## Miller, Diane M. (CDC/NIOSH/EID)

**From:** James Webber [webber@wadsworth.org]
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**Subject:** Comments on NIOSH Asbestos Roadmap

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**Attached please find my comments on "Asbestos and Other Mineral Fibers: A Roadmap for Scientific Research" in both Word and pdf formats. Please let me know if there are any questions.**

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**Comments on the NIOSH Asbestos Roadmap**

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May 30, 2007

**Overview**

NIOSH is to be congratulated for its willingness to take a fresh look at exposure to airborne asbestos. Its Roadmap is a careful and accurate evaluation of what has been learned about asbestos and directions to be taken. From a laboratory analyst's perspective, I see three outstanding needs to be included in their final objectives.

**1. The need to switch to a TEM-based analytical protocol**

It was encouraging to read that NIOSH is recognizing the role of thin fibers in respiratory disease. Also, the Roadmap cited recent findings that demonstrate that short fibers cannot be overlooked in health studies. Analysis of these thin and short fibers will require that NIOSH change its analytical protocols from phase-contrast-light-microscopy-based methods (NIOSH 7400 & 7402) to a TEM method that will be able to detect *and* positively identify asbestos fibers of any size.

**2. The need to evaluate membrane filters used for collecting airborne asbestos**

Both of the NIOSH methods (7400 & 7402) for collecting airborne fibers require use of mixed-cellulose ester (MCE) filters. Our recent discovery of several problems with these filters will be published in the September 2007 issue of *Journal of Occupational and Environmental Hygiene* (Webber *et al.*, 2007). A summary our findings:

<u>Fibers are undercounted due to hot-block collapse.</u>

We found that the popular hot-block method for using acetone to collapse MCE filters (detailed in NIOSH 7400) produced non-uniform distributions of fibers. As seen in Figure 1, the hot block's vigorous blast of hot acetone vapor created windrows of fibers on limited areas of the filter, leaving larger areas of fiber depletion.

This uneven distribution can lead to a negative bias for two reasons. The first is that accumulations of particles in these windrows create discontinuities during the application of the carbon film. These discontinuities are weaknesses that cause carbon films to rupture. Since analyses cannot be performed on these ruptured films, only the fiber-depleted areas remain for analysis. Second, even if carbon films around windrows remain intact, analysts are more likely to select areas with less fiber/particle density because of their clarity. This hypothesis about hot-block's negative bias is borne out by results from our proficiency-testing program for TEM analysis of airborne asbestos on MCE filters. An evaluation of laboratories that produced consistent results (recovery RSD <40% for 5 chrysotile rounds) revealed that laboratories using hot block reported approximately half the chrysotile asbestos concentrations of laboratories using the original dimethylformamide method (Table 1).

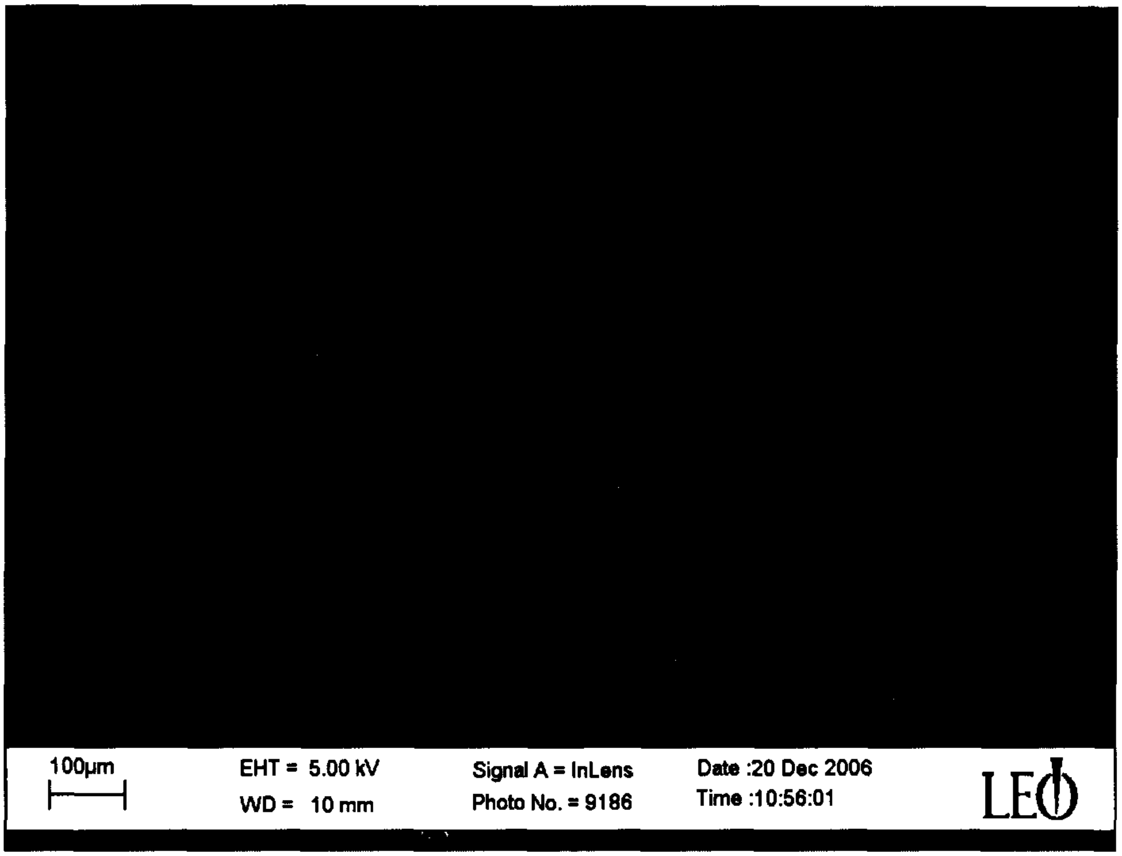


**Figure 1. Scanning electron micrograph of non-uniform distribution of fibers (accumulated in light-colored diagonal band) on MCE filter collapsed by hot block.**

