



GO₂TM
The Gold Standard for Water Disinfection

Product Information

May 2009





GO₂[®] Product information

GO₂ is a sophisticated delivery system to generate concentrated chlorine dioxide (CLO₂) in liquid form. The liquid CLO₂ has a purity of 95.0+% and a concentration of 4,000 ppm. As a biocide, CLO₂ is ten times more powerful than chlorine and chlorine-type disinfectants. CLO₂ works at a broad pH-range from 4-11 and does not generate harmful disinfection by-products (DBP's), or cause any adverse environmental impact when used.

CLO₂ is recognized by the WHO as a superior biocide and has been used to disinfect drinking water since 1944. It is employed in many industries, including the disinfection of potable water, waste water and effluent water treatment, the oil & gas industry, the paper and pulp industry, cooling towers, pipeline and tank cleaning, poultry and livestock raising, irrigation, post-harvest fruit and produce washing, horticulture, dairy, carcass washing, brewing, beverage production, swimming pools, ornamental water treatment and many other applications.

Chlorine and chlorine-type disinfectants generate extremely harmful DBP's. These include Trihalomethanes (THM's), Halo-acetic acids (HAA's), chloramines, bromides, bromines and Mutagen X (MX). These are all known carcinogens and pose a risk for human health. GO₂ does not generate these DBP's. The product is non-corrosive and will cause no damage to equipment, pumps, distribution systems, filters, RO membranes or any other infrastructure.

GO₂ kills all water-borne micro-organisms which contaminate drinking water, water used in food processing and the washing of produce, water used in fish and shellfish farming, the power generation industry, oil and gas industry and agricultural and horticultural irrigation. Examples include bacteria, yeast, fungi, mold, algae, spores, protozoans, cryptosporidia, actinomycetes, cysts, giardia and larval eggs (mosquito, tse tse fly), insect eggs and larvae (agricultural pests, fruit fly, floricultural and horticultural insects), problematic veligers (zebra mussels, quagga mussels), fish and shellfish diseases (VHS, KHS, ISA) and many others. The world's number one killers are water-borne viruses.

Unlike chlorine, GO₂ has the ability to kill water-borne viruses such as legionella, cholera, dengue, hepatitis and typhoid. GO₂ also kills airborne viruses when misted into air or applied to contaminated surfaces via HVAC or spray systems. Airborne viruses include anthrax, influenza, SARS, smallpox, chickenpox and avian flu. GO₂ kills all known bacteria, including coliform, salmonella, E-coli, listeria and cinobacteria. GO₂ eliminates microbial slime (biofilm) from water distribution and storage systems. It also removes phenols, cyanides, iron, manganese and methanogens from water.

GO₂ in Livestock



GO₂ greatly enhances livestock production and health. Test with poultry and dairy have demonstrated a significant increase in food conversion rates and milk yield. Somatic cell count in milk showed a decrease of 40-50%, resulting in improved profits for farmers.



GO₂ is easy to use, simple to apply and contributes positively to the health of humans, animals, poultry, livestock, fish and crops. GO₂ has no harmful environmental impact and is truly a green chemistry.

About GO₂ International

GO₂ International, based in California, is the manufacturer of GO₂. The product is sold worldwide through an extensive network of distributors.

GO₂ is liquid CLO₂ produced from two simple powders combined into ordinary tap water to produce a 4,000 ppm concentrate. Combination of the separate components in tap water produces a 95.0+% pure CLO₂ solution on-site. The concentrate is then simply dosed into the target water using an inexpensive dosing pump to produce safe, disinfected water. No investment in special equipment is necessary and no change to infrastructure is required to use GO₂. No special training is needed to use the product.

United States EPA approval is granted in May, 2009. (*U.S. EPA Reg. No 84912-2*).

