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WATER TECHNOLOGIES

WATER DISINFECTION CHEMICALS GUIDE

WALLACE & TIERNAN® PRODUCTS

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WATER DISINFECTION CHEMICALS

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Ammonia, Anhydrous

Also called: NH₃, Ammonia gas

Use: Ammonia combines with chlorine to give combined available chlorine residuals or chloramines. Chloramines do not react with certain chemicals with which chlorine will react, such as phenol. This is significant when certain tastes and odors are to be avoided. Chloramines are often employed for disinfection and slime growth control in water distribution systems. Ammonia is also used as a source of nitrogen and is fed as a nutrient into biological waste treatment systems. Ammonia is also used for pH control. It is used for solvent dewaxing and neutralizing acid treated oils in the petroleum industry, also for case hardening and brazing metal

Properties: A clear, colorless gas, easily compressed to a liquid for storage and shipping. Commercial grade 99-100% NH₃. Highly soluble in water. At 60F water takes up 683 times its own volume of NH₃ gas

Specific gravity, dry gas	- 0.587 at 70 F and 1 atm.
Specific gravity, liquid	- 0.6819 at -28 F
Latent heat of vaporization	- 589.3 Btu per lb. at -28 F
Specific volume, dry gas	- 20.78 cu.ft. per lb. at 32 F and 1 atm.
Solubility in water	- 44% at 32 F

Packaging: 50, 100, 150 lb. cylinder; tank cars

Compatible Materials: Hastelloy C, Alloy 20, 316 SS, PVC, TFE, Nordel, Kynar, Ceramic, Kalrez
Other: 1, 5, 11, 12, 13, 18, 20, 21, 23, 27, 28, 30, 33

Dosing Methods: Wallace & Tiernan 60-225 Direct Feed Ammoniator, or V-Notch™ Vacuum Feed

Special: Ammonia gas does not burn in air but a mixture of ammonia and oxygen explodes when ignited.
Injector water should be soft (less than 35 ppm calcium hardness as CaCO₃) unless an acid, such a phosphoric acid is used in nutrient feeding, is fed to injector water which prevents softening. Ammonia and chlorine feed equipment and storage containers should not be in the same room.

References: AWWA Standard B305-15 Anhydrous Ammonia

Ammonia, Aqua

- Also called: NH_4OH , ammonia water, Ammonium hydrate, Ammonium hydroxide
- Use: Formation of chloramines, nutrient, pH control
- Properties: Clear, unstable solution. Corrodes copper, aluminum alloys and galvanized surfaces. Commercial strengths are: Grade A: 29.4 %, Grade B: 25% min., Grade C: 15.6% min. NH_3 . Density of 29.4% solution is 0.8974, of 5% solution 0.974 compared to water at 60°F as 1
- Packaging: 10-gal. carboys, 375 and 750-gal. drums, 8000-gal. tank cars
- Compatible Materials: Hastelloy C, Alloy 20, 316 SS, PVC, TFE; Kynar, Kalrez
- Other: 4, 5, 8, 9, 11, 18, 20, 23, 29, 30, 33
- Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps
- Special: Keep cool in strong glass or plastic rubber-stoppered bottles not completely filled. Feeding systems should be vented to atmosphere
- References: AWWA Standard B306-15 Aqua Ammonia

Ammonium Sulfate

Also called: $(\text{NH}_4)_2 \text{SO}_4$, Sulfate of ammonia.

Use: Combined residual chlorination. Induced breakpoint chlorination. A source of ammonia. Nutrient feeding. Corrosion control

Properties: White to light gray-green crystalline material (45 lb. per cu.ft.).
Commercial strength 99% $(\text{NH}_4)_2 \text{SO}_4$ or 21% NH_3 -N. Solutions are acid.

Packaging: 25 lb. boxes, 100 lb. kegs, 100 lb. bags, 300 and 400-lb. barrels, bulk.

Compatible
Materials: 316 SS, Hypalon, Viton, PVC, TFE; Nordel, Kynar, Ceramic, Kalrez
Other: 3, 4, 11, 13, 14, 16, 18, 20, 22, 23, 25, 26, 29, 31, 33, 37, 38

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps for solution feed

Special: Dry feeding not recommended. Standard ammonium sulfate may cake or arch when stored in bulk. To prevent this, ground calcium sulfate has been added by some suppliers

References: AWWA Standard B302-16 Ammonium Sulfate

Calcium Hypochlorite

Also called: $\text{Ca}(\text{OCl})_2$, Cal Hypo, H.T.H.™ and other various proprietary tradenames.

