

Article 1



KELLY-MOORE

**MIXING, APPLYING, SANDING & CLEANUP
OF ASBESTOS CONTAINING FINISHING COMPOUND**

WORK PRACTICE STUDY

Prepared by

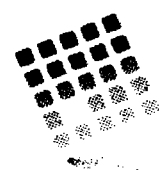
William E. Longo, Ph.D.
Richard L. Hatfield

October, 1999

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Protocol For Work-Practice Simulation Of Mixing, Applying, Sanding & Cleanup Of Asbestos Containing Joint Compound

This study was designed and conducted by Richard Hatfield and William Longo

The study was performed in an isolation chamber. The size of the chamber is approximately 20' x 15' x 8' and the walls and ceiling are constructed of a painted plastic laminate. The chamber was constructed with two viewing windows for video taping purposes and has an air exchange rate of approximately 200 cubic feet per minute with two primary inlet sources and a negative air machine that produces a constant airflow during the study. After the study, the inside of the chamber was decontaminated by standard asbestos abatement methods including HEPA vacuuming of all dust and debris and wet wiping of all surfaces.

During video taping of the workplace study, lighting was utilized inside the chamber to enhance the possible observations of dust release during the work practice. Previous studies have shown that the use of, what is commonly referred to as the "Tyndall light phenomena", is an effective method of displaying respirable size airborne dust generated from workplace activities.^{1,2,3}

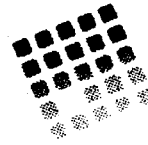
Materials Analytical Services was provided with some drywall finishing joint compound manufactured by Kelly-Moore. A sample of the joint compound was analyzed by polarized light microscopy (PLM) and transmission electron microscopy (TEM). The results indicated the joint compound contained approximately 8% chrysotile asbestos and the other components were mica, clay, talc and calcium carbonate.

During the study, air samples were collected using 25mm air cassettes containing 0.8 micron pore mixed cellulose ester (MCE) filters and a 5.0 micron backing pad and by the use of midget impingers. All air sampling pumps were calibrated both before and after sample collection. High volume pumps were used for area or bystander air samples during the study. The pumps were located outside the chamber and connected to the air sample cassettes by Tygon tubing through the walls of the chamber. The two area air samples were located on opposite ends of the chamber and were located approximately five feet from the floor and six to eight feet from the work activity. The high volume pumps were calibrated to a flow rate of 10 liters per minute. The investigator performing each of the work practice simulations were fitted with several personnel air samplers attached to their left and right shoulders to sample the breathing zone for possible asbestos exposure during the work place simulations. The

¹ Surgen Commander P.G. Harris, "The Effects and Control of Disease Associated with Exposure in Devonport Dockyard", Doctoral Dissertation.

² C.Dernchl & K.S. Lane, "Asbestos Toxicology Report", Union Carbide Corporation.

³ D.T. Chambers, "Dust Control Development (S. Chissick and R. Derricott) in Asbestos", Volume 2 Properties, Applications, and Hazard, 6 193, 1983.



personnel air samples were collected with battery operated Gillian pumps, calibrated to a flow rate of 2 liters per minute for the air cassettes and 2.75 liters per minute for the midget impingers. Before each work place simulation, background samples were collected both inside and outside the chamber. The air samples were collected in general accordance with methods outlined in NIOSH's 582 "Sampling and Evaluating Airborne Asbestos Dust" and by the U.S. Department of Health.

The individuals working inside the chamber wore Tyvek suits under cotton/polyester work clothes and were protected with Self-Contained Breathing Apparatus (SCBA). The chamber design included decontamination areas for clothing removal and for a shower to remove any residual asbestos contamination before the workers left the chamber area.

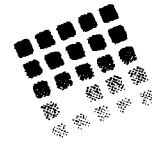
The three phases of the work practice study were:

1. Mixing and Applying Dry Wall Joint Finishing Compound
2. Sanding Dry Wall Finishing Compound
3. Cleaning up after mixing, applying, and sanding dry wall joint finishing compound

Initially, a piece of dry wall 6 x 3 foot in diameter was cut in quarters and attached to a wood frame which was placed inside the chamber. To initiate the first phase, the drywall seams were mudded and taped using non-asbestos containing U.S. Gypsum joint compound that was purchased at a local Lowe's building supply store. This joint compound was examined by PLM and confirmed not to contain asbestos. After allowing the joint compound to dry, it was sanded using a wet sponge to avoid creating dust from the non-asbestos containing joint compound. Following the wet sanding, the floor surface was wet wiped to remove any dust and debris material. Background air samples were collected both prior to and after the application of the non-asbestos containing joint compound.

