D15 Identification of Building Insulation and Soundproofing Products by Light and Electron Microscopy

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After attending this presentation, attendees will better understand how Polarized Light Microscopy (PLM), Scanning Electron Microscopy/Energy Dispersive X-ray Spectrometry (SEM/EDS), and Analytical Electron Microscopy (AEM) were used to determine the composition of insulating and soundproofing materials.

This presentation will impact the forensic science community by providing an analysis procedure that was developed over several years and used to determine the composition of insulating and soundproofing materials so they could be compared to the manufacturers' formulas for the purpose of cost-recovery litigation to reimburse the building owner for the cost of abatement.

When the Environmental Protection Agency (EPA) was tasked in the late 1980s with the implementation regarding the inspection of schools for Asbestos-Containing Materials (ACM) and the decision to remove materials that were friable, litigation resulted in the acquisition of formulas used by companies identified as producing ACM. The analysis methodology developed, once the formulas were decoded and the array of terminology used for raw materials by different companies was understood, required the microscopical characterization of the ingredients utilizing PLM, SEM/EDS, and AEM (Transmission Electron Microscopy/Energy Dispersive X-Ray Spectrometry (TEM/EDS) with selected area diffraction) on each sample.[1] By analyzing the sample using this combination of microscopical techniques, a cross-check was provided during the analysis ensuring that all of the ingredients were accurately characterized. For example, if PLM detected gypsum, vermiculite, and montmorillonite clay, then SEM/EDS and AEM would be expected to find the same ingredients. Other analytical techniques such as X-Ray Diffraction (XRD), Gas Chromatography (GC), loss on ignition, and acid-soluble weight percents were employed when the sample matrix required additional work.

Once a building survey was completed, samples were examined for the presence of asbestos using the regulatory definitions of the fibrous asbestos minerals amosite, chrysotile, tremolite, actinolite, anthophyllite, and crocidolite. Samples were then submitted to the laboratory to determine the composition of the material for comparison to formulas provided by the courts. Samples were photographed "as received" to document number and layer sequence. Multi-layered samples were treated as multiple samples requiring a complete analysis of each layer. PLM analysis was performed using slide mounts prepared to obtain visual estimates of the materials comprising each sample. Sub-samples were obtained and distributed for acid-soluble weight percent, SEM/EDS, and AEM analysis. Samples containing low amounts of acid-insoluble materials required the reanalysis of the acid-insoluble material collected on the filter during the acid digestion procedure using 10% v/v hydrochloric acid. Mineral wools could be removed from most samples by heating the 10% HCl solution and dissolving the mineral wool.

Although the types of asbestos fibers present were important, the materials were sorted based on their major, minor, and trace components. Many products could be differentiated based on their determined composition when compared to the formulas provided. Some products were very similar among manufacturers and could not be differentiated by microscopical techniques alone. Major components such as gypsum, Portland cement, glass fibers (including mineral wools), clays, and diatoms (including synthetic materials produced from diatoms) were identified using the combination of microscopical techniques described.[2,3] AEM was especially useful for the asbestos identification, clay identification, and other crystalline minerals used in the various formulations.

Reference(s):

1. Millette J., Boltin W., Brown R. A Dictionary of Terms Related to Additives Found in Asbestos Building Products. *Microscope*, Vol47:3, 163-171, 1999.
2. Brown R., Bandli B., Boltin W., Millette J. Light and Electron Microscopy of Mineral Wool Fibers. *Microscope*, Vol55:1,7-44, 2007.
3. Millette J.R., Brown R.S. Environmental Forensic Microscopy. Chapter 13 In: *Introduction to Environmental Forensics*, 3nd Ed., B. L. Murphy and R. D. Morrison, Eds., Academic Press, Elsevier, Amsterdam. pp:487-511. 2015. Published on-line Sept, 2014.

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