ASBESTOS IN SETTLED DUST: A BRIEF REVIEW

Background: Federal, State, and local asbestos regulations have established criteria for worker exposures, building occupancy, clearance levels, bulk sampling and analysis, and even safe drinking standards for water. These rulings are the keystone upon which laboratory results are interpreted and engineering and/or remediation controls applied. [1] In addition, similar standards for laboratory quality assurance and accreditation programs have continued to refine analytical sensitivities through proficiency testing programs.

Asbestos hazard control issues and asbestos laboratory development have matured over the last several years. Issues that used to cause controversy are now routine. The limitations of fiber counting by Phase Contrast Microscopy (PCM) have been answered by the continued utilization of Transmission Electron Microscopy (TEM) for the quantitation and qualification of suspect fibers in air thus eliminating non-asbestos fibers for critical exposure data. [2] Point Counting regimens are now routinely applied for more precise quantitative results by PLM [3]. Limitations inherent to the examination of floor tiles, roofing samples, and other Non-friable Organically Bound (NOB) materials by Polarized Light Microscopy (PLM), have been overcome with gravimetric reduction techniques as refined by ELAP 198.4 through TEM [4].

Consistent advances also include the development and use of a new improved EPA 600 Method for the analysis of asbestos in bulk building materials [5,6]. This 1993 method far exceeds the Interim Method published in 1982. NESHAP, OSHA, and other regulating bodies have posted rulings or interpretations regarding sheetrock and joint compound analyses. Methods (EPA 100.1 and 100.2) have been published that refine field and analytical approaches to asbestos in drinking water and wastewater. [7,8]

Another area that has experienced great improvement in both field and laboratory application concerns asbestos in settled dust. Most matrices involving asbestos leave little room for interpretation. For instance, clearly defined field sampling protocols and laboratory test methods exist for airborne asbestos, for asbestos in bulk building materials, for asbestos in water, etc. Asbestos in settled dust has, for too long, existed in a gray area, between the regulations and analytical details surrounding building materials, and those involving the potential for airborne exposure. This gray area has caused much debate among asbestos engineering and consulting professionals [1]. The laboratory professionals have known the limitations of analytical requests but have had little established methods for guidance. Indeed, the last source for direction on such gray areas is the government. "Governmental compliance monitoring methods for asbestos have proved to be more difficult to amend" because of any perceived increased cost and burden to the public. [9] The analytical community, through organizations like the American Society for Testing and Materials (ASTM), constantly develop, review, and amend field and laboratory methods. These published methods are, many times, what the environmental professional acknowledges as "state of the art". It is the ASTM Method D-5575 for Asbestos in Settled Dust that is the basis of this discussion.

Why is asbestos in dust a problem? The 1994 OSHA asbestos regulations housekeeping section discusses that "dust and debris in an area containing thermal system insulation or surfacing ACM/PACM or visibly deteriorated ACM, shall not be dusted or swept dry, or vacuumed without using a HEPA filter." OSHA recognized the potential for custodial and maintenance worker exposure under these conditions. [10] In addition, the National Institute of

Building Sciences (NIBS) addressed this issue in their Second Edition of the Guidance Manual Asbestos Operations and Maintenance Work Practices. The concerns with settled dust are that routine housekeeping or maintenance work may result in unnecessary worker exposures or further contamination of a building environment.

Studies have shown that normal activity in buildings with ACM lead to the release of the fibrous mineral from its building material matrix. [11] Ambient or existing conditions settled dust sampling in some buildings is needed to develop cost effective operations and maintenance programs and provide guidance to the building owner. During asbestos removal work, visible dust adjacent to containment areas may be suspected of contamination and require sampling. Building owners who have experienced an episodic release of asbestos (steam main burst, water damage, etc) are often left with the scenario of cleaning up all dust by "assuming" it is asbestos contaminated.

From an assessment perspective, debris (containing visibly recognizable pieces of building materials) can be sampled and analyzed by established means (PLM with either asbestos reported as a function of area percent, by volume percent, or by weight percent) and controls incorporated as management plans dictate. The sampling and analysis of dust presents several challenges discussed below. <u>The overall concern continues to be the potential for any asbestos to be reentrained into the air at levels exceeding exposure thresholds</u>.