In the next phase, approximately 7lbs of the Kelly-Moore Finishing Compound was mixed into the appropriate amount of water (2.25 qts.) using an electric drill mixer. While the finishing compound was mixed, small amounts of water was added to achieve the proper consistency required. The directions on the bag stated that the mixed finishing compound should set for 30 minutes prior to application. Therefore, the air sampling was stopped after the mixing process. Following the 30 minute setting time, the finishing compound was then applied to the taped drywall joints.

After the completion of this application, the Kelly-Moore dry wall finishing compound was allowed to dry for 2 days. During the second phase of the study, the finishing compound was then sanded by hand, first with a medium grade (80 grit) sand paper and then with a fine grain (100 grit) sand paper. Additional air samples were collected during the sanding process.



Two days later, the clean-up phase took place. This activity consisted of wiping the drywall with a clean cloth and then sweeping up of the dust residue. The dust on the floor was first swept into a pile and then swept into a dust pan using a hand brush. The dust was redeposited to a trashcan.

The sampling and work time for the mixing phase of the study was 10 minutes in length and 9 and 10 minutes for the sanding and the clean-up phases respectively. After the completion of each of the phases, swatch samples of the work clothing were taken and analyzed by the Chatfield method to determine the level of asbestos contamination in the clothing.⁴

The direct air samples were first analyzed by the NIOSH 7400 method for PCM using A counting rules.⁵ The midget impinger air samples were analyzed by the American Conference of Governmental Industrial Hygienist (ACGIH) method.⁶ For TEM analysis, a modified Yamate EPA level II indirect air sample analysis was performed.⁷ The samples for TEM analysis were first prepared using a redeposit method as detailed in the ASTM method D-5755-95.⁸ Additionally, portions of the redeposited filters were recounted by PCM for these studies since the direct samples were so heavily loaded with particulate that their analysis would cause a bias to lower concentrations.⁹

Upon completion of the workplace simulation study, the chamber was completely decontaminated to remove the asbestos containing dust. The black cloth sheeting on the inside surfaces of the chamber was removed and disposed. All surfaces were HEPA vacuumed and wet wiped according to standard asbestos abatement technology.

Conclusions:

The air samples collected by the midget impinger method shows that when conducting any of these operations, mixing, sanding, and cleanup will result in exposure levels in excess of the previous 5 million particles per cubic foot (MPPCF) standard. The sanding generated the highest level of dust, resulting in exposures nearly 18 times the 5 MPPCF standard. Also, as shown by the PCM results, the OSHA excursion limits would be exceeded during all three phases of this study.

⁴ Environmental Protection Agency, Roger C. Wilmoth, 5/6/88 Memo to Committee.

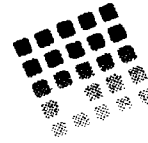
⁵ National Institute for Occupational Safety and Health; NIOSH Manual of Analytical Methods, 4th Ed. (DHH/NIOSH Pub. No. 84-100), Washington, DC, 1995, Method #7400-1-74001-14.

⁶ U.S. Department of Health, Education and Welfare, Public Health Service Publication, No. 614.

⁷ Environmental Protection Agency, Contract No. 68-02-3266, July, 19984.

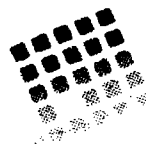
⁸ American Society for Testing Materials; Annual Book of ASTM Standards, Volume 11, Method #D5755-95.

⁹ Gypsum Association, Evaluation of Exposure to Asbestos During Mixing and Sanding of Joint Compounds," Denver, Colorado, November, 1973.



