MINERAL OILS*
(UNTREATED AND MILDLY TREATED)
First Listed in the *First Annual Report on Carcinogens*

CARCINOGENICITY

Untreated and mildly treated mineral oils are *known to be human carcinogens* based on sufficient evidence of carcinogenicity in humans. Exposure to mineral oils that have been used in a variety of occupations, including mulespinning, metal machining, and jute processing, has been associated strongly and consistently with the occurrence of squamous cell cancers of the skin, and especially of the scrotum (IARC 1984, 1987). Among 682 turners with 5 or more years of exposure to mineral oils, five cases of squamous cell carcinoma of the skin (four of the scrotum) occurred, with 0.3 expected. In a case-control study, an excess of sinonasal cancers was observed in toolsetters, set-up men, and toolmakers. One of three mortality studies on manual workers in the printing industry, not specifically addressing printing pressmen, did not show an increased lung cancer risk, whereas the other two studies found a statistically significant excess. One of two mortality studies of printing pressmen indicated a statistically significant increase in deaths from rectal cancer, and the other study showed a statistically nonsignificant increase in deaths from colon cancer. One mortality study among newspaper and other commercial printing pressmen showed a statistically significant excess of mortality from cancers of the buccal cavity and pharynx, whereas no such excess was observed in a cohort study. One case-control study indicted a statistically significant excess of cancers of the buccal cavity and pharynx (IARC 1987).

Vacuum-distillate fractions, acid-treated oils, mildly treated solvent-refined oils, mildly treated hydrotreated oils, solvent extracts (aromatic oils), and some cutting oils produced skin tumors after repeated skin applications to mice. Similar treatment with high-boiling, catalytically cracked oils produced skin tumors in rabbits and Rhesus monkeys. Some severely solvent-refined oils did not produce skin tumors in mice. Highly refined food-grade mineral oils did not produce skin tumors when applied to the skin of mice, although after intraperitoneal injection they produced plasma cell neoplasms and reticulum cell sarcomas in certain strains of female mice. An IARC Working Group concluded that the latter finding was difficult to interpret (IARC 1987). Analyses of mineral oils used for medicinal and cosmetic purposes reveal the presence of several carcinogenic polycyclic aromatic hydrocarbons (IARC 1984) (see Polycyclic Aromatic Hydrocarbons, 15 listings).

PROPERTIES

Mineral oils, refined from petroleum crude oils, are complex mixtures of straight- and branched-chain paraffinic, naphthenic, and aromatic hydrocarbons with 15 or more carbons and boiling points in the range of 300 to 600°C. Paraffinic crude oils are characterized by high wax content, high natural viscosity index (the rate of change of viscosity over a given temperature range), and relatively low aromatic hydrocarbon content. Naphthenic crude oils are generally low in wax content and relatively high in cycloparaffins and aromatic hydrocarbons. All crude oils contain some polycyclic aromatic compounds, and the proportions and types of these compounds in finished base oils are determined primarily by the refining processes. Medicinal

* No separate CAS registry number is assigned to mineral oils.

white mineral oils are clear, tasteless, and odorless at room temperature with little odor after heating. Some medicinal and technical-grade white mineral oils may contain up to 10 mg/kg α-tocopherol as an antioxidant. The U.S. Pharmacopeia (USP) and U.S. Cosmetic, Toiletry, and Fragrance Association have established specifications for medicinal white oils in regard to viscosity, specific gravity, odor, taste, PAH content, and other requirements (IARC 1984). Mineral oils pose a lower fire hazard than coal tars and must be preheated before ignition will occur (HSDB 2000).

USE

Mineral oils are primarily used as lubricant base oils to produce further refined oil products. These products include: engine oils, automotive and industrial gear oils, transmission fluids, hydraulic fluids, circulating and hydraulic oils, bearing oils, machine oils, machine-tool oils, compressor and refrigerator oils, steam-engine oils, textile machine oils, air-tool oils, metalworking oils (cutting oils, roll oils, can-forming oils, drawing oils), rust preventative oils, heat-treating oils, transformer oils, greases, medicinal and technical-grade white oils, and processing oils (product extenders, processing aids, carriers and diluents, water repellents, surface-active agents, batching oils, mold-release oils, wash oils). These oils are used in manufacturing (78.5% of the oils produced), mining (5.0%), construction (1.8%), and miscellaneous industries (14.7%). Approximately 57% of the lubricating oils produced are used by the automotive industry and the remaining 43% by other industries. In the automotive industry, lubricating oils are used as multigrade engine oils (23% of the lubricating oils produced), monograde engine oils (22%), transmission and hydraulic fluids (8%), gear oils (2%), and aviation oils (1%). Other industrial uses for lubricating oils include general industrial diesel engine oils (19%), process oils (13%), metalworking oils (4%), railroad diesel engine oils (3%), and marine diesel engine oils (2%). Technical-grade white oils are used in cosmetics (hair oils, creams), textile-machine lubricants, horticultural sprays, wrapping paper, for corrosion protection in the meat-packing industry, and as lubricants for watches, bicycles, and spindles. Medicinal white oils are used in pharmaceutical preparations (processing aids, intestinal lubricants), food additives (release agents, binders, flotation sealants, defoamants, protective coatings), food packaging and processing, and animal feed products. Medicinal white oils are also used in the chemical and plastics industry as processing media, extenders, and plasticizers (IARC 1984).

