

	X-OXIDE™ Stabilized Chlorine Dioxide	Bleach 5.25% Sodium Hypochlorite	Phenols	Quaternary Ammonium Compounds	Accelerated H2O2 Hydrogen Peroxide/anionic	Botanicals e.g. Benefect-Thymol	Silver Dihydrogen Citrate e.g. PureGreen 24
Description	Combination of Stabilized Chlorine Dioxide and two Food Grade Quats	EPA registered chlorine bleach at a 5.25% dilution. (Use only EPA registered products for disinfecting)	Ready-to-Use Usually an aerosol product. Warning –not intended for use as an air freshener.	Range of products that use “quats” as the active ingredients.	Hydrogen peroxide in synergy with a blend of commonly used ingredients.	Plant-based products with natural disinfecting characteristics	Combination of citric acid and a minute amount of silver ions.
EPA Toxicity Category <i>(See Chart Below)</i>	Category IV	Category I	Category I or II	Category III	Category III or IV, product specific.	Category IV	Category IV
Pre-cleaning Needed	Surfaces must be pre-cleaned according to label instructions. Best practices advise pre-cleaning all surfaces	Surfaces must be pre-cleaned. ¹ Best practices advise pre-cleaning all surfaces before disinfecting.	Surfaces must be pre-cleaned. ² Best practices advise pre-cleaning all surfaces before disinfecting.	Product specific. Some products registered as one-step disinfectant cleaners. Best practices advise pre-cleaning all surfaces before disinfecting.	Registered as one-step disinfectant cleaners. Best practices advise pre-cleaning all surfaces before disinfecting.	Surfaces must be pre-cleaned according to label instructions. Best practices advise pre-cleaning all surfaces	Surfaces must be pre-cleaned according to label instructions. Best practices advise pre-cleaning all surfaces
Storage	Stable in storage. 2-Year shelf life	If used for disinfecting purposes, bleach should not be stored longer than 3 months.	Stable in storage Flammable if in aerosol form. 4	Stable in storage	Stable in storage. 2-Year shelf life	Stable in storage. 2-Year shelf life	Stable in storage. No expiration date required.

	X-OXIDE™ Stabilized Chlorine Dioxide	Bleach 5.25% Sodium Hypochlorite	Phenols	Quaternary Ammonium Compounds	Accelerated H2O2 Hydrogen Peroxide/anionic	Botanicals e.g. Benefect-Thymol	Silver Dihydrogen Citrate e.g. PureGreen 24
Effectiveness	Effective against a broad spectrum of microbes including MRSA, norovirus, H1N1 (Influenza A). Mold and Mildew, Odor Eliminator, Allergen reduction, Hypoallergenic	Effective against most bacteria and some viruses and is registered as effective against HIV, HBV, H1N1 (Influenza A), MRSA and TB.5 See notes below	Read product label for effectiveness against specific microbes.	Generally effective against a broad spectrum of microbes including MRSA and H1N1 (Influenza A), not effective against spores.	Effective against a broad spectrum of microbes including H1N1 (Influenza A), norovirus and MRSA. Read product label for specific claims including TB.	Effective against a broad spectrum of microbes including H1N1 (Influenza A). TB and MRSA Read product label.	• Effective against a broad spectrum of microbes including MRSA, norovirus and H1N1 (Influenza A). Read product label.
Effectiveness in Organic Matter	Good	Poor	Good	Poor	Poor	Fair	Fair
Inactivated By Soap	No	No	No	Yes	No	No	No
Effective in hard water	Yes	Yes	Yes	No	Yes	Yes	Yes
Dwell Time	30 second to 10 minute dwell time Refer to the label	5-10 minute dwell time. Refer to the label	Generally 10 minute dwell time. Refer to the label	Generally 10 minute dwell time. Refer to the label	1-10 minute dwell time. Refer to the label	10 minute dwell time Refer to the label	30 second to 10 minute dwell time Refer to the label

