

TLV .5  
IDLH 10

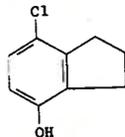
monary edema, death. Ingestion may produce severe oral, esophageal, gastric irritation.

USE: Bleaching of wood pulp, linen, cotton, straw, oils, soaps, and in laundering; oxidizer in calico printing to obtain white designs on a colored ground; destroying caterpillars; disinfecting drinking water, sewage, etc.; as a decontaminant for mustard gas and similar substances.

THERAP CAT: Germicide.

THERAP CAT (VET): Disinfectant for premises. Has been used as a topical antiseptic for superficial wounds.

**2061. Chlorindanol.** 7-Chloro-2,3-dihydro-1H-inden-4-ol; 7-chloro-4-indanol.  $C_9H_9ClO$ ; mol wt 168.63. C 64.10%, H 5.38%, Cl 21.03%, O 9.49%. Prepn: Buck *et al.*, *J. Am. Chem. Soc.* 79, 3559 (1957); Buck, U.S. pat. 2,990,324 (1961 to Esta Med. Labs.).



Needles from petr ether, mp 91-93°. Absorption spectra: Buck *et al.*, *loc. cit.* Ingredient of Lanesta.

THERAP CAT: Spermicide.

**2062. Chlorine.** Cl; at. wt 35.453; at. no. 17; valences 1 to 7; elemental state:  $Cl_2$ . A halogen. Abundance in igneous rock (95% of earth's crust): 0.031% by wt; in seawater: 1.9% by wt (primarily as NaCl). Natural isotopes:  $^{35}Cl$  (75.53%);  $^{37}Cl$  (24.47%); seven radioactive isotopes and two isomers are known; radioactive tracer elements:  $^{36}Cl$  ( $T_{1/2}$   $3.08 \times 10^5$  yrs;  $\beta^-$ , EC);  $^{38}Cl$  ( $T_{1/2}$  37.29 min;  $\beta^-$ ); formed in atm by bombardment with cosmic rays. Discovered in 1774 by Scheele; recognized as an element in 1810 by Davy. Produced on a large scale by electrolysis from fused chlorides. The industrial product is about 99.3% pure. Contaminants are traces of bromide, hexachloroethane, hexachlorobenzene, and water. Purification: Fye, Beaver, *J. Am. Chem. Soc.* 63, 1268 (1941); A. Klemenc, *Die Behandlung und Reindarstellung von Gasen* (Vienna, 2nd ed., 1948) p 153. Lab prepn from  $MnO_2$  and HCl: Schmeisser in *Handbook of Preparative Inorganic Chemistry* vol. 1, G. Brauer, Ed. (Academic Press, New York, 2nd ed., 1963) p 272. Manuf: Faith, Keyes & Clark's *Industrial Chemicals*, F. A. Lowenheim, M. K. Moran, Eds. (Wiley-Interscience, New York, 4th ed., 1975) pp 244-253. Reviews: *Ciba Review* vol. 12, no. 139 (Aug. 1960); *Chlorine*, J. S. Sconce, Ed., A.C.S. Monograph Series, no. 154 (Reinhold, New York, 1962) 901 pp; *MTP Int. Rev. Sci.: Inorg. Chem., Ser. One*, vol. 3, V. Gutmann, Ed. (Butterworths, London, 1972); Downs, Adams, "Chlorine, Bromine, Iodine and Astatine" in *Comprehensive Inorganic Chemistry*, vol. 2, J. C. Bailar, Jr. *et al.*, Eds. (Pergamon Press, Oxford, 1973) pp 1107-1594.

Greenish-yellow, diatomic gas; suffocating odor. mp  $-101.00^\circ$  ( $172.15^\circ K$ ); bp  $-34.05^\circ$  ( $239.10^\circ K$ ); d (liq,  $20^\circ$ , 6.864 atm) 1.4085; d (liq,  $-35^\circ$ , 0.9949 atm) 1.5649; critical temp  $144^\circ$ ; critical pressure 76.1 atm;  $C_p$  (gas,  $25^\circ$ ) 8.11 cal/mole/ $^\circ C$ . Marketed in the form of gas over liquid compressed into steel cylinders. **Caution: Never heat cylinders.** Vapor pressure data: Giauque, Powell, *J. Am. Chem. Soc.* 61, 1970 (1939). Sol in water ( $25^\circ$ ) with formation of aqueous  $Cl_2$  (0.062 moles/l), HOCl (0.030 moles/l) and  $Cl^-$  (0.030 moles/l); total soly: 0.092 moles/l. More sol in alkalies. See Chlorinated Lime and Sodium Hypochlorite Soln. Acts as an electron-acceptor in forming complexes with many donor species: Bent, *Chem. Rev.* 68, 587 (1968). Very reactive;  $E^0$  (aq)  $\frac{1}{2}Cl_2/Cl^-$  1.356 V; dissociation energy ( $25^\circ$ ): 57.978 kcal; combines readily with all elements except the rare gases (xenon excluded) and nitrogen. Forms explosive mixtures with hydrogen; many finely divided metals will burn in an atm of chlorine. Oxides are strong oxidizing agents and explosive. Monatomic chlorine is unstable under ordinary conditions, however, it can be formed as a result of thermal or optical dissociation, by an electrical discharge or as an intermediate during chemical reactions. **Dangerous to inhale.** LC<sub>50</sub> (1 hr), inhalation by rats, mice: 293 ppm, 137

ppm. K. C. Back *et al.*, *Reclassification of Materials Listed as Transportation Health Hazards* (TSA-20-72-3; PB 214-270).

