

Cyanide Compounds

74-90-8

Hazard Summary

Cyanide is used in a number of industries and is found at low levels in air from car exhaust. Cyanide is extremely toxic to humans. Chronic (long-term) inhalation exposure of humans to cyanide results primarily in effects on the central nervous system (CNS). Other effects in humans include cardiovascular and respiratory effects, an enlarged thyroid gland, and irritation to the eyes and skin. No data are available on the carcinogenic effects of cyanide in humans via inhalation. Animal studies have suggested that oral exposure to cassava (a cyanide-containing vegetable) may be associated with malformations in the fetus and low fetal body weights. EPA has classified cyanide as a Group D, not classifiable as to human carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (5), which contains information on oral chronic toxicity and the Reference Dose (RfD) and inhalation chronic toxicity and the Reference Concentration (RfC), and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Cyanide. (1)

Uses

- The major uses of hydrogen cyanide are as an intermediate in the production of a number of chemicals and as an insecticide for fumigating enclosed spaces. Hydrogen cyanide has also been used in gas chamber executions. (1)
- The two most important uses of other cyanide compounds are in electroplating and metal treatment. (1)

Sources and Potential Exposure

- The primary source of cyanide in the air is from car exhaust. Other airborne sources include emissions from chemical processing, other industries, and municipal waste incinerators. (1)
- Smoking is another important source of cyanide. (1)
- Cyanide may be found in water from discharges from organic chemical industries, iron and steel works, and wastewater treatment facilities. (1)
- Exposure to cyanide may also occur in the workplace. The electroplating, metallurgical, firefighting, steel manufacturing, and metal cleaning industries are a few of the workplaces where exposure may occur. (1)

Assessing Personal Exposure

- Blood and urinary levels of cyanide and thiocyanate, a compound produced from cyanide, can be measured. However, because the body normally contains very small amounts of these chemicals, these measurements are only useful when exposure to relatively large amounts of cyanide has occurred. (1)

Health Hazard Information

Acute Effects:

- Cyanide is extremely toxic to humans. Acute (short-term) inhalation exposure to 100 milligrams per cubic

meter (mg/m^3) or more of hydrogen cyanide will cause death in humans. (1,2)

- Acute exposure to lower concentrations (6 to $49 \text{ mg}/\text{m}^3$) of hydrogen cyanide will cause a variety of effects in humans, such as weakness, headache, nausea, increased rate of respiration, and eye and skin irritation. (1,2)
- Tests involving acute exposure of rats and mice have shown hydrogen cyanide to have extreme acute toxicity from inhalation exposure. (3)

Chronic Effects (Noncancer):

- Chronic exposure to cyanide in humans via inhalation results in effects on the CNS, such as headaches, dizziness, numbness, tremor, and loss of visual acuity. (1,2)
- Other effects in humans include cardiovascular and respiratory effects, an enlarged thyroid gland, and irritation to the eyes and skin. (1,5)
- Animal studies have reported effects on the nervous, cardiovascular, and respiratory systems. (1,4)
- The Reference Concentration (RfC) for hydrogen cyanide is $0.003 \text{ mg}/\text{m}^3$ based on CNS symptoms and thyroid effects in humans. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups), that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (5)
- EPA has low to medium confidence in the study on which the RfC was based because the symptomatology, although consistent with other epidemiological studies, was mostly subjective and self-reported among a small group of workers; low confidence in the database as there were no chronic inhalation studies and no multigenerational studies available; and, consequently, low confidence in the RfC. (5)
- The Reference Dose (RfD) for cyanide and hydrogen cyanide is 0.02 milligrams per kilogram body weight per day ($\text{mg}/\text{kg}/\text{d}$) based on weight loss, thyroid effects, and myelin degeneration in rats. (5,6)
- EPA has medium confidence in the studies on which the RfDs were based because adequate records of food consumption and body weight were maintained, and animals of both sexes were tested at two doses for 2 years; medium confidence in the database because a small but sufficient number of studies support the chosen study; and, consequently, medium confidence in the RfDs. (5,6)

Reproductive/Developmental Effects:

- No studies were located on the reproductive or developmental effects of cyanide in humans from inhalation exposure. (1)
- Animal studies have suggested that oral exposure to cassava (a cyanide-containing vegetable) may be associated with malformations in the fetus and low fetal body weights. (1)

Cancer Risk:

- No studies were located on the carcinogenic effects of cyanide, from inhalation or oral exposure, in humans or animals. (1)
- EPA has classified cyanide as a Group D, not classifiable as to human carcinogenicity. (6)

