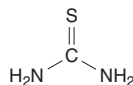


Thiourea

CAS No. 62-56-6

Reasonably anticipated to be a human carcinogen

First listed in the *Third Annual Report on Carcinogens* (1983)



Carcinogenicity

Thiourea is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity from studies in experimental animals.

Cancer Studies in Experimental Animals

Thiourea caused tumors in rats at several different tissue sites and by two different routes of exposure. Administration of thiourea in the drinking water caused benign and malignant thyroid-gland tumors (adenoma and carcinoma) in both sexes and cancer of the Zymbal gland (squamous-cell carcinoma) in males. Dietary administration caused benign liver tumors (hepatocellular adenoma) in rats of unspecified sex, and intraperitoneal injection followed by administration in the drinking water caused cancer of the Zymbal gland (squamous-cell carcinoma or mixed-cell sarcoma) in rats of both sexes (IARC 1974).

Cancer Studies in Humans

No epidemiological studies were identified that evaluated the relationship between human cancer and exposure specifically to thiourea.

Properties

Thiourea is a diamide of thiocarbonic acid and occurs as white or almost colorless crystals at room temperature (Akron 2009, HSDB 2009). It is soluble in cold water, alcohol, and ammonium thiocyanate, and sparingly soluble in ether (HSDB 2009). It is stable under normal temperatures and pressures (Akron 2009). Physical and chemical properties of thiourea are listed in the following table.

Property	Information
Molecular weight	76.1 ^a
Specific gravity	1.405 ^a
Melting point	176°C to 178°C ^a
Boiling point	sublimes <i>in vacuo</i> at 150°C to 160°C ^a
Log K_{ow}	-1.08 ^a
Water solubility	142 g/L at 25°C ^a
Vapor pressure	2.8×10^{-3} mm Hg at 25°C ^a
Dissociation constant (pK _a)	2.03 at 25°C ^b

Sources:^aHSDB 2009, ^bChemIDplus 2009.

Use

The most common uses for thiourea have been for the production of thiourea dioxide (30%), in leaching of gold and silver ores (25%), in diazo papers (blueprint papers) (15%), and as a catalyst in the synthesis of fumaric acid (10%) (IARC 2001). It has also been used in the production and modification of synthetic resins. Other uses of thiourea are as a photographic toning agent, in hair preparations, as a drycleaning agent, in the synthesis of pharmaceuticals and pesticides, in boiler-water treatment, and as a reagent for bismuth and selenite ions. It has also been used in textile and dyeing auxiliaries, in the production of industrial cleaning agents (e.g., for photographic tanks and metal surfaces in general), for engraving metal surfaces,

as an isomerization catalyst in the conversion of maleic to fumaric acid, in copper-refining electrolysis, in electroplating, and as an antioxidant. Other uses have included as a vulcanization accelerator, an additive for slurry explosives, as a viscosity stabilizer for polymer solutions, and as a mobility buffer in petroleum extraction. It is also used as an ingredient of consumer silver polishes (HPD 2009), and has been used in the removal of mercury from wastewater by chlorine-alkali electrolysis (IARC 1974, 2001, WHO 2003).

Production

Commercial production of thiourea in the United States began in 1938 (IARC 1974). In 1993, global production of thiourea was about 22 million pounds (WHO 2003). In 2015, combined U.S. production and imports of thiourea were reported to be in the range of half a million to one million pounds (EPA 2016). In 2009, thiourea was available from 81 suppliers worldwide, including 33 U.S. suppliers (ChemSources 2009).

Exposure

The routes of potential human exposure to thiourea are inhalation and dermal contact (HSDB 2009). There is a small risk of consumer exposure to thiourea in silver-tarnish removers, in which it is present at concentrations of up to 7% (HPD 2009). Thiourea may also be present in animal-hide glues and in diazo papers (WHO 2003). Thiourea has been found to occur naturally in laburnum shrubs and as a metabolite of the fungi *Verticillium albo-atrum* and *Bortrylio cinerea* (IARC 1974).