The separate powder components have a shelf-life of 5 years. The concentrate, when mixed for use, has full potency for approximately 14 days. The concentrate is fully ready for use within 30 minutes of being mixed. Other products require between 3 and 12 hours before they are ready for use. At 30-days, given proper storage in a cool, dark place in a sealed container, the potency is still approximately 50%, declining slowly in strength thereafter. For all normal municipal, commercial, industrial and agricultural purposes, it is sufficient to produce and consume the concentrate within 14 days of batch production.

GO₂ provides a total system for safe water disinfection. 100.0% of the concentrate product is useable, with no reactive by-products. The product delivers 100.0% biocidal performance (in most cases a 5-log kill within seconds/minutes) without the disadvantages associated with traditional disinfectants such as chlorine and “stabilized” chlorine dioxide (acidified sodium chlorite).

To assist our distributors and clients, GO₂ International has a team of specialists available. Each is an expert in their different industry. These include livestock, poultry, dairy, beverages, fish farming and processing, horticulture, agricultural irrigation, fruit and produce washing, food processing, oil and gas industry, municipal water treatment, cooling towers, hospitals and hotels, ornamental water, restaurants, hospitals, cruise ships and marine vessels, swimming pools, hot tubs and spas and many other applications. GO₂ International has a network of regional distributors able to provide expertise to custom-design the optimum water disinfection services to meet the requirements of our customers. As of 2008, GO₂ has been adopted in several countries throughout the world.

A wide variety of research has been conducted to develop and perfect the product. Extensive

GO₂[®] brings production of CLO₂ into the 21st century, with a 95+ % pure CLO₂ concentrate, zero by-products and zero residues.



scientific and practical application tests in live situations were completed before GO₂ was brought to the market.

GO₂ International is supported by clients, scientists, engineers, physicians, universities and laboratories to continuously develop, collect and disseminate data and practical experience based on our research. GO₂ is truly innovative.

GO₂ International's Mission

GO₂ eliminates the need for harmful chlorine, gas-generated ClO₂, chloramines and all traditional water disinfectants. GO₂ contributes to a better environment and to the safety of humans, animals, poultry, food and crops by providing safe, healthy drinking water, irrigation water and wash-water.

GO₂ and Microbial Contamination

Traditionally, microbial contamination has been controlled using chlorine. However, in an increasing number of industries, for example, poultry processing, high levels of chlorine traditionally used in process water is no longer permitted. In others, the health effects and environmental impact of DBP's caused by the chemical reaction of chlorine with organic materials are causing increasing concern. The chemistry of chlorine dates back 150 years. It is an old, cheap, crude and harmful product. Chlorine has adverse effects on health, the environment and equipment. It gasses off in production facilities. It creates corrosion, smell and taste problems. It is aggressive and hazardous to use, to store and to transport. It is ineffective outside of narrow pH levels. It does **not** kill viruses and it does **not** remove biofilms. In Europe, governments are imposing regulations that completely ban chlorine as a disinfectant used for human and animal drinking water and the washing of any vegetables, fruit, meat, fish or produce to be consumed by humans.

GO₂ is a 21st Century replacement for chlorine. It is a breakthrough technology that delivers real health, quality and financial benefits to urban, industrial, commercial and agricultural users. GO₂ is a stronger disinfectant and a green, clean, effective and safe technology to replace yesterday's product: harmful chlorine.

GO₂ kills bacteria, viruses, fungi and spores.



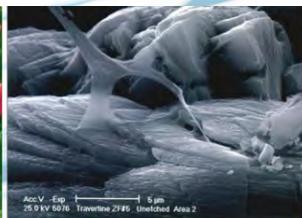
Bacillus 55



Slime



E-Coli



Slime



Legionella



GO₂ will 100% remove microbial slime (biofilm) from all water storage and distribution systems. ***This applies whether the source is a water well in a simple rural village well, a poultry or livestock farm, a factory, an irrigation system or a major city. GO₂ can be simply and immediately deployed, requiring no training and no investment in infrastructure. A dirty water source turns the distribution network into a transportation system for water-borne disease. Clean, healthy drinking water can be made available literally overnight to benefit people, improve food production and hygiene and to eliminate contamination and the spread of infectious disease.*** Once microbial slime has been eradicated from the distribution and storage system, the dosage level of GO₂ required to maintain a clean, healthy water system and to prevent re-colonization can be significantly reduced, thereby reducing costs on an ongoing basis for the user.

