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W.R. GRACE VERMICULITE MINE CLOSURE WATER QUALITY DATA REPORT NO. 1 NOVEMBER, 1991

ADMINISTRATIVE RECORD

Submitted to:

Montana Department of Health and Environmental Sciences
Hard Rock Mining Bureau
Helena, Montana

Submitted by:

Schafer and Associates
Bozeman, Montana

March 4, 1992

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Waste Management
Land Reclamation
Resource Inventory
Agricultural Consulting

Tom – I just read the data analysis section, but the report appears to be well done. It appears WQS for Asbestiform and possibly fluoride may not be met in lower Rainy Cr. However, it says contribution from natural and mining sources can't be determined. So, what does it all mean? Also, is there MPDES issue here? Fred

March 4, 1991

RECEIVED
MAR 0 1992
STATE LAND

Mr. Pat Plantenberg
Department of State Lands
Hardrock Mining Bureau
1625 Eleventh Avenue
Helena, Montana 59620

Dear Pat:

Enclosed are two copies of Water Quality Data Report No. 1 summarizing the results of the first round of water sampling at the W.R. Grace vermiculite mine near Libby, which was done in mid-November. Please forward one copy to Tom Reid at the Water Quality Bureau. The reports are delayed more than I would have liked. We had some difficulty getting a rapid turn-around on the asbestos samples. When we did finally get the results, they all looked reasonable except our blind control, which was nowhere near the duplicate we submitted. We requested EMSL to look at this sample again and they reported what seems to have been an obvious analytical error. Reanalysis of the control confirmed the analysis of the original sample. We have also put a considerable effort into the report for data interpretation which took some time. Later reports will not be so extensive.

We plan to make another sampling trip in late March at the start of spring runoff in an effort to get data when sediment loading is likely to be higher and then again when runoff has begun to decline. These sample dates would provide data in line with Tom Reid's response to our Water Quality Monitoring Plan. I would ask you to consider abandoning a summer sampling campaign in the interest of saving our client some money on an effort that is probably not going to provide any additional information. These sampling campaigns cost almost $6,000.00 each for the analytical work and our labor hours are in addition to that.

Let me know if you have any questions or comments regarding the data.

Sincerely,

Tom Hudson

Tom Hudson
Project Manager

Table of Contents

Section	Description	Page
1.0	BACKGROUND	1 - 1
2.0	METHODS	2 - 1
3.0	PRESENTATION OF DATA	3 - 1
4.0	DATA ANALYSIS	4 - 1

List of Tables

Number	Description	Page
Table 2.1.	Summary of sampling and analytical methods for water samples.	2 - 2
Table 3.1.	Field data summary.	3 - 2
Table 3.2.	Laboratory data summary for metals	3 - 3
Table 3.3.	Laboratory data summary for miscellaneous constituents	3 - 4
Table 3.4.	Laboratory data summary for asbestiform fibers	3 - 5
Table 4.1.	A comparison of measured water quality data with drinking water standards.	4 - 6

List of Figures

Number	Description	Page
Figure 1.1.	Water quality sampling location map.	1 - 2
Figure 4.1.	Schematic flow diagram of the Rainy Creek drainage with mass flow measurements for selected components.	4 - 2
Figure 4.2	Surface geology map of the Rainy Creek Complex.	4 - 4

1.0 BACKGROUND

The W.R. Grace vermiculite mine near Libby, Montana was closed in the fall of 1990. As part of the reclamation and closure, particularly as it applies to areas around the tailings impoundment, W.R. Grace submitted to the Water Quality Bureau a proposed Water Quality Monitoring Plan in September, 1991 (Schafer and Associates, 1991). The purpose of the Plan was to establish post-closure water quality data as a means of monitoring the performance of facility reclamation measures.

The plan calls for water sampling at several locations in the Rainy Creek drainage as shown on Figure 1.1. Contingent sampling on the Kootenai was proposed if initial data on Rainy Creek indicated any potential health concerns. Four sampling campaigns were proposed for the first year to assess seasonal variations in water quality. Additional annual sampling campaigns for a minimum of three years following closure were also proposed. This report presents the data from the first sampling event performed on November 13-15, 1991.

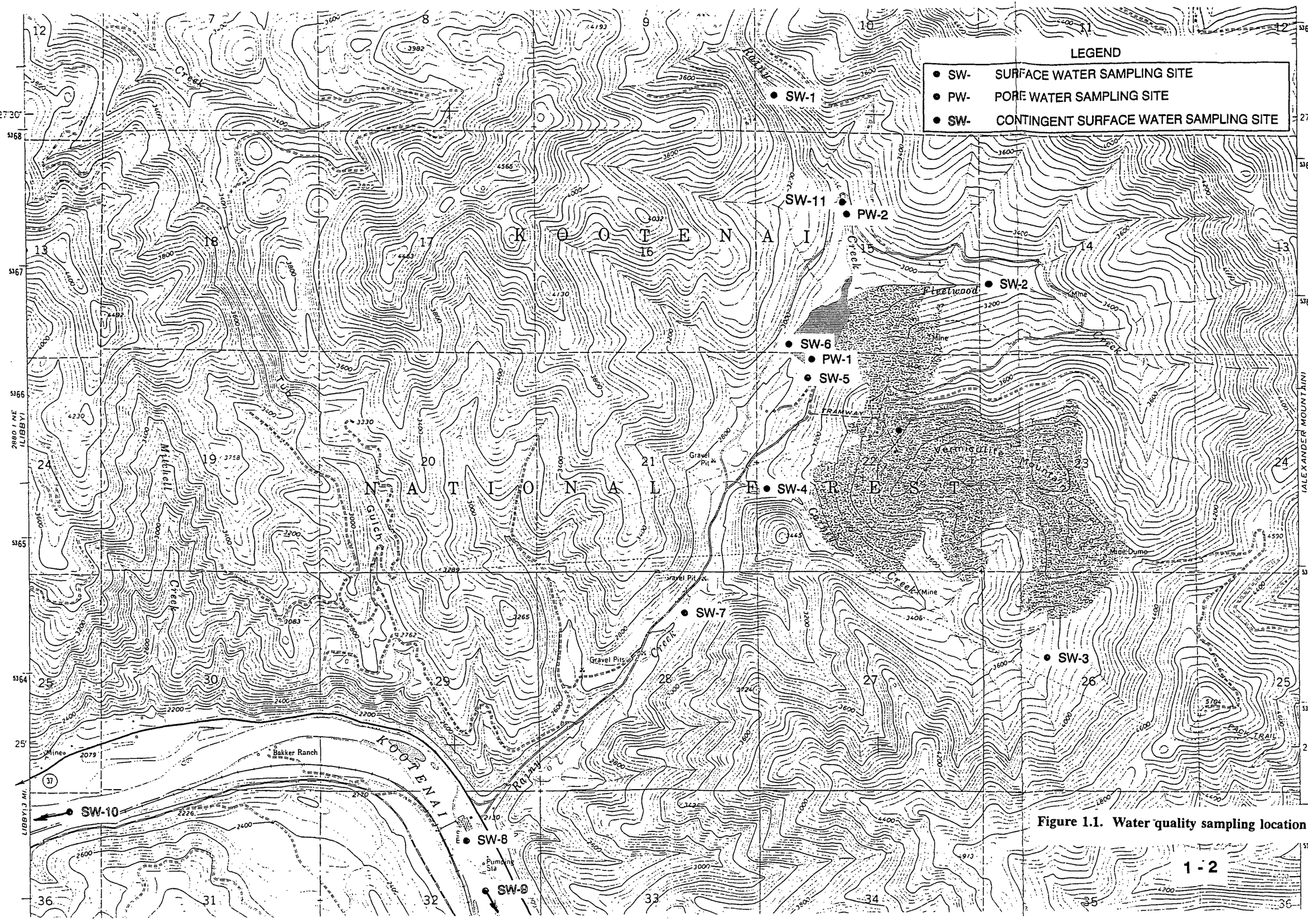

Figure 1.1. Water quality sampling location map.