Use: Disinfection. Slime control. Deodorizing.

Properties: Calcium hypochlorite is a stable chlorine carrier in solid form. Available as powder, granules or pellets (50-55 lb. per cu.ft.). Commercial grade about 70% available chlorine. Maximum practical solubility is about 3%. Solution should be decanted to separate insolubles after preparation and prior to feeding. A tablespoonful of Calgon for each gallon of solution will prevent carbonate deposition at point of application in hard water.

Packaging: 5, 15, 100 and 300 lb. cans, 415 lb. barrels, 800 lb. drums

Compatible Materials: Hastelloy C, Hypalon, Viton, PVC, TFE, Nordel, Kynar, Kalrez

Other: 4, 9, 11, 12, 13, 20, 23, 29, 33, 35

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps – Not fed as dry chemical.

Special: Storage areas should be kept cool and dry. Material is irritating to eyes, skin and mucous membrane. Contact with organic compounds must be avoided, the mixture may be explosive.

Solutions are alkaline. Neutralization of the alkalinity will release chlorine from solutions of 0.2% or above.

References: AWWA Standard B300-55 Hypochlorites

Carbon Dioxide

Also called: CO₂ , Dry ice

Use: Recarbonation in water treating, pH control.

Properties: Colorless, odorless gas which liquefies at -65 C and solidifies at – 78.2 C. Commercial strength almost 100%. Solutions are acid. Available as dry ice and liquefied gas under pressure.

Specific gravity, dry gas	- 1.5289 referred to air.
Vapor pressure	- 838.7 psig at 70F.
Specific volume	- 8.76 cu.ft. per lb.
Density, gas	- 0.1146 lb. per cu.ft.
Rate of withdrawal	- 100-120 lb. per 24 hr. from 50-lb. cylinder

Packaging: 150 lb. steel cylinders.

Compatible Materials: 316 SS, Carp 20, Hast-C, Hypalon, PVC, TFE, Kynar, Viton, Kalrez

Other: 1, 4, 9, 11, 12, 18, 20, 21, 23, 25, 27, 28, 29, 31, 33, 37

Dosing: Wallace & Tiernan V-Notch™ Carbon Dioxide feeder

Special: Feeder application of CO₂ competes with on-site generation and has many features:
Better pH control- There is no dilution with nitrogen and oxygen.
Less maintenance – Simple equipment; not fires to maintain or refractories to replace.
Better taste – There is no sulfur or other foreign matter.
Better control – Automatic control is accurate over a wide range.

References: AWWA Standard B510-12 Carbon Dioxide

Chlorine

Also called: Cl₂ , liquid chlorine, gas chlorine

Use: Disinfection of water and waste. Taste and odor control. Slime control. Activated silica production. Generation of chlorine dioxide.

Properties:

Specific gravity, dry gas	- 2.48 at 32 F and 1 atm referred to air
Specific gravity, liquid	- 1.47 at 32 F and 53.15 psia
Liquid to gas volume, ratio	- 1:457.6 at 32 F and 1 atm
Latent heat of vaporization	- 123.7 Btu per lb. at boiling pt., -29.29 F
Specific volume, dry gas	- 1 lb. = 4.99 cf at 32 F and 1 atm
Specific volume, liquid	- 1 lb. = 0.109 cf at 32 F and 53.15 psia
Weight, dry gas	- 1 cf = 0.2003 lb. at 32 F and 1 atm
Weight, liquid	- 1 cf = 91.67 lb. at 32 F
Solubility in water	- 0.997% at 50 F, 0.475% at 100 F

Packaging: 100 and 150 lb. cylinders, 1-ton containers, TMU (15 one-ton containers), 16, 30, and 55-ton tank cars.

Compatible Materials:

- Liquid: Carbon steel, copper
- Dry Gas: Carbon steel, copper
- Solution: PVC, polyethylene, glass

Dosing: Wallace & Tiernan S10k™, V10k™, V2000™ Chlorinators and 50-200 Series Evaporators

References: AWWA Standard B301-10 Liquid Chlorine

Chlorine Dioxide

Also called: ClO₂, Chlorine peroxide

Use: Taste and odor control. Precipitation or oxidation of manganese and iron. Bleaching.

