FILE NAME: RT Vanderbilt (RTV)

DATE: 2002 Dec 13

DOC#: RTV105

DOCUMENT DESCRIPTION: Letter from MVA Inc. to O'Brien Law Firm RE Vanderbilt Sample Analysis

MVA, Inc.
Excellence in Microanalysis

COPY

13 December 2002

O'Brien Law Firm, LLC
906 Olive Street
Suite 1150
Saint Louis, MO 63101
Attention: Mr. Andrew O'Brien

Re: Sample Analysis - MVA Project No. 5318
Vanderbilt IT3X Talc

Dear Mr. O'Brien:

Enclosed please find our report on the examination of one talc sample received by MVA, Inc. on 4 November 2002. If you have any questions, please call me at 770-662-8509.

Thank you for consulting MVA, Inc. The sample will be stored for the period of the project and returned upon your request.

Sincerely,

James R. Millette

James R. Millette, Ph.D.
Executive Director

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5500 Oakbrook Parkway, Suite 200, Norcross, GA 30093 • Telephone (770) 662-8509 FAX (770) 662-8532
www.mvainc.com

Report of Results: MVA 5318

Sample Analysis
Vanderbilt IT3X Talc

Prepared for:

O'Brien Law Firm, LLC
906 Olive Street
Suite 1150
Saint Louis, MO 63101
Attention: Mr. Andrew O'Brien

Prepared by:

MVA, Inc.
5500 Oakbrook Parkway, Suite 200
Norcross, GA 30093

13 December 2002

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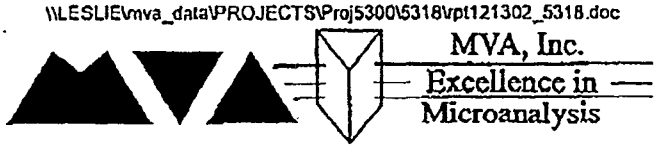

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Report of Results

MVA Project No. 5318
Sample Analysis
Vanderbilt IT3X Talc

INTRODUCTION

MVA, Inc., has analyzed one talc sample submitted for particulate characterization and received at MVA, Inc. on 4 November 2002. The sample was labeled: IT3X Industrial talc, tremolitic talc from the R.T. Vanderbilt Company, Inc. Upon receipt, the sample was assigned a unique laboratory identification number: M3832. It was requested that the sample be characterized as to the nature of the tremolite fibers. A sample of the National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 1867 - tremolite asbestos was also characterized.

Asbestos refers to a set of fibrous mineral materials. Amosite, chrysotile and crocidolite are considered common asbestos minerals. Tremolite, actinolite and anthophyllite are considered uncommon asbestos minerals. The asbestiform (morphology) habit of asbestos has been described in several analytical methods. A population of fibers as observed in a bulk sample having the asbestiform habit is generally recognized by the following characteristics (EPA/600/R-93/116):

Mean aspect ratios ranging from 20:1 to 100:1 or higher for fibers longer than 5 µm. Very thin fibrils, usually less than 0.5 µm in width, and two or more of the following:

Parallel fibers occurring in bundles,
Fiber bundles displaying splayed ends,
Matted masses of individual fibers, and/or
Fibers showing curvature.

Fibers occurring in the form of thin needles were also included as an asbestiform characteristic by Wylie, 1990.

It is more difficult to classify individual fibers as to asbestiform or cleavage fragments because individual fibers do not exhibit all the characteristics of a population. One fiber counting procedure considers a fiber with length greater than 5 µm and an aspect ratio of ≥3:1 to be a countable fiber for asbestos exposure assessment (NIOSH 7400 with NIOSH 7402). Other methods use an aspect ratio of ≥5:1 and lengths of either 0.5 µm or 5 µm to measure asbestos levels in the air (AHERA, ISO 10312).

Fiber widths are not generally considered in air analyses, except that fibers less than 0.25 µm are not seen by the NIOSH 7400 method. As a consequence, only those fibers greater than 0.25 µm in width are considered by the NIOSH 7402 method. When counting those fibers over 5 µm in length, the ISO 10312 method uses an upper limit for fiber width of 3 µm. Based on review of various studies, it has been suggested that only fibers with widths less than 1 µm should be considered as those important for regulation (Wylie et al. 1993).

ANALYSIS PROCEDURES

The sample was first examined by stereomicroscopy utilizing a Zeiss Stemi 2000 stereomicroscope having a magnification range from 6.5X to 47X. The sample was then examined by polarized light microscopy utilizing an Olympus BH-2 polarized light microscope having a magnification range from 40X to 1000X. Representative portions from the sample were examined and analyzed by scanning electron microscopy (SEM) using a JEOL 6500 coupled with an x-ray energy dispersive spectrometry (EDS) Noran Vantage system. Representative portions of the sample were also analyzed with analytical electron microscopy (AEM) using a JEOL 1200, 100 kV scanning transmission electron microscope (STEM), equipped with a Noran EDS x-ray analysis system.

RESULTS

Sample M3832 (IT3X) is a white powder containing talc fibers, talc ribbons, platy particles (lizardite) and tremolite particles. The tremolite particles exhibit morphologies from blocky (aspect ratios (AR) < 2:1) to acicular (AR up to approximately 50:1). The tremolite particles exhibiting aspect ratios greater than 3:1 comprise 20% to 35% by volume of the sample. Tremolite exhibiting aspect ratios greater than 20:1 comprise less than 1% by volume of the entire sample. As a population of particles, the tremolite particles in sample M3832 are consistent with a population of tremolite cleavage fragments as described by Wylie, 1990.

A number of the tremolite fibers in Sample M3832 are long and thin (have aspect ratios higher than 5:1, 10:1 or 20:1). A number of the tremolite fibers in M3832 are consistent with the tremolite asbestos fibers found in the NIST Standard Reference Material 1867 - tremolite asbestos. Aspect ratios were determined by SEM from 100 fibers (> 5µm) of each sample of SRM 1867 and M3832. Representative images appear in the Appendix. The data are compared in Table 1 and Figure 1. There is a significant overlap between the two populations. Representative transmitted light images appear as Figures 2 and 3.