**Table 1 Effects of MCE collapsing method on fiber recovery.**

| Collapsing Method | Laboratories | Recovery | RSD |
|---|---|---|---|
| Dimethylformamide | 5 | 155% | 26% |
| Acetone Atmosphere | 4 | 123% | 15% |
| Hot Block | 9 | 87% | 18% |

<u>Variation in etching of MCE filters alters fiber recovery</u>

The original MCE method of Burdett and Rood (1983) required an etching step to expose small fibers that might lie below the surface of the collapsed filter. (This step was not needed for NIOSH 7402, which was concerned only with large fibers.) Our in-laboratory studies showed that changing the amount of etching can cause losses of different fiber sizes.

<u>Fibers are more prone to be tilted in MCE filters</u>

Briefly, we found that tilting (out of perpendicular to the TEM beam) was more likely for fibers collected on MCE filters than for fibers collected on polycarbonate (PC) filters.

This can produce a negative bias because 1) tilted fibers will appear shorter than their actual length and thus possibly fall below a mandated fiber-length cut-off or 2) tilted fibers can produce SAED layer-line spacings that fall outside the 0.53-nm identification criterion.

Variations in manufactured MCE products can degrade uniform fiber distribution
All MCE filters are *not* created equal. The islands of non-porous MCE on the filter in Figure 2.b will undoubtedly create anomalies in distribution of collected fibers. Because MCE filters are collapsed to produce a smooth surface before analysis, analysts will remain unaware of any original surface anomalies. (Myron Getman uncovered this problem after our manuscript was accepted by *JOEH*).

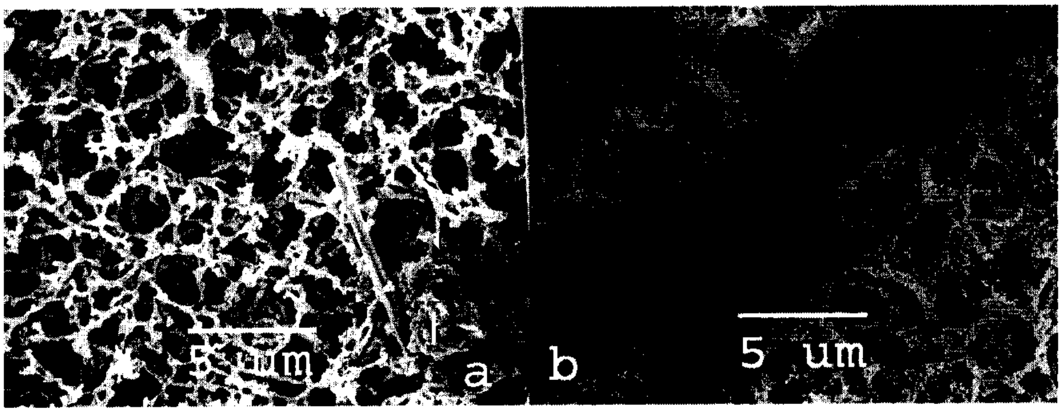


**Figure 2. Scanning electron micrographs of two 0.45-µm MCE filters. a, Manufacturer A; b, Manufacturer B. (Courtesy of Myron Getman)**

In fact, the pore sizes of MCE filters have little relation to length or diameter of retained fibers. MCE filters are tortuous-path filters whose nominal pore diameters are determined by the specific size of a bacterial species that can pass through the filter. For example, the 0.22-µm pore determination is made by passage of *Pseudomonas diminuta* (Chatfield 2000a). PC filters, on the other hand, have pore diameters that have been determined by actual measurement of their uniform capillary diameters. New solvents (Chatfield 2000b) have resolved the problems with residue around pores heated during carbon evaporation. Our laboratory, which uses PC filters for many applications, has not noticed the asbestos-contamination problems that were seen two decades ago.

**3. The need to include fibrous talc in any investigation of non-"asbestos" fibers**
In Section 1.2.1.1, NIOSH correctly reports that mineral fibers not traditionally termed "asbestos", but that share similar properties, need to be evaluated. In addition to the Libby amphiboles and erionite mentioned in this section, NIOSH should also take a closer look at fibrous "talc". Some sources of this material contain fibrous anthophyllite as well as intergrades between fibrous anthophyllite and fibrous talc. Pages 9 and 10 of the Roadmap cite evidence that occupational exposure to this (still-widely-exploited) mineral suite has negative health impacts. Laboratory studies on toxicology of these fibers should focus on the thoracic-size fraction, since these small fibers are the ones most likely to interact with lungs.

## References

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