Properties: ClO₂ is an unstable and, under certain conditions, explosive gas. It is yellowish-red in color and gives a yellow water solution. Solutions are produced by oxidation of chlorite solutions with chlorine or hypochlorite, or by reducing a chlorate. The gas is usually generated at the point of use. Generation by oxidation of chlorine requires a pH of 4 or below.

Packaging: Chlorine dioxide solution is prepared at point of use.

Compatible
Materials: PVC, glass, Kynar

Dosing: Wallace & Tiernan DIOX™ Chlorine Dioxide generators

Special: ClO₂ has advantages over Chlorine. It does not react with ammonia nor is its disinfection activity appreciably affected by pH.

For phenolic and chlorophenolic taste and odor control, the dosage varies from 1 to 6 pounds per million gallons. The average is 2.5. For the oxidation of manganese, 4.12 pounds of technical NaClO₂ is required per pound of manganese; iron requires 2.02 lbs. per pound of iron.

Sodium chlorite will withstand considerable rough handling is it is free from organic matter. However, in contact with clothing, sawdust, flour, brooms, etc., the mixture is extremely sensitive to heat, friction or impact, and will ignite. Diaphragm pumps rather than piston pumps should be used for sodium chlorite solution. Spilled sodium chlorite requires special handling described in Dyox bulletin listed below.

References: AWWA Standard B303-10 Sodium Chlorite

Hydrochloric Acid

Also called: HCl, Muriatic acid

Use: Regenerating water treating de-ionization units. Manufacture of chemicals. Oil well acidizing. Metal pickling. Chemical cleaning.

Properties: Clear, colorless to slightly yellow liquid. Highly corrosive to most metals. Commercial strengths 18° Be (27.92% HCl), 20° Be (31.45% HCl), and 22° Be (35.21% HCl)

Viscosity at 25 C – 5% is 0.98 cp, 10% is 1.06 cp, 15% is 1.15 cp, 28% is 1.50 cp, 31.5% is 1.62 cp, and 35% is 1.78 cp.

Packaging: 13-gal. carboys, 15 and 55-gal. drums, tank cars.

Compatible Materials: Hypalon, Viton, PVC, TFE; Kynar, ceramic, Kalrez

Other: 4, 11, 13, 18, 19, 22, 23, 25, 33, 36

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps

Special: The principal danger in handling hydrochloric acid is contact with the skin and eyes. Hydrochloric acid is not flammable, combustible, or explosive. It will attack most metals with the release of hydrogen, which may form explosive mixtures. Hydrogen chloride gas is released from concentrated solutions. This gas is also corrosive. Venting may be necessary.

References: MSDS, Muriatic Acid

Ozone

Also called: O₃

Use: Taste and odor control. Disinfecting, Waste treatment. Microcoagulant.

Properties: A faintly blue, gaseous allotropic form of oxygen obtained (usually much diluted) by the discharge of electricity in oxygen or in air.

Packaging: Generated at site. Corona discharge or UV.

Compatible

Materials: Wet: Viton, EPR, polyethylene, urethane, Teflon
Dry: Carbon steel, carbon steel (hardened), 301 SS, 302 SS, 316 SS, aluminum, Viton, EPR, urethane, Teflon

Dosing: Ozone Generator

Special: There are a number of proposed uses: In paper mills it gives brighter color with some processes, in difficult phenol treating problems, in mineral oil oxidation, in the bleaching of a number of organic liquids, in controlling odors in animal products' plants, in textiles when color and odor problems are involved, in oxidizing cyanide wastes, and as a microcoagulant in water treatment.

References: AWWA Standard B304-13 Liquid Oxygen for Ozone Generation in Water Treatment

Potassium Permanganate

Also called: KMnO_4 , permanganate

Use: In water treating, taste and odor control, and iron and manganese removal. It forms insoluble products which are removed by coagulation, sedimentation.

Properties: Odorless crystals, dark purple with blue metallic luster (90 to 105 lb. per cu.ft.). Stable in air. Maximum commercial strength 97%. Solubility in water of technical grad is about 4% at 10 C.

Packaging: 110 and 600 lb. drums, carloads.

Compatible

Materials: Hastelloy C, Alloy 20, 301 SS, 302 SS, 304 SS, 316 SS, Hypalon, Viton, PVC, TFE; Nordel, Kynar, ceramic, Kalrez

Other: 1, 3, 4, 5, 6, 10, 13, 18, 20, 22, 26, 31, 33

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps for solution feed

Special: Usual dosage 1.0 to 5.0 ppm, sometimes greater.