The analysis of the air samples by PCM was difficult due to the large amount of particulate on the filters. Initially, an attempt was made to count portions of the overloaded MCE filters and those results are reported in this study. While all the PCM air samples were very heavily loaded, the samples collected during the sanding were the worst with large clumps of particulate obscuring nearly all of the filter area. Only fiber extending out of the large clumps of particulate could be counted. The clumps of particulate obscured more than 75% of the filter surface. Therefore, a recount of the sanding samples was performed on portions of the filters prepared by the redeposit method. These filters had a dilution factor of approximately 33 times. The average of its original counted area samples was 0.41 f/cc and the average to the original counted personnel samples was 1.74 f/cc. When the samples were recounted, the averages were 1.25 f/cc and 38.25 f/cc respectively. These increases are each approximately 20 fold and would more accurately represent the true asbestos airborne exposure levels.

The PCM air samples from the other two studies (mixing and cleanup) were also analyzed by the redeposit method and also showed similar increases in the fiber per cc concentrations. It is believed that PCM recounts of the redeposited samples for all three studies more accurately reflect the true exposure levels as measured by PCM.



Work Practice Simulation Protocol

I) Chamber Setup

- A) The walls, ceiling, and floor are painted black to diminish light reflection.
- B) Arranged lighting for Tyndall effect in general accordance with the method described in by D.T. Chambers, "Asbestos", John Wiley & Sons, 6, 193, 1983.

II) Background Air Samples

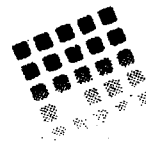
- A) Adjust and calibrate high volume area pump to appropriate flow rate.
- B) Set up two or more air samples inside the chamber and one outside air sample in general accordance with the procedure outlined in the NIOSH 7400 method.¹

III) Work Practice Study²

- A) Review the appropriate information on work practices simulation.
- B) Acquire all necessary tools and materials required for work practice simulation.
- C) Calibrate personnel and high volume sampling pumps appropriate to flow rates.
- D) Set ventilation to 200 cubic feet per minute as measured with the Extech Flow Anemometer.
- E) Set up two or more inside air samples and one outside air sample in general accordance with the procedure outlined in the NIOSH 7400 Method.¹
- F) Participants in the study are to wear protective clothing, work apparel, and respiratory protection equipment.
- G) Set up the personnel air samples in general accordance with the procedure outlined in the NIOSH 7400 method.¹
- H) Determine the appropriate time for the length of study.
- I) Work practice study performed as determined in Section III, A&B.

¹ If midjet impinger air sampling is to be done, set up the samples in general accordance with the ACGIH method.

² Parts of the procedure may be done in advance of chamber set up.



- J) If appropriate, film the work practice study from start to finish in two directions. During filming, turn off Tyndall lighting and turn the overhead lights on at least on one occasion.

IV. ANALYSIS

- A) Analyze air samples by NIOSH 7400 PCM methods with A counting rules.³ (See Note)
- B) Analyze air samples by the TEM indirect method.
- C) Analyze the cloth/fabric samples by the recommended EPA method.
- D) Analyze dust samples by the ASTM D-5755-95 method.

V. RESULTS

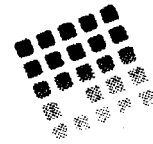
- A) Air: Report PCM results as fibers/cc, report TEM results all sizes (structures/cc) and greater than or equal to 5 microns in fibers/cc.
- B) Fabric: Report TEM results as number of asbestos structures per cm² and per square foot of cloth sample.
- C) Dust: Report TEM results as number of asbestos structures per cm² and per square foot of surface area sampled.

VI. OPTIONAL ANALYSIS

- A) Midget impinger samples analyzed by the ACGIH method.
- B) Dust samples analyzed by the ASTM D-5755-95.

Note: According to the NIOSH 7400 method, fiber counts outside 100-1300 fibers/mm² range have greater than optimal variability and are probably biased.

³ If the air samples are too overloaded for PCM analysis, use the indirect washout method.



**KELLY-MOORE FINISHING COMPOUND
ASBESTOS AIR, PARTICULATE & FABRIC ANALYSIS RESULTS**

MIXING

<u>Sample #</u>	<u>Sample Description</u>	<u>PCM Fibers/cc</u>	<u>TEM (All) Str/cc</u>	<u>TEM Fibers $\geq$ 5μm/cc</u>	<u>Midget Impinger M.P.P.C.F</u>
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Background Air Samples Before Application of USG Non-Asbestos Joint Compound

I-I-A-(N)	Background	<0.001	0.00	N/A	N/A
I-I-B-(S)	Background	<0.001	0.00	N/A	N/A

