

8. REGULATIONS AND ADVISORIES

The international, national, and state regulations and guidelines regarding cyanide in air, water, and other media are summarized in Table 8-1.

ATSDR has derived an intermediate oral MRL of 0.05 mg/kg/day for cyanide based on a NOAEL of 4.5 mg/kg/day and a LOAEL of 12.5 mg/kg/day from a study in which 10 male and 10 female rats were given 0.2–12.5 mg/kg/day cyanide, as sodium cyanide, in the drinking water for 13 weeks (NTP 1993).

EPA reference doses (RfDs) have been established for chronic oral exposure to cyanide and its compounds. These RfDs range from 2×10^{-1} mg/kg/day for potassium silver cyanide to 5×10^{-3} mg/kg/day for copper cyanide. The RfD for potassium silver cyanide was based on weight loss and thyroid effects in several rat studies (Howard and Hanzel 1955; Philbrick et al. 1979), while the RfD for copper cyanide was based on decreased body and organ weights and liver and kidney effects in an intermediate-duration rat study (Gerhart 1987). An EPA reference concentration (RfC) exists only for chronic inhalation exposure to hydrogen cyanide; this RfC is 3×10^{-3} mg/m³. The RfC was based on central nervous system and thyroid effects in a human occupational study (El Ghawabi et al. 1975).

The EPA has determined that cyanide is not classifiable as to its human carcinogenicity (Group D). No cancer classifications exist for the National Toxicology Program, IRIS, or IARC (no available data).

Several cyanide compounds are on the list of chemicals regulated under "The Emergency Planning and Community Right-to-Know Act of 1986" (EPCRA) (EPA 2004d). Section 313 of Title III of EPCRA requires owners and operators of certain facilities that manufacture, import, process, or otherwise use the chemicals on this list to report annually their release of those chemicals to any environmental media.

OSHA requires employers of workers who are occupationally exposed to cyanide to institute engineering controls and work practices to reduce and maintain employee exposure at or below permissible exposure limits (PELs). The employer must use engineering and work practice controls, if feasible, to reduce exposure to or below an 8-hour time-weighted average (TWA) of 10 ppm (11 mg/m³) as cyanide. Respirators must be provided and used during the time period necessary to install or implement feasible engineering and work practice controls (OSHA 2004d). NIOSH (2004) recommends a 10-minute ceiling of 5 mg/m³ for cyanide in compounds such as sodium cyanide or potassium cyanide.

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Cyanide and Cyanide Compounds

Agency	Description	Information	Reference	
<u>INTERNATIONAL</u>				
Guidelines:				
IARC	Carcinogenicity classification	No data	IARC 2004	
WHO	Air quality guideline value	No data	WHO 2000	
	Drinking water guideline value		WHO 2004	
	Cyanide	0.07 mg/L		
	Cyanogen chloride (for cyanide as total cyanogenic compounds)	0.07 mg/L		
<u>NATIONAL</u>				
Regulations and Guidelines:				
a. Air				
ACGIH	TLV (8-hour TWA)		ACGIH 2003	
	Cyanogen	10 ppm		
	Cyanogen chloride (ceiling limit) Hydrogen cyanide (ceiling limit) ^a	0.3 ppm 4.7 ppm		
EPA	Hazardous air pollutant		EPA 2004j 42USC7412	
	Cyanide compounds			
	Regulated toxic and flammable substances and threshold quantities for accidental release prevention		EPA 2005a 40CFR68.130	
	Cyanogen (toxic)	10,000 pounds		
	Cyanogen chloride (flammable)	10,000 pounds		
NIOSH	REL (10-hour TWA)		NIOSH 2005	
	Cyanogen	10 ppm		
	Cyanogen chloride (10-minute ceiling limit)	0.3 ppm		
	Hydrogen cyanide (short-term limit) ^a	4.7 ppm		
	Potassium cyanide (10-minute ceiling limit)	4.7 ppm		
	Sodium cyanide (10-minute ceiling limit)	4.7 ppm		
IDLH				
	Cyanogen	No data		
	Cyanogen chloride	No data		
	Hydrogen cyanide	50 ppm		
	Potassium cyanide (as cyanide)	25 mg/m ³		
	Sodium cyanide (as cyanide)	25 mg/m ³		
OSHA	PEL (8-hour TWA) for general industry		OSHA 2004d 29CFR1910.1000, Table Z-1	
	Hydrogen cyanide ^a	10 ppm		
	PEL (8-hour TWA) for construction industry		OSHA 2004c 29CFR1926.55, Appendix A	
	Cyanogen	10 ppm		
		Hydrogen cyanide ^a	10 ppm	
		PEL (8-hour TWA) for shipyard industry		OSHA 2004a 29CFR1915.1000, Table Z
	Cyanogen	10 ppm		
	Hydrogen cyanide ^a	10 ppm		