PRODUCTION

In 1981, approximately 19 billion lb of mineral oil products were used in the United States (NPRA 1981). These products included 16.2 billion lb of lubricating oils, 1.5 billion lb of waxes, 814 million lb of aromatic oils, and 462 million lb of greases. Twenty-three U.S. suppliers of mineral oil were identified (Chem Sources 2001).

EXPOSURE

The primary routes of potential human exposure to mineral oils are inhalation, ingestion, and dermal contact. The major hydrocarbon constituents of lubricant base oils and derived products occur naturally in crude petroleum. The general population is potentially exposed to unused and used mineral oils that are naturally occurring or present as environmental contaminants. Approximately 528 million gallons of used lubricating oils are released into the environment every year, including approximately 198 million gallons used as road oil or in asphalt. Potential occupational exposure to mineral oils can occur for workers employed in the manufacture of automobiles, airplanes and parts, steel products, screws, pipes, precision parts, and transformers, as well as workers employed in brass and aluminum production, engine repair, copper mining, and newspaper and commercial printing (IARC 1984). The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 6 million workers in nonagricultural industries were potentially exposed to mineral oils, 2 million to lubricating oils, 1 million to cutting oils, and 1 million to motor oils (NIOSH 1976). NIOSH reported the presence of mineral oils in the occupational environment of several plants. The concentration of cutting oil mist was reported to be 0.37 to 0.55 mg/m^3 for polishing aircraft engine blades; 0.4 to 6.0 mg/m^3 for machining rough iron castings into auto parts; 1.1 to 20 mg/m^3 for manufacturing aircraft components; 0.3 to 1.3 mg/m^3 for manufacturing automotive parts; <0.03 to 0.8 mg/m^3 for fabricating precision metal parts; and <0.035 to 3.1 mg/m^3 for milling and machining operations. The concentration of transformer oil in the workplace was reported to be 0.1 to 1.4 mg/m^3 for manufacturing and overhauling large transformers (IARC 1984). Oil mist concentrations from the use of cutting oils ranged from 0.2 to 2.9 mg/m^3 at three United States plants (NIOSH 1978). Oil mist concentrations in three machine shops equipped with lathes, mills, grinders, and sharpeners ranged from 0.07 to 110 mg/m^3 (Ely *et al.* 1970). Oil mist levels in a New York City pressroom ranged from 5 to 21 mg/m^3 (IARC 1984).

REGULATIONS

The U.S. Consumer Product Safety Commission (CPSC) regulates household products, drugs, and cosmetics containing 10% or more by weight of petroleum distillated having a viscosity less than 100 Saybolt universal seconds (SUS) at 100^{o}F, including mineral oil and mineral seal oil, under the Federal Hazardous Substances Act (FHSA) and/or the Poison Prevention Packaging Act (PPPA).

EPA regulates mineral oils under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which restricts the use of pesticides containing these substances and establishes tolerance concentrations for residues. EPA also regulates mineral oils under the Toxic Substances Control Act (TSCA), which describes how to dispose of mineral oil dielectric fluid from polychlorinated biphenyl-contaminated equipment. Under the Resource Conservation and Recovery Act (RCRA), wastes containing mineral oils are subject to reporting and record-keeping requirements under the hazardous waste disposal rule.

FDA regulates white mineral oils as direct and indirect food additives. FDA also regulates mineral oils as additives in animal feed. FDA recommends warning labels for drugs containing mineral oil that are taken internally and classifies over-the-counter drug products containing mineral oil as generally recognized as safe.

OSHA regulates mineral oils as chemical hazards in laboratories under the Hazard Communication Standard. Regulations are summarized in Volume II, Table 114.

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