MINERAL OILS:
UNTREATED AND MILDLY-TREATED OILS (Group 1)
HIGHLY-REFINED OILS (Group 3)

A. Evidence for carcinogenicity to humans (*sufficient* for untreated and mildly-treated oils; *inadequate* for highly-refined oils)

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[1]. Production processes for these oils have changed over time, and with more recent manufacturing methods highly-refined products are produced that contain smaller amounts of contaminants, such as polycyclic aromatic hydrocarbons.

Excess mortality or morbidity from gastrointestinal malignancies was seen in two out of three cohort studies of metal workers (stomach cancer in two studies, large-bowel cancer in one); however, the only significant excess was for the sum of stomach cancer plus large-bowel cancer in one study. Four cases of scrotal cancer were detected in one relatively small cohort study of metal industry workers[1]. Among 682 turners with five 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[2]. In a case-control study, a relative risk of 4.9 was reported for the association of scrotal cancer with potential exposure of metal workers to mineral oils. Neither the actual levels of exposure nor the classification of the mineral oil to which the machine workers were potentially exposed was available in the reports of the epidemiological studies[1].

In a case-control study, an excess of sinonasal cancers was seen in toolsetters, set-up men and toolmakers[1]. In a series of 344 cases of scrotal cancer from 1936 to 1976, 62% had held occupations in which exposure to mineral oils was likely to have occurred. The median latent period was 34 years[3].

An examination of the incidence of second primary cancers among men with scrotal cancer demonstrated excesses of respiratory, upper alimentary tract and skin cancers; when the occupations were grouped, the excess was largely confined to those with exposure to oil[1].

Excesses of bladder cancer have been reported in case-control studies in several countries among machinists and engineers, who were possibly exposed to cutting oils containing aromatic amines as additives[1].

With regard to printing pressmen, one of two cohort studies addressing lung cancer showed an excess and one of two proportionate mortality studies showed a small, statistically nonsignificant excess of lung cancer among newspaper pressmen but no excess among non-newspaper pressmen; the other study did not address lung cancer. One of three proportionate 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 proportionate mortality studies of printing pressmen indicated a statistically significant increase of deaths from rectal cancer, and the other showed a statistically nonsignificant increase of deaths from colon cancer; the cohort study considering colorectal cancers did not show an increased occurrence. One proportionate 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 indicated a statistically significant excess of cancers of the buccal cavity and pharynx. The findings regarding other malignancies were inconsistent; scrotal cancers were not mentioned. The type and amount of exposure were usually not described; exposure to both mineral oils and carbon blacks (see p. 142) would probably have been involved[1].

In mortality statistics from the UK and from Washington State, USA, excesses of lung and skin cancer have been registered for jobs entailing exposure to mineral oils[1].

B. Evidence for carcinogenicity to animals (*sufficient* for untreated and mildly-treated oils; *inadequate* for highly-refined oils)

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 tumours after repeated skin applications to mice. Similar treatment with high-boiling, catalytically-cracked oils produced skin tumours in rabbits and rhesus monkeys. Some severely solvent-refined oils did not produce skin tumours in mice. Highly-refined food-grade mineral oils did not produce skin tumours when applied to the skin of mice, although after intraperitoneal injection they produced plasma-cell neoplasms and reticulum-cell sarcomas in certain strains of mice[1]. It was agreed that, in accordance with the previous evaluation, 'the significant latter finding is difficult to interpret'[1].

C. Other relevant data

An increase in the frequency of chromosomal aberrations was observed in the peripheral blood lymphocytes of glass workers exposed to mineral oil mists. Urine from workers in a cold-rolling steel plant exposed to oil mists of solvent-refined oils was mutagenic to *Salmonella typhimurium* in the presence of an exogenous metabolic system[4].

Special test protocols may be necessary to evaluate mineral oils adequately in short-term tests. Vacuum distillates from oil refining were reported to be mutagenic to *S. typhimurium* in the presence of an exogenous metabolic system. Positive findings were also obtained

when the concentration of the exogenous metabolic system was five to ten fold that used generally. Acid-treated oils were not mutagenic to *S. typhimurium* in the presence of an exogenous metabolic system; solvent-refined oils were reported to be mutagenic in the presence of an exogenous metabolic system. Hydrotreated oil was reported to be mutagenic to *S. typhimurium* in the presence of an exogenous metabolic system, while white oils, highly-refined steel-hardening oil and solvent-refined steel-rolling oils were not. Unused crankcase oil was mutagenic to *S. typhimurium* in the presence of an exogenous metabolic system, while in other studies no mutagenic activity was found. Used crankcase oil from both gasoline and diesel engines was mutagenic to *S. typhimurium* both in the presence and absence of a metabolic system[4].

Two insulation oils from highly-refined mineral-base oils induced transformation of Syrian hamster embryo cells and enhanced transformation of mouse C3H 10T1/2 cells. Unused new, re-refined and used crankcase oils induced transformation in Syrian hamster embryo cells[4].

References

[1]*IARC Monographs, 33*, 87-168, 1984

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[3]Waldron, H.A., Waterhouse, J.A.H. & Tessema, N. (1984) Scrotal cancer in the West Midlands, 1936-76. *Br. J. ind. Med., 41*, 437-444

[4]*IARC Monographs, Suppl. 6*, 403, 1987