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Cyanide and Cyanide Compounds

Agency	Description	Information	Reference	
NATIONAL (cont.)				
OSHA	Highly hazardous chemicals which present a potential for a catastrophic event at or above the threshold quantity listed		OSHA 2004b 29CFR1910.119, Appendix A	
	Cyanogen	2,500 pounds		
	Cyanogen chloride	500 pounds		
	Hydrogen cyanide, anhydrous	1,000 pounds		
b. Water				
EPA	Drinking water standards and health advisories		EPA 2004a	
	Cyanide			
	1-day HA for a 10-kg child	0.2 mg/L		
	10-day HA for a 10-kg child	0.2 mg/L		
	DWEL	0.8 mg/L		
	Lifetime HA (70-kg adult)	0.2 mg/L		
	Cyanogen chloride			
	1-day HA for a 10-kg child	0.05 mg/L		
	10-day HA for a 10-kg child	0.05 mg/L		
	DWEL	2.0 mg/L		
	Designated as a hazardous substances pursuant to Section 311(b) of the Clean Water Act			EPA 2004t 40CFR116.4
	Ammonium thiocyanate	Yes		
	Calcium cyanide			
	Cyanogen chloride			
	Hydrogen cyanide			
Potassium cyanide				
Sodium cyanide				
National primary drinking water standards and public notification		EPA 2004h 40CFR141.32		
Cyanide ^b	0.2 ppm			
Reportable quantities of hazardous substances designated pursuant to Section 311(b) of the Clean Water Act		EPA 2004k 40CFR117.3		
Ammonium thiocyanate	5,000 pounds			
Calcium cyanide	10 pounds			
Cyanogen chloride	10 pounds			
Hydrogen cyanide	10 pounds			
Potassium cyanide	10 pounds			
Sodium cyanide	10 pounds			
National primary drinking water regulations (MCL)		EPA 2004g 40CFR141.62		
Cyanide	0.2 mg/L			
FDA	Bottled water		FDA 2003 21CFR165.110	
	Cyanide	0.2 mg/L		

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Cyanide and Cyanide Compounds

Agency	Description	Information	Reference
<u>NATIONAL</u> (cont.)			
c. Food			
EPA	Tolerance for residues of hydrogen cyanide from postharvest fumigation as a result of application of sodium cyanide on citrus fruits	50 ppm	EPA 2004m 40CFR180.130
	Exemptions from the requirement of a tolerance when used in accordance with good agricultural practices in pesticide formulations applied to growing crops; and when used as an adjuvant or intensifier for defoliation and weed control on cotton and soybeans	Ammonium thiocyanate	EPA 2004n 40CFR180.920
FDA	Indirect food additive for use only as a component of adhesives	Ammonium thiocyanate	FDA 2003 21CFR175.105
d. Other			
EPA	Carcinogenicity classification		IRIS 2004
	Calcium cyanide	No data	
	Chlorine cyanide	No data	
	Copper(I) cyanide	No data	
	Cyanide	Group D ^c	
	Cyanogen	No data	
	Hydrogen cyanide	No data	
	Potassium cyanide	No data	
	Potassium silver cyanide	No data	
	Sodium cyanide	No data	
	RfC ^d		
	Calcium cyanide	No data	
	Chlorine cyanide	No data	
	Copper(I) cyanide	No data	
	Cyanide	No data	
	Cyanogen	No data	
	Hydrogen cyanide	3x10 ⁻³ mg/m ³	
	Potassium cyanide	No data	
	Potassium silver cyanide	No data	
	Sodium cyanide	No data	
	RfD ^e		
	Calcium cyanide	4x10 ⁻² mg/kg/day	
	Chlorine cyanide	5x10 ⁻² mg/kg/day	
	Copper(I) cyanide	5x10 ⁻³ mg/kg/day	
	Cyanide	2x10 ⁻² mg/kg/day	
	Cyanogen	4x10 ⁻² mg/kg/day	
	Hydrogen cyanide	2x10 ⁻² mg/kg/day	
	Potassium cyanide	5x10 ⁻² mg/kg/day	
	Potassium silver cyanide	2x10 ⁻¹ mg/kg/day	
	Sodium cyanide	4x10 ⁻² mg/kg/day	