Twenty-three percent (23%) of the 100 tremolite fibers measured in Sample M3832 (IT3X) had fiber widths less than 1.0 µm. Some of the tremolite fibers are very thin, less than 0.5 µm in width. Four percent (4%) of the 100 tremolite fibers measured in Sample M3832 (IT3X) had fiber widths less than 0.5 µm. These thin fibers had aspect ratios ranging from 15:1 to 47:1. These findings differ somewhat with the report by Wylie in 1990 and Wylie et al. in 1993 of 9% less than 1.0 µm and 0% less than 0.5 µm in width for a sample of New York tremolite. It is not clear whether or not this New York tremolite was from a similar source as M3832. Both the sample in the Wylie report and Sample M3832 were analyzed by SEM.

A number of the individual fibers exhibit the characteristics of asbestos fibers. Some show parallel fibers occurring in bundles, fiber bundles displaying splayed ends, and/or fibers showing curvature. The tremolite fibers in Sample M3832 did not show evidence of matted masses of individual fibers.

DISCUSSION

The population of tremolite fibers in Sample M3832 is not consistent with commercial asbestos fibers. The population of tremolite particles in sample M3832 is consistent with a population of tremolite cleavage fragments. However, many of the individual tremolite fibers in M3832 exhibit characteristics of asbestos fibers and are consistent with the tremolite asbestos fibers in the NIST Standard Reference Material 1867. Some individual tremolite fibers in Sample M3832 would be counted by the various standard methods as asbestos fibers. There are some tremolite fibers in Sample M3832 that appear to be consistent with the tremolite fibers found in the lungs of mesothelioma cases as reported by Roggli et al., 2002. The Roggli report states that all tremolite fibers counted in the samples from the lung tissue were at least 5 µm in length and almost all had aspect ratios of 5 or greater.

REFERENCES

Baron, P., Method 7400, Revision No. 3, NIOSH Manual of Analytical Methods, National Institute for Occupational Safety and Health Administration, Cincinnati, Ohio, 7400-1 - 7400-14 (1994).

-NIOSH Method 7402, "Asbestos Fibers by Transmission Electron Microscopy (TEM)", NIOSH Manual of Analytical Methods, 4th Ed., U.S. Department of HHS, NIOSH Publ. 94-113, 1994.

International Standards Organization (ISO), Ambient Air - Determination of Asbestos Fibres - Direct-transfer Transmission Electron Microscopy Procedure. ISO-10312.

Roggli, V. L., Vollmer, R. T., Butnor, K.J. and Sporn, T. A. Tremolite and Mesothelioma, Ann. Occup. Hyg. Vol 46 (5):447-453, 2002.

US EPA, Test Method for the Determination of Asbestos in Bulk Building Materials. Office of Research and Development, Wash. DC. 1993 Publication: EPA/600/R-93/116.

U.S. EPA, 40 CFR Part 763. Asbestos-Containing Materials in Schools, Final Rule and Notice. Fed. Reg. 52(210): 41870-41893 (1987).

Wylie, A. G. Discriminating Amphibole Cleavage Fragments from Asbestos: Rationale and Methodology. Proc. Intern. Pneumoconiosis Conf. Nov. 1990. Publication No. 90-108 Part II.

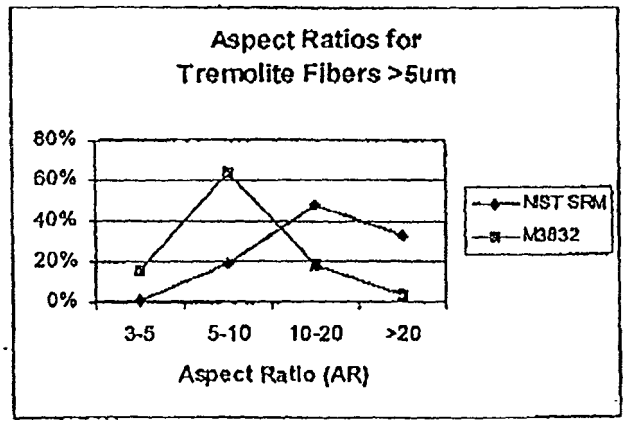
Wylie, A. G. , Bailey, K.F. Kelse, J.W. and Lee, R.J. The Importance of Width in Asbestos Fiber Carcinogenicity and Its Implications for Public Policy. Am. Ind. Hyg. Assoc. J. 54:239-252, 1993.

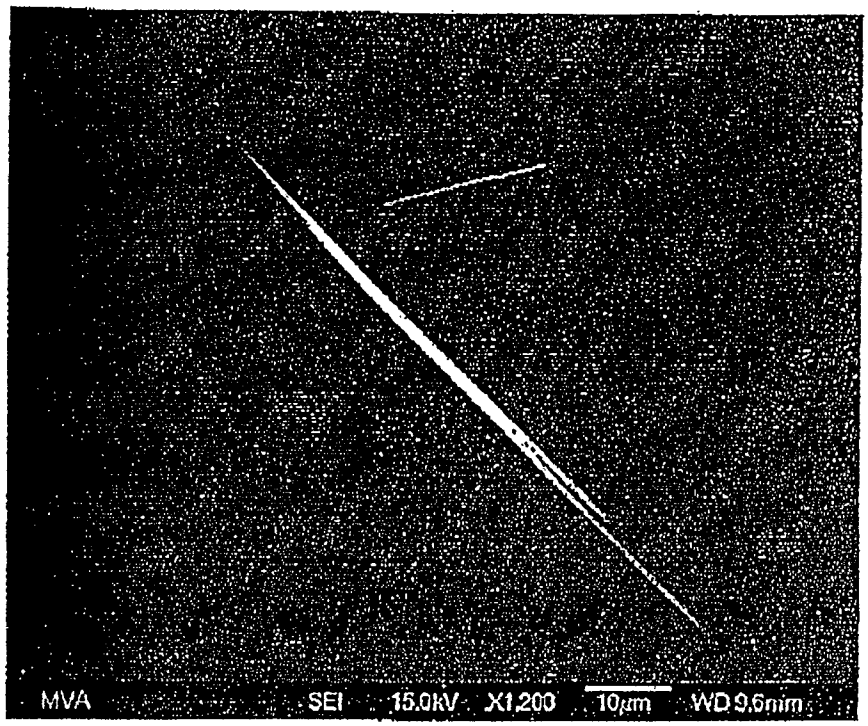
Table 1. Data from SEM Analysis of 100 Tremolite Fibers >5 µm

M3832	Length	Width	Aspect Ratio
Mean	14.5	2.1	8.5
St. Dev	9.9	1.6	5.5
Min.	5.2	0.3	3.8
Max.	55.6	9.1	47.7