	X-OXIDE™ Stabilized Chlorine Dioxide	Bleach 5.25% Sodium Hypochlorite	Phenols	Quaternary Ammonium Compounds	Accelerated H2O2 Hydrogen Peroxide/anionic	Botanicals e.g. Benefect-Thymol	Silver Dihydrogen Citrate e.g. PureGreen 24
Health Effects	No warning or first aid statements are required on the label. CAUTION: Direct contact may cause slight eye irritation. Avoid contact with eyes. If irritation occurs, flush thoroughly with large amounts of water for 15 minutes.	Mixing with ammonia, ammonium quaternary compounds and other acidic products can create poisonous gas.6 Corrosive to eyes and skin, and a respiratory irritant.7 Suspected cardiovascular, gastrointestinal or liver, kidney, central nervous system, respiratory, and skin or sense organ toxicant. 8	Phenols are recognized carcinogens (CA Prop. 65), suspected cardiovascular, developmental, neurological, reproductive, respiratory, skin and sense organ toxicant. 9 Corrosive to eyes and skin. 10 Absorbed through the skin and by inhalation. 11	Can cause contact dermatitis and nasal irritation.12 Ammonium quaternary compounds including benzalkonium chloride, dodecyl-dimethyl-benzyl ammonium chloride and lauryl dimethyl benzyl ammonium chloride are respiratory sensitizers, and are associated with asthma. 13	Eye contact. Causes permanent eye damage, including blindness. Skin contact. May be mildly irritating to skin. Inhalation. May cause irritation and corrosive effects to nose, throat and respiratory tract Ingestion: Corrosive. Causes burns to mouth, throat and stomach.	No warning or first aid statements are required on the material safety data sheet. The botanical oils in the product are either F.D.A (Food and Drug Administration) approved as Food Additives or on the United States G.R.A.S. (Generally Recognized as Safe) list.	No warning or first aid statements are required on the label. CAUTION: Direct contact may cause slight eye irritation. Avoid contact with eyes. If irritation occurs, flush thoroughly with large amounts of water for 15 minutes.
Exposure Controls	No special requirements. Regular ventilation is adequate. (see notes below)	Personal protection equipment and/or increased ventilation should be use. 14 (see notes below)	Requires personal protection equipment and increased ventilation. 15 (see notes below)	Requires personal protection equipment and proper ventilation (see notes below)	No special requirements. Regular ventilation is adequate. (see notes below)	No special requirements. Regular ventilation is adequate. (see notes below)	No special requirements. Regular ventilation is adequate. (see notes below)

	X-OXIDE™ Stabilized Chlorine Dioxide	Bleach 5.25% Sodium Hypochlorite	Phenols	Quaternary Ammonium Compounds	Accelerated H2O2 Hydrogen Peroxide/anionic	Botanicals e.g. Benefect-Thymol	Silver Dihydrogen Citrate e.g. PureGreen 24
Environmental Pros and Cons	Non-Toxic to aquatic life. Breaks down to simple salt.	Toxic to aquatic organisms. Produces harmful by products (THM) trihalomethanes (HAAS) haloacetic acids which are linked to cancer.	Toxic to aquatic organisms. ¹⁷ Considered a persistent bio accumulative toxin by EPA. ¹⁸ Disposal restrictions in some states. Check state and local regulations.	Very toxic to aquatic life. ¹⁹ Also see Material Safety Data Sheet. Associated with antimicrobial resistance. ²⁰	Some products using this technology have been third-party certified by EcoLogo to meet environmental and human health criteria. (EPA does not allow eco labels on disinfectants)	Third-party certified by EcoLogo to meet environmental and human health criteria. (EPA does not allow eco labels on disinfectants.)	25 Silver is listed the U.S. Environmental Protection Agency (USEPA) 1977 priority pollutant list (still in effect) and its discharge into the aquatic environment is therefore regulated by the EPA (Luamo 2008). Instudedieed
Disadvantages	Not yet widely available through vendors, may need to be ordered.	May damage floor finishes, carpets, clothing and other fibers when used in higher concentration Has an unpleasant odor. Must be stored separately from ammonia and flammable products. ²¹ Rinsing is required in application where direct skin or oral contact can occur (e.g. children's toys.) ²²	Not for use on food or food utensils. ²³ May damage floor finishes and other surfaces Caution: Do not use around babies and small children. ²⁴ Generally leaves a residue so rinsing is required.	Thorough rinsing required. See product label for specifics.	Rinsing is required where direct skin or oral contact can occur (e.g. children's toys).	Not yet widely available through vendors, may need to be ordered. Strong odor.	Not yet widely available through vendors, may need to be ordered.