<u>Settled Dust Sampling and Analysis.</u> The sampling and analysis of asbestos in settled dust presents several challenges. There are several options available to sample for asbestos in dust. These range from adhesive tape, wipe techniques, micro-vacuum protocols, Post-It note type sampling, removing whole swatches of material exposed surfaces, etc. Several studies have noted clear advantages and obvious disadvantages of these means of field sampling. [12, 13, 14, 15] The efficacy of certain techniques are evident in their ability to recover known amounts of asbestos from the matrix and in their ability to perform accurate and reproducible analyses.

In many cases PLM has been requested as the analytical tool to examine dust samples. Though this instrument, and its associated stereoscopic procedures, is the method of choice for bulk building materials, its inherent optical limitations can not resolve asbestos fibers typically found in settled dust. Furthermore, wipes and other adhesive tape methods many times introduce a factor of substrate matrix interference.

After years of peer review, ASTM published a thorough and detailed field sampling and analytical method for asbestos in settled dust. [16] It is this method that is established as a tool that can be used by the environmental and laboratory professional to quantitatively assess asbestos in this matrix. Corollaries exist that relate the results of these tests to potential for airborne asbestos reentrainment. [17, 18] In fact, empirical models have been developed that factor the type of asbestos building material present and the degree of severity of activity that might disturb the ACM, as its relates to potential reentrainment, and hence for any engineering or remediation controls employed . [19]

This method is taught by ASTM in its Asbestos Control Course. A key component of this course is the statement that there are no official EPA policies, no official methods, and no accredited laboratories for asbestos in settled dust. There is however, a Memorandum of Understanding from the EPA regarding this subject. This letter, does not necessarily sanction the ASTM Method, but it does indicate that anyone practicing due diligence will follow this established regimen.

The field sampling protocol for asbestos in settled dust is quite simple. The method requires a low volume pump, tubing, 25 or 37 mm air sampling cassettes, and area templates. Following the protocol listed in the method is important. It has been shown that either using the cassette to sample open faced or not submitting the sampling end of the tubing reduces the collection efficiency dramatically. [20]

The ASTM Course also notes that laboratories offering this method should be NVLAP accredited, members of ASTM and the Environmental Information Association (EIA), attend their meetings and conferences, and demonstrate competence in using the analytical method. That is demonstrating competence in a) understanding the limitations of tight turnaround times, b) running QC samples with each batch of micro-vac samples submitted, c) adhering to the subtleties of preparation (i.e. calibration of ultrasonicator), d) supplying clients with information in order that they might both apply the method and interpret the analytical results correctly.

IATL and Settled Dust Issues. IATL has been NVLAP certified since 1990. Our state of the art facilities and staff are geared to serve the client with years of experience in this complicated arena of analysis. Our laboratory is a member of ASTM. Our Laboratory Director is a member of EIA and the ASTM Committee D-22.07 for Sampling and Analysis of Asbestos. Representatives of our laboratory have attended ASTM and EIA Conferences in Boulder Colorado and Johnson Vermont. We have attended continuing education seminars held at ASTM headquarters in Philadelphia. The Laboratory Director has made various presentations to environmental groups concerning this subject.

IATL has been involved in settled dust analytical issues since 1992. Our laboratory has processed thousands of these samples including high profile projects involving building fire and explosion case studies to routine investigations in schools and other buildings.

IATL can provide inquiring environmental professionals with information and materials that will aid in understanding this powerful assessment tool.

For further information please contact:

ASTM at astm.org,
IATL at iatl.com,
Frank Ehrenfeld at frankehrenfeld@iatl.com,
International Asbestos Testing Laboratory
16000 Horizon Way, Unit 100
Mt. Laurel, NJ 08054
(856) 231-9449

References:

1 Rook, H. L., and Beard, M. E., "Advances in Environmental Measurement Methods for Asbestos", ASTM STP 1342, American Society for Testing and Materials, 1999.

