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On the Utility of Dark-Field Electron Microscopy in the Determination of the Degree of Deformation in Chrysotile Asbestos: An Environmental Research Application

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The degree of microcrystalline deformation in fibers of chrysotile asbestos may be distinguished using high resolution dark-field electron microscopy. This is demonstrated by comparing undeformed chrysotile with Union Internationale Contre le Cancer (UICC) standard reference samples. The UICC samples are shown to be partially deformed as a result of milling in the mixing process. Samples of used and unused brake shoe lining dust were examined using this technique; it is shown that chrysotile asbestos in various stages of deformation—relatively undeformed to heavily deformed—survives in automobile brake drum dust. Such dark-field images can serve to identify the source of asbestos found in environmental pollution samples.

INTRODUCTION

There is a controversy in the literature whether or not fibers of chrysotile asbestos survive in automobile brake drum dust; two studies (Rohl *et al.*, 1976; Alste *et al.*, 1976) report that the fibers do survive and earlier work (Lynch, 1968; Hickish and Knight, 1970) reports that they do not. The latter claim that the chrysotile is converted to forsterite under the high temperatures attained in the braking process.

As high resolution dark-field electron microscope images are sensitive to the degree of deformation, they can be used to distinguish between deformed and undeformed fibers and thus to resolve these two differing sets of results. It is shown using this technique that chrysotile asbestos fibers in various states of deformation—relatively undamaged to heavily deformed and recrystallized—exist in automobile brake drum dust.

SAMPLE SELECTION AND PREPARATION

Four samples were selected: (A) undeformed chrysotile ore samples from serpentine outcrops of Calaveras County (California); (B) slightly deformed UICC reference standards of Canadian chrysotile milled during preparation to reduce fiber size (Timbrell *et al.*, 1969); (C) unused brake lining dust, collected during burnishing prior to installation of new brake shoes; and (D) brake drum dust collected from the front and rear brake drums of a State vehicle obtained during brake shoe service (Seshan and Smith, 1977).

Samples were transferred directly to Formvar-coated electron microscope grids and coated with carbon on both sides.

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