8. REGULATIONS AND ADVISORIES

Table 8-1. Regulations and Guidelines Applicable to Cyanide and Cyanide Compounds

Agency	Description	Information	Reference	
<u>NATIONAL</u> (cont.)				
EPA	Hazardous waste identification		EPA 2004f	
	Calcium cyanide	P021	40CFR261,	
	Copper(I) cyanide	P029	Appendix VIII	
	Cyanides (soluble salts and complexes)	P030		
	Cyanogen	P031		
	Cyanogen chloride	P033		
	Hydrogen cyanide	P063		
	Potassium cyanide	P098		
	Potassium silver cyanide	P099		
	Sodium cyanide	P106		
	Pesticide (sodium cyanide) classified as restricted use and limited to use by or under the direct supervision of a certified applicator	All capsules and all ball formulations for all uses ^f	EPA 2004i	40CFR152.175
	Superfund; emergency planning and notification of extremely hazardous substances and their threshold quantities		EPA 2004e	40CFR355, Appendix A
	Hydrogen cyanide	100 pounds		
	Potassium cyanide	100 pounds		
	Potassium silver cyanide	500 pounds		
	Sodium cyanide	100 pounds		
	Superfund; designation of hazardous substances and their reportable quantities		EPA 2004d	40CFR302.4
	Ammonium thiocyanate ^g	5,000 pounds		
	Calcium cyanide ^h	10 pounds		
	Copper cyanide ⁱ	10 pounds		
	Cyanides (soluble salts and complexes)	10 pounds		
	Cyanogen ⁱ	100 pounds		
	Cyanogen chloride ^h	10 pounds		
Hydrogen cyanide ^h	10 pounds			
Potassium cyanide ^h	10 pounds			
Potassium silver cyanide ⁱ	1 pound			
Sodium cyanide ^h	10 pounds			
Tolerances for pesticide chemicals in food; when calcium cyanide and hydrogen cyanide are on the same agricultural commodity, the total amount shall not yield more residue than the larger of the two tolerances, calculated as hydrogen cyanide		EPA 2004o	40CFR180.3	
Toxic chemical release reporting; community right-to-know; effective date for hydrogen cyanide	01/01/1987	EPA 2004p	40CFR372.65	
TSCA chemical information rules; manufacturers reporting period for sodium cyanide		EPA 2004r	40CFR712.30	
Effective date	10/29/1990			
Reporting date	12/27/1990			

8. REGULATIONS AND ADVISORIES

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Agency	Description	Information	Reference
<u>NATIONAL</u> (cont.)			
EPA	TSCA health and safety data reporting for sodium cyanide		EPA 2004s 40CFR716.120
	Effective date	10/29/1990	
	Sunset date	12/19/1995	
<u>STATE</u>			
a. Air	No data		
b. Water	Drinking water standards and guidelines		HSDB 2004
Arizona	Calcium cyanide	220 µg/L	
	Copper(I) cyanide	1,300 µg/L	
	Potassium cyanide	220 µg/L	
	Potassium silver cyanide	50 µg/L	
	Sodium cyanide	220 µg/L	
Connecticut	Potassium silver cyanide	50 µg/L	
Florida	Cyanogen	10,000 µg/L	
	Cyanogen chloride	350 µg/L	
	Hydrogen cyanide	10,000 µg/L	
Maine	Potassium cyanide	154 µg/L	
	Potassium silver cyanide	50 µg/L	
	Sodium cyanide	154 µg/L	
Minnesota	Potassium cyanide	100 µg/L	
	Potassium silver cyanide	30 µg/L	
	Sodium cyanide	100 µg/L	
Wisconsin	Potassium silver cyanide	50 µg/L	
c. Food	No data		

