

**Chemistry Comparison between
Sodium Hypochlorite and
Chlorine Dioxide**

Active Ingredients

Sodium Hypochlorite Solution	Chlorine Dioxide
Sodium hypochlorite - NaOCl.	Chlorine dioxide - ClO ₂ .
Active chlorine releasing agent.	No free chlorine.

Mode of Action

Sodium Hypochlorite Solution	Chlorine Dioxide
Causes biosynthetic alterations in cellular metabolism and phospholipid destruction, interferes with cellular metabolism and causes irreversible enzymatic inactivation in bacteria, degrades lipids and fatty acids ⁽⁵⁾ .	Oxidises cells leading to cell lysis. Denatures proteins by oxidising specific amino acids ⁽²⁾ .

Appearance

Sodium Hypochlorite Solution	Chlorine Dioxide
Clear, slightly yellowish solution with a characteristic odour ⁽³⁾ .	Yellow-green solution ⁽⁴⁾ .

Efficacy at Concentration

Sodium Hypochlorite Solution	Chlorine Dioxide
Acidified bleach and regular bleach (5,000 ppm chlorine) can achieve a 6 log reduction in <i>C. difficile</i> spores in ≤ 10 minutes ⁽⁵⁾ . 0.5% to 5.25% NaOCl against bacteria in one minute ⁽⁶⁾ . Viruses inactivated after 10 minutes at 200 ppm available chlorine ⁽⁶⁾ .	When tested in accordance with European Norms ⁽⁷⁾ : Bacteria - 2 minutes at 0.02% Fungi - 2 minutes at 0.02% Viruses - 2 minutes at 0.02% Mycobacteria - 2 minutes at 0.02% Spores - 2 minutes at 0.02% Amoeba - 2 minutes at 0.02%
Published data: Hinenoya et al (2015) found that ClO ₂ is more effective against multi-drug resistant bacterial species than NaOCl. 100 ppm of ClO ₂ achieved a total kill of three strains of MRSA after one minute contact time. The same concentration of NaOCl did not significantly decrease the number of bacteria apart from one strain. 10 ppm of ClO ₂ achieved a complete kill of multi-drug resistant <i>P. aeruginosa</i> (MDRP) whereas NaOCl did not significantly reduce the number of MDRP. The study concluded that ClO ₂ is a more potent disinfectant than NaOCl for MDR strains evaluated ⁽⁸⁾ .	

Preparation and Concentration

Sodium Hypochlorite Solution	Chlorine Dioxide
Preparation instructions differ from one manufacturer to another. Always use correct dilutions. 0.1% (1,000 ppm) – general clinical environment ⁽⁹⁾ . 1% (10,000 ppm) – ophthalmic disinfection (10 minute contact time) ⁽¹⁰⁾ .	Step 1: Dispense two aliquots of Tristel Duo onto a dry wipe (Dry Wipes are recommended) or directly onto the instrument. Use the wipe to spread the foam over the surface of the instrument and ensure all areas are covered. Step 2: Leave the surface to dry to ensure a minimum contact time of two minutes . Step 3: Rinse the instrument with water of appropriate quality ⁽¹¹⁾ . 0.02% (200 ppm) – sporicidal efficacy for high-level disinfection of instruments used in ophthalmology ⁽⁷⁾ .

Health and Safety

Sodium Hypochlorite Solution	Chlorine Dioxide
<p>Gives off irritating or toxic fumes (or gases) in a fire.</p> <p>Decomposes or heating, on contact with acids and under influence of light producing toxic and corrosive gases including chlorine.</p> <p>Attacks many metals.</p> <p>Toxic to aquatic organisms.</p> <p>Wear protective gloves and protective clothing.</p> <p>Wear face shield or eye protection in combination with breathing protection ⁽¹²⁾.</p>	<p>In combustion emits toxic fumes. Biodegradable.</p> <p>No bioaccumulation potential.</p> <p>Readily absorbed into soil.</p> <p>Not classified as environmentally hazardous.</p> <p>Negligible ecotoxicity.</p> <p>Wear self-contained breathing apparatus.</p> <p>Wear protective clothing to prevent contact with skin and eyes ⁽⁴⁾.</p>

Packaging

Sodium Hypochlorite Solution	Chlorine Dioxide
<p>Differs from one manufacturer to another.</p>	<p>Bottles of 2x125ml: 310 aliquots for 155 procedures (two aliquots are required for each procedure).</p>

Storage and Shelf Life

Sodium Hypochlorite Solution	Chlorine Dioxide
<p>Ensure sufficient ventilation of the storage area. Keep container tightly closed. Avoid contact with water or humidity. A typical 14% solution has 12 months shelf life. Prepare daily and dispose of any unused solution within 24 hours. Stability of NaOCl is adversely affected by exposure to high temperatures, light, air and presence of organic and inorganic contaminants ⁽¹⁴⁾.</p>	<p>Ensure sufficient ventilation of the storage area. Store in a cool, well ventilated area. Keep container tightly closed. Hazardous reactions will not occur under normal transport or storage conditions. Two year shelf life ⁽¹³⁾.</p>

References:

- Estrela et al. (2012), 'Mechanism of action of sodium hypochlorite.', Braz Dent J. 13(2):113-7.
- Wei et al. (2012), '[Action modes of chlorine dioxide--a review].', Wei Sheng Wu Xue Bao. 52(4): 429-34.
- Lenntech.com, 'Disinfectants Sodium hypochlorite'. Available online: <https://www.lenntech.com/processes/disinfection/chemical/disinfectants-sodium-hypochlorite.htm>. Accessed: 03/05/2018.
- Tristel Duo OPH Working Solution SDS, Revision No. 6, 2017.
- Centers for Disease Control and Prevention (CDC) (2016), 'Guideline for Disinfection and Sterilization in Healthcare Facilities (2008). Available online: <https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/chemical.html>. Accessed: 03/05/2018.
- Zand et al. (2012), 'Efficacy of different concentrations of sodium hypochlorite and chlorhexidine in disinfection of contaminated Resilon cones', Med Oral Patol Oral Cir Buscal. 17(2): e352-e355.
- Tristel Duo OPH Microbiological Efficacy Summary, 2017.
- Hinenoya et al. (2015), 'Chlorine dioxide is a better disinfectant than sodium hypochlorite against multi-drug resistant Staphylococcus aureus, Pseudomonas aeruginosa, and Acinetobacter baumannii', Japanese Journal of Infectious Diseases. 68(4).
- The Northern Ireland Regional Infection Prevention and Control Manual, 'Cleaning & Disinfection'. available online: <https://www.niinfectioncontrolmanual.net/cleaning-disinfection>. Accessed: 16/05/2018.
- The Royal College of Ophthalmologists (2016), 'Ophthalmic Services Guidance. Ophthalmic Instrument Decontamination.' Available online: <https://www.rcophth.ac.uk/wp-content/uploads/2014/12/Ophthalmic-Instrument-Decontamination.pdf>. Accessed: 16/05/2018.
- Tristel Duo OPH User Guide, 2017.
- Centers for Disease Control and Prevention (CDC) (2015), 'Sodium Hypochlorite (Solution, Active chlorine >10%).' Available online: <https://www.cdc.gov/niosh/ipcsneng/neng1119.html>. Accessed: 16/05/2018.
- Tristel Duo OPH Brochure, 2018.
- Johnson and Remeikis (1993), 'Effective shelf-life of prepared sodium hypochlorite solution.', J Endod. 19(1): 40-3.