2.0 METHODS

Sampling methods were outlined in the Water Quality Monitoring Plan submitted in September, 1991. One modification to the plan was made in the field. It was observed that the diversion of Rainy Creek above the tailings impoundment was not totally effective and that appreciable flow was reestablished below the dam from runoff and groundwater seepage. In the interest of getting complete data this flow was also sampled at Site SW-11.

Some modifications were made to the sample preservation techniques outlined in the Plan to comply with accepted standard methods. The preservation techniques and analytical methods used are summarized in Table 2.1. All samples were stored and shipped on ice. Metals were analyzed as the "total recoverable" form according to procedures outlined in Standard Methods for Examination of Water and Wastewater (APHA, 1985).

Table 2.1. Summary of sampling and analytical methods for water samples.

Unpreserved Samples		Preserved Samples			Field Parameters	
Component	Analytical Method[1]	Component	Preservation/ Container[2]	Analytical Method[1]	Param.	Method
TDS	EPA 160.1	TPH	H_2SO_4/Glass	EPA 418.1	Flow	Pygmy current meter/ Baski
TSS	EPA 160.2	Cu	HNO_3/PE	EPA 220.1/200.7	pH	Field pH meter
Asbest. Fibers	EPA-600/4-83-043	Zn	HNO_3/PE	EPA 289.1/200.7	EC	Field EC meter
Hardness	EPA 130.2	Cd	HNO_3/PE	EPA 213.1/200.7	DO	Field D.O. meter
Alkalinity	EPA 310.1	Pb	HNO_3/PE	EPA 239.2/200.7	Temp.	Field meter
NO_3^-	EPA 353.2	Hg	HNO_3/PE	EPA 245.2		
SO_4^{-2}	EPA 375.3	Fe	HNO_3/PE	EPA 236.1/200.7		
Cl^-	EPA 325.3	As	HNO_3/PE	EPA 206.3		
F^-	EPA 340.2	Ni	HNO_3/PE	EPA 249.1/200.7		
Ca	EPA 215.1/200.7	Cr	HNO_3/PE	EPA 218.1/200.7		
Mg	EPA 242.1/200.7					
Na	EPA 273.1/200.7					
K	EPA 258.1/200.7					
CO_3^{-2}/HCO_3^-	EPA 310.1					

1 EPA procedures are described in 40 CFR Part 136, Table B. Procedures for asbestiform fibers are described in "Analytical Procedures for Determination of Asbestos Fibers in Water" (EPA-600/4-83-043).

2 Samples were acidified to a value less 2.0. The TPH sample was collected in a 1 L glass bottle; metals were collected in 500 ml polyethylene (PE) bottles.

3.0 PRESENTATION OF DATA

Results of the November 13-15, 1991 sampling campaign are summarized in tabular form as follows:

- Table 3.1 is a summary of field parameters including pH, electric conductivity (EC), temperature and flow. Dissolved oxygen monitoring was also planned. However, the meter failed in the field.
- Table 3.2 is a summary of metal analyses including selected heavy metals and major cations.
- Table 3.3 is a summary of miscellaneous analyses for various anions, petroleum hydrocarbons, hardness, etc.
- Table 3.4 is a summary of asbestiform fiber analyses.

Raw analytical data from Energy Laboratories and EMS Laboratories used to prepare Tables 3.2, 3.3 and 3.4, is included in Appendix A and B, respectively.

Table 3.1. Field data summary.

SITE NO.	DESCRIPTION	pH (su)	EC (mmhos/cm)	TEMP (°C)	FLOW (cfs)	D.O.[3] (ppm)
SW-1	Upper Rainy Creek above diversion dam	7.44	0.27	3.4	0.35[1]	
SW-2	Fleetwood Creek above coarse tails	7.56	0.37	5.9	0.19[2]	
SW-3	Upper Carney Creek at Zook's Dump	7.37	0.86	7.5	<.01[2]	
SW-4	Lower Carney Creek above Rainy Creek	8.35	0.69	4.3	0.24[2]	
SW-5	Tailings dam toe drains	6.78	0.75	9.1	1.22[1]	
SW-6	Tailings pond surface water	7.98	0.26	3.0	0.00	
SW-7	Lower Rainy Creek leaving mine property	8.03	0.66	4.4	1.10[1]	
SW-8	Lower Rainy Creek above Kootenai River	8.15	0.70	6.5	2.03[1]	
SW-9	Kootenai River above Rainy Creek	Not Sampled[4]				
SW-10	Kootenai River below Rainy Creek	Not Sampled[4]				
SW-11[5]	Rainy Creek flow into tailings pond	7.36	0.38	4.4	0.33[2]	
PW-1	Pore water from tailings	7.26	1.25	7.5	NA	
PW-2	Groundwater near SW-11	8.16	.58	4.5	NA	

1 Flow measurement was made with a Pygmy current meter.
2 Flow measurement was made with a Baski cutthroat flume.
3 The dissolved oxygen meter failed.
4 Samples of the Kootenai River were not taken as discussed in the Water Quality Monitoring Plan.
5 The Water Quality Monitoring Plan did not include this site. Rainy Creek reestablishes itself between the diversion dam and the tailings impoundment.

Table 3.2. Laboratory data summary for metals.

SITE NO.	DESCRIPTION	As (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Pb (mg/l)	Hg (mg/l)	Ni (mg/l)	Zn (mg/l)	K (mg/l)	Na (mg/l)	Ca (mg/l)	Mg (mg/l)
SW-1	Upper Rainy Creek above diversion dam	<0.001	<0.001	<0.02	<0.01	<0.03	<0.01	<0.001	<0.03	0.02	3	3	68	11
SW-2	Fleetwood Creek above coarse tails	<0.001	<0.001	<0.02	<0.01	<0.03	<0.01	<0.001	<0.03	0.05	9	4	88	16
SW-3	Upper Carney Creek at Zook's Dump	<0.001	<0.001	<0.02	<0.01	0.29	<0.01	<0.001	<0.03	0.01	18	8	118	34
SW-4	Lower Carney Creek above Rainy Creek	0.001	<0.001	<0.02	<0.01	0.05	<0.01	<0.001	<0.03	0.02	11	9	98	9
SW-5	Tailings dam toe drains	0.005	<0.001	<0.02	<0.01	0.07	<0.01	<0.001	<0.03	0.16	10	6	92	25
SW-6	Tailings pond surface water	<0.001	<0.001	<0.02	<0.01	0.09	<0.01	<0.001	<0.03	<0.01	2	1	14	4
SW-7	Lower Rainy Creek leaving mine property	0.003	<0.001	<0.02	<0.01	0.18	<0.01	<0.001	<0.03	<0.01	9	6	90	24
SW-0	Blind Control (Replicate of SW-7)	0.004	<0.001	<0.02	<0.01	0.16	<0.01	<0.001	<0.03	<0.01	10	6	91	24
SW-8	Lower Rainy Creek above Kootenai River	0.003	<0.001	<0.02	<0.01	0.17	<0.01	<0.001	<0.03	<0.01	10	6	91	22
SW-9	Kootenai River above Rainy Creek	Not Sampled												
SW-10	Kootenai River below Rainy Creek	Not Sampled												
SW-11	Rainy Creek flow into tailings pond	0.001	<0.001	<0.02	<0.01	<0.03	<0.01	<0.001	<0.03	<0.01	5	3	70	11
PW-1	Pore water from tailings	0.004	<0.001	<0.02	<0.01	1.72	<0.01	<0.001	<0.03	<0.01	19	13	175	64
PW-2	Groundwater near SW-11	<0.001	<0.001	<0.02	<0.01	<0.03	<0.01	<0.001	<0.03	<0.01	5	5	65	13

Table 3.3. Laboratory data summary for miscellaneous constituents.