	X-OXIDE™ Stabilized Chlorine Dioxide	Bleach 5.25% Sodium Hypochlorite	Phenols	Quaternary Ammonium Compounds	Accelerated H2O2 Hydrogen Peroxide/anionic	Botanicals e.g. Benefect-Thymol	Silver Dihydrogen Citrate e.g. PureGreen 24
Advantages	NSF (D-2) No rinse required on food contact surfaces. EPA registered hospital disinfectant. The same product can be used for routine and special event tasks, by simply changing the concentration. Mold and Mildew eliminator. Odor eliminator. Carpet and fabric sanitizer. Allergen eliminator.	Inexpensive Easy to purchase. The same product can be used for routine and special event tasks, by changing the concentration .	Readily Available	Readily Available Non-corrosive in diluted form. No rinsing required except as above. Some products are odorless.	Non-corrosive	No rinsing or wiping required. Approved by the Canadian Food Inspection Agency for use in Food Processing. Suitable for use on children's toys.	No rinsing required Non-corrosive. Odorless. EPA registered for use on toys. 24-hour residual protection.

Notes:

1. Pre-Cleaning - Except for disinfectant cleaners that are tested to disinfect in the presence of 5% of organic matter, all other disinfectants require pre-cleaning. Best practices recommend cleaning first and then disinfecting for optimal efficiency.
2. Dwell Time – is product specific. All disinfectants are tested and labeled for the specific amount of time they must be in contact with the surface to kill the microbes. The times listed here are approximate only.
3. Personal Protective Equipment - may be required for the concentrated form of some products, but not for the Ready to Use (pre-diluted form). Check the label and the Material Safety Data Sheet (MSDS).
4. pH is a measure of how acidic or basic a product is. Look for products with a neutral pH of 7 or as close to this number as possible.
5. Information is from material safety data sheets, Scorecard at <http://www.scorecard.org/chemical-profiles/>, Pesticide Action Network’s Pesticide Database and product information sheets.
6. Costs - When comparing costs, life cycle costs must be considered. Although a product may be less expensive to buy, its negative impact on surface materials may require replacing hard surfaces more frequently, may increase worker’s compensation claims and may cause environmental damage.

CDC Definition

CDC Definition of 3 Levels of Disinfection - means the use of a chemical procedure that eliminates virtually all recognized pathogenic microorganisms but not necessarily all microbial forms (e.g., bacterial endospores) on inanimate objects:

1. **High-level disinfection** - kills all organisms, except high levels of bacterial spores, and is affected with a chemical germicide cleared for marketing as a sterilant by FDA. Typically not used for generalized disinfecting.
2. **Intermediate-level disinfection** - kills mycobacterium, most viruses, and bacteria with a chemical germicide registered as a "tuberculocide" by EPA.
3. **Low-level disinfection** - kills some viruses and bacteria with a chemical germicide registered as a hospital disinfectant by the EPA.

EPA Toxicity Categories

Signal Word	Category	Oral Lethal Dose
DANGER, POISON (skull & crossbones)	I - Highly toxic	A few drops to a teaspoonful
WARNING	II - Moderately toxic	Over a teaspoonful to one ounce
CAUTION	III - Slightly toxic	Over one ounce to one pint
CAUTION	IV - Relatively non-toxic	Over one pint to one pound

Based on a 150-pound person.

