

Selenium Sulfide

CAS No. 7446-34-6

Reasonably anticipated to be a human carcinogen
First Listed in the *Third Annual Report on Carcinogens* (1983)



Carcinogenicity

Selenium sulfide is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (NCI 1980a). When administered by oral gavage, selenium sulfide induced hepatocellular carcinomas in rats of both sexes and female mice, and alveolar/bronchiolar carcinomas and adenomas in female mice. When applied topically, selenium sulfide and Selsun[®], an antidandruff shampoo containing 2.5% selenium sulfide, exhibited no carcinogenic effects in mice; however, these studies were not conclusive because the length of study was limited to 88 weeks by the relatively short lifespan of the strain of mouse (NCI 1980b,c).

No adequate human studies of the relationship between exposure to selenium sulfide and human cancer were found.

Properties

Selenium sulfide exists as an odorless, orange-yellow powder or tablet that is practically insoluble in water and organic solvents. It is soluble in carbon disulfide. It decomposes in alcohol and at temperatures >118°C (ATSDR 1996, HSDB 2001). It can ignite when ground with silver oxide. When heated to decomposition, it emits toxic fumes of sulfur oxides and selenium (HSDB 2001).

Use

Selenium sulfide is used as an ingredient in antidandruff shampoos and as a constituent of fungicides (ATSDR 1996). Prescription strength and nonprescription strength medications contain 2.5% and 1% selenium sulfide, respectively (MEDLINEplus 2001). Approximately 440 lb of selenium sulfide were consumed for pharmaceutical and cosmetic products in the early 1970s (IARC 1975).

Production

Selenium was first isolated from pyrite in 1817; however, almost all selenium is currently obtained as a byproduct from copper refining (IARC 1975). Five electrolytic copper refineries generated selenium in the United States in 2000; however, only one of these recovered commercial grade selenium. The other four refineries exported semi-refined selenium or selenium-containing slimes for further processing. Domestic production of selenium increased from 1999 to 2000 (Brown 2000). Specific production information for selenium sulfide was not found.

Two U.S. suppliers of selenium sulfide were identified in 1990, but none were currently listed (Chem Sources 1991, 2001). Approximately 1,800 lb of selenium sulfide were imported by U.S. companies in 1979 (TSCA 1979). No recent import or export data were found.

Exposure

Selenium is widely distributed throughout the environment, occurring in ground water, surface water, rocks, soil, and food (ATSDR 1996). No data on the environmental occurrence of selenium sulfide were located.

The primary routes of potential human exposure to selenium sulfide are dermal contact and inhalation. Shampoos containing 1% selenium sulfide are available without prescription and are recommended for use at least twice a week. Shampoos or lotions containing 2.5% selenium sulfide are available by prescription, with a recommended treatment for dandruff or seborrheic dermatitis of twice a week for the first two weeks and once per week or less thereafter. The 2.5% lotion may be used to

treat once a day for seven days to treat tinea versicolor (a type of skin fungus) (Medlineplus 2001). Residues of selenium sulfide may remain on the scalp after rinsing, although there is no substantial absorption through intact skin. Absorption has been reported in patients with open lesions on the scalp or in patients using a 1% cream on the back (NCI 1980c). A patient with scalp lesions that used selenium shampoos had a level of selenium sulfide as high as 32 µg/ml in her urine (NCI 1980a).

Workers are potentially exposed to airborne selenium sulfide dust during production, formulation, and packaging of consumer products. The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 8,500 workers were possibly exposed to selenium sulfide in the workplace in 1970 (NIOSH 1976). The National Occupational Exposure Survey (1981-1983) indicated that 2,965 total workers, including 2,490 women, potentially were exposed to selenium sulfide in the workplace (NIOSH 1984).