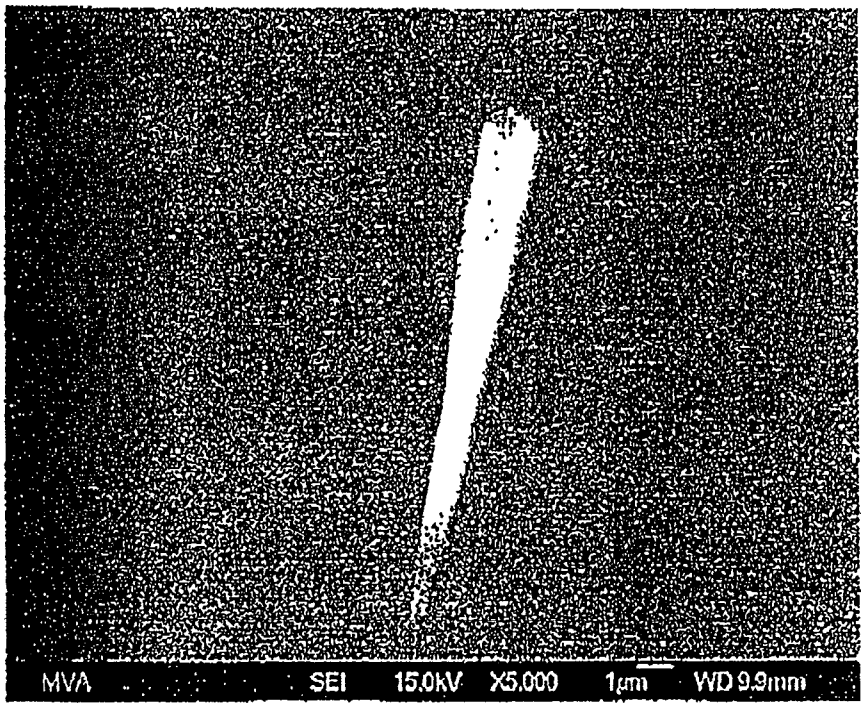
SRM 1867 Tremolite	Length	Width	Aspect Ratio
Mean	46.7	2.6	19.9
St. Dev	41.4	1.9	13.6
Min.	6.0	0.3	4.4
Max.	224.0	10.3	93.4

Figure 1. Comparison of Aspect Ratio Data from Sample M3832 and SRM 1867 Tremolite Asbestos

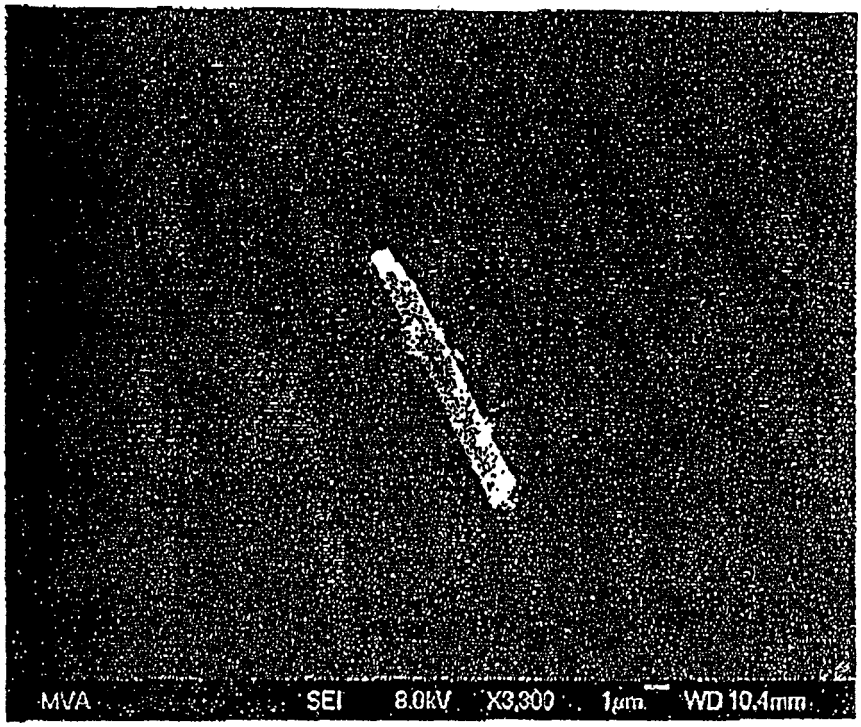




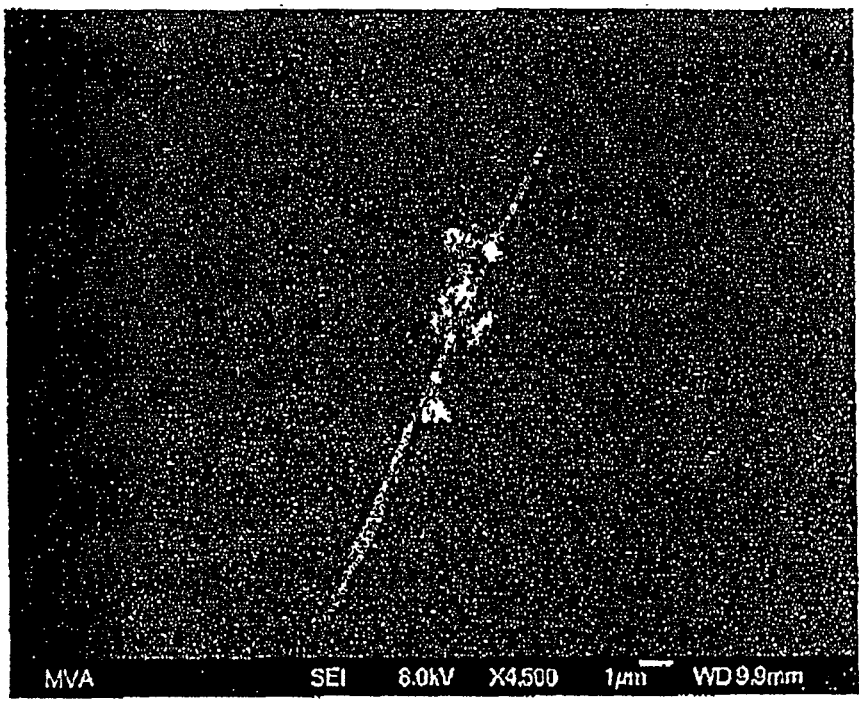
Micrograph 7. SEM Image of Tremolite from SRM 1867.