If released to air, thiourea is expected to remain in the vapor phase and to react with photochemically produced hydroxyl radicals, with a half-life of 2.4 hours. It has not been measured in ambient air (WHO 2003). If released to surface water, thiourea is expected to remain in the dissolved phase and to degrade with a half-life of 17 days. If released to soil, thiourea may leach to groundwater. It has been detected in one sample of groundwater in Germany at a concentration of 130 mg/L. According to EPA's Toxics Release Inventory, environmental releases of thiourea from 1988 to 2007 ranged from a high of 44,455 lb in 2001 (of which over 31,000 lb was released to an on-site hazardous-waste landfill) to a low of 1,333 lb in 2007, of which most was released to on-site surface impoundments (500 lb) or to air (513 lb) (TRI 2009).

Workers may be exposed to thiourea during its production or use (HSDB 2009). The National Occupational Exposure Survey (conducted 1981 to 1983) estimated that 37,571 workers, including 10,969 women, potentially were exposed to thiourea (NIOSH 1990).

Regulations

Environmental Protection Agency (EPA)

Comprehensive Environmental Response, Compensation, and Liability Act
Reportable quantity (RQ) = 10 lb.

Emergency Planning and Community Right-To-Know Act
Toxics Release Inventory: Listed substance subject to reporting requirements.

Resource Conservation and Recovery Act

Listed Hazardous Waste: Waste code for which the listing is based wholly or partly on the presence of thiourea = U219.

Listed as a hazardous constituent of waste.

Food and Drug Administration (FDA, an HHS agency)

Thiourea is not permitted in food for human consumption.

References

- Akron. 2009. *The Chemical Database*. The Department of Chemistry at the University of Akron. <http://ull.chemistry.uakron.edu/erd> and search on CAS number. Last accessed: 5/09.
- ChemIDplus. 2009. *ChemIDplus Advanced*. National Library of Medicine. <http://chem.sis.nlm.nih.gov/chemidplus/chemidheavy.jsp> and select Registry Number and search on CAS number. Last accessed: 5/09.

- ChemSources. 2009. *Chem Sources - Chemical Search*. Chemical Sources International. <http://www.chemsources.com/chemonline.html> and search on thiourea. Last accessed 5/09.
- EPA. 2016. *Chemical Data Reporting Summary: Thiourea*. U.S. Environmental Protection Agency. <https://chemview.epa.gov/chemview> and search on CAS number or substance name and select Manufacturing, Processing, Use, and Release Data Maintained by EPA and select Chemical Data Reporting Details.
- HPD. 2009. *Household Products Database*. National Library of Medicine. <http://hpd.nlm.nih.gov/cgi-bin/household/brands?tbl=chem&id=2208&query=thiourea&searchas=TblChemicals1&prodcats=all>. Last accessed: 5/09.
- HSDB. 2009. *Hazardous Substances Data Bank*. National Library of Medicine. <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB> and search on CAS number. Last accessed: 5/09.
- IARC. 1974. Thiourea. In *Some Anti-thyroid and Related Substances, Nitrofurans and Industrial Chemicals*. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 7. Lyon, France: International Agency for Research on Cancer. pp. 95-109.
- IARC. 2001. Thiourea. In *Some Thyrotropic Agents*. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 79. Lyon, France: International Agency for Research on Cancer. pp. 703-725.
- NIOSH. 1990. *National Occupational Exposure Survey (1981-83)*. National Institute for Occupational Safety and Health. Last updated: 7/1/90. <http://www.cdc.gov/noes/noes1/82272sic.html>.
- TRI. 2009. *TRI Explorer Chemical Report*. U.S. Environmental Protection Agency. <http://www.epa.gov/triexplorer> and select thiourea. Last accessed: 5/09.
- WHO. 2003. *Concise International Chemical Assessment Document 49. Thiourea*. <http://www.inchem.org/documents/cicads/cicads/cicad49.htm>.