2 Verma, D. K., and Clark, N. E., "Relationships Between Phase Contrast Microscopy and Transmission Electron Microscopy Results of Samples From Occupational Exposure to Airborne Chrysotile Asbestos," American Industrial Hygiene Association Journal, Vol. 56 September 1995.

3 Chatfield, E. J., "A Validated Method for Gravimetric Determination of Low Concentrations of Asbestos in Bulk Materials" Advances in Environmental Measurement Methods for Asbestos", ASTM STP 1342, H.L. Rook and M. E. Beard Eds., American Society for Testing and Materials, 1999.

4 Webber, J. S. and Jackson K. W., "Tranmission Electron Microscope Method for Identifying and Quantitating Asbestos in Non-Friable Organically Bound Bulk Samples. Method 198.4" In Environmental Laboratory Approval Program Certification Manual. Revision March 1, 1997.

5 United States Environmental Protection Agency. "Interim Method for the Determination of Asbestos in Bulk Samples. EPA 600/M4-82-020. 1982.

6 Perkins, R.L. and Harvey, B. W., "Test Method: Method for the Determination of Asbestos in Bulk Building Materials." EPA 600/R-93/116 1993.

7 Chatfield, E. J., and Dillion, M. J., "Determination of Asbestos Structures in Drinking Water." Method 100.1, EPA 600/4-83/043. 1983

8 Brackett, K. A., Clark, P. J., and Millette, J. R., "Determination of Asbestos Structures Over 10mm in Length in Drinking Water." Method 100.2, EPA 600/R-94/134. 1994

9 Rook, H. L., and Beard, M. E., "Overview Section in Advances in Environmental Measurement Methods for Asbestos", ASTM STP 1342, American Society for Testing and Materials, 1999.

10 Occupational Safety and Health Administration Field Operations Manual. "Instruction CPL 2-2.0A, March 1984, Chapter VII: Sampling for Surface Contamination. 1.h."

11 Ewing, Wm., E. and Alber, G. P., "Observations of Settled Asbestos Dust in Buildings." In Environmental Information Association Technical Journal, Summer 1996.

12 Crankshaw, O. S., Perkins, R. L., and Beard M. E., "An Overview of Settled Dust Analytical Methods and Their Relative Effectiveness." In Advances in Environmental Measurement Methods for Asbestos", ASTM STP 1342, H.L. Rook and M. E. Beard Eds., American Society for Testing and Materials, 1999.

13 Crankshaw, O. S., Perkins, R. L., and Beard, M. E., "Quantitative Evaluation of the Relative Effectiveness of Various Methods for the Analysis of Asbestos in Settled Dust, " Environmental Information Association Technical Journal, Vol. 4, No. 1, Summer 1996.

14 Millette, J. R., and Hays, S. M., "Settled Dust Sampling and Analysis." Lewis Publishers 1994.

15 Lee, R. J., Stewart I. M., and Van Orden D. R., "Dust and Airborne Concentrations – Is There a Correlation? Presentation at Joint ASTM Committee D-22 and EIA Conference: Advances in Environmental Measurement Methods for Asbestos, 1997 Boulder Colorado.

16 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentration. American Society for Testing and Materials. ASTM Method D5755-95

17 Millette, J. R., and Mount M. D., "Applications of the ASTM Asbestos Dust Method D5755". In Advances in Environmental Measurement Methods for Asbestos", ASTM STP 1342, H.L. Rook and M. E. Beard Eds., American Society for Testing and Materials, 1999.

18 Beard, M. E., "Monitoring Strategies and Data Interpretation for Asbestos in Settled Dust: Options and Recommendations". Presentation at ASTM Technical and Professional Training Course Asbestos Control PCN#36.003022.00 Version 1.1, June 2000.

19 Millette, J. R., Hays, S. M., and Ewing Wm., M., "Dust Sampling Studies and Recommended Action Levels." Presentation at ASTM Technical and Professional Training Course Asbestos Control PCN#36.003022.00 Version 1.1, June 2000.

