



Asbestos Analytical Methods

Bulk Samples

Polarized Light Microscopy (PLM) EPA/600/R-93/116

This method is used to determine the percent asbestos in bulk building materials. The sample is first examined under a binocular microscope to determine homogeneity and possible asbestos type and content. If necessary, the sample is homogenized and pulverized, or layers are separated to analyze independently. A portion of the sample is mounted in refractive index oil. This mount is examined under the polarized light microscope where the analyst measures the optical properties of any fibers in the sample to determine if they are asbestos and of which type. Results are given as the area percent asbestos by visual estimate.

Point Counts by PLM EPA/600/R-93/116

The EPA/600/R-93/116 method contains a section on Point Counts. This procedure is used to better characterize bulk materials with close to 1% asbestos. It is applicable to friable bulk material, but not to material with organic binder, such as roofing tar. By this method, the analyst examines 100 randomly chosen particles on each of 4 slide mounts and records the type of particle at each point. The asbestos percentage is determined by dividing the number of asbestos particles detected by the total number of particles examined (400).

Bulk Samples by TEM

The method, EPA/600/R-93/116, includes a section for TEM analysis of bulk samples. The sample must be ground to a very fine powder then mounted on a TEM grid for analysis. This method works well for samples such as floor tiles that contain fibers that may be too small to detect at PLM magnification. It also helps to identify coated fibers or other problematic materials. Results are given as area percent asbestos. Gravimetric prep is required for materials that cannot be readily ground, such as mastic, papery material, granular plasters, etc.

Gravimetric Prep of Bulk Samples

This prep method produces a more accurate estimate when the asbestos percent is close to 1%. Also, materials with organic binder, such as roofing tar or flexible vinyl tiles, must be prepped gravimetrically in order to perform PLM or TEM analysis. In using the gravimetric prep method, we weigh a portion of the sample, remove non-asbestos material by ashing and acid treatment, then weigh the residue. The analyst determines the percent asbestos in the residue, then calculates the asbestos percent in the sample before gravimetric reduction. Analysis of the residue can be done by PLM, TEM or both.

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Air Samples by Phase Contrast Microscopy (PCM) - NIOSH 7400

This method is used to analyze filter samples for airborne fibers. The analyst examines a known area of the filter and counts fibers $>5 \mu\text{m}$ long and $>0.25 \mu\text{m}$ in diameter. All fiber types, asbestos and non-asbestos, are counted; fiber types cannot be distinguished. This method is used mainly for personal samples and occupational exposures to meet OSHA requirements. Total fiber concentrations are given in Fibers per mm^2 of filter area and Fibers per mL (same as Fibers per cc). Particle sizing of material roughly $1\text{-}100 \mu\text{m}$ in size can also be performed using PCM.

Transmission Electron Microscopy (TEM)

Using Transmission Electron Microscopy the analyst can identify the different asbestos minerals by measuring the Selected Area Electron Diffraction (SAED) pattern, produced by the mineral's internal crystal lattice structure; and by examining the fiber's Energy Dispersive X-ray Analysis (EDXA) spectrum, which reveals the elemental composition of the fiber.

Air Sample Methods

NIOSH 7402 is intended to be the TEM equivalent of the PCM method, NIOSH 7400, and is used for personal samples. The PCM method will tell you total fiber concentration, regardless of fiber type. The TEM 7402 method will tell you the concentration of each asbestos fiber species and the total non-asbestos fiber concentration. As in PCM method NIOSH 7400, fibers $>5 \mu\text{m}$ long and $>0.25 \mu\text{m}$ in diameter are counted. NIOSH 7402 requires a minimum volume of 400 liters; the volume should be adjusted to achieve a loading of 100 to 1300 fibers per mm^2 . Results are given as fiber counts, fibers per mm^2 of filter area, and fibers per mL.

The AHERA method is intended to test an area for clearance. This method requires a minimum air volume of 1200 liters. A sufficient filter area must be analyzed to achieve a limit of detection of 0.0050 structures per mL. Asbestos structures, (fiber, bundle, cluster, matrix), are counted rather than individual fibers. The fibers making up the structures must be $>0.5 \mu\text{m}$ long (no minimum width). This method would give you the concentration of asbestos fiber structures $<5 \mu\text{m}$ long, which would not be counted using NIOSH 7402. Non-asbestos fibers that are detected are noted but are not counted.

The EPA Yamate Method, Levels 1, 2 & 3, are similar to the EPA AHERA Method. Some of the differences include filter type (AHERA uses 25-mm, 0.45 μm , MCE filters; Yamate uses 37- or 47-mm, 0.4 μm PC filters). The structure counting rules are basically the same as AHERA, except that rather than attaining a particular LOD, Yamate requires counting 100 structures or analysis of 10 grid openings before stopping. By the Yamate method, the mass concentration of asbestos (μg asbestos per mL of air) is also reported.

- **Yamate Level 1** is used for screening samples, and asbestos fibers are identified by morphology and visual inspection of the SAED pattern. Asbestos is identified as chrysotile or amphibole only.
- **Yamate Level 2** is used for regulatory action. Asbestos types are identified by morphology, SAED patterns and EDXA elemental analysis; the different amphibole asbestos mineral species are distinguished.
- **Yamate Level 3** is used for confirmatory analysis of controversial samples. This level additionally requires measurement and recorded images of SAED zone axis patterns.

Dust Sample Methods

The method, ASTM D 5755-03, is used to analyze microvac dust samples for asbestos, and ASTM D 6480-05 for asbestos analysis of settled dust collected using wipes. For ASTM D 5755-3, the sampler uses an air pump and connects a tube to the inlet of a PCM cassette to collect dust from a 100-cm^2 area. Using the alternate method, ASTM Method D 6480-99, the sampler uses ghost wipes to collect the sample. In the lab, we rinse the dust from the original cassette or the wipe, suspend it in water, and re-filter the suspension. The second filter is analyzed by TEM, and asbestos structures $>0.5 \mu\text{m}$ long are counted. Concentrations of each asbestos species and total asbestos are given in Structures per cm^2 of sampling area.

Drinking Water Method

EPA/600/4-83-043, methods 100.1 and 100.2, are used to analyze drinking water samples for asbestos. Three volumes of the sample are filtered. The analyst picks the filter with the best loading for analysis. Asbestos fibers $>10 \mu\text{m}$ long are counted. Results are given in Millions of Fibers per Liter (MFL). Waste and surface water samples can be analyzed by this method. However, if they contain a large amount of sediment, we may not be able to attain the EPA drinking water LOD of 0.2 MFL.