SITE NO.	DESCRIPTION	SO_4^{+2} (mg/l)	Cl^- (mg/l)	CO_3^{-2} (mg/l)	HCO_3^{-1} (mg/l)	TDS (mg/l)	TSS (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)	NO_3^- (mg/l)	F^- (mg/l)	TPH (mg/l)
SW-1	Upper Rainy Creek above diversion dam	4	<1	0	249	203	1	216	204	<0.05	0.25	<0.1
SW-2	Fleetwood Creek above coarse tails	15	5	0	320	312	3	283	262	<0.05	0.32	<0.1
SW-3	Upper Carney Creek at Zook's Dump	13	2	0	531	496	8	434	435	0.44	0.25	<0.1
SW-4	Lower Carney Creek above Rainy Creek	21	2	6	428	400	<1	363	361	0.25	0.28	<0.1
SW-5	Tailings dam toe drains	9	8	0	390	364	<1	332	319	<0.05	3.1	<0.1
SW-6	Tailings pond surface water	6	1	0	52	52	2	54	43	0.06	0.28	0.3
SW-7	Lower Rainy Creek leaving mine property	11	10	0	378	350	2	322	310	0.05	2.3	<0.1
SW-0	Blind Control (Replicate of SW-7)	11	10	0	381	353	4	325	313	0.05	2.4	<0.1
SW-8	Lower Rainy Creek above Kootenai River	11	10	0	367	348	6	318	301	0.06	1.6	<0.1
SW-9	Kootenai River above Rainy Creek	Not Sampled										
SW-10	Kootenai River below Rainy Creek	Not Sampled										
SW-11	Rainy Creek flow into tailings pond	5	<1	0	269	223	<1	220	220	<0.05	0.15	<0.1
PW-1	Pore water from tailings	1	18	0	911	822	NA	699	747	1.40	3.5	NA
PW-2	Groundwater near SW-11	9	2	0	243	252	NA	216	199	2.65	0.44	NA

Table 3.4. Laboratory data summary for asbestiform fibers.

SITE NO.	DESCRIPTION	DETECTION LIMIT (MFL)	FIBERS <2.5μm (MFL)	FIBERS 2.5 - 9.9μm (MFL)	FIBERS >10μm (MFL)	FIBER MASS (μg/l)
SW-1	Upper Rainy Creek above diversion dam	0.07	<0.07	<0.07	<0.07	BDL
SW-2	Fleetwood Creek above coarse tails	0.07	2.0	1.4	0.5	24
SW-3	Upper Carney Creek at Zook's Dump	0.2	5.4	8.4	1.8	42
SW-4	Lower Carney Creek above Rainy Creek	0.07	1.8	2.1	0.1	6.4
SW-5	Tailings dam toe drains	0.3	0.6	0.6	0.3	8.8
SW-6	Tailings pond surface water	0.6	9.0	16.4	1.7	52
SW-7	Lower Rainy Creek leaving mine property	1.5	62	56	12	140
SW-0	Blind Control (Replicate of SW-7)	2.1	66	75	19	250
SW-8	Lower Rainy Creek above Kootenai River	1.9	73	83	17	240
SW-9	Kootenai River above Rainy Creek	Not Sampled				
SW-10	Kootenai River below Rainy Creek	Not Sampled				
SW-11	Rainy Creek flow into tailings pond	0.07	<0.07	<0.07	<0.07	BDL
	EMS Laboratories Blank	0.04	<0.04	<0.04	<0.04	BDL

4.0 DATA ANALYSIS

The important findings of this testing are summarized as follows:

- Upper Rainy Creek (Sites SW-1 and SW-11) was found to be free of asbestiform fibers. Metal levels were all below detection limits with the exception of zinc which was .05 mg/l.

- Fleetwood Creek (SW-2) and Lower Carney Creek (SW-4) showed asbestiform fiber counts of about 4 million fibers per liter (MFL). Upper Carney Creek (SW-3), which originates as a trickle from a waste dump, contained 15.6 MFL. Otherwise, water quality was similar to that in Upper Rainy Creek with the exception of slightly elevated iron levels (.29 and .05 mg/l) in Carney Creek. The elevated iron may be attributed in part to higher sediment loading in these samples.

- Samples of the tailings impoundment toe drains (SW-5) indicated that As, Fe and Zn were elevated above ambient levels at 0.005, 0.07 and 0.16 mg/l respectively. Fluoride, which is present because of the use of HF as a flotation reagent, was 3.1 mg/l. This is about an order of magnitude higher than natural streams in the area. The toe drains contained only 1.5 MFL of asbestiform fibers ostensibly due to effective filtration in the dam foundation materials.

- Surface water from the tailings impoundment (there was no outfall at the time of sampling) had the lowest TDS values of any samples collected. This sample (SW-6) was collected from under an ice layer. As such, it may have been a product of purification by successive freezing and thawing or simply diluted by natural precipitation. This was the only sample to show any indication of petroleum hydrocarbons with a concentration of 0.3 mg/l, just above the detection limit. This sample did contain elevated levels of asbestiform fibers at 26.1 MFL.

- Samples from the two sites on Lower Rainy Creek (SW-7 and SW-8), below the tailings impoundment, show the impact of fluoride, arsenic and iron from the toe drains and Carney Creek but zinc is not detected at these sites. Asbestiform fibers from these sites were much higher than any other sampling locations, 130 and 173 MFL, respectively. The asbestiform fiber contamination certainly must be characterized as a non-point source impact based on this finding. As shown in Figure 4.1, over 95 percent of the asbestiform fibers entering the Kootenai River originate below Carney Creek. It is probable that much of the high tremolite fiber content is derived from the early years of operation before the existence of the tailings impoundment. Tremolite is believed to have formed through hydrothermal alteration of pyroxenite during the last stage of geologic development when quartz and calcite