20 Ewing, Wm. M., "Further Observations of Settled Asbestos Dust in Buildings." In Advances in Environmental Measurement Methods for Asbestos", ASTM STP 1342, H.L. Rook and M. E. Beard Eds., American Society for Testing and Materials, 1999.

21 Standard Test Method for Wipe Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentration. American Society for Testing and Materials. ASTM Method D6480-99.

F. Ehrenfeld - 1
7

1997 BOULDER CONFERENCE:
Advances in Environmental Measurement Methods for Asbestos

Sponsored by:
ASTM Committee D-22 on Sampling and Analysis of Atmospheres and the
Environmental Information Association

Abstract Booklet
Final Program

July 13-17, 1997
University of Colorado
Boulder, Colorado

Comparison Standards

"Experience Standard"
vs.
Resuspension Factor

1000 s/cm^2 = "Low"

* *0.001 s/cm^3*

10,000 s/cm^2 = "Above Background"

* *0.01 s/cm^3*

100,000 s/cm^2 = "High"

* *0.10 s/cm^3*

From: "Settled Dust Sampling and Analysis," Chapter 6, Data: Levels of Asbestos in Dust, page 49-50, James R. Millette and Steve M. Hays, Lewis Publishers, 1994, ISBN 0-87371-948-4

* Potential Air Concentration Assuming $K = 10^{-6}$

Summary of "Observations...in Buildings" (GeoMeans)

Exterior of Urban Buildings	-	5,100 s / cm^2
No Known Surfacing ACM	-	1,000 s / cm^2
Acoustical Plaster ACM	-	160,000 s / cm^2
Fireproofing (No Ceiling)	-	3.6 million s / cm^2
Fireproofing (Above Ceiling)	-	3.8 million s / cm^2

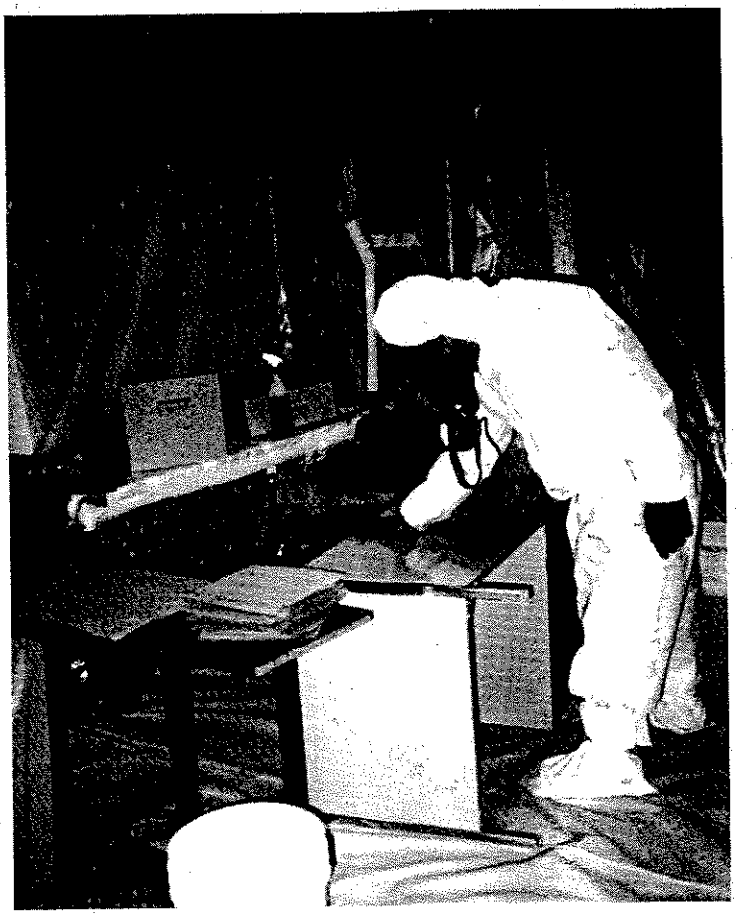
MONITORING ASBESTOS IN SETTLED DUST: AN UPDATE OF ASTM D22.07 ACTIVITIES

Michael E. Beard*
Consultant
Raleigh, North Carolina

***Chair, ASTM Subcommittee D22.07**

Michael E. Beard
4004 Brewster Drive
Raleigh, NC 27606-1710
Tel 919-851-5076
e-mail mebeard@bellsouth.net