Technical Free Flowing Grade is available with additive to prevent caking, bridging, and arching. Without additive, the material become like damp sugar. Free-flowing grade should not be used in W&T Saturator 47-050.

Potassium permanganate may be kept indefinitely if stored in a cool, dry area in closed containers. When exposed to intense heat, acids, reducing agents, and many organic compounds it constitutes a fire hazard and, in some cases, may cause explosions.

References: AWWA Standard B603-98 Potassium Permanganate

Sodium Bisulfite

Also called: NaHSO_3 , Sodium acid sulfite

Use: Dechlorination. Chromium reduction. Oxygen scavenger.

Properties: Sodium bisulfite is a white powder or granular material (74-85 lb. per cu.ft.) but it is generally purchased as a solution in strengths to 44%. When a dry form is required the metabisulfite is available. Bisulfite solutions are prepared by adding SO_2 to caustic solution. Sp.gr. of 10% solution in water is 1.07, 20% is 1.15, 30% is 1.24, and 47% is 1.3712.

Packaging: 100-lb. bags, 100 and 400 lb. drums.

Compatible

Materials: Hastelloy C. Alloy 20, 304 SS, 316 SS, 440 SS, Hypalon, Viton, PVC, TFE; Nordel, Kynar, ceramic, Kalrez

Other: 3, 4, 11, 13, 18, 20, 22, 23, 25, 26, 33, 35, 37

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps for solution feed

Special: Commercial sodium bisulfite powder consists chiefly of sodium metabisulfite, the anhydride ($\text{Na}_2\text{S}_2\text{O}_5$), and for all practical purposes has the same properties. When dissolved in water, it dissociates into the bisulfite.

References: AWWA Standard B601-11 Sodium Metabisulfite

Sodium Chloride

Also called: NaCl, salt, common salt, table salt, rock salt, solar salt.

Use: Regeneration of ion exchange, electrolysis of chlorine, brine refrigeration, as food.

Properties: Available forms: rock (50-60 lb. per cu.ft.), granular, crystals and powder (58-70 lb. per cu.ft.). Commercial strength is 98% NaCl. Slightly hygroscopic when pure, very hygroscopic in commercial form. 35g will dissolve in 100 cc water. Density of 26% solution is 1.2.

Packaging: 100-lb. bags, 25-lb. drums, barrels, carloads.

Compatible Materials: Hastelloy C, Alloy 20, Hypalon, Viton, PVC, TFE, Nodel, Kynar, ceramic, Kalrez

Other: 3, 4, 11, 13, 16, 18, 20, 21, 22, 23, 26, 33, 35, 37, 38

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps for solution feed

Special: Dissolving characteristics vary with form and temperature. AWWA specifies maximum dissolving time of 20 minutes. Up to 2 lbs. of salt per gallon of dilution water should dissolve within 5 to 10 minutes.

For large ion exchange installation, salt may be stored in wet salt tanks containing a saturated solution. Bulk delivery is made directly into these tanks.

Commercially available salts exist in a wide range of purity and particle size. Some of the very fine food grade salts are almost like face powder and will arch. Some salts contains calcium and magnesium chlorides which absorb moisture and cause caking. Some manufacturers add about 1½ tricalcium phosphate as an anti-caking agent.

References: AWWA Standard B200-12 Sodium Chloride

Sodium Chlorite

Also called: NaClO_2 , chlorite, stabilized chlorine dioxide

Use: Production of chlorine dioxide, oxidizing and bleaching.

Properties: Available with to orange colored in powder, flake, crystal, and solution forms. The loose bulk density is about 53 lb. per cu.ft. Packed bulk density is 69 lb. per cu.ft. The solutions contain approximately 40% sodium chlorite. Solution is shipped in tank cars and tank trucks hot. It begins to crystallize at about 95 F. A 20% solution has the lowest temperature of crystallization of 10 F.

Packaging: 25-lb. pails, 100-lb. drums, solutions in tank trucks and tank cars.

Compatible
Materials: Hastelloy C, Nordel, ceramic, Kalrez

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps for solution

Special: See page for more details under title of chlorine dioxide. Store dry material in the original shipping container. Do not expose dry material to heat, fire (cigarette), organic material or strong acids. Any spillage should be immediately cleaned up.