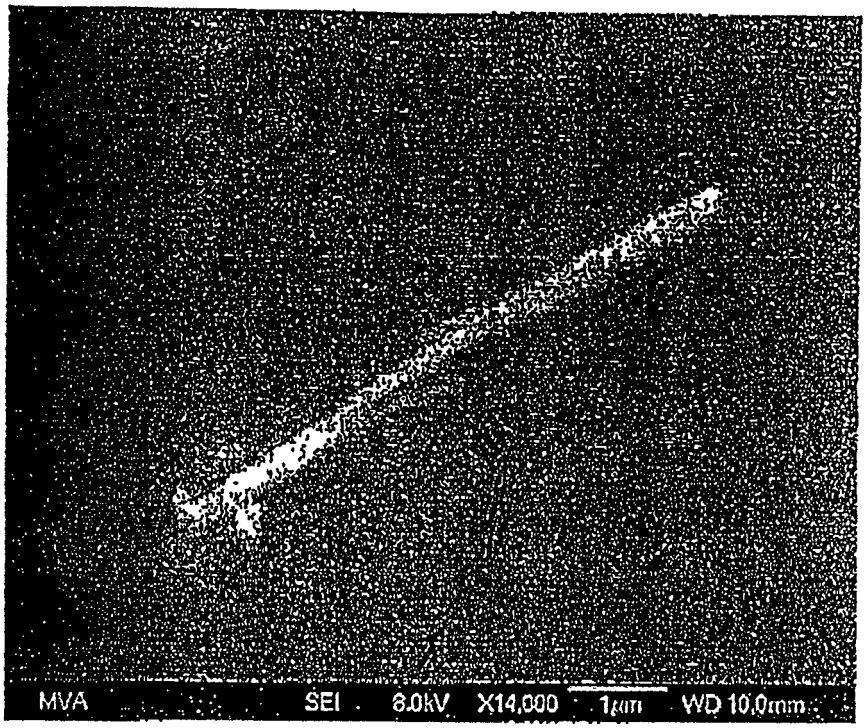
Micrograph 8. SEM Image of Tremolite from SRM 1867.



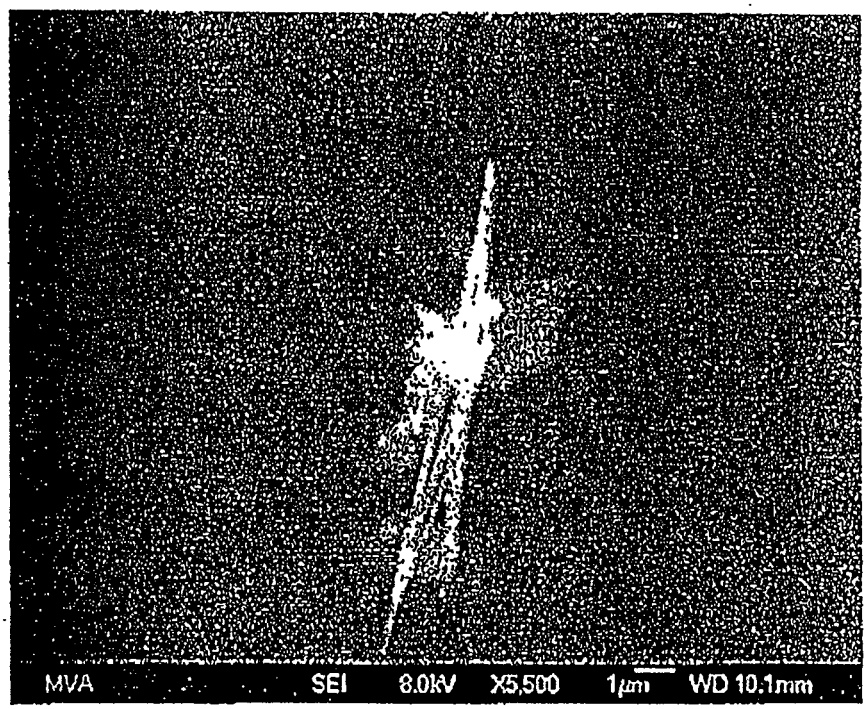
Micrograph 3. SEM Image of Tremolite from Sample M3832.



Micrograph 4. SEM Image of Tremolite from Sample M3832



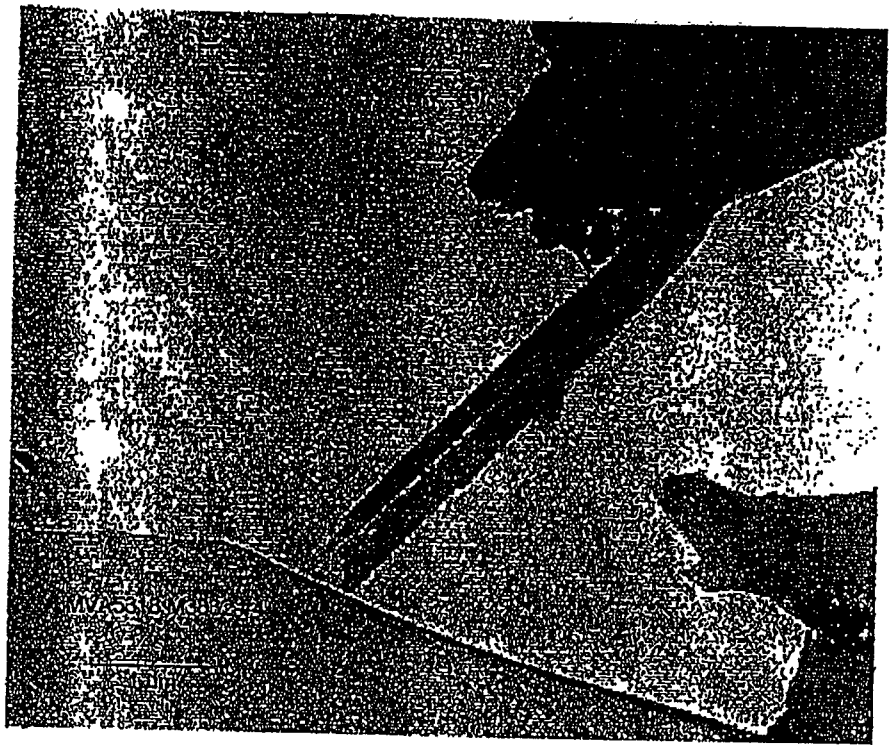
Micrograph 1. SEM Image of Tremolite from Sample M3832.