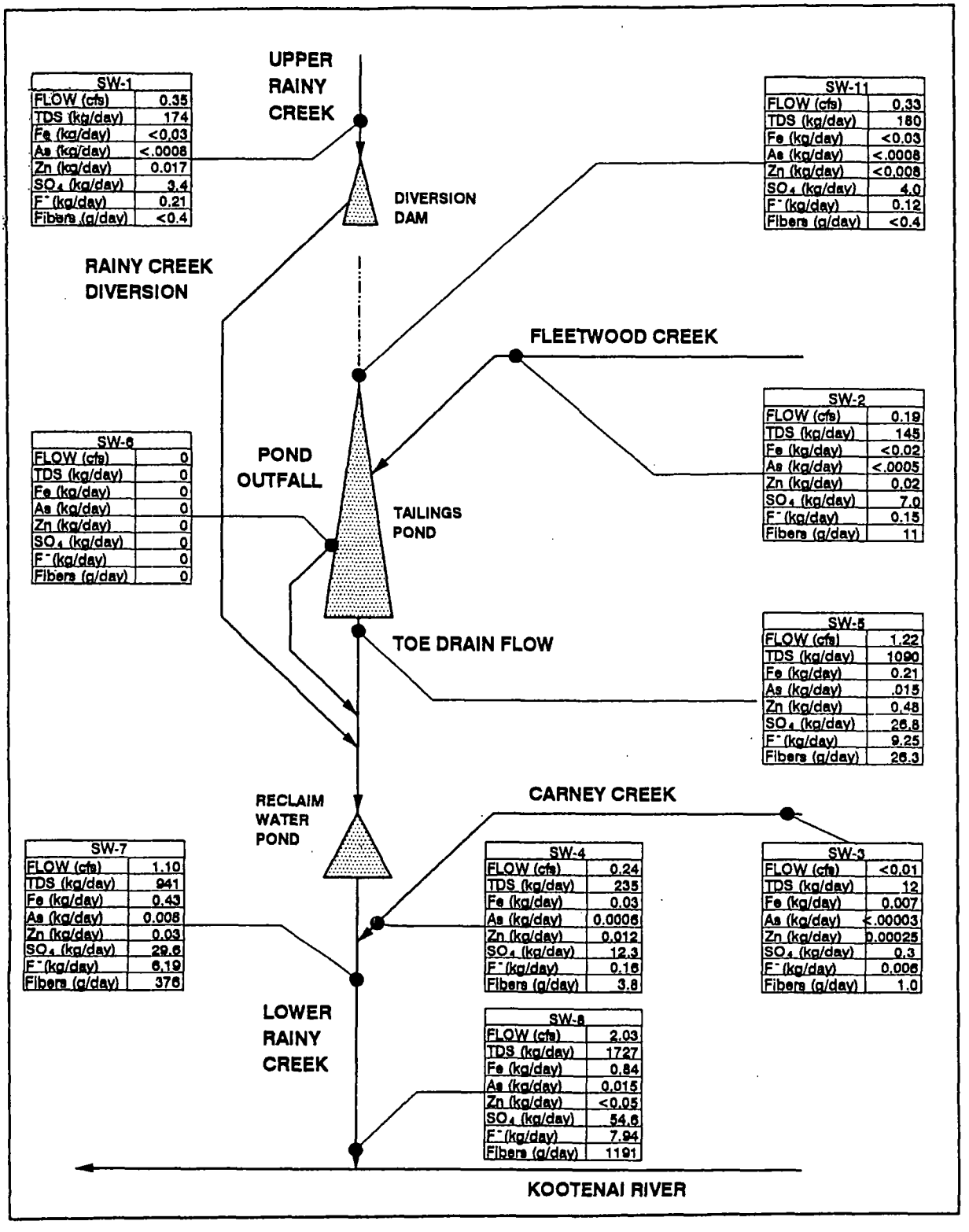

Figure 4.1 Schematic flow diagram of the Rainy Creek drainage with mass flow measurements for selected components.

veins intruded the Rainy Creek Complex (Boettcher, 1966). Figure 4.2 shows that Fleetwood Creek appears to have exposed the pyroxenite through erosion. Consequently, alluvial deposits in Lower Rainy Creek probably also contain tremolite fibers of natural origin. The relative contribution of tremolite from natural and historic mining sources cannot be determined.

- The flow at site SW-7 was only 1.10 cfs. This is less than the total flows from the toe drains, Carney Creek and the diverted Upper Rainy Creek (a total of 1.81 cfs). This site is in a relatively flat portion of the Rainy Creek Drainage below the water storage pond. It is probable that soils in this area are gravelly and that the pond acts to divert a portion of the surface flow back to groundwater flow thereby reducing the flow measured at SW-7. Most of this flow appears to be recovered as surface flow by the time Rainy Creek reaches SW-8. Most drainages contain both surface flow and an associated subsurface flow. Gaining or losing stretches where groundwater may emerge as surface flow or surface flow may infiltrate to groundwater are normal, particularly in small streams.

- Fluoride analyses appear to be a good indicator of the combined surface and subsurface flow, below the tailings dam. An estimate of total system flow can be calculated for sites SW-7 and SW-8 based on fluoride analyses making the following assumptions:

  1) there is no attenuation of fluoride in the streambed,

  2) there are no other water inputs containing high fluoride other than the toe drain flow, and

  3) all additional groundwater and surface recharge to Rainy Creek is at the 0.3 mg/l F concentration typical of the area.

  Using these assumptions, the calculated system flows at SW-7 and SW-8 are 1.71 and 2.28 cfs, respectively.

- The water balance around the tailings impoundment suggests that additional groundwater is being released from the toe drains as a result of natural seepage in this area (this was their intended purpose) and/or pore water draining from the tailings material as a result of the recent efforts to lower the water level in the tailings pond. Measured inputs to the impoundment are 0.52 cfs but toe drain flow is 1.22 cfs.

- Pore water samples showed some differences in Ca/Mg ratios between the local groundwater and stream flows (typically about 6:1) and water in the tailings impoundment (measured at 2.73:1). The toe drain Ca/Mg ratio was intermediate compared to these. Based on these ratios an estimated 60 to 70 percent of toe drain

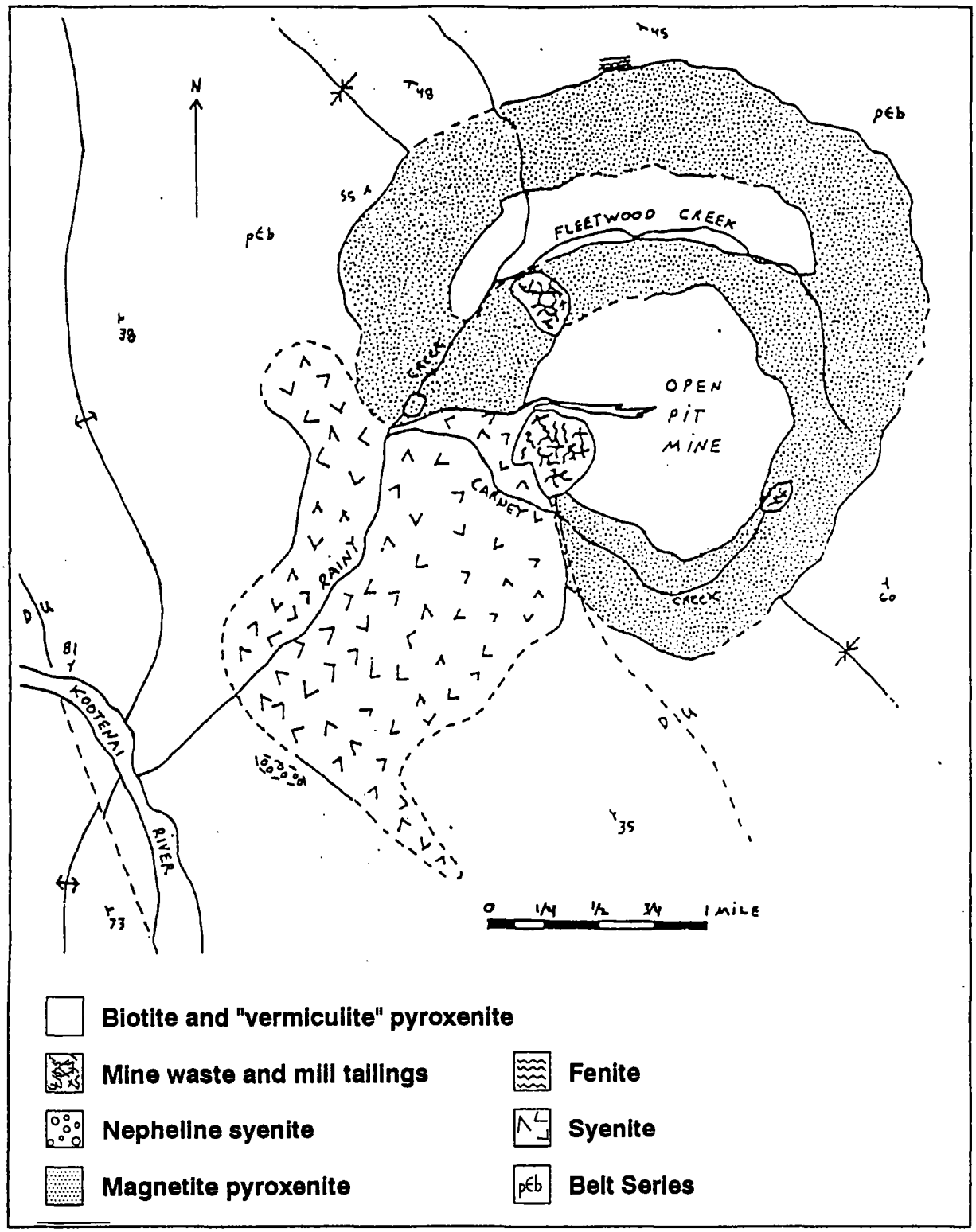

Figure 4.2 Surface geology map of the Rainy Creek Complex. Erosion of the pyroxenite formation in the Fleetwood Creek drainage may be a natural source of tremolite fibers in Lower Rainy Creek.

flows originate in or pass through the tailings materials. This analysis is confirmed by the elevated fluoride levels in the toe drains.

