary product name. The EPA Reg# of a product for primary registrants consists of two set of numbers separated by a hyphen (-). (for example EPA Reg#12345-12.) The first set of numbers refers to the registrant's identification number and the second set of numbers represents the product number. A distributor's product is the same as the primary product, and may use a different name, but must have the first two sets of EPA Reg# of the primary registrant, plus a third set of numbers that represents the Distributor/Relabeler ID number. (for example EPA Reg#12345-12-2567.)

An EPA Establishment number (EPA Est#) is the place where the pesticide, formulation or a device is produced and it is indicated by a set of codes which consist of the registrant's ID number followed by the State where the product is made and facility number (for example EPA Est.#12345-CA-2).

The above lists are updated periodically to reflect label changes, cancellations, and transfers of product registrations. Information on the above list does not constitute a label replacement. Inclusion of products in these lists does not constitute an endorsement of one product over another. Before applying any antimicrobial product, users must determine if the product is approved for the intended use site/pest. Check the container/package label to determine if the intended use site/pest is written on the label. Always read the product label of an EPA-registered product label thoroughly before use. It is a violation of Federal Law to use an EPA registered product in a manner inconsistent with its label and labeling.

The approved label of a product can be found in the HYPERLINK "http://oaspub.epa.gov/pestlabl/ppls.home" \o "http://oaspub.epa.gov/pestlabl/ppls.home" Pesticide Product Label System (PPLS) database. To obtain a product label, search the PPLS database by providing

the EPA Reg# of the primary product (registrant's identification number and its product number). Refer to the HYPERLINK "http://www.epa.gov/pesticides/pestlabels/index.htm" \o "http://www.epa.gov/pesticides/pestlabels/index.htm" PPLS Web page for additional information about the Pesticide Product Label System (PPLS) database and the TIF software program for viewing the label images.

For information about a disinfectant product, search for the product in the HYPERLINK "http://www.cdpr.ca.gov/docs/label/labelque.htm" \o "http://www.cdpr.ca.gov/docs/label/labelque.htm" California Department of Pesticide Regulation (CDPR) database or subscribe to the HYPERLINK "http://ceris.purdue.edu/npirs" \o "http://ceris.purdue.edu/npirs" National Pesticide Information Resource Service (NPIRS) HYPERLINK "http://www.epa.gov/epahome/exitepa.htm" \o "http://www.epa.gov/epahome/exitepa.htm" INCLUDEPICTURE "cid:image002.gif@01C8721B.FBA3D240" * MERGEFORMATINET .

More information about product name search, active chemical ingredient search, Registrant/Company search and Pesticide Product Label Search is available from the HYPERLINK "http://ppis.ceris.purdue.edu/" \o "http://ppis.ceris.purdue.edu/" Pesticide Product Information Service (PPIS) HYPERLINK "http://www.epa.gov/epahome/exitepa.htm" \o "http://www.epa.gov/epahome/exitepa.htm" INCLUDEPICTURE "cid:image002.gif@01C8721B.FBA3D240" * MERGEFORMATINET .

Definitions of an antimicrobial product as well as the different types (categories) of antimicrobial products as used by EPA under Federal Insecticide Fungicide and Rodenticide Act (FIFRA), rules and regulation can be found on the HYPERLINK "http://www.epa.gov/oppad001/ad_info.htm" \o "http://www.epa.gov/oppad001/ad_info.htm" What are Antimicrobial Pesticides?

Below is from the HYPERLINK "http://www.epa.gov/oppad001/ad_info.htm" \o "http://www.epa.gov/oppad001/ad_info.htm" What are Antimicrobial Pesticides? Web page:
HYPERLINK "http://www.epa.gov/oppad001/ad_info.htm" \o "http://www.epa.gov/oppad001/ad_info.htm" http://www.epa.gov/oppad001/ad_info.htm

What Are Antimicrobial Pesticides?

Antimicrobial pesticides are substances or mixtures of substances used to destroy or suppress the growth of harmful microorganisms whether bacteria, viruses, or fungi on inanimate objects and surfaces. Antimicrobial products contain about 275 different active ingredients and are marketed in several formulations: sprays, liquids, concentrated powders, and gases. Today, approximately one billion dollars each year are spent on a variety of different types of antimicrobial products. More than 5000 antimicrobial products are currently registered with the U.S. Environmental Protection Agency (EPA) and sold in the marketplace. Nearly 60% of antimicrobial products are registered to control infectious microorganisms in hospitals and other health care environments.

