ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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Tetrachloroethene: Health Information Summary

Tetrachloroethene, also known as perchloroethylene or PCE, is a synthetic liquid chemical. It is used in dry cleaning, metal degreasing, fabric manufacturing and the production of other chemicals. Some consumer products may contain PCE including glues, polishes, paint removers, water repellants, rug cleaners, and rust removers. Most of the PCE released to the environment goes directly into the atmosphere. PCE in liquid and solid wastes may be released to land and surface water where it readily migrates to groundwater. PCE degrades slowly in groundwater and may remain there for months to years. Under low oxygen conditions in groundwater, PCE may degrade to the more toxic chemicals trichloroethylene (TCE) and vinyl chloride. The odor threshold for PCE in water is reported to be 0.3 parts per million (ppm); the reported odor threshold in air is 1.0 ppm.

Health Effects

Absorption/Metabolism

Animal studies have shown that almost all of the PCE that is taken orally is absorbed, followed by inhalation. Dermal absorption of PCE does occur, but it is an exposure route of much less importance than either inhalation or oral exposure. In the majority of studies, at least 90 percent of absorbed PCE was eliminated by the body within three days. After exposure ends, the remainder may take up to two weeks to be eliminated because of PCE's temporary storage in fat tissue. PCE can be transferred from an exposed mother to her fetus. Because PCE dissolves in fat, it can build up to relatively high levels in breast milk if a nursing mother is exposed to high PCE concentrations in water or air.

Short-Term (Acute) Effects

At high inhaled concentrations, PCE acts as an anesthetic, depressing the central nervous system (CNS). CNS symptoms after exposure include headache, dizziness, incoordination, sleepiness, and unconsciousness. Exposure to PCE at high concentrations can also cause heart arrhythmia and fluid in the lungs.

Toxic effects to the liver have been noted in animals exposed to PCE both orally and by inhalation. Effects suggesting toxicity to the brain after animals were exposed to PCE included reduction in brain weight and changes in normal levels of both brain proteins and substances involved in sending signals through nerves in the brain.

Long-term (Chronic) Effects

Workers who breathed high levels of PCE reported symptoms of dizziness and forgetfulness. CNS effects observed in workers exposed to lower PCE concentrations consisted of significant delays in reaction times and visual changes including a reduced ability to detect color differences. In studies of PCE exposed workers, researchers found mildly toxic effects to the kidneys and liver as well as changes in red and white blood cell counts.

Animal studies confirm that PCE exposure can be toxic to the kidney and liver. Changes in blood cell counts were also seen in animals.

Reproductive/Developmental Effects
Human exposure to PCE in drinking water was associated with lower birth weights and increases in cleft lip and cleft palette birth defects. A few studies of women exposed while working in the dry cleaning industry found an association between PCE exposure and spontaneous abortions.

When animals were exposed to PCE before mating, fewer live babies were born. Animals exposed to PCE as fetuses had lower weights and delays in hardening of their skeleton. Animals exposed to PCE for a short time after birth were hyperactive as adults. Hyperactivity was also noted in rats that were exposed as fetuses. These studies are an indication that the developing nervous system may be a sensitive target.

Carcinogenic (cancer-causing) Effects
Studies of workers found an association between PCE exposure and increases in bladder cancer, non-Hodgkin's lymphoma (NHL) and bone marrow tumors known as multiple myeloma. Studies in which animals breathed PCE found an increase in cancer of the liver, kidney, brain, and leukemia. Animals exposed orally had an increase in liver cancer. After an extensive review of the toxicological information, EPA has classified PCE as "likely to be carcinogenic to humans" by all exposure routes.

Health Standards and Criteria

The EPA has established a Maximum Contaminant Level (MCL) for PCE. MCLs are enforceable drinking water standards determined by balancing the adverse health effects of a particular chemical against the feasibility and costs of treating contaminated water. The MCL for PCE is 5 parts per billion (ppb). The EPA has also established a Maximum Contaminant Level Goal (MCLG) of 0 ppb (parts per billion also equals micrograms per liter or ug/l) for PCE in public drinking water systems. MCLGs are health-based non-enforceable guidelines and have traditionally been set at zero for potential human carcinogens.

Because PCE is considered a potential human carcinogen, there may be some degree of carcinogenic risk even below the MCL. Based upon the current information of PCE's carcinogenic potential, the EHP estimates that ingesting drinking water containing 5 ppb PCE would be associated with an increased lifetime risk of cancer of three in ten million (three excess cancer cases in 10,000,000 people exposed). This estimate is based on a daily intake of two liters of water per day for 70 years.

The Occupational Safety and Health Administration enforceable standard, a permissible exposure limit or PEL, for PCE in workplace air is 100 ppm averaged over an eight hour workday.

Suggested Reading and References

Casarett and Doull's Toxicology: The Basic Science of Poisons, Sixth Edition. Klaassen, C.D., ed. McGraw-Hill Publishing Co. Inc., New York, 2001.

Case Studies in Environmental Medicine: Tetrachloroethylene (PCE) Toxicity. Agency for Toxic Substances and Disease Registry (ATSDR). Atlanta, GA. May, 2008.

Toxicological Profile for Tetrachloroethylene (Update). Agency for Toxic Substances and Disease Registry (ATSDR). Atlanta, GA. September, 1997.

Toxicological Review of Tetrachloroethylene (Perchloroethylene). In Support of Summary Information on the Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. February 2012.