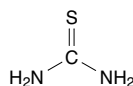


## Thiourea

### 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 <sup>a</sup>
Specific gravity	1.405 <sup>a</sup>
Melting point	176°C to 178°C <sup>a</sup>
Boiling point	sublimes <i>in vacuo</i> at 150°C to 160°C <sup>a</sup>
Log $K_{ow}$	-1.08 <sup>a</sup>
Water solubility	142 g/L at 25°C <sup>a</sup>
Vapor pressure	$2.8 \times 10^{-3}$ mm Hg at 25°C <sup>a</sup>
Dissociation constant ( $pK_a$ )	2.03 at 25°C <sup>b</sup>

Sources: <sup>a</sup>HSDB 2009, <sup>b</sup>ChemIDplus 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 (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 10,000 metric tons (22 million pounds) (WHO 2003). In 2009, thiourea was produced by 19 manufacturers worldwide, none in the United States (SRI 2009), and was available from 81 suppliers, including 33 U.S. suppliers (ChemSources 2009). Reports filed under the U.S. Environmental Protection Agency's Toxic Substances Control Act Inventory Update Rule between 1986 and 1998 indicated that U.S. production plus imports of thiourea totaled between 1 million and 10 million pounds; in 2002, the quantity fell to between 500,000 and 1 million pounds (EPA 2004).

### 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-treated papers, such as blueprints (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)

Thiourea is not permitted in food for human consumption.

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