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Toluene: Health Information Summary

Toluene is a clear, colorless, flammable liquid that is naturally found in petroleum. It is added to gasoline at 5 to 7 percent by weight to improve the octane rating. It is used as a solvent in paints, adhesives, ink, and cleaning compounds. It is found in dyes, nail polish, and explosives. It is used in the manufacture of nylon, polyurethane, and to synthesize other chemicals.

The low range of the odor threshold for toluene in water is 0.04 parts per million (ppm). The odor threshold for toluene in air is reported as 8 ppm.

Because of its usage in consumer products, toluene concentrations in indoor air may exceed those in outdoor air. Between exposure to indoor levels of toluene from consumer products and outdoor levels due to releases from vehicle exhaust or unburned gasoline vapors, an average absorbed dose from inhalation exposure is estimated at about 300 micrograms per day (ug/day).

Health Effects

Absorption/Metabolism

Toluene is absorbed almost completely from the gastrointestinal tract following ingestion. It is also absorbed via inhalation, and to a lesser degree, through the skin.

Toluene is not stored in the body. Greater than 75 percent is eliminated within 12 hours after exposure.

Short-Term (Acute) Effects

As demonstrated by occupational inhalation exposures, toluene is a respiratory irritant and has effects on the central nervous system (CNS). Inhalation of high levels of toluene vapors for a short period may cause drowsiness, headache, nausea, visual changes, muscle spasm, dizziness, and loss of coordination.

The threshold exposure level for which acute effects have not been observed in occupational studies is a concentration in air below 50 ppm. Based on an 8 hour workday, 50 ppm of toluene in the air results in an absorbed toluene dose of approximately 700 milligrams (mg) per workday.

Long Term (Chronic) Effects

Occupational inhalation studies have shown that toluene exposure can result in nervous system effects such as reductions in thinking, memory, and muscular abilities, as well as some losses in hearing and color vision.

Exposure to extremely high levels that may occur with inhalation abuse has demonstrated that toluene can cause permanent toxicity to the brain.

An increase in liver and kidney weights at a high dose (450 milligrams per kilogram of bodyweight or mg/kg/day) of toluene and toxicity to those organs at higher doses was observed in an oral exposure rat study. Human studies have, in general, only reported minor changes in liver or kidney function from toluene exposure.

In a two-year animal inhalation study, the most sensitive effect on rats was non-cancerous lesions and degeneration of the inner lining of the nose and the respiratory tract.

Reproductive/Developmental Effects

One occupational study reported a significant increase in spontaneous abortion among exposed women, but the results of animal studies have not supported this finding. Animal studies indicate that toluene exposure during pregnancy can delay fetal growth, retard skeletal development, and cause behavior changes in offspring, but only at levels which also cause toxic effects to the mother

Carcinogenic (cancer causing) Effects)

There are no occupational studies that associate human exposure to toluene with an increased incidence of cancer. A rat study of lifetime toluene exposure by inhalation failed to find any increase in tumors. Because of some shortcomings of the rat study, the results are not considered adequate to demonstrate that toluene is not a carcinogen. There are no adequate data to determine the carcinogenicity of toluene by oral exposure. The U.S. Environmental Protection Agency (EPA) has categorized toluene as a Group D carcinogen (inadequate evidence to classify).

Health Standards and Criteria

The EPA has established a Maximum Contaminant Level Goal (MCLG) for toluene in public drinking water systems. MCLGs are non enforceable health standards for drinking water. MCLGs are set at a level at which no adverse health effects would be expected to result from the consumption of two liters (0.53 gallons) of contaminated water per day by a 70 kg (154 lb) adult. The MCLG for toluene is 1,000 ppb (ppb = micrograms per liter or ug/l).

The EPA has also established a Maximum Contaminant Level (MCL) for toluene in public drinking water systems. MCLs are enforceable drinking water standards determined by balancing the adverse health effects of a particular chemical against the feasibility and cost of treating contaminated water. The MCL for toluene is also 1,000 ppb.

The Occupational Safety and Health (OSHA) enforceable standard (permissible exposure limit or PEL) for toluene in workplace air is 200 ppm averaged over eight hours. However, the American Conference of Governmental Industrial Hygienists (ACGIH) recommended limit for toluene in workplace air is 50 ppm.

For more information, please contact the DES Environmental Health Program, 29 Hazen Drive, Concord, NH 03302-0095; (603) 271-4608.

Suggested Reading and References

Casarett and Doull's Toxicology: The Basic Science of Poisons, Fifth Edition. Klaassen, C.D., ed. McGraw-Hill Publishing Co., Inc., New York, 1995.

Toxicological information on toluene. Integrated Risk Information System (IRIS). U.S. EPA, Office of Health and Environmental Assessment. Last significant revision 2/92.

Toxicological Profile for Toluene (Update). Agency for Toxic Substances and Disease Registry (ATSDR). Atlanta, GA. September, 2000.