Acetonitrile

75-05-8

Hazard Summary

Acetonitrile has many uses, including as a solvent, for spinning fibers, and in lithium batteries. It is primarily found in air from automobile exhaust and manufacturing facilities. Acute (short-term) inhalation exposure results in irritation of mucous membranes. Chronic (long-term) exposure results in central nervous system effects, such as headaches, numbness, and tremors. No data are available on its carcinogenic effects in humans; EPA has classified it as a Group D, not classifiable as to human carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Health and Environmental Effects Profile for Acetonitrile (1) and the Hazardous Substances Data Bank (HSDB) (2), a database of summaries of peer-reviewed literature. Other sources include EPA's IRIS (5), which contains information on chronic toxicity and the RfC, and the Registry of Toxic Effects of Chemical Substances (RTECS) (4), a database of toxic effects that are not peer reviewed.

Uses

- Acetonitrile is predominantly used as a solvent in the manufacture of pharmaceuticals, for spinning fibers and for casting and molding of plastic materials, in lithium batteries, for the extraction of fatty acids from animal and vegetable oils, and in chemical laboratories for the detection of materials such as pesticide residues. (1)
- Acetonitrile is also used in dyeing textiles and in coating compositions as a stabilizer for chlorinated solvents and in perfume production as a chemical intermediate. (1)

Sources and Potential Exposure

- Sources of acetonitrile emissions into the air include manufacturing and industrial facilities, automobile exhaust, and volatilization from aquatic environments. (1)
- Individuals may be exposed to acetonitrile through breathing contaminated air, from smoking tobacco or proximity to someone who is smoking, or through skin contact in the workplace. (1)

Assessing Personal Exposure

- There are tests currently available to determine personal exposure to acetonitrile, such as the determination of blood cyanide or urinary thiocyanate. (2)

Health Hazard Information

Acute Effects:

- Concentrations up to 500 parts per million (ppm) acetonitrile through inhalation exposure cause irritation of mucous membranes in humans, and higher concentrations can produce weakness, nausea, and convulsions. (1-3)
- Tests involving acute exposure of rats, mice, rabbits, cats, and guinea pigs have shown acetonitrile to have moderate to high acute toxicity from oral exposure and moderate acute toxicity from inhalation exposure. (4)

Chronic Effects (Noncancer):

- Chronic inhalation exposure of humans to acetonitrile results in cyanide poisoning from metabolic release of cyanide after absorption. The major effects consist of those on the central nervous system (CNS), such as headaches, numbness, and tremor. (1-3)
- Cyanide poisoning can also be produced through the ingestion of acetonitrile or from contact with the skin. (1-3)
- Application of acetonitrile to the skin may produce dermatitis in humans. (2)
- Animal studies have shown that different species vary widely in susceptibility to acetonitrile by various routes. (2)
- EPA has not established a Reference Dose (RfD) for acetonitrile. (5)
- The Reference Concentration (RfC) for acetonitrile is 0.06 milligrams per cubic meter (mg/m^3) based on mortality in mice. 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 medium confidence in the study, because even though the sample sizes were appropriate, histopathology was extensive, and data were reported in detail, hematology was not measured in mice; medium confidence in the database because of the absence of two-generation studies; and consequently, medium confidence in the RfC. (5)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of acetonitrile in humans. (1-3)
- Animal studies appear to suggest that acetonitrile may cause developmental and reproductive effects such as a decrease in average fetal body weight and a significant increase in the number of malformed offspring. (1-3)

Cancer Risk:

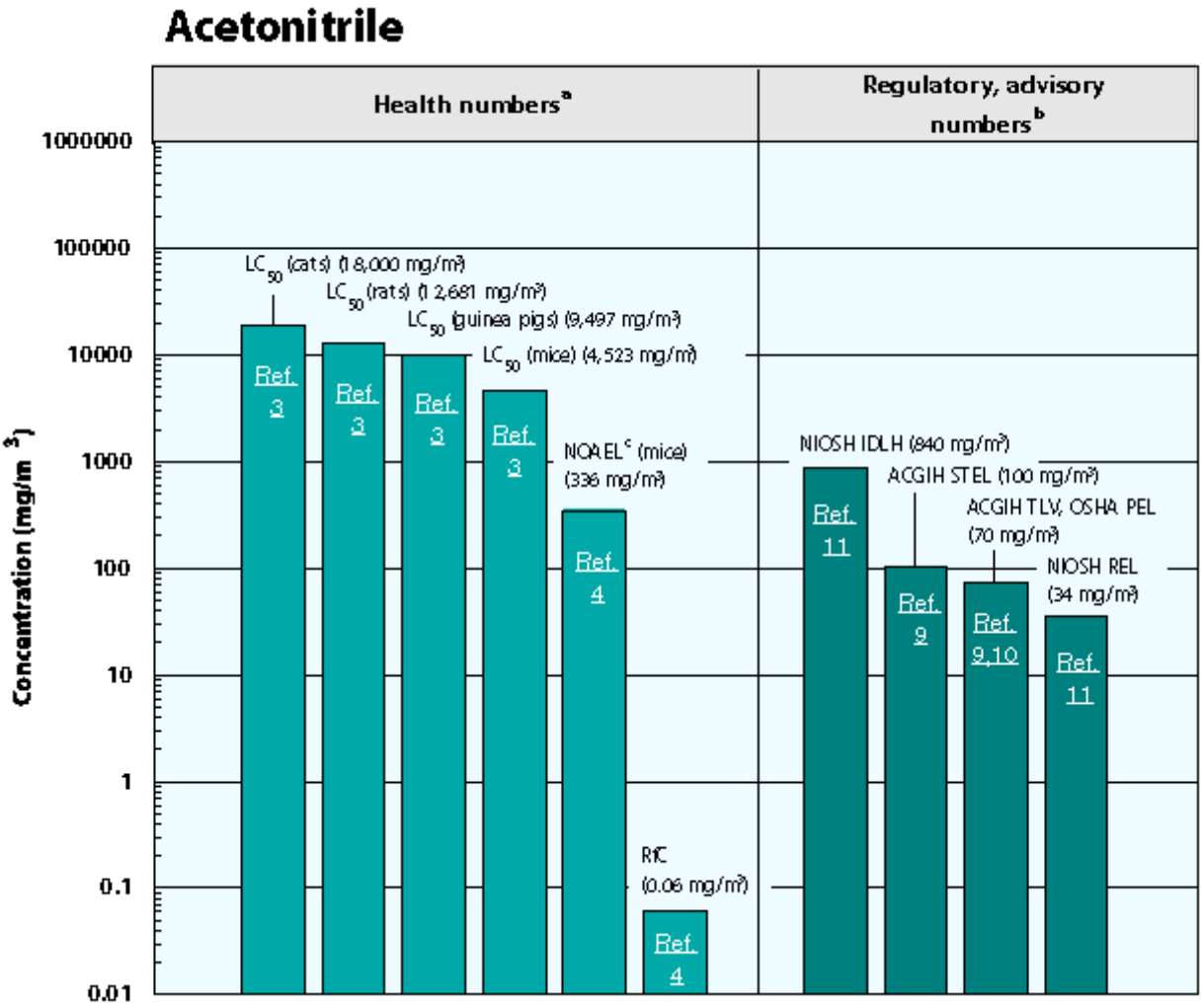
- No pertinent data concerning the carcinogenicity of acetonitrile in humans were located. (1-3,7)
- The National Toxicology Program (NTP) completed a 2-year carcinogenesis inhalation study on acetonitrile and concluded that there was equivocal evidence of carcinogenicity in male rats, and no evidence in male or female mice or in female rats. (6)
- EPA has classified acetonitrile as a Group D, not classifiable as to human carcinogenicity (5).

Physical Properties

- Acetonitrile is a clear colorless liquid with a sweet ethereal odor. (1,8)
- Acetonitrile has an odor threshold of 170 ppm. (9)
- Acetonitrile is very soluble in water and is quite flammable. (9)
- The chemical formula for acetonitrile is C_2H_3N, and the molecular weight is 41.05 g/mol. (1)
- The vapor pressure for acetonitrile is 74 mm Hg at 20 °C, and it has an octanol/water partition coefficient (log K_{ow}) of -0.34. (1)

Conversion Factors:
To convert concentrations in air (at 25°C) from ppm to mg/m^3: mg/m^3 = (ppm) × (molecular weight of the compound)/(24.45).
For acetonitrile: 1 ppm = 1.66 mg/m^3.

Health Data from Inhalation Exposure



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC_{50} (Lethal Concentration$_{50}$)--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.

NOAEL--No-observed-adverse-effect level.

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 REL--NIOSH's recommended exposure limit; NIOSH recommended exposure limit for an 8- or 10-h time-weighted average exposure and/or ceiling.

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.

[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 and ACGIH numbers are advisory.

[c] The NOAEL is from the critical study used as the basis for the EPA RfC.

Summary created in April 1992, updated in January 2000

References

1. U.S. Environmental Protection Agency. Health and Environmental Effects Profile for Acetonitrile. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1985.
2. U.S. Department of Health and Human Services. Hazardous Substances Data Bank (HSDB, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
3. U.S. Environmental Protection Agency. Health Effects Assessment for Acetonitrile, Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1987.
4. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
5. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on Acetonitrile. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1999.
6. National Toxicology Program. Toxicology and Carcinogenesis Studies of Acetonitrile (CAS No. 75-05-8) in F344/N Rats and B6C3F1 Mice (Inhalation Studies). NTP TR-447. Department of Health and Human Services, Public Health Service, National Institutes of Health, Bethesda, MD. 1996.
7. G.D. Clayton and F.E. Clayton, Eds. Patty's Industrial Hygiene and Toxicology. Volume IIA. 3rd revised ed. John Wiley & Sons, New York. 1981.
8. The Merck Index. An Encyclopedia of Chemicals, Drugs, and Biologicals. 11th ed. Ed. S. Budavari. Merck and Co. Inc., Rahway, NJ. 1989.
9. J.E. Amoore and E. Hautala. Odor as an aid to chemical safety: Odor thresholds compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution. Journal of Applied Toxicology, 3(6):272-290. 1983.
10. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices. Cincinnati, OH. 1999.
11. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. Code of Federal Regulations. 29 CFR 1910.1000. 1998.
12. 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.