Antimicrobial pesticides have two major uses:

1.) disinfect, sanitize, reduce, or mitigate growth or development of microbiological organisms
2.) protect inanimate objects (for example floors and walls), industrial processes or systems, surfaces, water, or other chemical substances from contamination, fouling, or deterioration caused by bacteria, viruses, fungi, protozoa, algae, or slime.

This category does not include certain pesticides intended for food use; but does encompass pesticides with a wide array of other uses. For example, antimicrobial pesticides act as preserving agents in paints, metalworking fluids, wood supports, and many other products to prevent their deterioration. Some examples of antimicrobial pesticide chemicals can be found in the HYPERLINK "http://www.epa.gov/oppad001/chemregindex.htm" \o "http://www.epa.gov/oppad001/chemregindex.htm" Antimicrobial Chemical Indexes.

Types of Antimicrobial Products

Antimicrobial products are divided into two categories based on the type of microbial pest against which the product works. Non-public health products are used to control growth of algae, odor-causing bacteria, bacteria which cause spoilage, deterioration or fouling of materials and microorganisms infectious only to animals. This general category includes products used in cooling towers, jet fuel, paints, and treatments for textile and paper products. Public health products are intended to control microorganisms infectious to humans in any inanimate environment. The more commonly used public health antimicrobial products include the following:

Sterilizers (Sporicides): Used to destroy or eliminate all forms of microbial life including fungi, viruses, and all forms of bacteria and their spores. Spores are considered to be the most difficult form of microorganism to destroy. Therefore, EPA considers the term Sporicide to be synonymous with "Sterilizer." Sterilization is critical to infection control and is widely used in hospitals on medical and surgical, instruments and equipment. Types of sterilizers include steam under pressure (autoclaving), dry heat ovens, low temperature gas (ethylene oxide), and liquid chemical sterilants. Gaseous and dry heat sterilizers are used primarily for sterilization of medical instruments. Liquid sterilants are primarily used for delicate instruments which cannot withstand high temperature and gases.

Disinfectants*:* Used on hard inanimate surfaces and objects to destroy or irreversibly inactivate infectious fungi and bacteria but not necessarily their spores. Disinfectant products are divided into two major types: hospital and general use. Hospital type disinfectants are the most critical to infection control and are used on medical and dental instruments, floors, walls, bed linens, toilet seats, and other surfaces. General disinfectants are the major source of products used in households, swimming pools, and water purifiers.

Sanitizers*:* Used to reduce, but not necessarily eliminate, microorganisms from the inanimate environment to levels considered safe as determined by public health codes or regulations. Sanitizers include food contact and non-food contact products. Sanitizing rinses for surfaces such as dishes and cooking utensils, as well as equipment and utensils found in dairies, food-processing plants, and eating and drinking establishments comprise the food contact Sanitizers. These products are important because they are used on sites where consumable food products are placed and stored. Non-food contact surface sanitizers include carpet sanitizers, air sanitizers, laundry additives, and in-tank toilet bowl sanitizers.

Antiseptics and Germicides*:* Used to prevent infection and decay by inhibiting the growth of microorganisms. Because these products are used in or on living humans or animals, they are considered drugs and are thus approved and regulated by the Food and Drug Administration (FDA).

Below is a table of some of the organisms that chlorine dioxide has been tested with.

Bacteria:	Ref.
Arcanobacterium pyogenes	45
Bacillus subtilis B	45
Blakeslea trispora	28
Bordetella bronchiseptica	8
Brevibacterium mcbrellneri	45
Brucella suis	30
Burkholderia glumae	45
Burkholderia mallei	36
Burkholderia pseudomallei	36
Camobacterium alterfunditum	45
Camobacterium divergens	45
Camobacterium gallinarum	45
Campylobacter jejuni	39
Clostridium botulinum	32
Clostridium difficile	44
Corynebacterium bovis	8
Corynebacterium variabile	45
Coxiella burneti (Q-fever)	35
E. coli ATCC 11229	3
E. coli ATCC 51739	1
E. coli K12	1
E. coli O157:H7 13B88	1
E. coli O157:H7 204P	1
E. coli O157:H7 ATCC 43895	1
E. coli O157:H7 EDL933	13
E. coli O157:H7 G5303	1
E. coli O157:H7 C7927	1
Erwinia carotovora (soft rot)	21
Franscicella tularensis	30
Fusarium sambucinum (dry rot)	21
Fusarium solani var. coeruleum (dry rot)	21
Helicobacter pylori	8
Helminthosporium solani (silver scurf)	21
Klebsiella pneumonia	3
Lactobacillus acidophilus NRRL B1910	1
Lactobacillus brevis	1
Lactobacillus buchneri	1
Lactobacillus plantarum	5
Lactococcus raffinolactis	45
Legionella	38
Legionella pneumophila	42
Leuconostoc citreum TPB85	1
Leuconostoc mesenteroides	5
Listeria innocua ATCC 33090	1
Listeria monocytogenes F4248	1
Listeria monocytogenes F5069	19
Listeria monocytogenes LCDC-81-861	1
Listeria monocytogenes LCDC-81-886	19
Listeria monocytogenes Scott A	1
Methicillin-resistant Staphylococcus aureus (MRSA)	3

