EXHIBIT
UC-1139

INTERNAL CORRESPONDENCE

CHEMICALS AND PLASTICS

P. O. BOX 471, TEXAS CITY, TEXAS 77590

TO (NAME) Mr. T. L. Rapp
COMPANY
LOCATION

DATE February 9, 1973

COPY TO Messrs. W. C. McNutt
D H. Glenn, M.D.
R. L. Yelton

SUBJECT Asbestos Training Film

Dear Tom:

The Training Director, Mr. Wayland McNutt, just informed me that a video tape is in the making to train craftsmen on how to protect themselves from asbestos exposure while doing their job. The idea is a good one. However, since control of asbestos exposure is supposed to be my area of expertise, it strikes me rather strangely that no opportunity has been presented me to have any input as to the content of such a program.

I question the judgment of the planners in not including anyone in the field of environmental health as a part of this effort. In the future I should hope we would be included as a vital part in the planning of such training programs.

Very truly yours,

Don

D. E. Deese, M.P.H.
Senior Industrial Hygienist
Gulf Coast Area

DED/eb

The ideal chemical composition of chrysotile approximates 44% MgO, 43% SiO_2, and 13% H_2O, although small amounts of other elements such as iron, aluminum, and nickel may substitute for magnesium in the structure (2,4). Chrysotile will decompose under severely acid conditions (5), whereby essentially all the MgO and H_2O are dissolved, as indicated by a 56% weight loss, leaving behind a silica skeleton. Amphibole forms of asbestos possess superior resistance to acid.

Chrysotile also decomposes at elevated temperatures (6,7) and exhibits an intense dehydroxylation endotherm at approximately 650°C and an exotherm at 820°C which is believed to be associated with the formation of forsterite (Mg_2SiO_4) and/or enstatite ($MgSiO_3$).

The nature of chrysotile bears an important relationship to its atomic structure. Together with the other serpentine minerals, lizardite and antigorite, chrysotile is classed as a phyllosilicate or "sheet-like" silicate. All three minerals are considered polymorphs of the same basic chemical composition, and are built up of similar, infinite, two-dimensional sheets. Each individual sheet consists of a silicate layer and a magnesium hydroxide layer, with an overall thickness of 7.3A.

A small, but important, difference in the preferred lattice spacing of the silicate and magnesium hydroxide layers appears to cause the wide variations in morphology of serpentine mineral In chrysotile, the strain caused by this difference is relieved when several adjacent sheets "curl up" to form the hollow tube structure that constitutes an individual chrysotile filament. High resolution electron micrographs of chrysotile fibers in cross-section have shown both the multiple spiral pattern and the characteristic hollow center of this structure very clearly (8). The three known varieties of chrysotile are related to the manner in which these spirals form. Clino-chrysotile, the most common type, curves around the a axis of its monoclinic unit cell. In ortho-chrysotile, the unit cell is orthorhombic, but curvature remains around a. A rarer form, parachrysotile, also has an orthorhombic unit cell but is curved about the b axis.

Antigorite and lizardite must relieve the same strain, but they do so by quite different mechanisms: antigorite forms a "wavy" sheet structure with a very long unit cell repeat, while lizardite generally contains other elements that substitute within the silicate or magnesium hydroxide layers in a manner that equalizes the lattice spacings. It is interesting to note that, although the differences in morphology between the filament structure of chrysotile and the plate-like or lath-like habit of antigorite or lizardite are conspicuous, the similarities in structure on the atomic scale make it relatively difficult to distinguish these serpentine minerals from each other by X-ray powder diffraction (2).

The characteristic morphology of chrysotile fibers can be observed with the transmission electron microscope, an important aid in their identification. The interior cavity of a chrysotile fiber is usually visible and has an average inner diameter of 80-100Å. However, a hollow center is not always seen (8), and amorphous material may be observed within the interior of the filaments (2). Outer diameters of chrysotile fibers range from 150 to 1000Å. The mean diameter is about 340Å in the industrial samples we have examined, but other reports (2,8) cite mean diameters from 250 to 500Å. The narrowness of its individual filaments gives rise to one of the most important physical properties of chrysotile asbestos, namely, its very high specific surface area which can be in excess of 10 m^2/g. Fibers of the amphibole varieties of asbestos are considerably larger in cross-section (9).

The ratio of length to diameter, known as the aspect ratio, may be quite large for individual chrysotile fibrils. Aspect ratio of several hundred are normal for most vein materials, but very short fibers with aspect ratios of 5 to 10 may be found in the serpentinite matrix of many ore bodies (2). Mean aspect ratios in samples related to the chlor-alkali process range from about 30 to over 400, corresponding to average lengths up to about 15 microns. Obviously, any processing which tends to shear or gri the asbestos will both increase the number of fibers and decrea their aspect ratio.

Chrysotile may occur either as individual fibrils or as bundles of fibrils. Since the diameters of single chrysotile filaments are only a fraction of the wave length of visible light, individual fibers cannot be resolved visually, even with the best optical microscope. The measurement of chrysotile by optical methods is therefore confined to material which may occur as bundles or other filamentary masses.

The electron microscope is by far the most useful instrument for identification and quantification of individual chrysotile fibers. With an instrument equipped with accessories for selected area electron diffraction and energy dispersive X-ray spectroscopy, the morphological data can be supplemented with the diffraction pattern and quantitative elemental identificat applied to individual particles. When somewhat larger quantit are involved, a successful analytical technique--atomic absorp spectroscopy (10), infrared spectroscopy (11), X-ray diffracti (12), differential thermal analysis (6), optical microscopy/in of refraction (3)--can be devised by exploiting some of the characteristic chemical and physical properties discussed abov

REFERENCES

(1) P. B. Meijer and W. E. DeKoning-Pierens, TNO Nieuws 27, 661 (1972) (Eng.).

(2) F. A. Mumpton, Siemens Review XLI, 75 (1975).

(3) W. C. McCrone and I. M. Stewart, American Laboratory 6 (4) 13 (1974); Y. Julian and W. C. McCrone, The Microscope 18, (1970).

(4) E. J. W. Whittaker and F. J. Wicks, Amer. Mineral. 55, 102 (1970).

(5) M. S. Badollet, Can. Mining Met. Bull. No. 468, 237 (1951)

(6) J. P. Schelz, Thermochimica Acta 8, 197 (1974).

(7) L. A. Drobyshev and Ya. Ya. Govorova, Kristallografiya 16, 544 (1971) (Russ.).

(8) K. Yada, Acta Cryst. 23, 704 (1967).

(9) D. V. Rosato, "Asbestos, Its Industrial Applications." Reinhold Publishing Corp., New York, 1959, p. 43.

(10) R. G. Keenan and J. R. Lynch, Amer. Ind. Hyg. Ass., J. 31, 587 (1970).

(11) J. A. Gadsden, J. Parker, and W. L. Smith, Atmos. Environ 4, 667 (1970).

(12) K. Goodhead and R. W. Martindale, Analyst (London) 94, 985 (1969).