OxyChem®

Basic Chemicals

Sodium Chlorite Technical (EPA Registered) for Chlorine Dioxide Generation

Chlorine dioxide, a powerful oxidizing agent, can be efficiently and economically generated when sodium chlorite is either chlorinated or acidified, or both, under appropriate pH and temperature conditions. The chlorine dioxide may result naturally from process conditions, or may be produced by means of an external generator. Commonly, solutions of 25% active sodium chlorite or less are used to charge chlorine dioxide generators.

OxyChem Technical Sodium Chlorite is an excellent source of chlorine dioxide. Technical Sodium Chlorite is available in dry form or as a 31% or 25% solution. Chemical and physical proprieties are given in Tables 1, 2, and 3.

Table 1
Properties of Technical Sodium Chlorite Dry

Sodium Chlorite, (%)	80
Sodium Chloride, (%)	11 - 19
Water, Max. (%)	6
Appearance	white flakes
Bulk Density (lb/ft^3) Packed	69

Table 2
Properties of Sodium Chlorite 31% Active

Sodium Chlorite, (%)	31
Sodium Chloride, (% max.)	3.5
Water (%)	61-69
Appearance	clear, slightly yellow liquid
Density @ 35°C (lb/gal)	10.6
Crystallization Point (°C)	3

Table 3
Properties of Technical Sodium Chlorite Solution 31.25 (25%)

Sodium Chlorite, (%)	25
Sodium Chloride, Max. (%)	3.0
Water (%)	70 - 75
Appearance	clear, pale, yellow
Density @ 25°C (lb/gal)	10.1
Crystallization Point (°C)	-8

EPA Registration

When used as the parent chemical for on-site production of chlorine dioxide in pesticidal applications, sodium chlorite is governed by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended. This

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means that the sodium chlorite sold for this purpose must be registered as a pesticide with the United States Environmental Protection Agency, under a label or labels containing these uses.

Pesticidal uses of chlorine dioxide generated by sodium chlorite are biocidal, disinfective or sanitizing in nature. Examples of such uses are: as a bactericide or slimicide in treatment of drinking water, processing plant flume water and rinse water in produce packing facilities; as a slimicide in recirculating cooling waters; and as a microbiocide in oil recovery operations.

OxyChem EPA Registered sodium chlorite products are registered for these applications under the following EPA Registration Numbers:

5382-42 Technical Sodium Chlorite Dry
5382-45 31% Active Sodium Chlorite Solution
5382-43 Technical Sodium Chlorite Solution 31.25

Mechanical Generation of Chlorine Dioxide

Chlorine dioxide can be generated by activating technical sodium chlorite ($NaClO_2$) with an oxidizing agent or an acid. The most common oxidant is chlorine. It may be reacted in solution or in its gaseous form with sodium chlorite.

The principal reaction of sodium chlorite with chlorine is:

$$2NaClO_2 + Cl_2 \rightarrow 2ClO_2 + 2NaCl$$

Stoichiometrically, 1.68 lbs. of dry technical sodium chlorite reacts with 0.5 lbs. of chlorine to produce 1.0 lb. of chlorine dioxide. The reaction is usually carried out by dissolving the chlorine in a chlorinator and then bringing it into contact with a solution of $NaClO_2$ in a reaction column. A slight excess of chlorine will insure that the reaction solution has a pH of 2-4 and will produce chlorine dioxide with high efficiency.

If chlorine is not readily available, chlorine dioxide can also be prepared by mixing sodium hypochlorite bleaching solution with sodium chlorite and acid:

$$2NaClO_2 + NaOCl + H2SO_4 \rightarrow$$
$$2ClO_2 + NaCl + Na_2SO_4 + H_2O$$

Although sulfuric is shown as the acid, other inorganic acids may be used. Numerous other acids, oxidizers, and available chlorine compounds are potential activators for chlorine dioxide generation from sodium chlorite. Again, a slight excess of acid is employed to adjust pH to 2-4. Hydrochloric acid is reportedly the most efficient producer of chlorine dioxide. Where efficiency is not critical, chlorine dioxide can also be generated simply by acidifying a solution of sodium chlorite in modified generators.

$$5NaClO_2 + 4HCl \rightarrow 4ClO_2 + 2H_2O + 5NaCl$$

This reaction illustrates the easiest method for generating chlorine dioxide. However, concentrated acid should never be mixed with concentrated sodium chlorite solutions. This can cause rapid generation of chlorine dioxide gas, potentially resulting in an explosion.

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Commercial generators are available based on the chemistry described in these equations. The ease of generation of chlorine dioxide in a closed system is shown in Figure 1, using activation by chlorine as an example. In this example, a 0.1% Cl_2 solution is fed from the chlorinator at 10 gal/min and mixed with a 10% $NaClO_2$ solution pumped at 0.2 gal/min into a reaction tower filled with Raschig rings. The resulting product contains about 1500 ppm of chlorine dioxide, which can be introduced in the system for water treatment.