Multiple Drug Resistant Salmonella typhimurium (MDRS)	3
Mycobacterium bovis	8
Mycobacterium fortuitum	42
Pediococcus acidilactici PH3	1
Pediococcus pentosaceus	45
Pseudomonas aeruginosa	3
Pseudomonas aeruginosa	8
Salmonella	1
Salmonella spp.	2
Salmonella Agona	1
Salmonella Anatum Group E	1
Salmonella Choleraesins ATCC 13076	1
Salmonella choleraesuis	8
Salmonella Enterica (PT30) BAA-1045	1
Salmonella Enterica S. Enteritidis	13
Salmonella Enterica S. Javiana	13
Salmonella Enterica S. Montevideo	13
Salmonella Enteritidis E190-88	1
Salmonella Javiana	1
Salmonella newport	4
Salmonella Typhimurium C133117	1
Salmonella Anatum Group E	1
Shigella	38
Staphylococcus aureus	23
Staphylococcus aureus ATCC 25923	1
Staphylococcus epidermidis	45
Staphylococcus faecalis ATCC 344	1
Staphylococcus gallinarum	45
Staphylococcus hominis	45
Staphylococcus xylosus	45
Streptococcus mutans	45
Tuberculosis	3
Tsukamurella inchonensis	45
Vancomycin-resistant Enterococcus faecalis (VRE)	3
Vibrio strain Da-2	37
Vibrio strain Sr-3	37
Yersinia enterocolitica	40
Yersinia pestis	30
Yersinia ruckerii ATCC 29473	31

Viruses:	Ref
Adenovirus Type 40	6
Calicivirus	42
Canine Parvovirus	8
Coronavirus	3
Feline Calici Virus	3
Foot and Mouth disease	8
Hantavirus	8
Hepatitis A Virus	3
Hepatitis B Virus	8
Hepatitis C Virus	8
Human coronavirus	8

Human Immunodeficiency Virus	3
Human Rotavirus type 2 (HRV)	15
Influenza A	22
Minute Virus of Mouse (Parovirus)(MVM-i)	8
Minute Virus of Mouse (Parovirus)(MVM-p)	8
Mouse Hepatitis Virus (MHV-A59)	8
Mouse Hepatitis Virus (MHV-JHM)	8
Mouse Parvovirus type 1 (MPV-1)	8
Murine Parainfluenza Virus Type 1 (Sendai)	8
Newcastle Disease Virus	8
Norwalk Virus	8
Poliovirus	20
Rotavirus	3
Severe Acute Respiratory Syndrome (SARS) Coronavirus	43
Sialodscryoadenitis Virus (Coronavirus) (SDAV)	8
Simian rotavirus SA-11	15
Theiler's Mouse Encephalomyelitis Virus (TMEV)	8
Vaccinia Virus	10

Algae/Fungi/Mold/Yeast:	Ref.
Alternaria alternata	26
Aspergillus aeneus	28
Aspergillus aurolatus	28
Aspergillus brunneo-uniseriatus	28
Aspergillus caespitosus	28
Aspergillus cervinus	28
Aspergillus clavatonanicus	28
Aspergillus clavatus	28
Aspergillus egyptiacus	28
Aspergillus elongatus	28
Aspergillus fischeri	28
Aspergillus fumigatus	28
Aspergillus giganteus	28
Aspergillus longivesica	28
Aspergillus niger	12
Aspergillus ochraceus	28
Aspergillus parvathecius	28
Aspergillus sydowii	28
Aspergillus unguis	28
Aspergillus ustus	28
Aspergillus versicolor	28
Botrytis species	3
Candida spp.	5
Candida albicans	28
Candida dubliniensis	28
Candida edax	45
Candida maltosa	28
Candida parapsilosis	28
Candida sake	28
Candida sojae	28
Candida spp.	5