- There is evidence of very low levels of nitrate input to Carney Creek probably from the waste rock dumps which could have residual nitrate as the result of blasting. The nitrate is also evident in Lower Rainy Creek; however, it is just above detection limits.

- There is a general trend toward an increase in hardness and alkalinity as one moves down the Rainy Creek drainage. Mine wastes probably contribute to this as evidenced by samples from Upper Carney Creek (SW-3) and the tailings pore water sample (PW-1) both of which are generated by direct contact of water with mine wastes.

- Table 4.1 compares measured values with applicable drinking water standards. The only issues of concern appear to be asbestiform fibers and fluoride which are marginally higher than drinking water standards for some samples. There is no current drinking water standard for nickel. The EPA Gold Book Update No. 1 (USEPA, 1987) lists a human health criterion for nickel of 0.1 mg/l.

- The Gold Book (USEPA, 1986) also lists an increased risk level of 10^{-6} for asbestos at a concentration of 30,000 fibers per liter without specific reference to size or aspect ratios and without judgement on what constitutes acceptable risk. The drinking water standard for asbestos which takes effect in July, 1992 presumably reflects the current thinking on asbestos-related health risks in public water supplies.

Table 4.1 A comparison of measured water quality data with drinking water standards.

Constituent	Measured Concentration (mg/l)	Location of Sample with Maximum Concentration	Primary Drinking Water Standard (mg/l)	Secondary Drinking Water Standard (mg/l)
As	<0.001 to 0.005	SW-5	0.05	
Cd	<.001	All	0.005[1]	
Cr	<.002	All	0.1[1]	
Cu	<.01	All		1.0
Fe	<0.03 to 0.29	SW-3		0.3
Pb	<.01	All	0.05	
Hg	<.001	All	0.005	
Ni	<.03	All		
Zn	<0.01 to 0.16	SW-5	5.0	
Asbestos	<0.07 to 19.0	SW-8	7.0[1,2]	
SO_4^{-2}	4 to 21	SW-4		250
Cl^-	<1 to 10	SW-8		250
NO_3^-	<0.05 to 0.44	SW-3	10.0	
F^-	0.25 to 3.1	SW-5		2.0
pH	6.78 to 8.35	SW-5(min); SW-8(max)		6.5 to 8.5
TDS	52 to 496	SW-3		500

1 These standards are added or revised effective July 1992.

2 Fiber counts are based on fibers greater than 10 microns in length with an aspect ratio greater than 3:1.

REFERENCES

American Public Health Association, 1985. Standard Methods for the Examination of Water and Wastewater, Part 300: Determination of Metals.

Boettcher, A.L., 1966. The Rainy Creek Igneous Complex Near Libby, Montana, unpublished Ph.D dissertation, Pennsylvania State University.

Schafer and Associates, 1991. W.R. Grace Vermiculite Mine Closure Water Quality Monitoring Plan, submitted to Montana Department of Health and Environmental Sciences, Water Quality Bureau.

USEPA, 1986. Quality Criteria for Water 1986.

USEPA, 1987. Quality Criteria for Water 1986, Update #1.

APPENDIX A

ENERGY LABORATORIES DATA REPORTS

APPENDIX B

EMS LABORATORIES DATA REPORTS

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406)252-6325
FAX (406)252-6069 • 1-800-735-4489

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45313
ADDRESS:	P.O. Box 6186 Bozeman, MT 59715	DATE:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-0
Sampled 11/14/91 @ 0930
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	10
Sodium	6
Calcium	91
Magnesium	24
Sulfate	11
Chloride	10
Carbonate	0
Bicarbonate	381
Total Dissolved Solids @ 180°C	353
Total Suspended Solids	4
Total Hardness as $CaCO_3$	325
Total Alkalinity as $CaCO_3$	313
Nitrate plus Nitrite as N	0.05
Fluoride	2.4
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	0.004
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	0.16
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	<0.01

* Analysis done by EPA method 418.1

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406)252-6325
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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45314
ADDRESS:	P.O. Box 6186 Bozeman, MT 59715	DATE:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-1
Sampled 11/13/91 @ 1350
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	3
Sodium	3
Calcium	68
Magnesium	11
Sulfate	4
Chloride	<1
Carbonate	0
Bicarbonate	249
Total Dissolved Solids @ 180°C	203
Total Suspended Solids	1
Total Hardness as $CaCO_3$	216
Total Alkalinity as $CaCO_3$	204
Nitrate plus Nitrite as N	<0.05
Fluoride	0.25
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	<0.001
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	<0.03
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	0.02

* Analysis done by EPA method 418.1

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
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FAX (406)252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Schafer & Associates
ADDRESS: P.O. Box 6186
Bozeman, MT 59715

LAB NO.: 91-45315
DATE: 12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-2
Sampled 11/14/91 @ 1450
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	9
Sodium	4
Calcium	88
Magnesium	16
Sulfate	15
Chloride	5
Carbonate	0
Bicarbonate	320
Total Dissolved Solids @ 180°C	312
Total Suspended Solids	3
Total Hardness as $CaCO_3$	283
Total Alkalinity as $CaCO_3$	262
Nitrate plus Nitrite as N	<0.05
Fluoride	0.32
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	<0.001
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	<0.03
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	0.05

* Analysis done by EPA method 418.1

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45316
ADDRESS:	P.O. Box 6186 Bozeman, MT 59715	DATE:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-3
Sampled 11/14/91 @ 1400
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	18
Sodium	8
Calcium	118
Magnesium	34
Sulfate	13
Chloride	2
Carbonate	0
Bicarbonate	531
Total Dissolved Solids @ 180°C	496
Total Suspended Solids	8
Total Hardness as $CaCO_3$	434
Total Alkalinity as $CaCO_3$	435
Nitrate plus Nitrite as N	0.44
Fluoride	0.25
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	<0.001
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	0.29
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	0.01

* Analysis done by EPA method 418.1

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FAX (406)252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Schafer & Associates
ADDRESS: P.O. Box 6186
Bozeman, MT 59715

LAB NO.: 91-45317
DATE: 12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-4
Sampled 11/14/91 @ 1145
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	11
Sodium	9
Calcium	98
Magnesium	29
Sulfate	21
Chloride	2
Carbonate	6
Bicarbonate	428
Total Dissolved Solids @ 180°C	400
Total Suspended Solids	<1
Total Hardness as $CaCO_3$	364
Total Alkalinity as $CaCO_3$	361
Nitrate plus Nitrite as N	0.25
Fluoride	0.28
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	0.001
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	0.05
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	0.02

* Analysis done by EPA method 418.1

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LABORATORY REPORT

TO: Schafer & Associates
ADDRESS: P.O. Box 6186
Bozeman, MT 59715

LAB NO.: 91-45318
DATE: 12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-5
Sampled 11/14/91 @ 1600
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	10
Sodium	6
Calcium	92
Magnesium	25
Sulfate	9
Chloride	8
Carbonate	0
Bicarbonate	390
Total Dissolved Solids @ 180°C	364
Total Suspended Solids	<1
Total Hardness as $CaCO_3$	332
Total Alkalinity as $CaCO_3$	319
Nitrate plus Nitrite as N	<0.05
Fluoride	3.1
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	0.005
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	0.07
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	0.16

* Analysis done by EPA method 418.1

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45319
ADDRESS:	P.O. Box 6186	DATE:	12/09/91 crp
	Bozeman, MT 59715	REVISED:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-6, Tailing Imp.,
Sampled 11/14/91 @ 1700
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	2
Sodium	1
Calcium	14
Magnesium	4
Sulfate	6
Chloride	1
Carbonate	0
Bicarbonate	52
Total Dissolved Solids @ 180°C	52
Total Suspended Solids	2
Total Hardness as $CaCO_3$	54
Total Alkalinity as $CaCO_3$	43
Nitrate plus Nitrite as N	0.06
Fluoride	0.28
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	0.3

Total Recoverable Metals:

Arsenic	<0.001
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	0.09
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	<0.01