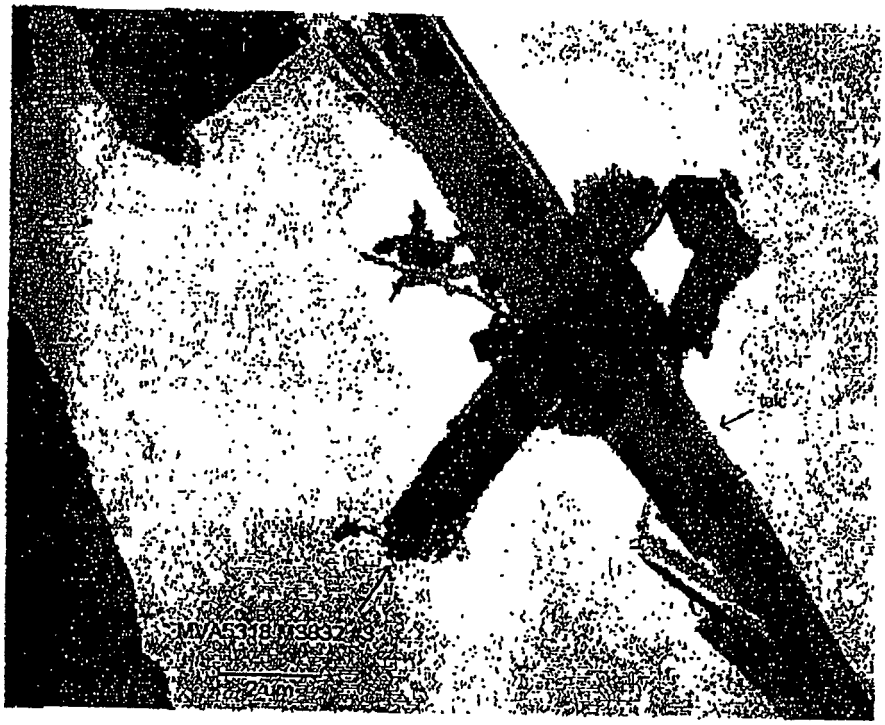
Micrograph 2. SEM Image of Tremolite from Sample M3832.

Micrograph 11. TEM Image of Tremolite from Sample M3832.

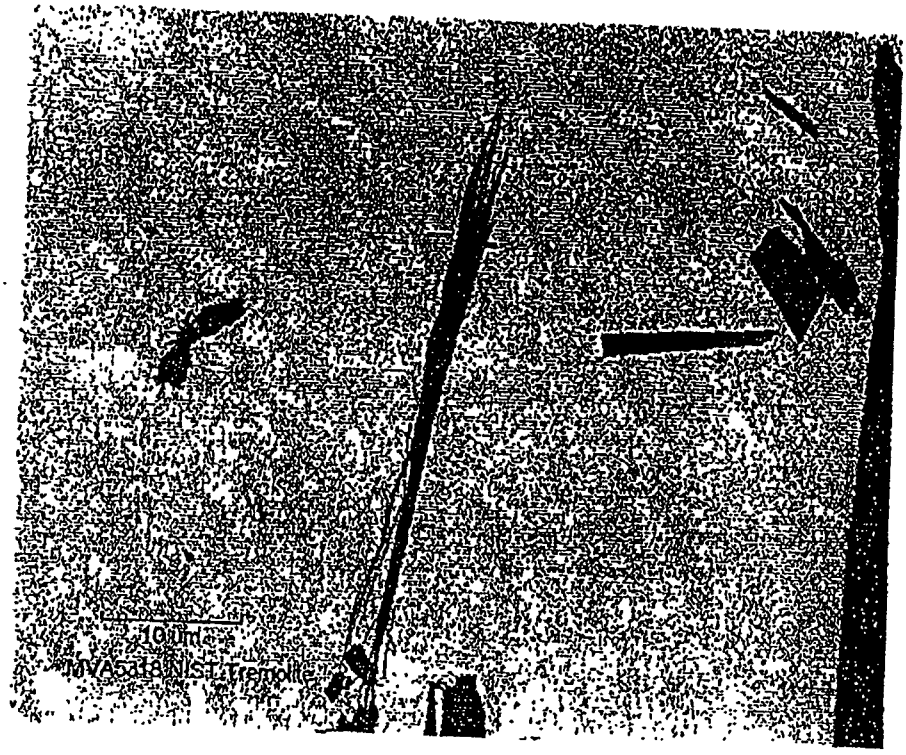
Micrograph 12. TEM Image of Tremolite from Sample M3832.



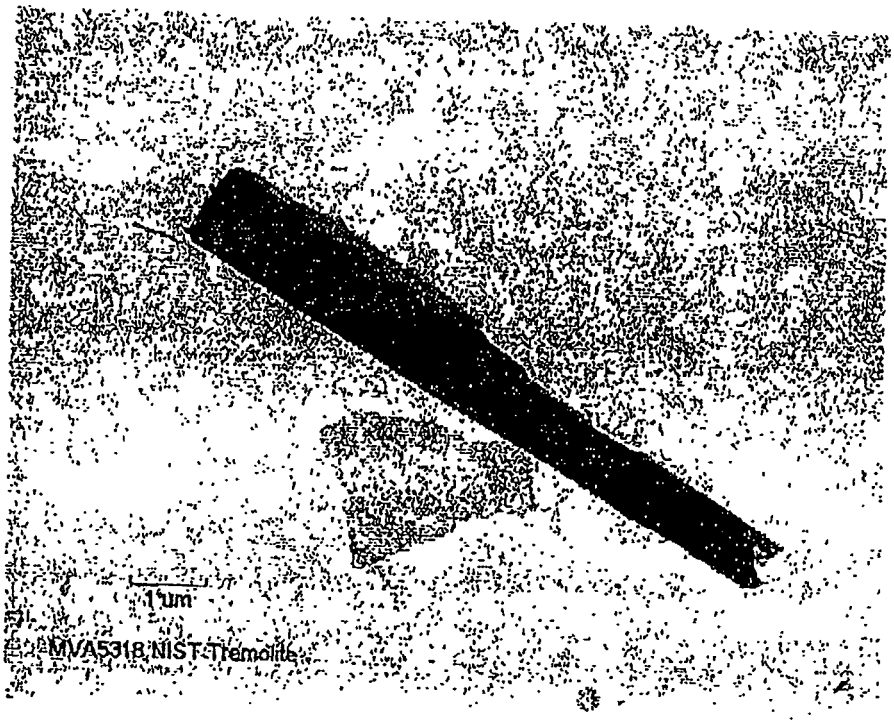
Micrograph 9. TEM Image of Tremolite from Sample M3832.