Regulations

DOT

Selenium compounds are considered hazardous materials and special requirements have been set for marking, labeling, and transporting these materials

EPA

Clean Air Act

NESHAP: Selenium compounds listed as Hazardous Air Pollutants (HAPs)

Clean Water Act

Biosolids Rule: Ceiling concentration of total selenium for land application = 100 mg/kg

Effluent Guidelines: Listed as a Toxic Pollutant (selenium and compounds)

Water Quality Criteria: Based on fish/shellfish and water consumption = 170 µg/L (selenium); based on fish/shellfish consumption only = 4,200 µg/L (selenium)

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 codes in which listing is based wholly or partly on substance - U205

Listed as a Hazardous Constituent of Waste

Safe Drinking Water Act

Maximum Contaminant Level (MCL) = 0.05 mg/L (selenium)

FDA

Selenium sulfide is permitted in antidandruff shampoos and for the control of seborrheic dermatitis at concentrations not to exceed 1% (selenium sulfide) or 0.6% (micronized selenium sulfide)

Maximum permissible level in bottled water = 0.05 mg/L (selenium)

OSHA

Permissible Exposure Limit (PEL) = 0.2 mg/m³ (as selenium) (applies to selenium compounds, except selenium hexafluoride)

Guidelines

ACGIH

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 0.2 mg/m³ (selenium & compounds)

NIOSH

Immediately Dangerous to Life and Health (IDLH) = 1 mg/m³ (as selenium)

Recommended Exposure Limit (REL) = 0.2 mg/m³ (as selenium) (applies to selenium compounds, except selenium hexafluoride)

REFERENCES

- ATSDR. 1996. Toxicological Profile for Selenium. Update. (Final Report). NTIS Accession No. PB97-121032. Atlanta, GA: Agency for Toxic Substances and Disease Registry. 322 pp.
- Brown Jr., R. D. 2000. Selenium and Tellurium. Minerals Yearbook. U.S. Geological Survey. <http://minerals.usgs.gov/minerals/pubs/commodity/selenium>.
- ChemSources. 1991. Chem Sources, USA, 32nd ed. Omond Beach, FL: Directories Publishing Company, Inc.
- ChemSources. 2001. Chemical Sources International, Inc. <http://www.chemsources.com>.
- HSDB. 2001. Hazardous Substances Data Base. National Library of Medicine. <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>.
- IARC. 1975. Some Arizidines, N-, S-, and O-Mustards and Selenium. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 9. Lyon, France: International Agency for Research on Cancer. 286 pp.
- MEDLINEplus. 2001. Selenium Sulfide (topical). National Library of Medicine. <http://www.nlm.nih.gov/medlineplus/>.
- NCI. 1980a. Bioassay of Selenium Sulfide (Gavage) for Possible Carcinogenicity (CAS No. 7446-34-6). Technical Report Series No 194. DHHS (NIH) Publication No. 80-1750. Bethesda, MD: National Institutes of Health. 137 pp.
- NCI. 1980b. Bioassay of Selenium Sulfide (Dermal Study) for Possible Carcinogenicity (CAS No. 7446-34-6).

SUBSTANCE PROFILES

- Technical Report Series No 197. DHHS (NIH) Publication No. 80-1753. Bethesda, MD: National Institutes of Health. 83 pp.
- NCI. 1980c. Bioassay of Selsun(R) for Possible Carcinogenicity. Technical Report Series No 199. DHHS (NIH) Publication No. 80-1755. Bethesda, MD: National Institutes of Health. 75 pp.
- NIOSH. 1976. National Occupational Hazard Survey (1972-74). Cincinnati, OH: Department of Health, Education and Welfare.
- NIOSH. 1984. National Occupational Exposure Survey (1981-83). Cincinnati, OH: U. S. Department of Health and Human Services. <http://www.cdc.gov/noes/noes3/empl0003.html>.
- Stenback, F. 1977. Local and systemic effects of commonly used cutaneous agents: lifetime studies of 16 compounds in mice and rabbits. *Acta Pharmacol Toxicol (Copenh)* 41(5): 417-431.
- TSCA. 1979. Toxic Substances Control Act, Chemical Substances Inventory.
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