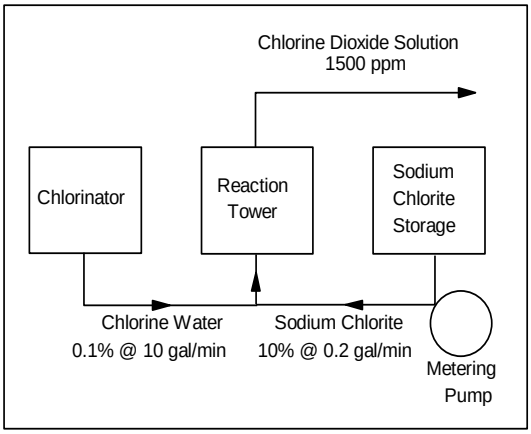

Figure 1: Chlorine Dioxide Mechanical Generator

Electrolytic Generation of Chlorine Dioxide

Chlorine dioxide may also be generated by electrolysis from a solution of sodium chlorite according to the following half-cell reactions:

Anode: $2Na^+ + 2ClO_2^- \rightarrow 2Na^+ + 2ClO_2 + 2e^-$

Cathode: $2H_2O + 2e^- \rightarrow 2OH^- + H_2$

Combining these reactions, chlorine dioxide is formed at the anode, while sodium hydroxide is formed at the cathode.

Depending on the type of generator equipment and the sodium chlorite product used, the sodium chlorite solution may require additional dilution. The system may also require the addition of sodium chloride.

Chlorine Dioxide Applications

Chlorine dioxide has a variety of commercial uses. In all of the following applications, sodium chlorite is used to generate chlorine dioxide.

Treatment of Potable Water. Chlorine dioxide has long been used to remove tastes and odors in potable water. It is also used in the disinfection of water, particularly where trihalomethanes are of concern. And it oxidizes soluble manganese and iron compounds, eliminating a major cause of stained sinks and fixtures.

Bacterial Control in Oil Wells and Petroleum Systems. A patented use for chlorine dioxide is to treat water that is or will be contaminated with petroleum oil. Many such mixtures contain sulfite-reducing bacteria that form undesirable sulfide compounds. Chlorine dioxide oxidizes these sulfides to sulfates, while preventing or substantially retarding the formation of colloidal sulfur.

Bacterial Slime Control in Paper Mills. Some of the major operational problems in paper and

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paperboard production are caused by proliferation of microbiological organisms in white water and stock systems. An oxidizing biocide, chlorine dioxide, can control microbiological growths which cause paper malodors and discoloration, deterioration of felts, equipment corrosion, fouling of pipes and showers, and paper quality problems such as spots, specks and holes.

Food Processing. Chlorine dioxide is highly effective for microbiological control in organically contaminated flume waters. Control of microbiological growths is necessary to ensure food product safety and quality. Chlorine dioxide has also found application in cherry bleaching.

Algae Control in Cooling Towers. Chlorine dioxide efficiently and economically controls microbiological growths in industrial cooling waters under conditions unfavorable to chlorine. It is the primary microbiological control agent in systems with high pH, ammonia-nitrogen contamination, or persistent slime problems.

Treatment of Wastes. Chlorine dioxide is used to disinfect sewage and plant wastes. It destroys phenolics, simple cyanides and sulfides by oxidation.

Stripping Dyestuffs from Textiles. Chlorine dioxide removes dyestuffs from textiles with a minimum of fiber degradation. However, its effectiveness depends upon the dyestuff and the type of fabric. This method also provides a good bottom for redyeing.

Upgrading of Fats and Oils. Chlorine dioxide is effective in bleaching fats. The process is simple and low cost, and since it eliminates the need for a filter medium, it produces a higher yield than other methods. (About 30% of the weight of the filter residue, which is generally discarded, is tallow.) Problems such as storage and handling of the filter medium and disposal of filter residues are eliminated as well.

Bleaching of Natural Foliage. Chlorine dioxide is used for removing color from natural foliage. The foliage can then be used in the white state or it can be dyed. Degradation of cellulosic structure is minimal.

Safety and Handling

The following summary of health and safety information is not intended to be complete. For complete information, read the current Safety Data Sheet (SDS). To obtain a SDS, contact OxyChem's Technical Service Department.

Toxicological Properties

Sodium chlorite is toxic by ingestion. Sodium chlorite may cause anemia by oral exposure and has low toxicity by dermal exposure. OxyChem sodium chlorite has an oral LD_{50} (rat) of 165 mg/kg. Sodium chlorite has a dermal LD_{50} (rabbit) of greater than 2 g/kg. Sodium chlorite can produce severe irritation or burns to the skin and eyes. Corneal damage can occur if not washed immediately from the eyes.