GO₂ provides a radical solution for the control of microbial contamination in hot and cold water services, potable supplies, cooling water, process waters, waste water, irrigation and effluent across a wide range of applications where microbial control is essential.

One gallon of GO₂ at 4,000 ppm concentration and a dosage rate of 0.1 ppm will disinfect 40,000 gallons of drinking water!

GO₂ and Health Issues

The key to the success of GO₂ in controlling microbial contamination of water systems is its unique ability to remove and prevent the growth of microbial slime (biofilm) throughout the entire water distribution and storage system. GO₂ is also a powerful oxidizer of various chemical contaminants, including iron, manganese, sulphides, amines, mercaptans, cyanides and phenols. GO₂ oxidizes sulphides and prevents smells, taste, and rust and corrosion problems associated with these chemicals.

The unique GO₂ two-component concentrate delivers a powerful disinfectant for water systems and hard surfaces in a wide range of industries including food processing, medical, animal health, bottled water, soft drinks and brewing. GO₂ has been endorsed by the HSE in ACOP (7) as a recognized alternative to high hot water temperatures for the eradication of Legionnaires Disease. Recent tests in US hospitals have shown CLO₂ to be an effective weapon in the fight against Legionnaires Disease. GO₂ International has worked with a leading US expert in Legionnaires Disease and with facilities treatment specialists to effectively demonstrate the efficacy and ease-of-use of the product.

GO₂ in Agriculture and Horticulture



GO₂ in irrigation water improves absorption of water into plant roots. Larger and healthier crops with better resistance for viral or bacterial contamination are the results.



Chlorine Dioxide Production and GO₂

For many decades CLO₂ has been recognized as a superior disinfectant. However, production has been fraught with problems. Machine-generated CLO₂ requires a significant investment in equipment, specialized training and precursor chemicals. More than 99.0% of machine-generated gas is wasted. Conversely, 95.0+% of gas produced by GO₂ is dissolved into water to create the concentrate. 100.0% of the concentrate is useable. Also, machine-generated CLO₂ is not affordable to most small and medium users due to high investment cost and expensive production. Traditional CLO₂ generation carries a risk of explosion. Thus the equipment requires secure, fire-proof rooms and a high level of training. Production is restricted only to authorized personnel. The application of equipment-generated CLO₂ is only suitable for high volume users due to the high investment costs and expensive costs of operation. GO₂ is simple and affordable to everyone, from a major urban water authority to a village well. Use of GO₂ requires the simple mixing of two powders into regular tap water.

An alternative conventional means of producing CLO₂ is to use what is commonly (an incorrectly) known as "liquid" CLO₂. This is a misnomer for a liquid "bleach" produced from acidified sodium chlorite. In this process the chemistry management is imprecise, the concentration level low i.e. approximately 12.5% vs. 95.0+%. There are also myriad harmful by-products created from the reaction with organic matter by the free chlorine radicals inevitably present in the liquid. Liquid CLO₂ is yesterday's technology, with myriad problematic side-effects.

GO₂ eliminates all the above problems. The product is 95.0+% pure CLO₂ in liquid form. There is no wasted product. 100% of the concentrate is consumed in the target water, leaving zero by-products and zero residues. GO₂ does not require acid activators, and does NOT create chlorites, chlorates, chloramines, chloroforms or any other DBP's.

Chlorine and chlorine-type disinfectants (e.g. sodium hypochlorite, calcium hypochlorite, etc.) all generate "free chlorine". This free chlorine, also known as hypochlorous acid, is the component that does the actual killing of bacteria. This free chlorine is released by chlorine and chlorine-type disinfectants when applied in water. GO₂ is **not** a chlorine-type disinfectant. GO₂ does **not** release free chlorine to provide the disinfection function. With GO₂ the pure CLO₂ kills the full spectrum of problematic bacteria, algae, fungi, protozoans, yeast, mold, microbial slime, methanogens and viruses.

