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Comparing biological effects of mineral fibres

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Lung tumour distribution related to cumulative dosage

Material (no of rats)	*BAH* (a)*	*Adenoma† (b)*	*Adenoma‡ (c)*	*Adenocarcinoma (d)*	*All neoplasms (b + c + d)*	*Averaged cumulative dose per rat at 12 months*	*Tumours per 100 fibres/cm³ × 8*
UICC chrysotile (48)	5	0	1	11	12	636	1·8
Glass microfibre (48)	3	0	0	1	1	223	0·4
Rock wool (48)	1	1	1	0	2	39	5·1
Glass wool with resin (48)	3	0	0	1	1	55	1·8
Glass wool resin free (47)	1	1	0	0	1	41	2·4
Controls (48)	1	0	0	0	0	—	—

*Bronchoalveolar hyperplasia.
†Benign.
‡Some features of malignancy.
§Fibres/cm³.
Note: This table is reproduced from "Request from HSE for an opinion on the carcinogenic potential of glass fibre, glass wool, slag wool and rock wool. A resume of the revelant biological properties" which was prepared for the Committee on carcinogenicity.

ing: erionite samples: $^{-}1{\cdot}1 \times 10^{5}$; crocidolite: $6{\cdot}28 \times 10^{5}$; chrysotile: $348{\cdot}8 \times 10^{5}$. For fibre lengths equal to or smaller than 5 microns the difference is even more pronounced. These observations do not rule out other important factors in possible reasons for a gradient in fibre potency, such as chemical differences in fibre types, durability (persistence in tissues), and possibly others. For a similar mass, a sample with a higher number of fibres would also have a larger surface area than a sample with lower fibre number.

At present, TLVs for asbestos fibre types are in fibre numbers almost everywhere, whereas gravimetric standards (from ~5 to 10 mg/m³) are still the current rule for manmade mineral fibres in many countries, although some national regulatory authorities have recently adopted standards in fibre numbers. Thus it will be interesting to follow up the developments and to watch how TLVs for manmade mineral fibres will eventually compare with each asbestos fibre type.

Meanwhile, carefully planned animal experimentation, where doses are measured in fibre numbers, and where results are expressed in effects//fibre number, would certainly help to support the contention that if chrysotile must be controlled to low levels such as 1 f/ml, manmade mineral fibres must also be controlled at the same levels (and possibly lower levels in the case of rock wool). The manmade mineral fibres, as well as the refractory (ceramic) fibres, are used/proposed as asbestos substitutes in many applications including friction materials, thermal insulation, fibre reinforced plastics and resins, and gaskets and joints.

Current status of regulation for manmade mineral fibres

Regulations governing exposure to manmade mineral fibres in many countries are still based on gravimetric measurements, from ~5 to 10 mg/m³. Sweden and Poland, however, have now turned to fibre number (2·0 f/ml), and Denmark, Norway, and Sweden are considering a TLV of 1·0 f/ml. Superfine manmade mineral fibres are classified as a "suspected carcinogen" by Austria and the USSR, and are strictly regulated in the United Kingdom with a TLV of 1·0 f/ml. In the United States the Occupational Safety and Health Administration is considering a recommendation of 3 f/ml made by the National Institute for Occupational Safety and Health. Methods for fibre counts are already available. The ISO has published a proposed method (Determination of the number of airborne inorganic fibres by phase contrast optical microscopy-membrane filter method) which is expected to be officially adopted in 1989 or 1990.[7] The WHO/Regional Office for Europe/Copenhagen has also published a reference method for measuring airborne manmade mineral fibres.[8]

It seems therefore that the stage is set for an increasing trend away from gravimetric data to fibre counts, and that if TLVs are to be expressed in fibre numbers per unit volume of air such TLVs should be based on scientific data which are reported on the basis of fibre number rather than on a mass basis.

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