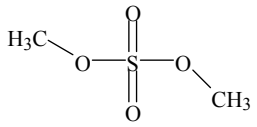
**DIMETHYL SULFATE**
**CAS No. 77-78-1**
First Listed in the *Second Annual Report on Carcinogens*




## CARCINOGENICITY

Dimethyl sulfate is *reasonably anticipated to be a human carcinogen* based on sufficient evidence of carcinogenicity in experimental animals (IARC 1974, 1982, 1987, 1999). When administered by inhalation, dimethyl sulfate induced squamous cell carcinomas of the nasal cavity in rats. When administered by subcutaneous injection, dimethyl sulfate induced local sarcomas in rats. When administered by intravenous injection to pregnant rats, dimethyl sulfate induced tumors of the nervous system in their offspring (IARC 1974).

There was inadequate evidence for the carcinogenicity of dimethyl sulfate in humans (IARC 1987, 1999). Four cases of bronchial carcinoma were reported in men occupationally exposed to dimethyl sulfate. Additional case reports have since appeared: a case of pulmonary carcinoma in a man exposed for seven years to "small amounts" of dimethyl sulfate, but to larger amounts of bis(chloromethyl) ether and chloromethyl methyl ether, and a case of choroidal melanoma in a man exposed for six years to dimethyl sulfate (IARC 1999).

## PROPERTIES

Dimethyl sulfate is an oily, colorless liquid with a faint, onion-like odor. It is soluble in water, ether, dioxane, acetone, and aromatic hydrocarbons and slightly soluble in carbon disulfide and aliphatic hydrocarbons. It is stable at room temperature, and rapidly hydrolyzes in water. Dimethyl sulfate is corrosive (HSDB 2001). When heated, this chemical produces toxic fumes including sulfur oxides and reacts with water to produce sulfuric acid and heat. Dimethyl sulfate reacts violently with concentrated aqueous ammonia, bases, acids, and strong oxidants with risks of fire and explosions (IPCS 1995). Commercial and technical grades are available that may contain small amounts of acid or dimethyl ether impurities (HSDB 2001).

## USE

Dimethyl sulfate is used primarily as a methylating agent to convert compounds such as phenols, amines, and thiols to the corresponding methyl derivatives (IARC 1999). It is used in the manufacture of methyl esters, ethers, and amines in dyes, drugs, perfumes, pesticides, phenol derivatives, and other organic chemicals. It is also used as a solvent for the separation of mineral oils and for the analysis of auto fluids and as a component of polyurethane-based adhesives. Formerly, diethyl sulfate was used as a war gas (HSDB 2001).

## PRODUCTION

Dimethyl sulfate has been produced commercially in the United States since at least the 1920s. It can be made by the continuous reaction of dimethyl ether with sulfur trioxide (IARC 1974, 1999). Chem Sources (2001) identified 21 domestic suppliers of dimethyl sulfate. Total imports for diethyl and dimethyl sulfate exceeded 1.1 billion lb in 1985 and 1.5 billion lb in 1987 (USDOC Imports 1986, 1988). No current data on imports or exports were available.

## EXPOSURE

The primary routes of potential occupational exposure to dimethyl sulfate are inhalation and dermal contact at facilities where the chemical is produced or where its derivatives are formulated (HSDB 2001). The National Occupational Exposure Survey (1981-1983) indicated that 10,483 workers, including 2,456 women, were potentially exposed to dimethyl sulfate (NIOSH 1984). This estimate was derived from observations of the actual use of the compound (96% of total observations) and the use of trade name products known to contain the compound. In 1979, NIOSH estimated that 4,200 workers were exposed to dimethyl sulfate annually in the workplace (Sittig 1985). Dimethyl sulfate enters air and water largely through production losses. EPA's Toxic Chemical Release Inventory (TRI) estimated that 10,064 lb of dimethyl sulfate were released to the environment, specifically as air emissions, from 16 facilities that produced, processed, or used the chemical in the United States in 1999. Releases of dimethyl sulfate were quite variable from 1989 to 1997, ranging from reductions of 31% to increases of 28%; however, a substantial increase was observed in 1998, with an increase of 67% in the amount of dimethyl sulfate released when compared to the amount released in 1997 (TRI99 2001).

## REGULATIONS

EPA regulates dimethyl sulfate under the Clean Air Act (CAA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Superfund Amendments and Reauthorization Act (SARA), and Toxic Substances Control Act (TSCA). The National Emission Standards for Hazardous Air Pollutants (NESHAP) addresses dimethyl sulfate emissions from processing facilities under CAA. A reportable quantity (RQ) of 100 lb has been established for this chemical under CERCLA. RCRA regulates dimethyl sulfate as a hazardous constituent of waste. Dimethyl sulfate is subject to reporting requirements under RCRA, SARA, and TSCA. It has been approved for use as an inert ingredient in pesticide products registered under FIFRA.

Under the Food, Drug, and Cosmetic Act (FD&CA), FDA regulates the chemical as an optional component of polyurethane-based adhesives. Migration of dimethyl sulfate to food is not expected under the conditions of use specified in the adhesive regulation.

ACGIH recommends a threshold limit value (TLV) at 0.1 ppm (0.52 mg/m$^3$). NIOSH has set a recommended exposure limit (REL) for dimethyl sulfate at 0.1 ppm (0.5 mg/m$^3$) as an 8-hr time-weighted average (TWA); the potential for skin absorption was noted. OSHA has set an 8-hr TWA permissible exposure limit (PEL) of 0.1 ppm (0.5 mg/m$^3$) limit for dimethyl sulfate in the workplace; this standard was adopted for carcinogenicity. The potential for skin absorption is noted. OSHA also regulates dimethyl sulfate under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table 78.

## REFERENCES

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