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THE CONCENTRATION AND STUDY OF THE
INTERSTITIAL MATERIAL IN
CHRYSTILE ASBESTOS

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ABSTRACT

Electron microscopic studies reported in the literature have shown chrysotile asbestos to have a tubular morphology with a heretofore unidentified material filling the voids between fibers. This fine material is believed by some to be amorphous and by others to be crystalline. By placing chrysotile crudes in an ultrasonic field transmitted through a liquid the fine material was dispersed, making it possible to separate it from the bulk of the fiber. Electron diffraction and microscopic studies of the concentrates of the interstitial material from three samples indicate that it is amorphous and may vary in size.

INTRODUCTION

Electron micrographs of individual fibers of chrysotile have shown it to have a tubular morphology (Turkevich and Hillier, 1949; Bates *et al.*, 1950). Studies with bulk specimens revealed a fine material filling the interstices between fibers (Bates and Comer, 1959); Maser *et al.* (1960) examined thin cross sections of chrysotile and observed material plugging the voids. Pundsack (1956) and Kalousek and Muttart (1957) measured the densities of intact bundles of chrysotile and concluded there was a small void volume; a subsequent investigation (Pundsack, 1961) described the pore size distribution of chrysotile indicating material filling the interstices. Whitaker (1957) suggested that the fine material has the same composition and structure as the tubes but in the form of curved laths; Bates and Comer (1959) describe the interstitial material as "amorphous appearing."

These studies have not resolved the difference of opinion as to whether the material filling the voids is crystalline or amorphous. The dispersion of the fine material during the fiberization of chrysotile by ultrasonic energy made it possible to obtain a concentrate of the fine material which could be examined with the electron microscope.

DESCRIPTION OF EQUIPMENT AND SAMPLE PREPARATION

Ultrasonic unit. A Westinghouse Corporation ultrasonic cleaning system WEHH was used to fiberize the chrysotile samples. The following is a description of the generator and cleaning unit:

Generator		Cleaning Unit	
Model	M 2000	Model	SLA-10
Frequency	20 kc nominal	Capacity	3 gal. (11"×10"×8")
Power Out	1000 watts ¹	Transducer	Magnetostrictive
Power In	110 v., 20 a., 60 cps.	Frequency	20 kc nominal

¹ Variable from 200 to 1200 watts.

Three grams of chrysotile crudes, from which the ends had been cut to minimize contamination from wallrock material, were pulled apart with tweezers. The chrysotile was placed in a small bottle with 200 ml of methanol which was then put in the ultrasonic cleaning unit filled with water. The sample was subjected to the ultrasonic energy for 30 minutes at a power output of 1200 watts.

The chrysotile was fiberized by the ultrasonic energy and the methanol became cloudy due to the dispersed colloidal material and fine chrysotile down to unit fibers. The solution was carefully decanted from the bulk of the chrysotile and then centrifuged to remove the solids consisting of a mixture of the fine material and some chrysotile fibers.

Electron microscope and diffraction. An RCA Model EMU-2D electron microscope was used. Specimens were prepared by placing drops of the diluted suspensions of fine material on grids containing collodion substrates. Electron diffraction patterns of several areas of each specimen were obtained by the selected area diffraction technique using platinum apertures of various sizes to examine fields as small as 2 microns in diameter.

Samples. Chrysotile crudes from the following Canadian mines were subjected to the ultrasonic treatment

Lake Asbestos of Quebec, Black Lake, Quebec
 Johns-Manville, Asbestos, Quebec
 Bell, Thetford Mines, Quebec
 Vimy Ridge, Quebec
 Cassiar, British Columbia

All samples liberated an ultrafine material when subjected to ultrasonic irradiation. However, electron micrographs and diffraction patterns were obtained only on the fine material from the Lake Asbestos of Quebec and Johns-Manville chrysotile samples.

RESULTS AND DISCUSSION

An electron micrograph of the fine material dispersed from a chrysotile crude by ultrasonic energy is shown in Fig. 1. The decanting and centrifuging procedure for concentration of the fine material was not completely effective in eliminating all of the chrysotile fibers, but it was

possible with the electron microscope to select a field containing only the fine material. A study of the electron diffraction patterns indicated that the fine material is not crystalline.

The fine amorphous material fills the interstices between fibers so it is logical to assume that it may have an effect on both the physical and chemical properties of a given fiber. Study of the electron micrographs of the amorphous material indicated an apparent difference in the size of the particles. The fine material obtained from the Asbestos, Quebec,

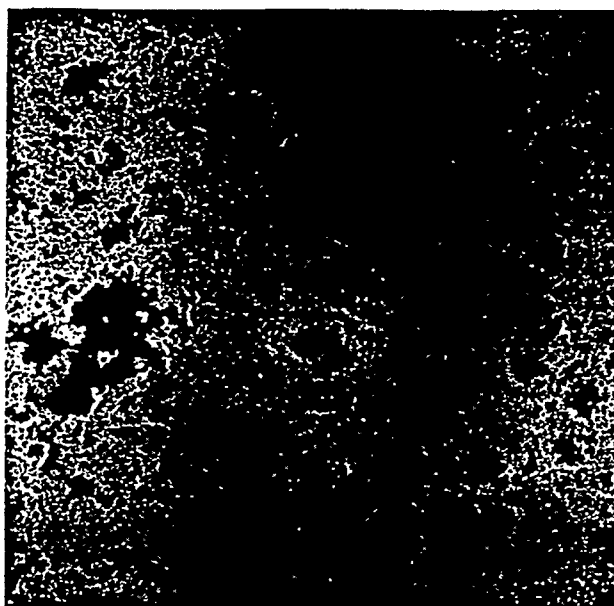


FIG. 1. Electron micrograph of dispersed fine material from chrysotile crude, Black Lake, Quebec.

sample appeared to be smaller in size compared to the one shown in Fig. 1. Whether this is due to lack of dispersion in the coarser material is not known. Only three samples from two sources were submitted for observation with the electron microscope so definite conclusions are not possible. However, this may be a real difference. If so, the size of the amorphous particles may be the reason chrysotile varies in harshness or softness of fiber depending on the source (Cirkel, 1910; Soboleff and Tatarinoff, 1933). Further study of samples from many sources will be required to verify this hypothesis.

A surface property such as the zeta potential may be influenced by the amorphous material. The effect of pH on the zeta potentials of chrysotile has been studied using two techniques. Pundsack (1955) measured the turbidities of standardized chrysotile suspensions in which the pH had been adjusted by the additions of sodium hydroxide or hydrochloric acid. The chrysotile had been finely ground and the suspensions allowed to settle for forty minutes. Minimum turbidity was obtained at a pH of 10.1 and this was called the isoelectric pH, with the zeta potential being positive at lower pH's and negative in more alkaline solutions. Martinez and Zucker (1960) obtained an isoelectric pH of 11.8 using streaming potential measurements with chrysotile samples that were not extensively ground.

The zeta potential investigations were run on chrysotile crudes obtained from two sources in Quebec. However, the difference in results may possibly be due to the amount of grinding required; the turbidity procedure involved a severe grinding of the sample which would liberate the amorphous material. It is conceivable that the turbidity measurements were made on a system containing a higher concentration of the amorphous material than in the original crude since the fine amorphous particles would stay in suspension, whereas the coarser chrysotile fibers would settle out.

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