Mineral Oils* (Untreated And Mildly Treated)

Known to be human carcinogen
First Listed in the *First Annual Report on Carcinogens* (1980)

Carcinogenicity

Untreated and mildly treated mineral oils are *known to be human carcinogens* based on sufficient evidence of carcinogenicity in humans that indicates that exposure to these types of mineral oils causes cancer. The carcinogenicity of exposure to mineral oils has been evaluated in numerous studies in a variety of occupations including metal working, jute processing, mulespinning, newspaper press operation, and other newspaper work. Exposure to mineral oils was consistently and strongly associated with an increased risk of squamous cell cancers of the scrotum and skin in many workers including metal workers, mulespinners, and jute processors. An analysis of a series of 344 cases of scrotal cancer occurring from 1936 to 1976 in the West Midlands, UK, reported that 62% of the cases had been exposed to mineral oils. Epidemiological studies (case-control, cohort, and proportional mortality studies) in metal workers have reported excesses of gastrointestinal, sinonasal, and bladder cancers in addition to skin and scrotal cancer. Some but not all studies (case-control, cohort, and proportional mortality studies) of workers in the printing industry have reported significantly increased incidences or death from cancers of the lung, rectum, buccal cavity, and pharynx. The International Agency for Research on Cancer concluded that there was sufficient evidence for the carcinogenicity of untreated and mildly treated mineral oils in humans (IARC 1984, 1987).

There is sufficient evidence that some untreated and mildly treated mineral oils are carcinogenic in experimental animals. The evaluation of carcinogenicity of mineral oils in experimental animals has mainly involved experiments in which petroleum-derived base oils and formulated products have been applied repeatedly to the skin of mice, although for some types of mineral oil preparations, there are studies in other species and by other routes of administration. Vacuum-distillate fractions, acid-treated oils, mildly solvent-refined oils, mildly treated hydrotreated oils, aromatic oils (including solvent extracts and high-boiling fractions of catalytically cracked oils), and some cutting oils caused skin tumors in mice. High-boiling fractions of cracked oils also caused skin tumors in rabbits and monkeys (IARC 1984, 1987).

Properties

Mineral oils include lubricant base oils and products derived from them. The physical properties of lubricant oils vary widely but generally are defined by crude oil source, carbon number distribution, boiling range, and viscosity. Mineral oils, which are 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°C to 600°C, although boiling points up to 815°C have been reported for heavier oils. The viscosity of lubricant oils is described as 'light' or 'heavy' depending upon whether the maximum viscosity at 37.8°C is less than or equal to 20.5 mm^2/sec (centistokes). The density of mineral oils at 15°C ranges from 0.820 kg/L for light paraffinic base/process oils to just over 1.0 kg/L for high aromatic base/process oils. The complete description of a mineral oil must include the nature of the final treatment step, which determines whether the material is mildly or severely treated during the refining process. Medicinal white mineral oils, which are pharmaceutical- and food-grade materials, are highly refined and free of all aromatic and unsaturated compounds. As highly refined oils, these products are not covered under this listing.

Mineral oils are insoluble in water and alcohol but are soluble in benzene, chloroform, ether, carbon disulfide, and petroleum ether. 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 hydrocarbons (PAHs), and the proportions and types of these compounds in finished base oils are determined primarily by the refining processes (IARC 1984). Mineral oils generally do not present a fire hazard and must be preheated before ignition will occur (HSDB 2003).

Use

Mineral oils are primarily used as lubricant base oils to produce further refined oil products. These include the following products: 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, and 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, and 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%) (IARC 1984).

Production

In 1981, approximately 19 billion pounds (8.6 million metric tons) of mineral oil products were used in the United States (NPRA 1981). These products included 16.2 billion pounds (7.3 million metric tons) of lubricating oils, 1.5 billion pounds (680,000 metric tons) of waxes, 814 million pounds (369,000 metric tons) of aromatic oils, and 462 million pounds (210,000 metric tons) of greases. Twenty U.S. suppliers of mineral oil were identified (ChemSources 2003). In 1984, the U.S. imported 17,000 kg (37,000 lb) and exported 75,000 kg (165,000 lb) of mineral oil (type of mineral oil not identified) (HSDB 2003).

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 2 billion liters (528 million gallons) of used lubricating oils are released into the environment every year, including approximately 750 million liters (198 million gallons) used as road oil or in asphalt (IARC 1984).

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 Exposure Survey (NOES), conducted by the National Institute for Occupational Safety and Health (NIOSH) from 1981 to 1983, estimated that 1,009,473 workers, including 392,294 women, were exposed to mineral oils. NIOSH reported the presence of mineral oils in the occupational environment of

several plants in the 1970's. 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; from less than 0.03 to 0.8 mg/m^3 for fabricating precision metal parts; and from less than 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).

Regulations

CPSC

Products containing 10% or more of petroleum distillates require special labeling due to aspiration hazard

Special packaging is required for any household products, drugs, or cosmetics containing 10% or more hydrocarbons and with a viscosity less than 100 Saybolt Universal Seconds (SUS)

EPA

Federal Insecticide, Fungicide, and Rodenticide Act

The tolerance for residues of mineral oil on corn, grain, and sorghum = 200 ppm

FDA

Drugs for pasture cattle may contain up to 1% mineral oil

Some over the counter products containing mineral oil must contain a warning label

OSHA

Permissible Exposure Limit (PEL) = 5 mg/m^3 (mineral oil mist)

Guidelines

ACGIH

Threshold Limit Value - Short Term Exposure Limit (TLV-STEL) = 10 mg/m^3

Threshold Limit Value - Time-Weighted Average Limit (TLV-TWA) = 5 mg/m^3 (mineral oil mist)

NIOSH

Immediately Dangerous to Life and Health (IDLH) = 2,500 mg/m^3 (mineral oil mist)

Short-Term Exposure Limit (STEL) = 10 mg/m^3 (mineral oil mist)

Recommended Exposure Limit (REL) = 5 mg/m^3 (mineral oil mist)

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

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