Candida tropicalis	28
Candida viswanathil	28
Chaetomium globosum	7
Cladosporium cladosporioides	7
Cryptococcus curvatus A	45
Debaryomyces etchellsii	28
Eurotium spp.	5
Fusarium solani	3
Lodderomyces elongisporus	28
Mucor circinelloides	28
Mucor flavus	28
Mucor indicus	28
Mucor mucedo	28
Mucor rademosus	28
Mucor ramosissimus	28
Mucor saturnus	28
Penicillium chrysogenum	7
Penicillium digitatum	3
Penicillium herquei	28
Penicillium spp.	5
Phormidium boneri	3
Pichia pastoris	3
Poitrasia circinans	28
Rhizopus oryzae	28
Roridin A	33
Saccharomyces cerevisiae	3
Stachybotrys chartarum	7
Stachybotrys bisbyi	45
T-mentag (athlete's foot fungus)	3
Verrucarin A	33

Bacterial Spores:	Ref.
Alicyclobacillus acidoterrestris	17
Bacillus coagulans	12
Bacillus anthracis	10
Bacillus anthracis Ames	30
Bacillus atrophaeus	14
Bacillus atrophaeus ATCC 49337	31
Bacillus megaterium	12
Bacillus polymyxa	12
Bacillus pumilus ATCC 27142	12
Bacillus pumilus ATCC 27147	11
Bacillus subtillis (globigii) ATCC 9372	11
Bacillus subtillis ATCC 19659	31
Bacillus subtillis 5230	12
Clostridium. sporogenes ATCC 19404	12
Geobacillus stearothermophilus ATCC 12980	11
Geobacillus stearothermophilus ATCC 7953	31
Geobacillus stearothermophilus VHP	11
Bacillus thuringiensis	18

Chemical Decontamination:	Ref.
Mustard Gas	
Ricin Toxin	10
dihydronicotinamide adenine dinucleotide	24
microcystin-LR (MC-LR)	25
cylindrospermopsin (CYN)	25

Protozoa:	Ref.
Chironomid larvae	27
Cryptosporidium	34
Cryptosporidium parvum Oocysts	9
Cyclospora cayetanensis oocysts	41
Giardia	34

Beta Lactams:	Ref.
Amoxicillin	29
Amplicillin	29
Cefadroxil	29
Cefazolin	29
Cephalexin	29
Imipenem	29
Penicillin G	29
Penicillin V	29

Microsporidia:	Ref.
Encephalitozoon intestinalis	41

As shown above Chlorine Dioxide Gas has proven effective at eliminating a wide range of organisms. Testing is still being performed on other organisms, and will be added to this list as results come in. If an organism is not listed here, it does not mean that Chlorine Dioxide Gas is ineffective against it. Please contact us to see if there is any data or information regarding your specific organism, or to arrange for testing to be done.

References:

Selecting Surrogate Microorganism for Evaluation of Pathogens on Chlorine Dioxide Gas Treatment, Jeongmok Kim, Somi Koh, Arpan Bhagat, Arun K Bhunia and Richard H. Linton. Purdue University Center for Food Safety 2007 Annual Meeting October 30 - 31, 2007 at Forestry Center, West Lafayette, IN.

Decontamination of produce using chlorine dioxide gas treatment, Richard Linton, Philip Nelson, Bruce Applegate, David Gerrard, Yingchang Han and Travis Selby.

Chlorine Dioxide, Part 1 A Versatile, High-Value Sterilant for the Biopharmaceutical Industry, Barry Wintner, Anthony Contino, Gary O'Neill. BioProcess International DECEMBER 2005.