- 1 A. Culver, M. Feinberg et.al. Cleaning for Health Products and Practices for a Safer Indoor Environment. 2002. INFORM Inc. <http://informinc.org/cleanforhealth.php>
- 2 See specific product information sheet.
- 3 University of Oklahoma Health Sciences Environmental Health and Safety Office Saf-T-Gram. Letter from the Clorox Company. <http://www.ouhsc.edu/ehso/saf-t-gram/Spring01.pdf>
- 4 Material Safety Data Sheet. <http://www.spartanchemical.com/sfa/MSDSRep.nsf/0/ebe0e15bf7c02fc285256ea0005451f3!OpenDocument>
- 5 EPA, Selected EPA Registered Disinfectants. <http://www.epa.gov/oppad001/chemregindex.htm>
- 6 Agency for Toxic Substances & Disease Registry (ATSDR) (2007). Medical Management Guidelines for Calcium Hypochlorite and Sodium Hypochlorite. <http://www.atsdr.cdc.gov/MHMI/mmg184.html>
- 7 Clorox Bleach Material Safety Data Sheet http://www.thecloroxcompany.com/products/msds/bleach/cloroxregularbleach0505_.pdf Agency for Toxic Substances & Disease Registry (ATSDR) (2007). Medical Management Guidelines for Calcium Hypochlorite and Sodium Hypochlorite. <http://www.atsdr.cdc.gov/MHMI/mmg184.html>
- 8 Scorecard, Chemical Profiles. <http://www.scorecard.org/chemical-profiles/>
- 9 Scorecard, Chemical Profiles. <http://www.scorecard.org/chemical-profiles/>
- 10 Material Safety Data Sheets
- 11 Material Safety Data Sheets
- 12 Guidelines for Protecting the Safety and Health of Health Care Workers. <http://www.cdc.gov/niosh/docs/88-119/chemical.html>
- 13 AOEC List of Asthmagens. <http://www.aoecdata.org/ExpCodeLookup.aspx>
- 14 Guidelines for Protecting the Safety and Health of Health Care Workers. <http://www.cdc.gov/niosh/docs/88-119/chemical.html>
- 15 Guidelines for Protecting the Safety and Health of Health Care Workers. <http://www.cdc.gov/niosh/docs/88-119/chemical.html>
- 16 Brite Bleach Material Safety Data Sheet. <http://www.masseywholesale.com/msds/britebleach.pdf>
- 17 NIOSH International Chemical Safety Card. Phenol- <http://www.cdc.gov/niosh/ipcsneng/neng0070.html>
- 18 Ohio EPA Pollution Prevention Fact Sheet. http://www.epa.state.oh.us/ocapp/p2/mercury_pbt/fact99.pdf
- 19 Pesticide Action Network Pesticide Database. http://www.pesticideinfo.org/Detail_Product.jsp?REG_NR=00087500081&DIST_NR=000875
- 20 R.Ventullo, R. Larson (1986) Adaptation of Aquatic Microbial Communities to Quaternary Ammonium Compounds. Applied and Environmental Microbiology. Vol. 51, No. 2: 356-361. Feb 1986. <http://aem.asm.org/cgi/content/abstract/51/2/356>.
G. Sundheim, S. Langsrud, E. Heir and A. L. Holck. International Biodeterioration & Biodegradation. Volume 41, Issues 3-4, 1998, Pages 235-239. http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VG6-3TN9PP1B&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&_view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=574a268bde54f837ce9cecad2519433
- 21 Brite Bleach Material Safety Data Sheet. <http://www.masseywholesale.com/msds/britebleach.pdf>
- 22 Chlorox Health Center: SARS. Cleaning & Sanitation in Daycare Facilities, Schools and Universities. <http://www.cloroxprofessional.com/healthcenter/sars6.shtml>
- 23 L. Crawford, Z.Yu, E. Keegan, T. Yu. Infection Control Today. A Comparison of Commonly Used Surface Disinfectants. <http://www.infectioncontroltoday.com/articles/0b1feat2.html>
- 24 Ohio EPA Pollution Prevention Fact Sheet. http://www.epa.state.oh.us/ocapp/p2/mercury_pbt/fact99.pdf
- 25 Nano & Biocidal Silver Extreme Grem Killer Present A Growing Threat to Public Health. <http://www.foe.org/healthyMpeople/nanosilver>