**Caution:** A powerful irritant. Can cause fatal pulmonary edema. Threshold odor detection: 0.2-0.4 ppm. *cf.* Patty's *Industrial Hygiene and Toxicology* vol. 2B, G. D. Clayton, F. E. Clayton, Eds. (Wiley-Interscience, New York, 3rd ed., 1981) pp 2954-2965.

USE: Largely for manuf chlorinated lime which is used in bleaching all kinds of fabrics; for purifying water; disinfecting; detinning and dezincing iron; manuf synthetic rubber and plastics, chlorinated hydrocarbons, and a large number of other chemicals. It is an indispensable reagent in synthetic chemistry. Has been used as a military poison gas under the name *bertholite*.  $^{36}Cl$  is considered an extinct nuclide and provides a method of determining the geological age of meteors.

**2063. Chlorine Dioxide.** Chlorine peroxide.  $ClO_2$ ; mol wt 67.46. Cl 52.56%, O 47.44%. Prepn from chlorine and sodium chlorite: Derby, Hutchinson, *Inorg. Syn.* 4, 152 (1953); from potassium chlorate and sulfuric acid: Bodenstein *et al.*, *Z. Anorg. Allgem. Chem.* 147, 233 (1925); by passing  $NO_2$  through a column of sodium chlorate: Hutchinson, Derby, *Cereal Chem.* 24, 372 (1947); alternate methods of prepn: Schmeisser in *Handbook of Preparative Inorganic Chemistry* vol. 1, G. Brauer, Ed. (Academic Press, New York, 2nd ed., 1963) p 301. Review: Bedumeau, *Rev. Prod. Chim.* 57, 173-177, 257-261 (1954).

Strongly oxidizing, yellow to reddish-yellow gas at room temp. Unpleasant odor similar to that of chlorine and reminiscent of that of nitric acid. Unstable in light; stable in dark if pure, but chlorides catalyze its decompn even in the dark. **Reacts violently with organic materials.** In concns in excess of 10% at atm pressure easily detonated by sunlight, heat, contact with mercury or carbon monoxide. mp  $-59^\circ$ ; bp  $11^\circ$ ;  $d_4^{20}$ (liq) 1.642; Cheesman, *J. Chem. Soc.* 1930, 35. Sol in water (3.01 g/l at  $25^\circ$  and 34.5 mm Hg), with slight hydrolysis to chlorous and chloric acid; sol in alkaline and sulfuric acid solns. Solid  $ClO_2$  is yellowish-red cryst mass; liquid  $ClO_2$  is reddish-brown.

USE: Bleaching cellulose, paper-pulp, flour, leather, fats and oils, textiles, beeswax; purification of water; taste and odor control of water; cleaning and detanning leather; manuf of chlorite salts; oxidizing agent; bactericide and antiseptic. **Caution:** May be highly irritating to skin and mucous membranes of respiratory tract. May cause pulmonary edema.

**2064. Chlorine Heptoxide.** Dichlorine heptoxide; perchloric anhydride.  $Cl_2O_7$ ; mol wt 182.91. Cl 38.77%, O 61.23%. Prepd by dehydration of perchloric acid with  $P_2O_5$ ; Michael, Conn, *Am. Chem. J.* 23, 445 (1900); 25, 92 (1901); Meyer, Kessler, *Ber.* 54, 566 (1921); Goodeve, Powney, *J. Chem. Soc.* 1932, 2078.

Colorless, very volatile oily liquid.  $d_4^{20}$  1.86. mp  $-91.5^\circ$ ; bp  $82^\circ$ ; bp<sub>23.7</sub>  $0^\circ$ . Trouton constant 23.4. The most stable oxide of chlorine. **Explodes violently upon concussion or on contact with a flame or iodine.** Dipole moment in  $CCl_4$  at  $20^\circ$  is 0.72. Does not attack wood or paper. Slowly hydrolyzed by water, forming perchloric acid.

USE: Catalyst in cellulose esterification. **Caution:** May be irritating to skin, mucous membranes.

**2065. Chlorine Monofluoride.** Chlorine fluoride. ClF; mol wt 54.46. Cl 65.11%, F 34.89%. Prepd from  $Cl_2$  and F<sub>2</sub> at  $400^\circ$ ; Ruff *et al.*, *Z. Anorg. Allgem. Chem.* 176, 256 (1928); Kwasnik in *Handbook of Preparative Inorganic Chemistry* vol. 1, G. Brauer, Ed. (Academic Press, New York, 2nd ed., 1963) p 153.

Colorless gas. Slightly yellow when liquid. mp  $-155.6^\circ$ ; bp  $-100.1^\circ$ . Crit temp  $-14^\circ$ . d (liq;  $-108^\circ$ ) 1.67. **Extremely reactive.** Destroys glass instantly, attacks quartz readily in presence of moisture; organic matter bursts into flame on contact; violent reaction with water.

**Caution:** Extremely corrosive and irritating to skin, eyes, mucous membranes, respiratory tract.

**2066. Chlorine Monoxide.** Dichlorine monoxide; dichlorine monoxide; dichloroxide; hypochlorous anhydride.  $Cl_2O$ ; mol wt 86.91. Cl 81.59%, O 18.41%. Prepd from yellow mercuric oxide and chlorine: Cady, *Inorg. Syn.* 5, 156 (1957); Secoy, Cady, *J. Am. Chem. Soc.* 62, 1036 (1940):