The precursors used to generate GO₂ are fully compliant with the European Standard DIN EN12671 which governs the world's most stringent rules for purity and quality of chemicals used for drinking water disinfection.

GO₂ in Cooling and Energy Industry



GO₂ improves the efficiency of cooling towers. By eliminating algae and slime, cooling processes work better and consume less energy.



GO₂ Chemistry

Both chlorine and ClO₂ are chemically defined as oxidizing agents, i.e., electron receivers. Chlorine has the capacity to take in 2 electrons, whereas ClO₂ can absorb 4. This property explains the substantial difference in performance between the two compounds. GO₂ has a 4-mole chemical capacity.

In the chlorine-based process, about 10.0% of the ClO₂ combines directly with "aromatic" components. Aromatic compounds have atoms arranged in rings, plus other atoms attached to these rings, including chlorine. Within the group of chlorinated aromatics, which are toxic to most organisms, are lethal dioxins. The chemical behavior of ClO₂ as an oxidizing agent is totally different. Instead of combining with the aromatic rings, ClO₂ breaks the rings apart. In addition, as the use of ClO₂ increases, the generation of chlorinated organics is dramatically reduced.

The chemistry of ClO₂ also explains why it is such an effective oxidant or bleaching agent. It is 260.0% more powerful than chlorine gas and much more selective, targeting viruses and bacteria first and then reacting with organic compounds. These characteristics make ClO₂ the preferred environmental standard for disinfection of water for numerous applications.



GO₂[®] is EASY and SAFE to use and SIMPLE to apply

GO₂ is 21st century chemical technology



GO₂ has been developed and tested by the best laboratories. Our manufacturing is California EPA certified. We closely collaborate with scientists from industry and universities to develop the best applications, support, documentation and safety in our products and services.



GO₂ 4,000 ppm Concentrate

The concentrate is made by mixing the components directly into normal tap water and leaving the mixture to stand. After 30 minutes, the concentrate should be lightly stirred with a non-metal instrument to ensure a homogenous mix. The concentrate is then ready for use. It should be stored in a UV-proof container in a cool, low-light or dark room. The container should be sealed. Only a simple dosing pump and a CLO₂ meter is required to use GO₂.

Every water supply has its own characteristics and different biological load. Therefore, the target water will require a different dosage rate of GO₂. In general, a dosage of 2.0 ppm will eliminate all microbial slime from a water distribution system. The time required to clean the system will depend upon the degree of contamination, the age of the system and other factors. However, GO₂ will progressively eliminate the contamination. Where necessary, shock-doses can be used to accelerate the clean-up. Once the microbial slime has been removed, the dosage rate can be reduced to 0.05 ppm and ongoing maintenance costs are thus lowered. Deviations from these dosing rates are to be expected. However, 100.0% elimination of the contamination is certain.

GO₂ in agriculture



Irrigation with GO₂ stimulates crop growth and reduces the risk of destructive mold, fungal and bacterial infection.



Advantages of GO₂

The WHO Guidelines for Drinking Water Quality recommend CLO₂ as an effective residual for continued microbial control. GO₂ offers the perfect solution to microbial fouling, meeting all the requirements as an alternative to chlorine and delivering a wide range of benefits to users.