Physical Properties

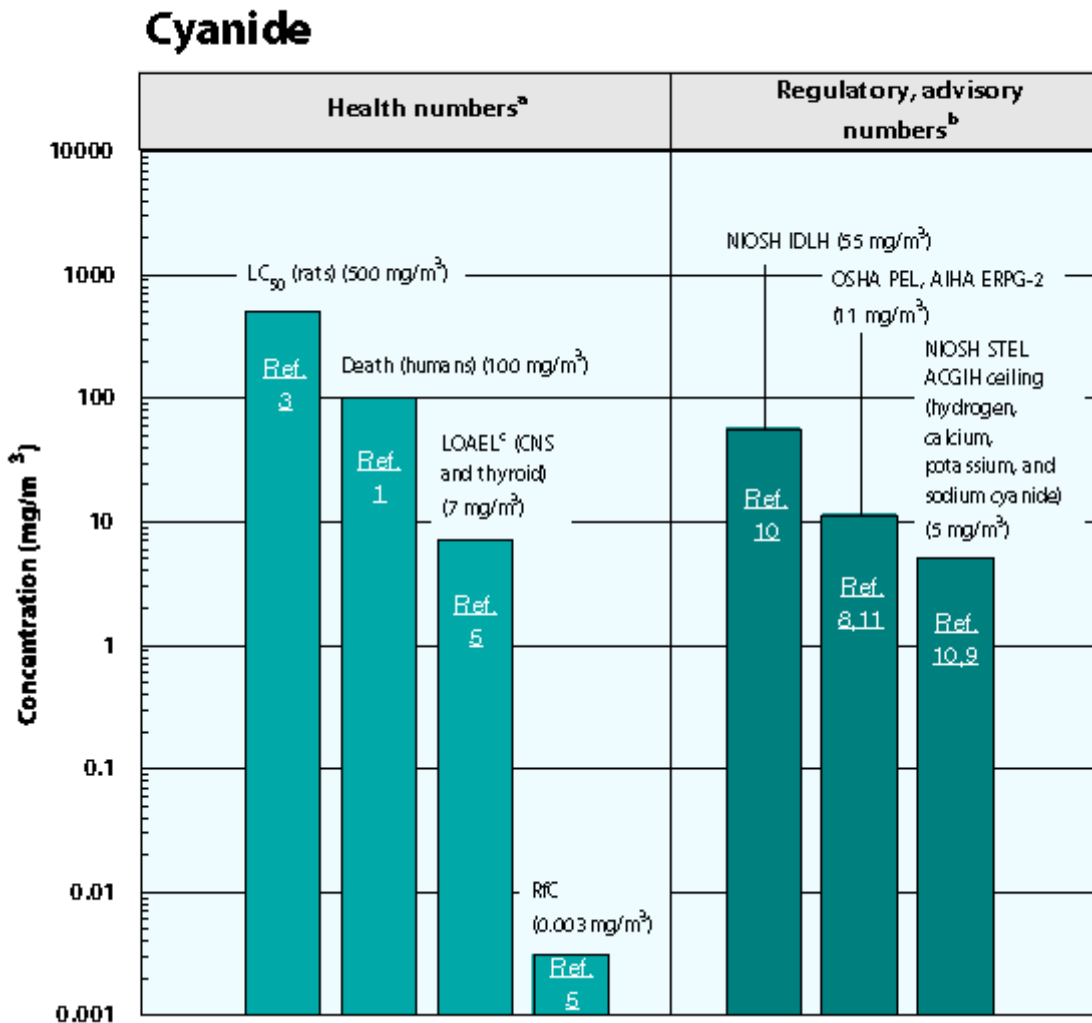
- Cyanides are naturally occurring substances found in a number of foods and plants and produced by certain bacteria, fungi, and algae. (1)
- Cyanide is present in a number of compounds such as hydrogen cyanide, sodium cyanide, and potassium cyanide. (1)
- Hydrogen cyanide is a colorless gas or liquid with a faint, bitter almond odor. The odor threshold for hydrogen cyanide is 0.58 parts per million (ppm). (7)
- The chemical formula for hydrogen cyanide is HCN, and the molecular weight is $27.03 \text{ g}/\text{mol}$. (7)

- The vapor pressure for hydrogen cyanide is 264.3 mm Hg at 0 °C, and its log octanol/water partition coefficient ($\log K_{ow}$) is 0.66. (1)
- Sodium cyanide and potassium cyanide are both colorless solids that possess the slight odor of bitter almonds. (1,2)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For hydrogen cyanide: $1 \text{ ppm} = 1.1 \text{ mg}/\text{m}^3$; for calcium cyanide: $1 \text{ ppm} = 3.8 \text{ mg}/\text{m}^3$; for potassium cyanide: $1 \text{ ppm} = 2.7 \text{ mg}/\text{m}^3$; for sodium cyanide: $1 \text{ ppm} = 2.0 \text{ mg}/\text{m}^3$.

Health Data from Inhalation Exposure*



ACGIH TLV ceiling--American Conference of Governmental and Industrial Hygienists' threshold limit value ceiling; the concentration of a substance that should not be exceeded during any part of the working exposure.

AIHA ERPG--American Industrial Hygiene Association's emergency response planning guidelines. ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing or developing irreversible or other serious health effects that could impair their abilities to take protective action.

length of time is expected to cause death in 50% of a defined experimental animal population.

LC₅₀ (Lethal Concentration₅₀)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH IDLH --National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NIOSH STEL --NIOSH's recommended short-term exposure limit; a 15-minute TWA exposure which should not be exceeded at any time during a workday.

OSHA PEL --Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average: the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

* All health and regulatory numbers are for hydrogen cyanide unless otherwise noted.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH, ACGIH, and AIHA numbers are advisory.

^c The LOAEL is from the critical study used as the basis for the RfC.

Summary created in April 1992, updated January 2000

References

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10. National Institute for Occupational Safety and Health (NIOSH). [Pocket Guide to Chemical Hazards](#). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.
11. American Industrial Hygiene Association (AIHA). The AIHA 1998 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook. 1998.

a. This fact sheet refers to free cyanide as "cyanide" and refers to individual compounds, such as hydrogen cyanide by their individual names.