On contact with strong acids, chlorine dioxide is generated. Chlorine solution is reacted with sodium chlorite solution to generate chlorine dioxide.

References: AWWA Standard B303-10 Sodium Chlorite

Sodium Hypochlorite

Also called: NaOCl, bleach, chlorine bleach, hypo

Use: Disinfection. Slime control. Bleaching.

Properties: Available as solution only. Commercial strengths are from 1 to 16% NaOCl by weight. Most common and readily available is household bleach containing 5¼% NaOCl of 5% by weight of chlorine.

Packaging: 5 and 13-gal. carboys, 30-gal. drums, tank cars.

Compatible Materials: Hastelloy C, Hypalon, PVC, TFE, Kynar, Kalrez

Other: 9, 13, 20, 21, 22, 33, 35, 38, 39

Dosing: Wallace & Tiernan Chem-Ad® Metering Pumps

Special: Store in cool place, vent containers, protect from light. The more concentrated the solution, the shorter is the shelf life. The shelf life of household bleach is about 700 days; for 15.75% solution, it is about 60 days when properly stored.

1.05% NaOCl by weight	–	1 gal.	Weights	8.4 lbs.	and contains	0.08 lbs. Cl ₂
5.25%	“	“	“	-	“	“ 8.9 “ “ “ 0.44 “ “
10.5%	“	“	“	-	“	“ 9.7 “ “ “ 0.97 “ “
15.75%	“	“	“	-	“	“ 10.5 “ “ “ 1.6 “ “

References: AWWA Standard B300-10 Hypochlorites

Sulfur Dioxide

Also called: SO₂ , Sulfurous acid

Use: Dechlorinating agent, especially where super chlorination is used. Also used to remove dissolved O₂, to prevent the precipitation of iron, to remove H₂S and in the treatment of chromium wastes. Activation of silica. Preparation of chlorine dioxide in paper mills.

Properties: Colorless gas, soluble in water (1 lb. to 1 gal.). Dissolves to form sulfurous acid (H₂SO₃).

Vapor pressure	- 34.4 psig at 70 F
Specific volume	- 5.9 cu.ft. per lb. at 70 F and 1 atm
Specific gravity	- 2.264 referred to air
Latent heat of vaporization	- 94.9 cal per g at boiling point
Specific heat, liquid	- 0.318 cal per g per degree C
Specific heat, gas Cp.	- 0.1516 cal per g per degree C
Solubility in water	- 18.6% at zero C and 1 atm
Density, liquid	- 89.58 lb. per cu.ft. at 32 F

Packaging: 25, 30, 70, 100, 150 and 200 lb. cylinders.

Dosing: Wallace & Tiernan S10k™, V10k™, V2000™ Chlorinators and 50-200 Series Evaporators

Special: Maximum rate of withdrawal from an SO₂ cylinder is about 20 lbs. per day at 70 F and from a ton container about 225 lbs. per day.

Not flammable or explosive.

References: AWWA Standard B512-15 Sulfur Dioxide

Chemical Compatibility Information

All information in this reference relating to Chemical Compatibility assumes moderate temperatures and atmospheric pressure. Although more severe conditions may be tolerated by the material to the individual chemicals, it is beyond the scope of this reference to further characterize compatibility. For more specific information, contact your local Wallace & Tiernan® products representative or your chemical supplier.

NUMBERED REFERENCES

Aluminum	1	Nylon	21
Brass	2	Polyethylene	22
Buna-N	3	Polypropylene	23
Carbon	4	Polyvinyl Chloride	24
Carbon Steel	5	Rubber	25
Carbon Steel (Hardened)	6	Ryton	26
Cast Bronze	7	Stainless Steel 301	27
Cast Iron	8	Stainless Steel 302	28
Ceramic	9	Stainless Steel 304	29
Copper	10	Stainless Steel 316	30
Epoxy	11	Stainless Steel 440	31
Ethylene Propylene	12	Stainless Steel (Hardened)	32
Ethylene Propylene Rubber	13	Teflon	33
Hastelloy C	14	Tetrafluoroethylene	34
Hypalon	15	Titanium	35
Hytrel	16	Tygon	36
Kynar	17	Urethane	37
Neoprene	18	Vamac	38
Nordel	19	Viton	39
Nodyl	20		