The most important advantages of GO₂ compared to chlorine and other disinfectants are:

- ▶ Full spectrum kill
- ▶ Stronger and faster biocidal function (kills 99.999% of all bacteria in seconds/minutes)
- ▶ 260% more disinfection power compared to chlorine products
- ▶ 10 times more oxidizing power compared to chlorine products
- ▶ 1,000 times more disinfection power than chloramines
- ▶ Low volume and low cost of chemicals required
- ▶ Low dosage of CLO₂ is required
- ▶ No Disinfection by-Products (DBP's). Eliminates THM's, HAA's, MX, chloramines, bromides, bromines
- ▶ Unlike chlorine, GO₂ does not react with ammonia, ammonium or most organic compounds
- ▶ GO₂ does not chlorinate organic materials. It produces no THM's, HAA's, chloramines and other organic, carcinogenic or estrogenic compounds
- ▶ Guaranteed removal of microbial slime from the entire water distribution system
- ▶ Steady bactericidal action within a broad pH bandwidth (4-11). No chemicals are required to adjust pH levels.
- ▶ 100% kill of all water-borne micro-organisms, bacteria, viruses, protozoans, fungi, algae, mold, spores, cysts, larval eggs, veligers, together with plant, animal, poultry and human viral diseases
- ▶ No build-up of resistance by micro-organisms
- ▶ No adverse effect on materials, filters, equipment, pumps, water pipes (metal or PVC).
- ▶ Corrosivity less than the corrosivity of fresh water. No residues except common salt at levels less than naturally present in fresh water
- ▶ High efficiency in the removal of iron and magnesium compounds
- ▶ High solubility in water and can be applied with immediate effect
- ▶ Long shelf life (5 years).
- ▶ Concentrate ready for use in 30-minutes

GO₂ in Food Processing



Cleaning-in-place (CIP), food washing and fresh food cooling are essential applications for GO₂ in various industries, from egg-hatcheries to beverage production.



- ▶ 15-day life at full concentration in dark, cool storage before onset of gradual decline in potency.
- ▶ 50.0% potency at 30-days
- ▶ No wasted product. GO₂ provides 95.0+% purity, plus 100.0% yield into target water and 100.0% consumption in target water
- ▶ Lightweight powder, safe, easy to use, store and transport.
- ▶ Minimal investment in equipment required (simple dosing pump and automatic CLO₂ sensor)
- ▶ No construction modifications or certifications required
- ▶ No gassing off, no smell, improved taste and improved color of water
- ▶ Non-explosive
- ▶ Zero residual products
- ▶ Affordable to small, medium and large-scale users
- ▶ Immediate deployment
- ▶ No smell, no skin, eye or mucous tissue irritation (swimming pools/showers)



Setup with 2 GO₂ 500 liter containers for potable water application



GO₂ 1,000 liter containers (approx. 265 gallon)

GO₂ in Landscaping



GO₂ in landscaping, ornamental waters and open ponds. Eliminates algae, improves appearance, protects fish stocks and plant life.



The killing power of GO₂

Measured Performance Time Reduction

Test	Test Organism	Contact Time	Result	Test	Test Organism	Contact Time	Result
9a	Aspergillus fumigatus spores	60 seconds	99.9999% kill	10	Proteus mirabilis	60 seconds	99.999999% kill
9b	Bacillus cereus Spores	5 minutes	99.999% kill		Pseudomonas aeruginosa	60 seconds	99.999999% kill
8f	Candida albicans	60 seconds	99.99999% kill	8e	Pseudomonas aeruginosa	10 minutes	100% kill
12	Canine Parvovirus	10 minutes	100% virucidal	8a	Pseudo rabies virus	10 minutes	100% virucidal
	Erwinia carotovora carotovara	60 seconds	99.999% kill	5c	Saccharomyces cerevisiae	60 seconds	99.999% kill
1	Escherica coli	60 seconds	99.99999% kill	11	Salmonella choleraesuis	10 minutes	100% kill
	Lactobacillus sp.	60 seconds	99.999% kill	8c	Salmonella choleraesuis	60 minutes	100% kill
3	Legionella pneumophila	60 seconds	99.999% kill	5a	Salmonella typhimurium	60 seconds	99.999% kill
4	Listeria monocytogenes	60 seconds	99.99999% kill	6a	Staphylococcus aureus	10 minutes	100% kill
	Listeria monocytogenes *	60 seconds	99.999% kill	2	Staphylococcus aureus	60 minutes	100% kill
	Mycobacterium bovis	10 minutes	> 6 log kill	5b	Staphylococcus aureus	60 seconds	99.9999% kill
	Newcastle Disease virus	10 minutes	100% virucidal	6b	Streptococcus faecalis	60 seconds	99.99999% kill
13	Pediococcus sp.	60 seconds	99.999% kill	8b	Streptococcus faecium	60 seconds	99.9999% kill
				8g	Trichophyton mentagro phytes	5 minutes	100% kill