Chlorine Dioxide Gas Decontamination of Large Animal Hospital Intensive and Neonatal Care Units, Henry S. Luftman, Michael A. Regits, Paul Lorcheim, Mark A. Czarneski, Thomas Boyle, Helen Aceto, Barbara Dallap, Donald Munro, and Kym Faylor. Applied Biosafety, 11(3) pp. 144-154 © ABSA 2006

Efficacy of chlorine dioxide gas as a sanitizer for tanks used for aseptic juice storage, Y. Han, A. M. Guentert*, R. S. Smith, R. H. Linton and P. E. Nelson. Food Microbiology, 1999, 16, 53]61

Inactivation of Enteric Adenovirus and Feline Calicivirus by Chlorine Dioxide, Jeanette A. Thurston-Enriquez, Charles N. Haas, Joseph Jacangelo, and Charles P. Gerba. APPLIED AND ENVIRONMENTAL MICROBIOLOGY, June 2005, p. 3100–3105.

Effect of Chlorine Dioxide Gas on Fungi and Mycotoxins Associated with Sick Building Syndrome, S. C. Wilson,* C. Wu, L. A. Andriychuk, J. M. Martin, T. L. Brasel, C. A. Jumper, and D. C. Straus. APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Sept. 2005, p. 5399–5403.

BASF Aseptrol Label

Effects of Ozone, Chlorine Dioxide, Chlorine, and Monochloramine on Cryptosporidium parvum Oocyst Viability, D. G. KORICH, J. R. MEAD, M. S. MADORE, N. A. SINCLAIR, AND C. R. STERLING. APPLIED AND ENVIRONMENTAL MICROBIOLOGY, May 1990, p. 1423-1428.

NHSRC's Systematic Decontamination Studies, Shawn P. Ryan, Joe Wood, G. Blair Martin, Vipin K. Rastogi (ECBC), Harry Stone (Battelle). 2007 Workshop on Decontamination, Cleanup, and Associated Issues for Sites Contaminated with Chemical, Biological, or Radiological Materials Sheraton Imperial Hotel, Research Triangle Park, North Carolina June 21, 2007.

Validation of Pharmaceutical Processes 3rd edition, edited by Aalloco James, Carleton Frederick J. Informa Healthcare USA, Inc., 2008, p267

Chlorine dioxide gas sterilization under square-wave conditions. Appl. Environ. Microbiol. 56: 514-519 1990. Jeng, D. K. and Woodworth, A. G.

Inactivation kinetics of inoculated Escherichia coli O157:H7 and Salmonella enterica on lettuce by chlorine dioxide gas. Food Microbiology HYPERLINK "http://www.sciencedirect.com/science?_ob=PublicationURL&_tockey=%23TOC%236800%232008%23999749997%23678648%23FLA%23&_cdi=6800&_pubType=J&view=c&_auth=y&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=91d6b6a647d45e641e7e4ac488d0ea18" Volume 25, Issue 2, February 2008, Pages 244-252, Barakat S. M. Mahmoud and R. H. Linton.

Determination of the Efficacy of Two Building Decontamination Strategies by Surface Sampling with Culture and Quantitative PCR Analysis. APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Aug. 2004, p. 4740–4747. Mark P. Buttner, Patricia Cruz, Linda D. Stetzenbach, Amy K. Klima-Comba, Vanessa L. Stevens, and Tracy D. Cronin

Inactivation of Human and Simian Rotaviruses by Chlorine Dioxide. APPLIED AND ENVIRONMENTAL MICROBIOLOGY, May 1990, p. 1363-1366. YU-SHIAW CHEN AND JAMES M. VAUGHN

Information obtained from CSI internal testing with Pharmaceutical customer.

Efficacy of chlorine dioxide gas against *Alicyclobacillus acidoterrestris* spores on apple surfaces, Sun-Young Lee, Genisis Iris Dancer, Su-sen Chang, Min-Suk Rhee and Dong-Hyun Kang**,** International Journal of Food Microbiology, Volume 108, issue 3, May 2006 Pages 364-368

Decontamination of Bacillus thuringiensis spores on selected surfaces by chlorine dioxide gas, Han Y, Applegate B, Linton RH, Nelson PE. J Environ Health. 2003 Nov;66(4):16-21.