* Analysis done by EPA method 418.1

ENERGY LABORATORIES

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45320
ADDRESS:	P.O. Box 6186	DATE:	12/09/91 crp
	Bozeman, MT 59715	REVISED:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-7
Sampled 11/14/91 @ 1015
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	9
Sodium	6
Calcium	90
Magnesium	24
Sulfate	11
Chloride	10
Carbonate	0
Bicarbonate	378
Total Dissolved Solids @ 180°C	350
Total Suspended Solids	2
Total Hardness as $CaCO_3$	322
Total Alkalinity as $CaCO_3$	310
Nitrate plus Nitrite as N	0.05
Fluoride	2.3
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	0.003
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	0.18
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	<0.01

* Analysis done by EPA method 418.1

ENERGY LABORATORIES, INC.
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) • 1-800-735-4489

LABORATORY REPORT

Schafer & Associates
P.O. Box 6186
Bozeman, MT 59715

LAB NO.:	91-45320 dup	45321
DATE:	12/09/91 crp	09/91 crp
REVISED:	12/11/91 crp	11/91 crp

QUALITY ASSURANCE - DUPLICATE ANALYSIS

W.R. Grace Mine, Libby, MT
SW-7
Sampled 11/14/91 @ 1015
Submitted 11/20/91

Constituent	mg/l (ppm)	)
Potassium	11	
Sodium	7	
Calcium	91	
Magnesium	23	
Sulfate	10	
Chloride	10	
Carbonate	0	
Bicarbonate	376	
Total Dissolved Solids @ 180°C	351	
Total Suspended Solids	2	
Total Hardness as $CaCO_3$	322	
Total Alkalinity as $CaCO_3$	308	
Nitrate plus Nitrite as N	0.05	
Fluoride	2.4	
Total Acidity as $CaCO_3$	N/A	
Total Petroleum Hydrocarbons*	N/A	
Total Recoverable Metals:		
Arsenic	0.003	
Cadmium	<0.001	
Chromium	<0.02	
Copper	<0.01	
Iron	0.18	
Lead	<0.01	
Mercury	<0.0001	1
Nickel	<0.03	
Zinc	0.01	

* Analysis done by EPA method 418.1

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45321
ADDRESS:	P.O. Box 6186	DATE:	12/09/91 crp
	Bozeman, MT 59715	REVISED:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-8
Sampled 11/14/91 @ 0815
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	10
Sodium	6
Calcium	91
Magnesium	22
Sulfate	11
Chloride	10
Carbonate	0
Bicarbonate	367
Total Dissolved Solids @ 180°C	348
Total Suspended Solids	6
Total Hardness as $CaCO_3$	318
Total Alkalinity as $CaCO_3$	301
Nitrate plus Nitrite as N	0.06
Fluoride	1.6
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	0.003
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	0.17
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	<0.01

* Analysis done by EPA method 418.1

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45321 spi
ADDRESS:	P.O. Box 6186	DATE:	12/09/91 crp
	Bozeman, MT 59715	REVISED:	12/11/91 crp

QUALITY ASSURANCE - SPIKED ANALYSIS

W.R. Grace Mine, Libby, MT
SW-8
Sampled 11/14/91 @ 0815
Submitted 11/20/91

Constituent	% Recovery
Potassium	90
Sodium	96
Calcium	95
Magnesium	97
Sulfate	98
Chloride	97
Carbonate	N/A
Bicarbonate	N/A
Total Dissolved Solids @ 180°C	N/A
Total Suspended Solids	N/A
Total Hardness as $CaCO_3$	N/A
Total Alkalinity as $CaCO_3$	N/A
Nitrate plus Nitrite as N	98
Fluoride	94
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	N/A
Total Recoverable Metals:	
Arsenic	85
Cadmium	97
Chromium	90
Copper	96
Iron	91
Lead	95
Mercury	99
Nickel	91
Zinc	93

* Analysis done by EPA method 418.1

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45322
ADDRESS:	P.O. Box 6186	DATE:	12/09/91 crp
	Bozeman, MT 59715	REVISED:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
SW-11
Sampled 11/14/91 @ 1515
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	5
Sodium	3
Calcium	70
Magnesium	11
Sulfate	5
Chloride	<1
Carbonate	0
Bicarbonate	269
Total Dissolved Solids @ 180°C	223
Total Suspended Solids	<1
Total Hardness as $CaCO_3$	220
Total Alkalinity as $CaCO_3$	220
Nitrate plus Nitrite as N	<0.05
Fluoride	0.15
Total Acidity as $CaCO_3$	N/A
Total Petroleum Hydrocarbons*	<0.1

Total Recoverable Metals:

Arsenic	0.001
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	<0.03
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	<0.01

* Analysis done by EPA method 418.1

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LABORATORY REPORT

TO:	Schafer & Associates	LAB NO.:	91-45323
ADDRESS:	P.O. Box 6186	DATE:	12/09/91 crp
	Bozeman, MT 59715	REVISED:	12/11/91 crp

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
PW-1
Sampled 11/15/91 @ 0800
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	19
Sodium	13
Calcium	175
Magnesium	64
Sulfate	1
Chloride	18
Carbonate	0
Bicarbonate	911
Total Dissolved Solids @ 180°C	822
Total Hardness as $CaCO_3$	699
Total Alkalinity as $CaCO_3$	747
Nitrate plus Nitrite as N	1.40
Fluoride	3.5
Total Acidity as $CaCO_3$	N/A

Total Recoverable Metals:

Arsenic	0.004
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	1.72
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	<0.01

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FAX (406)252-6069 • 1-800-735-4489

LABORATORY REPORT

TO:	Schafer & Associates	**LAB NO.:**	91-45324
ADDRESS:	P.O. Box 6186	**DATE:**	12/09/91 crp
	Bozeman, MT 59715	**REVISED:**	12/11/91

WATER ANALYSIS

W.R. Grace Mine, Libby, MT
PW-2
Sampled 11/15/91 @ 0815
Submitted 11/20/91

Constituent	mg/l (ppm)
Potassium	5
Sodium	5
Calcium	65
Magnesium	13
Sulfate	9
Chloride	2
Carbonate	0
Bicarbonate	243
Total Dissolved Solids @ 180°C	252
Total Hardness as $CaCO_3$	216
Total Alkalinity as $CaCO_3$	199
Nitrate plus Nitrite as N	2.65
Fluoride	0.44
Total Acidity as $CaCO_3$	N/A

Total Recoverable Metals:

Arsenic	<0.001
Cadmium	<0.001
Chromium	<0.02
Copper	<0.01
Iron	<0.03
Lead	<0.01
Mercury	<0.0001
Nickel	<0.03
Zinc	<0.01

RECEIVED JAN 3 0 1992

January 27, 1992

Thomas Hudson
Schafer & Associates
P. O. Box 6186
Bozeman, MT 59715

SUBJECT: Correction, Report No. 22965

Dear Mr. Hudson:

Enclosed is a corrected report and analysis of Sample SW-0-4.

During sample preparation, several dilutions of each sample are made and evidently the box containing this particular sample was mislabelled. When we looked at the filter it was obviously heavily loaded with particulates which the paper work indicated to the contrary.

We went back to the original water sample and reprepared it from scratch.

We apologize for the error.

Sincerely yours,

EMS LABORATORIES, INC.

B M Kolk

B. M. Kolk
Laboratory Director

DATE:	January 27, 1992
CLIENT:	Schafer & Associates P. O. Box 6186 Bozeman, MT 59715
ATTENTION:	Thomas Hudson
REFERENCE:	Letter dated November 19, 1991
REPORT NO:	22965 - Correction
SUBJECT:	ANALYSIS OF WATER SAMPLES BY TRANSMISSION ELECTRON MICROSCOPY
ACCREDITED:	National Institute of Standards and Technology through NVLAP (Laboratory No. 1218)`

Ten surface water samples were submitted for TEM analysis of asbestos structures. The samples came from the W. R. Grace mine near Libby, Montana.

The water samples were analyzed according to the U.S. EPA method EPA-600/4-83-043.

