



Characterizing asbestos fiber comminution resulting from preparation of environmental samples

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Abstract

The evaluation of asbestos fibers by transmission electron microscopy requires that particulate be deposited on a filter and that the filter be prepared for analysis in a manner that retains the spatial characteristics of the particulate as it was deposited. Occasionally, the samples are prepared by redistributing the particulate onto a second filter. While numerous reports have described the effect of the redistribution of the particulate in terms of the number of particles or the resulting size of particles, no study has attempted to model the effect of redistribution. The effect of this redistribution on particle size is evaluated here and is described using standard comminution models. The proposed model is shown to reasonably fit the observed data.

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1. Introduction

The microscopic evaluation of environmental asbestos fibers is a multi-step process requiring the deposition of particulate on a filter, preparation of the filter for analysis, and analysis of the prepared material. The particulate, whether airborne or surface dust, is collected by pulling air, using a vacuum pump, through either a polycarbonate or mixed cellulose ester filter. The preferred sample preparation procedure is to transfer the collected particles from the filter to a carbon film in a manner that preserves the size and spatial arrangement of the collected particles (termed “direct” preparation). The carbon film is then inserted into the microscope for analysis.

Direct preparation, the preferred procedure for exposure assessment, was the procedure used for determining asbestos exposure in cohort health risk investigations [1]. Because asbestos exposure standards have been established on the basis of these health studies [2], proper correlation of direct versus indirect sample preparation is essential if indirectly prepared samples are to be used for risk attribution.

A number of circumstances can occur that causes a sample to be collected that is overloaded with particulate. This may either prevent an acceptable particle transfer to the carbon film or the prepared sample may contain so many particles that the fibers of interest are obscured or otherwise hidden, thus potentially biasing the analysis. When this occurs, the samples are sometimes prepared using an intermediate step where the collected particles are suspended in water, agitated using an ultrasonic bath to disperse the particles, an aliquot transferred to a new filter, and the new filter prepared for analysis. This procedure is referred to as “indirect” preparation.

The use of these intermediate steps has been examined by several investigators [3–6] who have shown that the number of asbestos fibers increases when compared with direct preparation and that the size of the indirectly prepared fibers is shorter and thinner than those prepared directly. These investigators have also suggested that the indirect preparation procedure increases the variability of the measurements [3,4]. Crankshaw et al. [7] report median fiber dimensions before the indirect preparation of 3 μm long by 0.1 μm wide and 1.8 μm long by 0.067 μm wide after indirect preparation. The use of an ultrasonic bath to agitate the suspension has been suggested as the cause for the change in fiber dimensions as the use of ultrasonic energy

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