Settled Asbestos Dust



Sampling and Analysis

James R. Millette
Steve M. Hays

Table of Contents

"RAISING THE DUST"

ASSUME:

A. One Gram of Settled Dust Collected from One Square Meter of Surface in a Room Having an Eight Foot Ceiling.

B. 0.1 % Asbestos in the Dust.

Then, 0.001 grams / square meter = 100 nanograms /square centimeter = surface concentration.

Fraction of Dust Reentrained (Activity Related)	**Fibers/cm^3** (Surface Fibers/cm^2 = 3,260 f/cm^2) (1x15 μm=32.6 f/ng)	**Fibers/cm^3** (Surface Fibers/cm^2 = 979,400 f/cm^2) (0.1x5 μm=9794 f/ng)
1	13.4 f/cm^3	4017 f/cm^3
0.001	0.0134 f/cm^3	4.017 f/cm^3
0.000001	0.0000134 f/cm^3	0.004017 f/cm^3
Activity ?	? f/cm^3	? f/cm^3

Weight of a single fiber

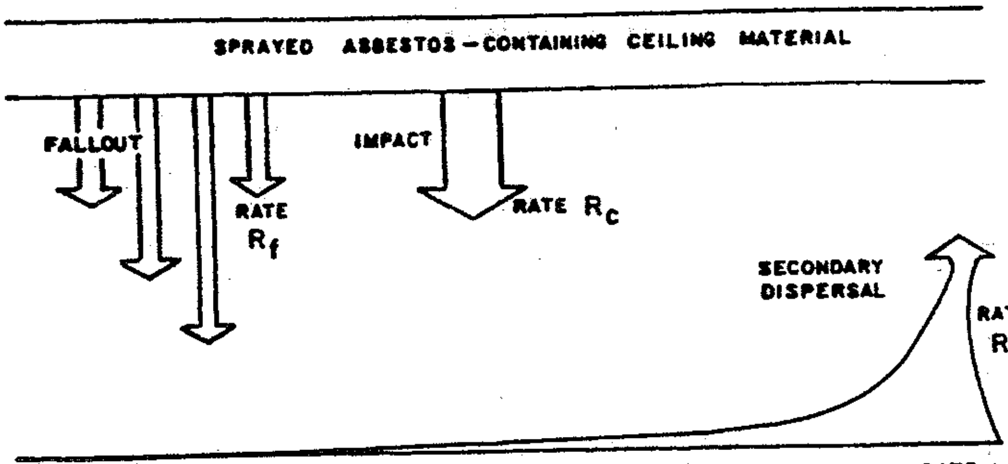
$(D/2)^2 * \pi * L * P$ = MASS

Where D = diameter
π = 3.14159
L = length
P = density = 0.0026 nanograms per cubic micrometer (chrysotile)
and Fibers per nanogram = 1/Unit Mass of Fiber in nanograms

Air Concentration

f / 243.8 cm = f / cm^3

Where f = number of fibers on one square centimeter of surface
243.8 = centimeters above surface in room with 8 foot ceiling



MODE	CAUSES	FREQUENCY	RATE
FALLOUT	AIR MOVEMENT VIBRATION	CONSTANT	LOW (R_f)
IMPACT	MAINTENANCE ACCIDENTAL IMPACT	OCCASIONAL	HIGH (R_c)
SECONDARY DISPERSAL	USUAL ACTIVITY CUSTODIAL SERVICE	FREQUENT	LOW TO HIGH (R_r)

Figure I-2-3. Modes and rates of fiber dispersal.

From: Asbestos-Containing Materials in School Buildings: A Guidance Document
EPA C00090, March 1979 ("Orange Book")