The asbestiform which was present in the water samples was from the tremolite/actinolite group of amphiboles; the asbestos fibers often contained sodium.

The results are as follows:

ASBESTOS FIBER LENGTH DISTRIBUTION (MFL)

Sample No.	<2.5µm	2.5 to 9.9µm	>10 µm	D.L.
SW-1-4	BDL	BDL	BDL	0.07
SW-2-4	2.0	1.4	0.5	0.07
SW-3-4	5.4	8.4	1.8	0.2
SW-4-4	1.8	2.1	0.1	0.07
SW-5-4	0.6	0.6	0.3	0.3
SW-6-4	9.0	16.4	1.7	0.6
SW-7-4	62	56	12	1.5
SW-8-4	73	83	17	1.9
SW-0-4	66	75	19	2.1
SW-11-4	BDL	BDL	BDL	0.07
EMS Blank	BDL	BDL	BDL	0.04

DL = Detection limit
MFL = Millions of fibers per liter
BDL = Below detection limit

Respectfully submitted,

EMS LABORATORIES, INC.

B. M. Kolk
Laboratory Director

This report, from a NIST accredited laboratory through NVLAP, must not be used by the client to claim product endorsement by NVLAP or any agency of the Government.

DATE:	January 14, 1992
CLIENT:	Schafer & Associates P. O. Box 6186 Bozeman, MT 59715
ATTENTION:	Thomas Hudson
REFERENCE:	Letter dated November 19, 1991
REPORT NO:	22965
SUBJECT:	ANALYSIS OF WATER SAMPLES BY TRANSMISSION ELECTRON MICROSCOPY
ACCREDITED:	National Institute of Standards and Technology through NVLAP (Laboratory No. 1218)`

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The results are as follows:

ASBESTOS FIBER LENGTH DISTRIBUTION (MFL)

Sample No.	<2.5µm	2.5 to 9.9µm	>10 µm	D.L.
SW-1-4	BDL	BDL	BDL	0.07
SW-2-4	2.0	1.4	0.5	0.07
SW-3-4	5.4	8.4	1.8	0.2
SW-4-4	1.8	2.1	0.1	0.07
SW-5-4	0.6	0.6	0.3	0.3
SW-6-4	9.0	16.4	1.7	0.6
SW-7-4	62	56	12	1.5
SW-8-4	73	83	17	1.9
SW-0-4	0.3	0.6	0.6	0.3
SW-11-4	BDL	BDL	BDL	0.07
EMS Blank	BDL	BDL	BDL	0.04

DL = Detection limit
MFL = Millions of fibers per liter
BDL = Below detection limit

Respectfully submitted,

EMS LABORATORIES, INC.

B M Kolk

B. M. Kolk
Laboratory Director

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Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-83-043)

EMS No.	22965	Client	SCHAFER & ASSOC.
Sample No.	SW-0-4		
Date	1/23/92		

Total Asbestos Fibers	160	MFL
Chrysotile Fibers	*BDL	MFL
Amphibole Fibers	160	MFL
> 5 Micron length (chrysotile)	*BDL	MFL
> 5 Micron length (amphibole)	49	MFL
Mass (Chrysotile)	*BDL	µg/L
Mass (amphibole)	250	µg/L
More/Less than 5 Chrysotile Fibers in Sample	LESS	
More/Less than 5 Amphibole Fibers in Sample	MORE	
Poisson 95% Confidence Interval	130 to 200	MFL
Detection Limit	2.1	MFL

* BDL : Below Detection Limit; MFL: Million Fibers per Liter

Size Distribution (Chrysotile and Amphibole)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	5	9	8	9	44

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	5	7	19	12	32

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
19	27	17	6	3	3

TEM ASBESTOS ANALYSIS

EMS Lab No. 22965
Client Schafer & Associates
Sample No. SW-0-4

RECEIVING

METHOD OF ANALYSIS
- EPA Yamate Level I ☐
- Level II ☐
- Level III ☐
- AHERA ☐

LENGTHS
- All Sizes (EPA) ☐
- (µm): ≥0.5 ☐
- ≥1.0 ☐
- ≥5.0 ☐
- ≥10.0 ☐
- PCM Range* ☐ (*≥0.25 µm width, 25.0 µm length)

ASPECT RATIO 3:1 ☐ 5:1 ☐

Approved By _____ Date _____

FILTER TYPE/AREA (mm²)
- MCE/385 ☐
- MCN/960 ☐
- MCE/960 ☐
- 1017 Other ☑

TYPE OF SAMPLE
- Air ☐ Water ☐
- Soil ☐ Wipe ☐
- Bulk ☐ Other ☐
- Dust/Microvac ☐

PORE SIZE
- 0.45 µm ☐
- 0.8 µm ☐
- .1 µm ☑
- .22 µm ☐
- Other ☐

G.O. Area (mm²) 0.0068
No. of G.O. to Analyze 21
Filter Lot No. _____

PREP

- DIRECT PREP ☑
- INDIRECT PREP ☐

Volume _____ liters
Working Volume 15 ml
Weight _____ grams
Ashed Area _____ %

Prepared By FG

ANALYSIS

GRID
- 1 ☑ 3 ☐
- 2 ☐ 4 ☐

Grid Address 1-A
Screen Magnification 19300 x
Camera Constant 284
Accelerating Voltage 100 KV
Beam Current 10 µa

Analyst F.M. Date 1/22/97

MICROSCOPE
- 600A ☐
- 600B ☑
- HU11E ☐
- HU125E ☐

A

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	01	F	1	22												✓					3	10	2			EDS Tremolite
	02	F	2	80												✓					3	10	1	1		EDS Tremolite
	03	F	5	160	✓											✓				1	3	10	1	2		EDS
	04	F	4	50												✓										Tremolite
	05	F	5	120												✓										Tremolite
2	06	F	4	110												✓					3	10	1	2		EDS
	07	F	3	35												✓										Tremolite
	08	F	4	115												✓										— " —
	09	F	1.5	60												✓										— " —
	10	F	3	55												✓					3	10	1	1		EDS
	11	F	3	73												✓										Tremolite
3	12	F	5	180												✓										— " —
	13	F	3	35												✓										— " —
	14	F	5	220												✓					4	10	1	1		EDS
	15	F	2.5	35												✓										Tremolite
	16	F	5	70												✓										Tremolite
4	17	F	16	950												✓					3	10	2	1		EDS Tremolite
	18	F	8	130												✓										— " —
	19	F	10	380												✓					3	10	1	1		EDS Tremolite
	20	F	2	13												✓										— " —
	21	F	4	40												✓										— " —
5	22	F	3	75												✓										— " —
	23	F	8	44												✓										— " —
	24	F	4	40												✓										— " —

OBSERVATIONS:

Clean ☐

Debris: ☑ Very Light ☐ Light ☑ Moderate ☑ Heavy ☐ Very Heavy ☐

Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

Other ☐

EM ASBESTOS ANALYSIS

MS Lab No. 22965

ample No. SW-0-4

RECEIVING

Page 2 of

ANALYSIS

GRID 1 ☐ 2 ☐ 3 ☐ 4 ☐

MICROSCOPE 600A ☐ 600B ☐ HU11E ☐ HU125E ☐

Grid Address _____

Screen Magnification _____ x

Camera Constant _____

Accelerating Voltage 100 KV

Beam Current _____ µa

A

Analyst _____ Date _____

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AQ	ADQ	AZQ	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
5	25	F	3	55												✓										Tremolite
	26	F	3	60												✓										— " —
6	27	F	3	70												✓										— " —
	28	F	2	50												✓										— " —
	29	F	6	85												✓				1	3	10	1	1		EDS
	30	F	10	115												✓										Tremolite
	31	F	10	43												✓										— " —
	32	F	2.5	70												✓										— " —
	33	F	7	26												✓										— " —
	34	F	2	25												✓										— " —
	35	F	5	440												✓					3	10	2	1		EDS Tremolite
	36	F	3	20												✓										— " —
7	37	F	1.5	75												✓										— " —
	38	F	4	30												✓										— " —
	39	F	1	27												✓										— " —