Decontamination of Strawberries Using Batch and Continuous Chlorine Dioxide Gas Treatments, Y Han, T.L. Selby, K.K.Schultze, PE Nelson, RH Linton. Journal of Food Protection, Vol 67, NO 12, 2004.
Mechanisms of Inactivation of Poliovirus by Chlorine Dioxide and Iodine, MARIA E. ALVAREZ AND R. T. O'BRIEN, APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Nov. 1982, p. 1064-1071
The Use of Chlorine Dioxide in potato storage, NORA OLSEN, GALE KLEINKOPF, GARY SECOR, LYNN WOODELL, AND PHIL NOLTE, University of Idaho, BUL 825.
Protective effect of low-concentration chlorine dioxide gas against influenza A virus infection Norio Ogata and Takashi Shibata Journal of General Virology (2008), 89, 60–67
Preparation and evaluation of novel solid chlorine dioxide-based disinfectant powder in single-pack Zhu M, Zhang LS, Pei XF, Xu X. Biomed Environ Sci. 2008 Apr;21(2):157-62.
Chlorine dioxide oxidation of dihydronicotinamide adenine dinucleotide (NADH), Bakhmutova-Albert EV, Margerum DW, Auer JG, Applegate BM. Inorg Chem. 2008 Mar 17;47(6):2205-11. Epub 2008 Feb 16.
Oxidative elimination of cyanotoxins: comparison of ozone, chlorine, chlorine dioxide and permanganate, Rodríguez E, Onstad GD, Kull TP, Metcalf JS, Acero JL, von Gunten U., Water Res. 2007 Aug;41(15):3381-93. Epub 2007 Jun 20.
Inhibition of hyphal growth of the fungus Alternaria alternata by chlorine dioxide gas at very low concentrations, Morino H, Matsubara A, Fukuda T, Shibata T. Yakugaku Zasshi. 2007 Apr;127(4):773-7. Japanese.
Inactivation of Chironomid larvae with chlorine dioxide, Sun XB, Cui FY, Zhang JS, Xu F, Liu LJ., J Hazard Mater. 2007 Apr 2;142(1-2):348-53. Epub 2006 Aug 18.
Information obtained from CSI decontamination at Pharmaceutical facility.
Information obtained from CSI beta-lactam inactivation at Pharmaceutical facility.
Decontamination of Surfaces Contaminated with Biological Agents using Fumigant Technologies, S Ryan, J Wood, 2008 Workshop on Decontamination, Cleanup, and Associated Issues for Sites Contaminated with Chemical, Biological, or Radiological Materials Sheraton Imperial Hotel, Research Triangle Park, North Carolina September 24, 2008.
Sporicidal Action of CD and VHP Against Avirulent Bacillus anthracis – Effect of Organic Bio-Burden and Titer Challenge Level, Vipin K. Rastogi, Lanie Wallace & Lisa Smith, 2008 Workshop on Decontamination, Cleanup, and Associated Issues for Sites Contaminated with Chemical, Biological, or Radiological Materials Sheraton Imperial Hotel, Research Triangle Park, North Carolina September 25, 2008.
Clostridium Botulinum, ESR Ltd, May 2001.
Efficacy of Chlorine Dioxide as a Gas and in Solution in the Inactivation of Two Trichothecene Mycotoxins, S. C. Wilson, T. L. Brasel, J. M. Martin, C. Wu, L. Andriychuk, D. R. Douglas, L. Cobos, D. C. Straus, International Journal of Toxicology, Volume 24, Issue 3 May 2005 , pages 181 – 186.
Guidelines for Drinking-water Quality, World Health Organization, pg 140.
Division of Animal Resources Agent Summary Sheet, M. Huerkamp, June 30, 2003.
NRT Quick Reference Guide: Glanders and Melioidosis
Seasonal Occurrence of the Pathogenic Vibrio sp. of the Disease of Sea Urchin Strongylocentrotus intermedius Occurring at Low Water Temperatures and the Prevention Methods of the Disease, K. TAJIMA, K. TAKEUCHI, M. TAKAHATA, M. HASEGAWA, S. WATANABE, M. IQBAL, Y.EZURA, Nippon Suisan Gakkaishi.VOL.66;NO.5;PAGE. 799-804(2000).
Biocidal Efficacy of Chlorine Dioxide, TF-249, Nalco Company, 2008.
Sensitivity Of *Listeria Monocytogenes, Campylobacter Jejuni* And *Escherichia Coli* Stec To Sublethal Bactericidal Treatments And Development Of Increased Resistance After Repetitive Cycles Of Inactivation, N. Smigic, A. Rajkovic, H. Medic, M. Uyttendaele, F. Devlieghere, Oral presentation. FoodMicro 2008, September 1st – September 4th, 2008, Aberdeen, Scotland.
Susceptibility of chemostat-grown Yersinia enterocolitica and Klebsiella pneumoniae to chlorine dioxide, M S Harakeh, J D Berg, J C Hoff, and A Matin, Appl Environ Microbiol. 1985 January; 49(1): 69–72.
Efficacy of Gaseous Chlorine Dioxide as a Sanitizer against *Cryptosporidium parvum, Cyclospora cayetanensis*, and *Encephalitozoon intestinalis* on Produce, Y. Ortega, A.