Background Air Samples Before Mixing and Application of Kelly-Moore Topping Compound

I-II-A (N)	Background	<0.001	<0.02	N/A	N/A
I-II-B (S)	Background	<0.001	<0.02	N/A	N/A
I-II-D-MI	Background	N/A	N/A	N/A	0.06 Million

Mixing

I-III-A (W)	IWA Area	1.42	52.38	2.69	N/A
I-III-B (S)	IWA Area	1.10	79.24	8.06	N/A
I-III-D-MI	IWA Area		Pump Failure		
I-IV-A-PLR	IWA Personnel	5.08	149.71	27.22	N/A
I-IV-B-PLL	IWA Personnel	4.90	146.45	33.28	N/A
I-IV-C-MI	IWA Personnel	N/A	N/A	N/A	7.3 Million

Structures/sq ft.

Structures/cm²

I-V-Blank	Fabric	N/D	N/D
I-V-PL	Fabric	10.6 Billion	11.4 Million

<u>Sample #</u>	<u>Sample Description</u>	<u>Redeposited PCM Fibers/cc</u>
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I-III-A (N)	IWA Area	3.55
I-III-B (S)	IWA Area	2.92
I-IV-A-PLR	IWA Personnel	7.57
I-IV-B-PLL	IWA Personnel	14.46

**MATERIALS ANALYTICAL SERVICES, INC.
CHAIN-OF-CUSTODY****CLIENT:** MAS Corporate**MAS JOB:** M21837**CONTACT:** Bill Longo**DATE RECEIVED:** 7/8/99**PHONE:** (770) 448-3200**SUBMITTED BY:** Brayton, et al.**CLIENT JOB NAME:** Paco Finishing Compound**TRANSPORT:** FedEx**CLIENT JOB#:****RECEIVED BY:** Bill Longo**CLIENT DOC(S):****CONDITION:** good**FAX NUMBER:** (770) 368-8256**MAS # CLIENT SAMPLE****MAS # CLIENT SAMPLE****MAS # CLIENT SAMPLE**

001

1

INITIAL FILE REVIEW: _____**DATE:** _____**SAMPLE PREP BY:** _____**DATE:** _____**SAMPLE ANALYSIS BY:** _____**DATE:** _____**COMMENT:** _____

Materials Analytical Services, Inc.
3945 Lakefield Court
Suwanee, Georgia 30024
(770) 448-3200

MATERIALS ANALYTICAL SERVICES, INC.
PLM ANALYSIS

Proj#-Spl#: M21837-001 Analyst: W.B. Egeland Date: 7/8/99
ClientName: MAS Corporate ClientSpl: 1
Location: _____
Type_Mat: Paco finishing Compound
Gross White. Fine powder.
Visual: _____

OPTICAL DATA FOR ASBESTOS IDENTIFICATION

Morphology	<u>Wavy</u>		
Pleochroism	<u>None</u>		
Refract Index	<u>1.555/1.548</u>		
Sign	<u>+</u>		
Extinction	<u>Parallel</u>		
Birefringence	<u>Low</u>		
Melt	<u>No</u>		
Fiber Name	<u>Chrysotile</u>		

ASBESTOS MINERALS

EST. VOL. %

Chrysotile.....	<u>8</u>
Amosite.....	
Crocidolite.....	
Tremolite/Actinolite.....	
Anthophyllite.....	

OTHER FIBROUS COMPONENTS

_____	_____
_____	_____
_____	_____
_____	_____

NON FIBROUS COMPONENTS

_____	_____
_____	_____
_____	_____
Binder	<u>92</u>

Effervescence: Strong.

Binder Description: Carbonate, mica and fine-grained aggregate.

Comments: No starch observed



ADDITIONAL BULK ANALYSIS

Sample #: M21837-001

Analyst: W.B. EGELAND

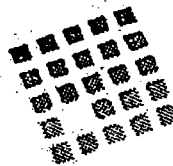
Date: 9/30/99

ACID DISSOLUTION

1) Petri dish plus sample	10.1576g
2) Petri dish minus sample	8.4589g
3) Original sample weight	1.6987g
4) Filter weight	0.0681g
5) Clean petri dish weight	8.4023g
6) Final sample weight plus filter and petri dish	8.9082g
7) Final sample weight $((6) - [(4) + (5)])$	0.4378g
8) Percent residue wt $((7) / (3) * 100)$	25.8%
9) Amount in solution $(100 - (8))$	74.2%

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MATERIALS
ANALYTICAL
SERVICES

MINERAL ANALYSIS SHEET

TEM ANALYSIS:	BULK ANALYSIS
PROJECT:	PACO FINISHING COMPOUND
SAMPLE NUMBER:	1721832-001
SAMPLE ID:	PACO FINISHING COMPOUND
DATE OF ANALYSIS:	10/5/99
ANALYST:	W. B. G.