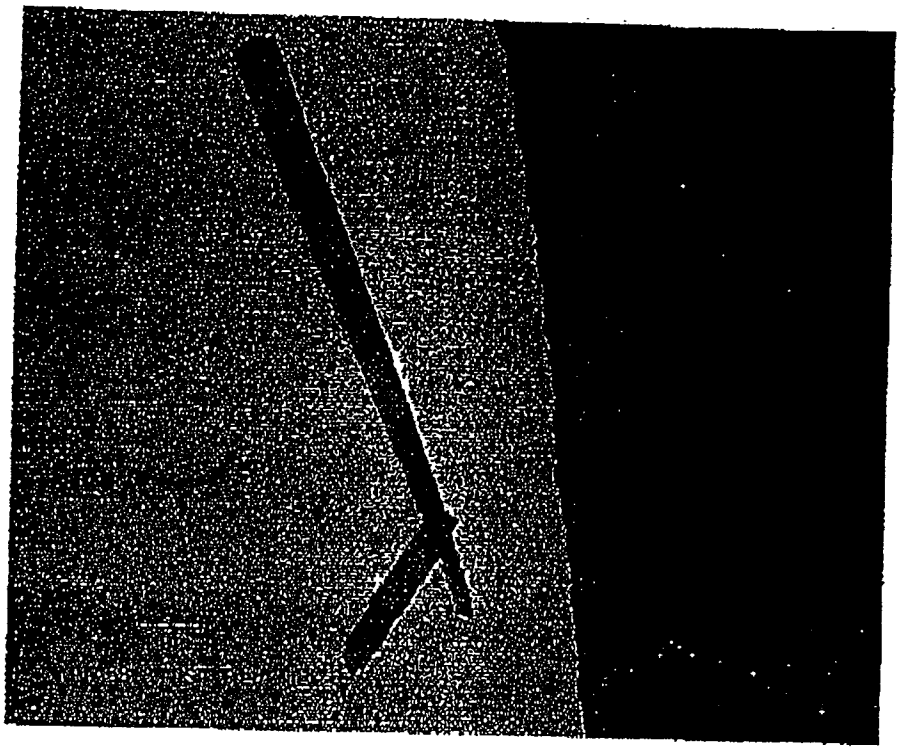
Micrograph 10. TEM Image of Tremolite from Sample M3832.



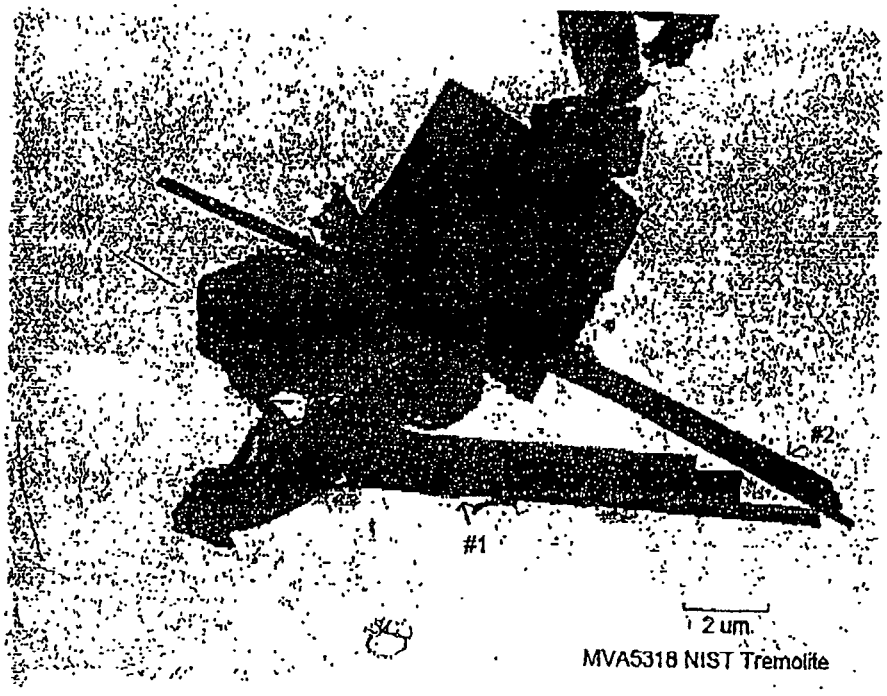
Micrograph 13. TEM Image of Tremolite from SRM 1867.



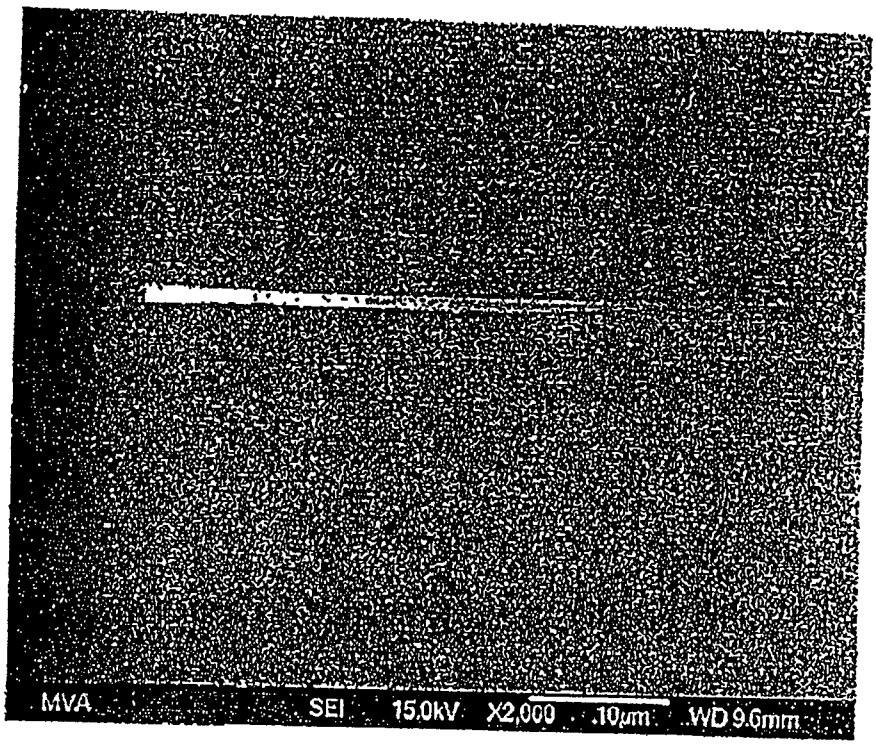
Micrograph 14. TEM Image of Tremolite from SRM 1867.