*) ATCC15313, Briel, Scott A

*Test Types

- AOAC Germicidal & Detergent Sanitiser Test
- AOAC Available Chlorine Germicidal Equivalent Concentration Test
- 3 & 4 Bacterial Studies
- 5 a-c Bacterial Studies – Dental Pumice Slurry Disinfectant
- 6 a-b Bactericidal Study – Water Tank Disinfectant

- AOAC Fungicidal Study
- 8 a-g European Suspension Tests (0.03% BSA Organic load)
- 9 a-b European Suspension Tests – Sporocidal Tests – (0.03% BSA O.L.)
- 10-12 Virucide Assay – EPA Method – Pesticide Assessment Guidelines
- Qualitative Tuberculocidal Test Log Reduction Method

GO₂ in the Food Industry



GO₂ in the food industry: Bread, cheese factories, meat washing, meat processing, poultry processing. The use of GO₂ improves product quality and reduces contamination with E-coli, salmonella and listeria. GO₂ improves the cost effectiveness of these processes.



Product Line Overview

GO ₂ P/D Matrix		Amount of water to be treated at:				
Stk #	4,000 ppm kit	1.0 ppm	0.5 ppm	0.3 ppm	0.2 ppm	0.1 ppm
G-1000	264 Gallons	1,058,201	2,116,402	3,527,337	5,291,005	10,582,011
	1000 Liters	4,000,000	8,000,000	13,333,333	20,000,000	40,000,000
G-0500	132 Gallons	529,101	1,058,201	1,763,668	2,645,503	5,291,005
	500 Liters	2,000,000	4,000,000	6,666,667	10,000,000	20,000,000
G-0200	53 Gallons	211,640	423,280	705,467	1,058,201	2,116,402
	200 Liters	800,000	1,600,000	2,666,667	4,000,000	8,000,000
G-0100	26.4 Gallons	105,820	211,640	352,734	529,101	1,058,201
	100 Liters	400,000	800,000	1,333,333	2,000,000	4,000,000
G-0050	13.2 Gallons	52,910	105,820	176,367	264,550	529,101
	50 Liters	200,000	400,000	666,667	1,000,000	2,000,000
G-0025	6.6 Gallons	26,455	52,910	88,183	132,275	264,550
	25 Liters	100,000	200,000	333,333	500,000	1,000,000
G-0010	2.64 Gallons	10,582	21,164	35,273	52,910	105,820
	10 Liters	40,000	80,000	133,333	200,000	400,000
G-0005	1.32 Gallons	5,291	10,582	17,637	26,455	52,910
	5 Liters	20,000	40,000	66,667	100,000	200,000
G-0001	0.26 Gallons	1,058	2,116	3,527	5,291	10,582
	1 Liters	4,000	8,000	13,333	20,000	40,000



United Nations certified pails for one time use only with green lid for Component A and blue lid for Component B.



Contact GO₂ USA

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A decorative graphic at the bottom of the page shows a splash of clear water with several bubbles, set against a light blue background.

If you need more information or contact details of local distributors in our worldwide distribution network, visit www.go2intl.com, or mail to: pureclo2@go2intl.com



GO₂™ - Improving the World of Disinfection.

GO₂™ is a 21st Century Technology.

Safe to use. Environmentally friendly.

U.S. EPA Reg No. 84912-2

U.S. EPA Est No. 66397-OK-1

GO₂™ is a trademark of eOx, llc

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