Mann, M. Torres, V. Cama, Journal of Food Protection, Volume 71, Number 12, December 2008 , pp. 2410-2414.

Inactivation of Waterborne Emerging Pathogens by Selected Disinfectants, J. Jacangelo, pg 23.

SARS Fact Sheet, National Agricultural Biosecurity Center, Kansas State University.

High sporocidal activity using dissolved chlorine dioxide (SanDes) on different surface materials contaminated by Clostridium difficile spores, Andersson J., Sjöberg M., Sjöberg L., Unemo M., Noren T. Oral presentation. 19th European Congress of Clinical Microbiology and Infectious Diseases, Helsinki, Finland, 16 - 19 May 2009.

Information obtained from CSI decontamination at Pharmaceutical facility.

Below is from the EPA-registered Disinfectants website

HYPERLINK "http://www.epa.gov/oppad001/list_a_sterilizer.pdf" \o "http://www.epa.gov/oppad001/list_a_sterilizer.pdf" List A: EPA's Registered Antimicrobial Products as Sterilizers (PDF) (11 pp, 46k)

HYPERLINK "http://www.epa.gov/oppad001/list_b_tuberculocide.pdf" \o "http://www.epa.gov/oppad001/list_b_tuberculocide.pdf" List B: EPA Registered Tuberculocide Products Effective Against *Mycobacterium tuberculosis* (PDF) (33 pp, 162k)

HYPERLINK "http://www.epa.gov/oppad001/list_c_hiv.pdf" \o "http://www.epa.gov/oppad001/list_c_hiv.pdf" List C: EPA's Registered Antimicrobial Products Effective Against Human HIV-1 Virus (PDF) (89 pp, 417)

HYPERLINK "http://www.epa.gov/oppad001/list_d_hepatitisbhiv.pdf" \o "http://www.epa.gov/oppad001/list_d_hepatitisbhiv.pdf" List D: EPA's Registered Antimicrobial Products Effective Against Human HIV-1 and Hepatitis B Virus (PDF) (30 pp, 128k)

HYPERLINK "http://www.epa.gov/oppad001/list_e_mycobact_hiv_hepatitis.pdf" \o "http://www.epa.gov/oppad001/list_e_mycobact_hiv_hepatitis.pdf" List E: EPA's Registered Antimicrobial Products Effective Against *Mycobacterium tuberculosis* Human HIV-1 and Hepatitis B Virus (PDF) (8 pp, 53k)

HYPERLINK "http://www.epa.gov/oppad001/list_f_hepatitisC.pdf" \o "http://www.epa.gov/oppad001/list_f_hepatitisC.pdf" List F: EPA's Registered Antimicrobial Products Effective Against Hepatitis C Virus (PDF) (22 pp, 94k)

HYPERLINK "http://www.epa.gov/oppad001/list_g_norovirus.pdf" \o "http://www.epa.gov/oppad001/list_g_norovirus.pdf" List G: EPA's Registered Antimicrobial Products Effective Against *Norovirus* (PDF) (7 pp, 51k)

HYPERLINK "http://www.epa.gov/oppad001/list_h_mrsa_vre.pdf" \o "http://www.epa.gov/oppad001/list_h_mrsa_vre.pdf" List H: EPA's Registered Antimicrobial Products Effective Against Methicillin Resistant *Staphylococcus aureus (MRSA)* and Vancomycin Resistant *Enterococcus faecalis* or *faecium* (VRE) (PDF) (40 pp, 566k)

HYPERLINK "http://www.epa.gov/oppad001/list_j_medicalwaste.pdf" \o "http://www.epa.gov/oppad001/list_j_medicalwaste.pdf" List J: EPA's Registered Antimicrobial Products for Medical Waste Treatment (PDF) (4 pp, 36k)

Take from website: **HYPERLINK "http://www.epa.gov/oppad001/chemregindex.htm" \o "http://www.epa.gov/oppad001/chemregindex.htm"** http://www.epa.gov/oppad001/chemregindex.htm