ASBESTOS MINERALS:

CHRYSTOTILE (EDS) (DIFA)

OTHER COMPONENTS:

CA PARTICLES (EDS)

MICA (EDS)

KASOLINITE (EDS)

TALC (EDS) (PLATE)

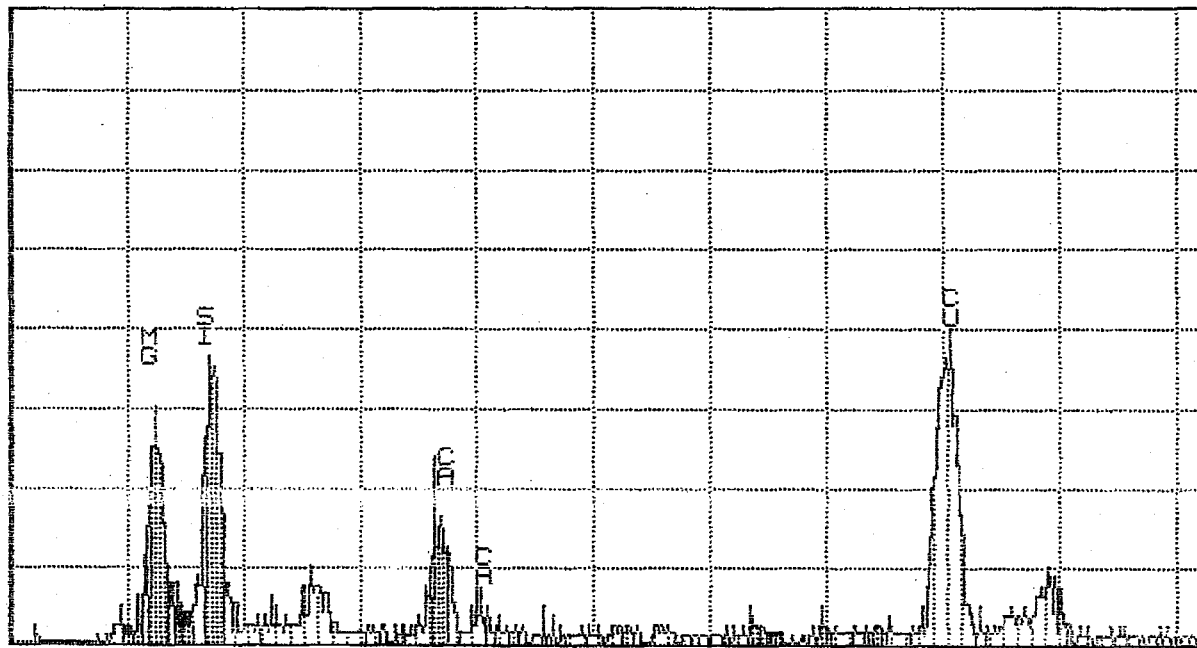
OTHER COMMENTS:

MATERIALS ANALYTICAL SERVICES

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ROI (SIK α) 1.650: 1.810=353