8. REGULATIONS AND ADVISORIES

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Agency	Description	Information	Reference
STATE (cont.)			
d. Other	No data		

^aSkin designation: Potential significant contribution to the overall exposure by the cutaneous route, including mucous membranes and the eyes, either by contact with vapors, or of probable greater significance, by direct skin contact with the substance.

^bEPA sets drinking water standards and has determined that cyanide is a health concern at certain levels of exposure. This inorganic chemical is used in electroplating, steel processing, plastics, synthetic fabrics, and fertilizer products; it usually gets into water as a result of improper waste disposal. This chemical has been shown to damage the spleen, brain, and liver of humans fatally poisoned with cyanide. EPA has set the drinking water standard for cyanide at 0.2 ppm to protect against the risk of these adverse health effects. Drinking water that meets the EPA standard is associated with little to none of this risk and should be considered safe with respect to cyanide (EPA 2004h).

^cGroup D: Not classifiable as a human carcinogen.

^dAn estimate (with uncertainty spanning an order of magnitude) of a daily inhalation exposure concentration that is likely to be without significant risk of adverse effects during a lifetime (chronic exposure).

^eAn estimate (with uncertainty spanning an order of magnitude) of a daily oral exposure dose that is likely to be without significant risk of adverse effects during a lifetime (chronic exposure).

^fThe criteria influencing the restriction of sodium cyanide is based on the inhalation hazard to humans. Also, sodium cyanide capsules may only be used by certified applicators who have also taken the required additional training.

^gDesignated as a hazardous substance pursuant to Section 311(b)(2) of the Clean Water Act.

^hDesignated as a hazardous substance pursuant to Section 311(b)(2) of the Clean Water Act and Section 3001 of RCRA.

ⁱDesignated as a hazardous substance pursuant to Section 3001 of RCRA.

ACGIH = American Conference of Governmental Industrial Hygienists; CFR = Code of Federal Regulations; DWEL = drinking water equivalent level; EPA = Environmental Protection Agency; FDA = Food and Drug Administration; HA = health advisory; HSDB = Hazardous Substances Data Bank; IARC = International Agency for Research on Cancer; IDLH = immediately dangerous to life or health; IRIS = Integrated Risk Information System; MCL = maximum contaminant level; NIOSH = National Institute for Occupational Safety and Health; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; RCRA = Resource Conservation and Recovery Act; REL = recommended exposure limit; RfC = reference concentration; RfD = reference dose; TLV = threshold limit values; TSCA = Toxic Substances Control Act; TWA = time-weighted average; USC = United States Codes; WHO = World Health Organization

8. REGULATIONS AND ADVISORIES

Cyanide is regulated by the Clean Water Effluent Guidelines as stated in Title 40, Sections 400–475, of the Code of Federal Regulations. For each point source category, cyanide may be regulated as amenable or total cyanide. The point source categories for which cyanide is controlled include electroplating; metal finishing; organic chemicals; plastics and synthetic fibers; hydrogen peroxide manufacturing; iron and steel; nonferrous metals; steam electric power; ferroalloy manufacturing; pharmaceuticals; battery manufacturing; aluminum forming; nonferrous metal forming; and coil coating.

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), food tolerance restrictions (see Table 8-1) apply to various cyanide compounds when applied to growing crops (EPA 2004m, 2004n, 2004o).

Under the Resource Conservation and Recovery Act (RCRA), cyanide is listed as a hazardous waste when it is a discarded commercial chemical product, off-specification species, container residue, or spill residue (EPA 1980c); a waste from non-specific sources (EPA 1981c); or a waste from specific sources (EPA 1981c).