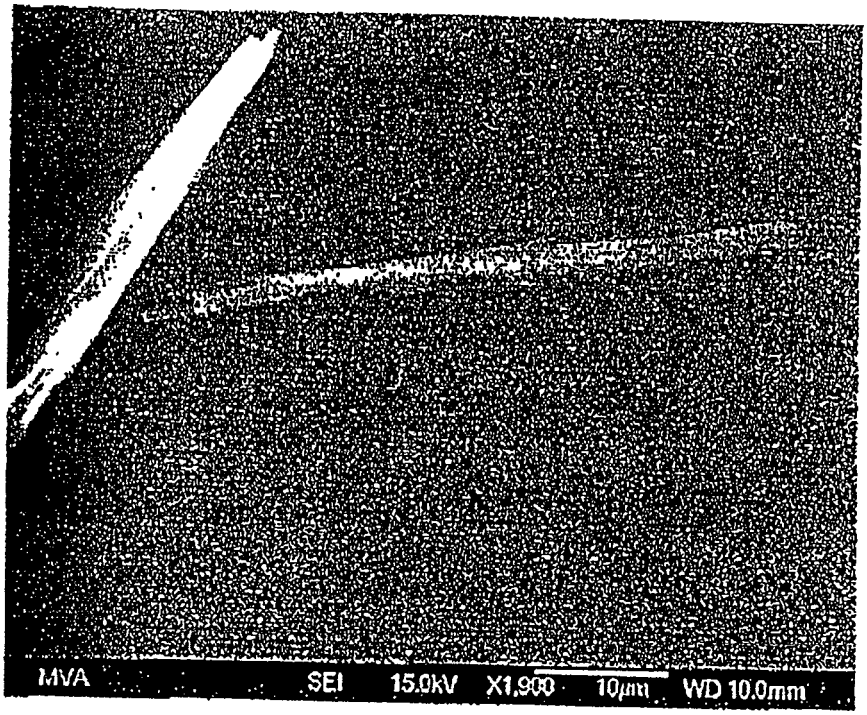
Micrograph 15. TEM Image of Tremolite from SRM 1867.



Micrograph 16. TEM Image of Tremolite from SRM 1867.



Micrograph 5. SEM Image of Tremolite from SRM 1867



Micrograph 6. SEM Image of Tremolite from SRM 1867.

Kelse, John

From: Ann G. Wylie [awylie@deans.umd.edu]
Sent: Tuesday, December 17, 2002 3:54 PM
To: Kelse, John
Subject: Re: FW: Photos from Millette

John; I have never seen tremolite that displays the habit Jim illustrates. Lacking is the evidence that it is tremolite. I wonder if any calcium at all qualified this as tremolite in his classification. I do not see chemical data. This will be hard to defend since he will assert that there is Ca present and who can say that it is not there????
I will help you on this. We will have to discuss how. Ann

JKELSE@rtvanderbilt.com wrote:

> Ann - this follows my FAX regarding Millettes report. These are the photomicrographs that I'm sure are unintelligible in the FAX.
> ----Original Message----
> **From:** Amy Clark [mailto:aclark@hrva.com]
> **Sent:** Tuesday, December 17, 2002 12:13 PM
> **To:** drace@akingump.com; drew@rjla.com; Kelse, John
> **Cc:** Lisa LaConte
> **Subject:** Photos from Millette
>
> Lisa LaConte asked me to send you these photos. Please let me know if you have any problems opening them. Amy ClarkHeyl, Royster, Voelker & Allen(309) 676-0400

--
Ann G. Wylie
Assistant President and Chief of Staff
Professor of Geology
1101 Main Administration
University of Maryland
College Park, MD 20742
301-405-6848

Kelse, John

From: Ann Wylie [awylie@deans.umd.edu]
Sent: Wednesday, January 01, 2003 2:42 PM
To: Kelse, John
Subject: [Fwd: testimony]

RE: testimony

John: I have several issues with Jim's report

1. There is no supporting documentation to be able to see if the longest of his fibers are intergrowths. There is a history of some TEM labs (long ago) calling this material low Ca tremolite. Greenwood has some tremolite-talc intergrowths. Jim does not understand that this type of intergrowth is even possible and is unaware, it seems, that Stemple and Brindley first describes tremolite-talc intergrowths as fibrous talc.
2. Jim does not know what asbestos is. He only knows what counting rules are and seems confused about what they mean. He seems to think that asbestos is sometimes asbestos and sometimes not and that cleavage fragments are sometime asbestos and sometimes not, depending on the counting rules. This is nonsensical.
3. He persists in referring to my comments on needle-like, which I used early on but then found it to be covered by other parts of the definition. Also, by needle like, mineralogists do not mean the tip of the needle. The term is used to define the general aspect ratio. Jim seems to have used the term to any elongated particle that tapers on one end. This has never been a characteristic of asbestos and was not implied by the term.
4. His population characteristics are those of cleavage fragments. My characterization of tremolite for the NIEHS study showed about 4% at 20:1 or greater. Other cleavage fragment populations might be up to 10%. I do not see that there is any evidence for tremolite-asbestos at all in these population statistics.

I will be in my office tomorrow afternoon for conversation. I will also then look over my notes again to see if I can add to the above. Ann

--
Ann G. Wylie
awylie@deans.umd.edu
Assistant President and Chief of Staff
University of Maryland
College Park, MD 20742
(301)405-6848

Kelse, John

From: Drew Van Orden [drew@rjlg.com]
Sent: Thursday, January 02, 2003 5:16 PM
To: Kelse, John
Cc: Rich Lee; Patty Polka
Subject: RT Vanderbilt IT-3X

The following are preliminary notes on Vanderbilt talc. A more detailed report can be issued as needed.

RJ Lee Group received a sample of material identified as IT-325 from John Kelse (R.T. Vanderbilt Company, Inc.) on 12/11/02. The sample was logged into our project database (job number LSH212880) and assigned sample number 3037447.