0.000

VFS = 64

10.240

18

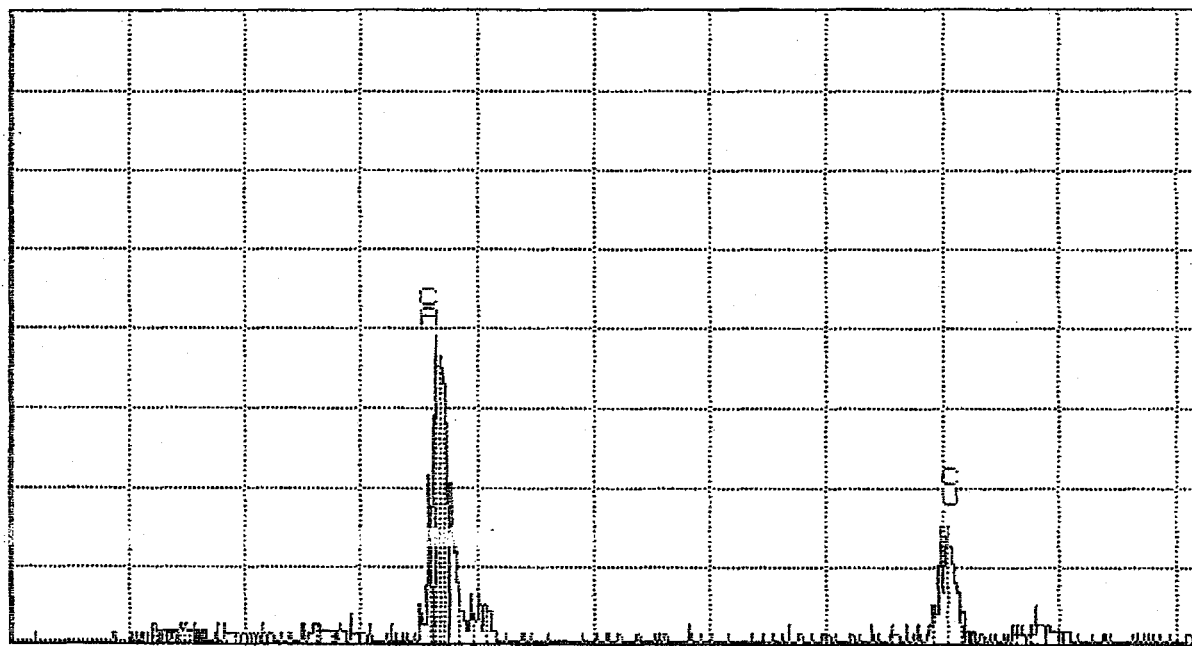
M21837-001, CHRYSOTILE

MATERIALS ANALYTICAL SERVICES

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ROI (SIK α) 1.660: 1.810=10



0.000

VFS = 64

10.240

8

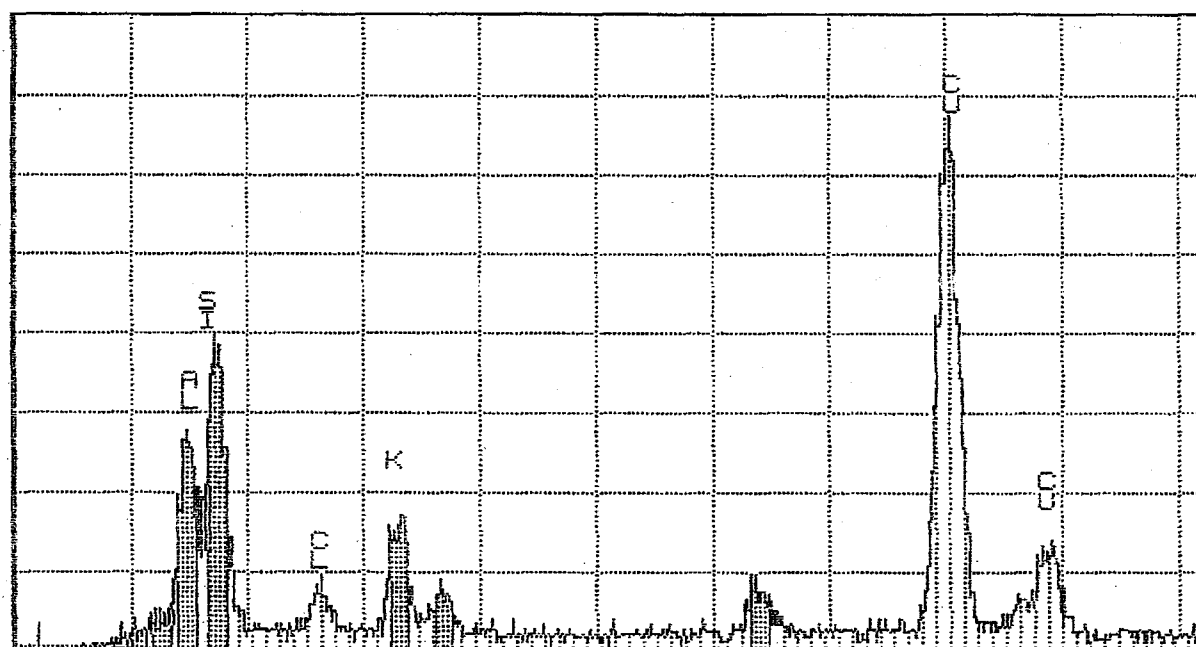
M21837-001, CA PARTICLE

MATERIALS ANALYTICAL SERVICES

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ROI (SIK α) 1.660: 1.810=804