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Personnel Protection
When handling sodium chlorite solutions, chemical goggles, face shield, neoprene gloves, apron, and boots should be worn. Wear a NIOSH approved acid gas respirator with a dust/mist filter if any exposure is possible. Local exhaust is required where exposure to dust or mist might occur. If sodium chlorite is spilled on clothing, remove and wash contaminated clothing at once to avoid the potential of fire.

First Aid
Eyes: Immediately flush eyes with large amounts of water for at least 15 minutes while frequently lifting the upper and lower eyelids. Consult a physician immediately.

Skin: Remove contaminated clothing. Immediately flush exposed skin areas with large amounts of water for at least 15 minutes. Consult a physician if burning or irritation of the skin persists. Contaminated clothing must be laundered before re-use.

Ingestion: DO NOT induce vomiting. Drink large quantities of water. Consult a physician immediately. DO NOT give anything by mouth if the person is unconscious or having seizures.

Inhalation: Move patient to fresh air and monitor for respiratory distress. If cough or difficulty in breathing develops, administer oxygen, and consult a physician immediately. In the event that breathing stops, administer artificial respiration and obtain emergency medical assistance immediately.

Notes to Physician: Chlorine dioxide vapors are emitted when this product contacts acids or chlorine. If these vapors are inhaled, monitor patient closely for delayed development of pulmonary edema which may occur up to 48-72 hours post-inhalation.

Following ingestion, neutralization and use of activated charcoal is not indicated.

Storage and Handling
Do not contaminate sodium chlorite with incompatible materials such as dirt, organic matter, oxidizers, reducing agents, chemicals, soap products, solvents, acids, paint products, or combustible materials. Do not store or transport sodium chlorite with incompatible materials. Contamination may start a chemical reaction with generation of heat and emission of chlorine dioxide (a poisonous, explosive gas). A fire or explosion may result. Rinse empty containers thoroughly with water and dispose of in accordance with label instructions.

Dry sodium chlorite. Do not expose to moisture during storage. Store in the original container, in a cool, dry, well-ventilated area away from direct sunlight. Always replace cover tightly since dry sodium chlorite can pick up moisture from the air. Mix only into water using a clean, dry metal scoop dedicated to this product alone. Keep away from flame or any burning material (such as a lighted

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cigarette). If fire occurs, extinguish with plenty of water. Cool any unopened drums near the fire by spraying water on them.

Sodium chlorite solutions. Store in clean, closed, non-translucent containers. Exposure to sunlight or ultra-violet light will reduce product strength.

Do not allow solution to evaporate to dryness. This product becomes a fire or explosion hazard if allowed to dry and can ignite in contact with combustible materials.

Spill and Leak Procedures

In the event of a spill or leak, remove all sources of ignition. Wear NIOSH approved positive pressure, self-contained breathing apparatus with a chemically impermeable, fully encapsulated suit. Follow OSHA regulations for respirator use (see 29 CFR 1910.34).

Sodium chlorite dry, is a fire or explosion hazard if contaminated with combustible material. Clean up in a manner to avoid contamination. Spilled material should be picked up, by using a clean, dry, plastic, scoop or shovel and placed into a clean, dry, container.

Do not return spilled material to the original container. Isolate the recovery container outside or in a well-ventilated area and hold for proper waste disposal. Do not seal the container. Flush any residual material with large quantities of water.

Sodium chlorite solution also becomes a fire or explosion hazard if allowed to dry and can ignite on contact with combustible material. Continue to keep damp. Contain spilled material by diking or absorbing with clay, soil or non-combustible commercial absorbents. Do not return spilled material to original container. Place in a clean container and isolate outside or in a well-ventilated area. Do not seal the container. Flush any residual material with large quantities of water.

Disposal

Spill residues may be a hazardous waste as defined in 40 CFR 261. The EPA hazardous waste designation for dry sodium chlorite waste would be D001 and sodium chlorite solution waste would have the waste designation of D002. As a hazardous waste, it will be subject to the Land Disposal Restrictions under 40 CFR 268 and must be managed accordingly. As a hazardous waste solution or solid, it must be disposed of in accordance with local, state, and federal regulations in a permitted hazardous waste treatment, storage and disposal facility.

Shipping Information

Technical Sodium Chlorite Dry is available in 100-lb drums. Technical Sodium Chlorite Solution 31.25 or 31% Active Solution is available in railcars, tank trucks, 330-gallon totes or in 55-gallon drums.

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Further Information

More detailed information is available upon request through the OxyChem Technical Service Department. Call or write to:

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