The sample was analyzed using transmission electron microscopy (TEM) generally following the analytical portion of ASTM D-5756 (dust mass method). A portion of the sample was weighed and placed in a beaker; 100 ml of deionized water were added. The suspension was sonicated for 3 minutes to disperse the sample. An aliquot of the suspension was removed (without any settling time) and deposited on a clean filter. The filter was prepared for TEM examination using the standard direct preparation procedures.

All particles with an aspect ratio $\geq$ 3:1 were examined in the TEM at a magnification of 20,000X. Fibrous talc was observed in the sample, as were talc/anthophyllite intergrowth particles and tremolite cleavage fragments. No asbestiform tremolite fibers were observed during the analysis.

These results are different than those reported by MVA, Inc. (December 13, 2002, Report of Results: MVA 5318) where fibrous tremolite particles were reported. Micrographs 1-4 and 9-12 of that report are represented to be images of fibrous tremolite.

The Vanderbilt ore is a complex amalgam of fibrous talc, platy tremolite, intergrowth particles of talc/anthophyllite and talc/tremolite, serpentine minerals, and other particles. It is not possible to simply examine a micrograph and conclude the particle is "tremolite". Because the ore body contains the intergrowth fibers (as stated before, both talc/anthophyllite and talc/tremolite) each particle must be examined using both selected area diffraction (SAED) and energy dispersive x-ray spectroscopy (EDXA or EDS). These techniques, providing information on crystal structure (SAED) and chemistry (EDS), must be performed at multiple locations on the particle because of the intergrowth possibility. The diffraction patterns (SAED) for intergrowth patterns will show complex patterns representative of two different crystal structures overlaying each other; the EDS spectra will show reduced peaks for calcium and/or magnesium (for the talc/tremolite intergrowth) or magnesium and/or iron (for the talc/anthophyllite intergrowth).

No diffractions patterns (SAED) were included in the MVA materials reviewed by RJ Lee Group. Of the EDS spectra included in the supplementary materials (Exhibit 2 of the Millette deposition), the EDS spectra identified as M3632 Tremolite are show reduced levels of magnesium, suggesting the minerals reported as tremolite may actually be a diopside mineral.

All of the asbestos analytical methods were developed for analysis of the asbestiform minerals; more recently

published methods expressly limit the asbestiform minerals to the regulated varieties. Each current method lists the minerals of interest. No published TEM method calls for the inclusion of non-regulated amphiboles or cleavage fragments in the asbestos count.

There has been much debate over the years by people who do not understand mineralogy or polarized light microscopy about what constitutes cleavage fragments. A primary reference for definitions pertinent to asbestos analysis was published by the Bureau of Mines (IC 8751). Wylie proposed a discriminating function that could be used to aid in identifying fibers that are cleavage fragments from other asbestos fibers. OSHA's record on regulating the non-asbestiform amphiboles (preamble to the 1992 regulations) contains a clear summary of the issues related to the definition of asbestiform and cleavage fragments. EPA has recognized that cleavage fragments can be an interference in asbestos analysis and has consistently ruled they should not be counted. EPA has attempted to limit these counts by providing improved definitions of asbestos in later protocols.

However, in all of the analytical methods, the microscopist is required to analyze for asbestos – each protocol then provides a sizing guideline to use in deciding whether the observed asbestos fibers should be recorded. The sizing guidelines in the analytical methods (such as NIOSH 7402 where you count fibers longer then 5 um and wider than 0.25 um with a minimum aspect ratio [l/w] of 3:1) do not define whether the particle is asbestiform.

The Vanderbilt talc materials have been extensively analyzed by many groups (including RJ Lee Group, RTI, DataChem, Bureau of Mines, Penn State University, University of Maryland among many)over at least a 40 year period. In all of the published data, no one has ever reported asbestiform tremolite in the talc – only cleavage tremolite or tremolite/talc intergrowth fibers (see Stemple and Brindley, J American Ceramic Society, vol. 43, p. 34 – 42, 1960).

The data reported by MVA lack supporting analytical information (such as EDS and SAED) and are contradicted by our analysis of a subsample of the same talc analyzed by MVA as well as the published literature.

Based on the above, we do not believe the fibers reported as tremolite by MVA are asbestiform tremolite fibers.

Drew R. Van Orden, PE
RJ Lee Group, Inc.
drew@rjlg.com
www.rjlg.com

From: Drew Van Orden [mailto:drew@rjlg.com]
Sent: Tuesday, December 17, 20024:13 PM
To: John Kelse (jkelse@rtvanderbilt.com)
Subject: Millette

I received the fax and read through it. Sorry I missed your call this morning. WE have analyzed the talc sample twice (using new material each time) and have not found tremolite fibers by TEM - we have found cleavage fragments and intergrowth fibers, but not real tremolite fibers.

Millette did PLM, SEM, and TEM, though his reliance on the SEM is questionable. You can't really see the intergrowth by SEM. Anyway, there seems to be some circular arguments used in the report.

1. All methods require you to analyze asbestos, the methods indicate which sizes of the asbestos you are to record - the sizes do not determine that a particle/fiber is asbestos. He seems to have that backward - he is saying the methods say if the particles meet these sizes, it must be asbestos.

2. He is comparing the fiber distribution to the NIST SRM material to be able to say your fibers are also asbestos. Basically - if the SRM is really asbestiform, then he would have an argument. However, the SRM is cleavage fragments and is a very low grade material. His data in Table 1 confirms this. His minimum width is 0.3 µm, but the average is 2.1 (± 1.96 * 0.16 for the 95% confidence interval) for the talc and 2.6 (± 1.96 * 0.19). Statistically, his reported minimum is a statistical outlier form the measured population. In addition, if you do a simple unpaired comparisons of the means, you find there is a statistically significant difference in diameter between these two populations (as well as aspect ratios). Thus, his assumption that they are similar is incorrect. You may want to ask him if he performed any statistical comparison on his data to verify if the populations are similar. His reasoning is that they overlap (you can thank Mike Beard for that one), so there must be similarities. He should produce the raw data used to generate Table 1 and Figure 1.

3. He should clearly describe his understanding of intergrowth fibers and how to detect them and what they represent. Even OSHA/Dan Crane gets this correct. Even RTI never reported tremolite fibers in the crayons - didn't they only report anthophyllite?

4. In looking at his photos (for what they were worth), only figures 9 and 11 cause me some concern. He should produce his chemistries and diffraction patterns for these images.

Drew R. Van Orden, PE
RJ Lee Group, Inc.
drew@rjlg.com
www.rjlg.com

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