0.000

VFS = 128

10.240

14

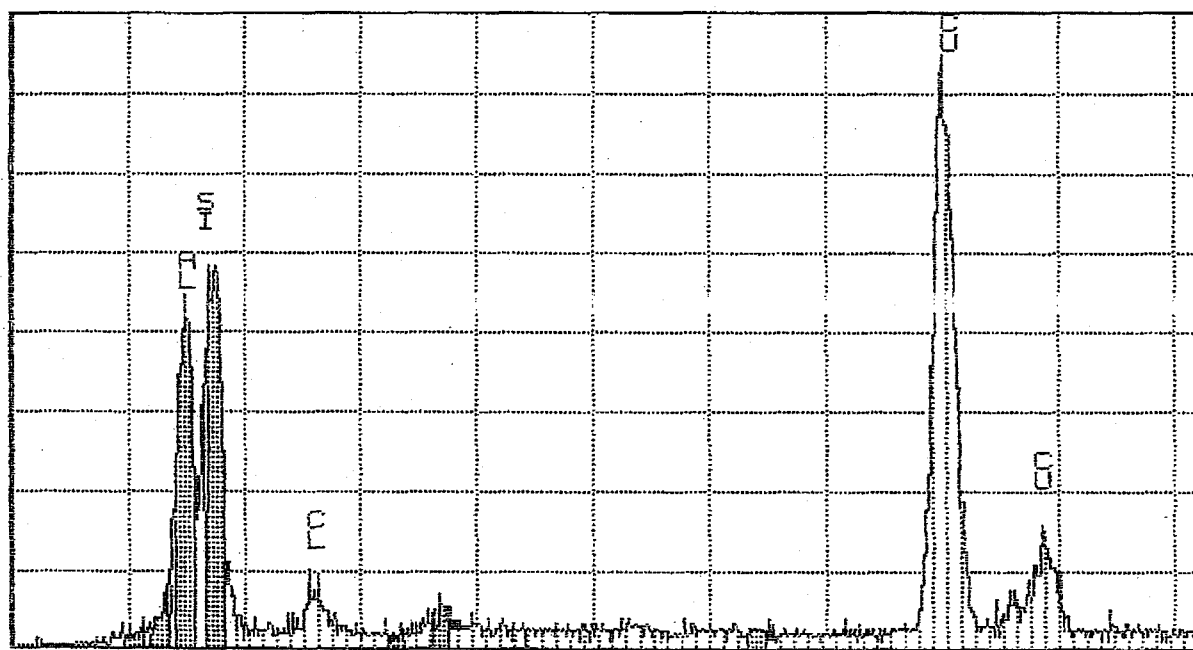
M21837-001, MICA

MATERIALS ANALYTICAL SERVICES

TUE 05-OCT-99 15:03

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ROI (SIK α) 1.660: 1.810=1009



0.000

VFS = 128

10.240

15

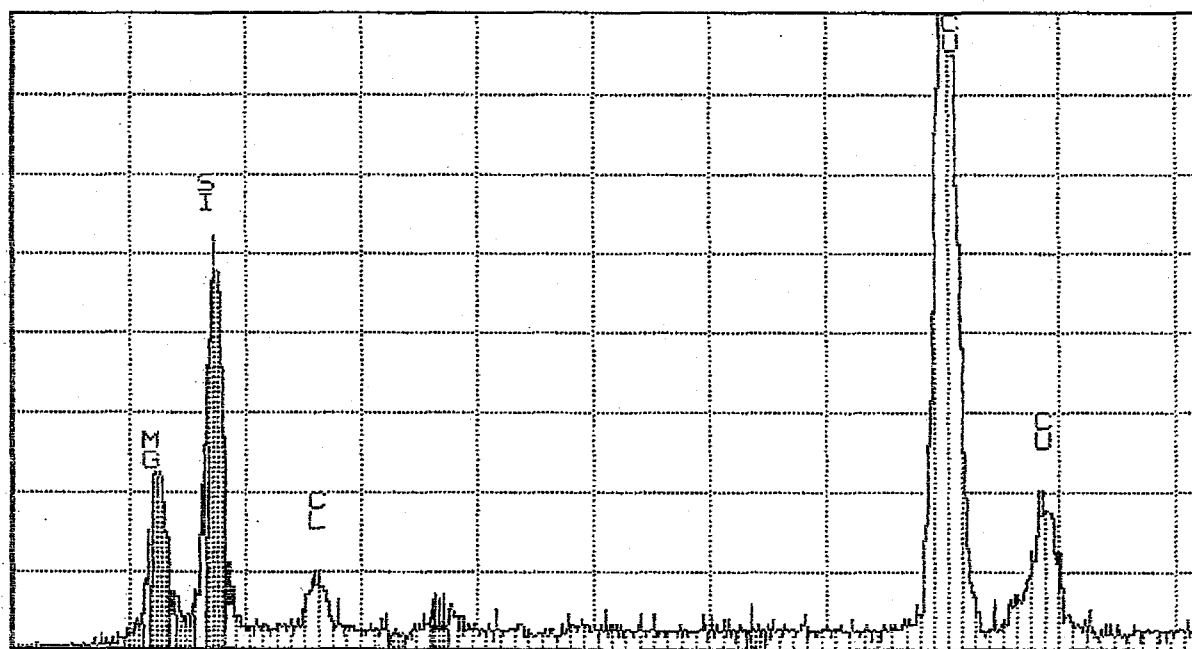
M21837-001, KAOLINITE

MATERIALS ANALYTICAL SERVICES

TUE 05-OCT-99 15:06

Cursor: 0.000keV = 0

ROI (SIK α) 1.660: 1.810=1011



0.000

VFS = 128

10.240

17

M21837-001, TALC

**MATERIALS ANALYTICAL SERVICES, INC.
CHAIN-OF-CUSTODY****CLIENT:** MAS Corporate**MAS JOB:** M22384**CONTACT:** Bill Longo**DATE RECEIVED:** 10/5/99**PHONE:** (770) 448-3200**SUBMITTED BY:** Bill Longo**CLIENT JOB NAME:** USG Sheet Rock Joint Compound**TRANSPORT:** Hand Delivery**CLIENT JOB#:****RECEIVED BY:** Bill Egeland**CLIENT DOC(S):** Purchased at Lowe's**CONDITION:** OK**FAX NUMBER:** (770) 368-8256**MAS # CLIENT SAMPLE****MAS # CLIENT SAMPLE****MAS # CLIENT SAMPLE**

001 USG Joint Compound

INITIAL FILE REVIEW: _____**DATE:** _____**SAMPLE PREP BY:** _____**DATE:** _____**SAMPLE ANALYSIS BY:** _____**DATE:** _____**COMMENT:** _____

Materials Analytical Services, Inc.
3945 Lakefield Court
Suwanee, Georgia 30024
(770) 448-3200

MATERIALS ANALYTICAL SERVICES, INC.
PLM ANALYSIS

Proj#-Spl#: M22384-001 Analyst: W.B. Egeland Date: 10/5/99
ClientName: MAS Corporate ClientSpl: USG Joint Compound
Location: _____
Type_Mat: _____
Gross White. Fine matrix.
Visual: _____

OPTICAL DATA FOR ASBESTOS IDENTIFICATION

Morphology	_____	_____	_____
Pleochroism	_____	_____	_____
Refract Index	_____	_____	_____
Sign	_____	_____	_____
Extinction	_____	_____	_____
Birefringence	_____	_____	_____
Melt	_____	_____	_____
Fiber Name	_____	_____	_____

ASBESTOS MINERALS

EST. VOL. %

NO ASBESTOS OBSERVED

Chrysotile.....
Amosite.....
Crocidolite.....
Tremolite/Actinolite.....
Anthophyllite.....

OTHER FIBROUS COMPONENTS

NON FIBROUS COMPONENTS

Binder

100

Effervescence: Strong.

Binder Description: Carbonate and fine aggregate

Comments: No starch observed