OBSERVATIONS: Clean ☐ Debris: ☐ Gypsum: ☐ Very Light ☐ Very Light ☐ Light ☐ Light ☐ Moderate ☐ Moderate ☐ Heavy ☐ Heavy ☐ Very Heavy ☐ Very Heavy ☐

22-Jan-1992 17:40:21
Execution time = 6 seconds
22965,SW-04,1A,01,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 38 secs

Energy	Counts	X-Ray Lines
0.51	307.	O K , O K , V L , V L , V L , V L
1.25	214.	Mg K , Mg K , Mg K
1.74	647.	Si K , Si K
3.69	115.	Ca K , Ca K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 5948

22-Jan-1992 17:42:55
Execution time = 6 seconds
22965,SW-04,1A,02,FM Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 28 secs

Energy	Counts	X-Ray Lines
0.51	1439.	O K , O K , V L , V L , V L , V L
1.00	116.	Na K , Na K , Zn L , Zn L , Zn L , Zn L
1.25	894.	Mg K , Mg K , Mg K
1.73	2652.	Si K , Si K
3.32	147.	K K , K K
3.68	323.	Ca K , Ca K
Quantex)	198.	Fe K , Fe K

0.160 Range= 10.230 keV 10.230
Integral 0 = 13036

22-Jan-1992 17:45:26
Execution time = 6 seconds
22965,SW-04,1A,03,FM Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 31 secs

Energy	Counts	X-Ray Lines
0.51	1533.	O K , O K , V L , V L , V L , V L
1.01	237.	Na K , Na K , Zn L , Zn L , Zn L , Zn L
1.25	959.	Mg K , Mg K , Mg K
1.73	3139.	Si K , Si K
3.32	130.	K K , K K
3.68	278.	Ca K , Ca K
Quantex)	511.	Fe K , Fe K

0.160 Range= 10.230 keV 10.230
Integral 0 = 14618

22-Jan-1992 17:49:57
Execution time = 6 seconds
22965,SW-04,1A,06,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 27 secs

Energy	Counts	X-Ray Lines
0.51	387.	O K , O K , V L , V L , V L , V L
1.25	234.	Mg K , Mg K , Mg K
1.74	673.	Si K , Si K
3.69	72.	Ca K , Ca K
6.40	112.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 5361

22-Jan-1992 17:59:51
Execution time = 7 seconds
22965,SW-04,1A,10,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 37 secs

Energy	Counts	X-Ray Lines
0.52	848.	O K , O K , V L , V L , V L , O V L
1.24	572.	Mg K , Mg K
1.73	1733.	Si K , Si K
3.69	253.	Ca K , Ca K
6.39	221.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 9333

22-Jan-1992 18:06:24
Execution time = 7 seconds
22965,SW-04,1A,14,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 35 secs

Energy	Counts	X-Ray Lines
0.52	578.	O K , O K , V L , V L , V L , O V L
1.25	366.	Mg K , Mg K , Mg K
1.74	948.	Si K , Si K
3.69	135.	Ca K , Ca K
6.39	108.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 7118

22-Jan-1992 18:10:28
Execution time = 7 seconds
22965,SW-04,1A,17,FM Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 35 secs

Energy	Counts	X-Ray Lines
0.51	1928.	O K , O K , V L , V L , V L , V L
1.25	1160.	Mg K , Mg K , Mg K
1.48	120.	Al K , Al K
1.74	3654.	Si K , Si K
3.68	863.	Ca K , Ca K
4.03	120.	Ca K , Ca K
6.39	339.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 17899

22-Jan-1992 18:13:27
Execution time = 6 seconds
22965,SW-04,1A,19,FM Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 35 secs

Energy	Counts	X-Ray Lines
0.51	1571.	O K , O K , V L , V L , V L , V L
1.24	951.	Mg K , Mg K
1.48	117.	Al K , Al K
1.74	3376.	Si K , Si K
3.32	107.	K K , K K
3.69	494.	Ca K , Ca K
6.39	290.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 14854

22-Jan-1992 18:25:58
Execution time = 9 seconds
22965,SW-04,1A,29,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 42 secs

Energy	Counts	X-Ray Lines
0.51	756.	O K , O K , V L , V L , V L , V L
1.24	506.	Mg K , Mg K
1.74	1492.	Si K , Si K
3.29	121.	K K , K K
3.69	199.	Ca K , Ca K
6.41	123.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral O = 8705

22-Jan-1992 18:30:12
Execution time = 6 seconds
22965,SW-04,1A,35,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 41 secs

Energy	Counts	X-Ray Lines
0.52	846.	O K , O K , V L , V L , V L , V L
1.25	499.	Mg K , Mg K , Mg K
1.73	1498.	Si K , Si K
3.69	305.	Ca K , Ca K
6.39	159.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral O = 7644

GM ASBESTOS ANALYSIS

MS Lab No. 22965

Sample No. Schafer & Associat

SW-0-4

ANALYSIS

GRID: 1 ☐ 3 ☐ 2 ☒ 4 ☐

Grid Address: 1-B

Screen Magnification: 1940 x

Camera Constant: 36.4

Accelerating Voltage: 100 KV

Beam Current: 10 pa

Analyst: RS

Date: 1/23/92

MICROSCOPE: 600A ☒ 600B ☐ IRIIIE ☐ IRIIISE ☐

B

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	1		7	250X													✓				3	10	2	1		Tremolite
	2		8	200													✓				3	10	2	1		"
	3		3	70	✓																					EDS
	4		15	75													✓									"
	5		2	20	✓																					"
	6		8	260X													✓				3	10	1	1		Tremolite
	7		5	120	✓																					
2	8		6	35	✓																					
	9		4	105											✓		✓				3	10	3	0		Tremolite
	10		3	38											✓											
	11		4	42													✓				3	10	2	2		Tremolite
	12		4	35											✓											Tremo.
	13		3	16	✓																					
	14		6	130X											✓											Tremo.
	15		4	130X											✓											Tremo.
2	16		3	60											✓											Tremo.
	17		3	70											✓											Tremo
	18		3	40	✓																					
	19		5	100											✓		✓				3	10	3	1		Tremolite
	20		10	60													✓									
	21		8	24	✓																					
	22		5	22											✓											
	23		10	130X											✓											
	24		6	225													✓				3	10	3	5		Tremolite

OBSERVATIONS:

Clean ☐

Debris: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

EM ASBESTOS ANALYSIS

MS Lab No. 22965

mple No. Schafer & Associat

SW-0-4

ANALYSIS

GRID
1 ☐ 3 ☐
2 ☒ 4 ☐

MICROSCOPE
600A ☒
600B ☐
HU11E ☐
HU12SE ☐

Grid Address 1-6

Screen Magnification 1940 x

Camera Constant 36.4

Accelerating Voltage 100 KV

Beam Current 10 pa

B

Analyst RS

Date 1/23/92

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
4	25		12	50	✓																					
	26		3	18											✓											Tremolite
	27		10	142											✓											Tremolite
	28		5	25	✓																					
	29		1.5	68	✓																					
	30		3	44											✓											Tremolite
	31		5	65													✓				3	10	2	1		Tremolite
	32		3	18	✓																					

OBSERVATIONS:

Clean ☐					
Debris: ☐	Very Light ☐	Light ☐	Moderate ☒	Heavy ☐	Very Heavy ☐
Gypsum: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐

23-Jan-1992 08:38:19
Execution time = 6 seconds
22965,0-4,B,#01,RS Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 22 secs

Energy	Counts	X-Ray Lines
1.25	707.	Mg K , Mg K , Mg K
1.74	2395.	Si K , Si K
3.34	109.	K K , K K
3.69	399.	Ca K , Ca K
5.43	67.	Cr K , Cr K
6.41	257.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 21787

23-Jan-1992 08:40:05
Execution time = 6 seconds
22965,0-4,B,#02,RS Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 23 secs

Energy	Counts	X-Ray Lines
1.25	417.	Mg K , Mg K , Mg K
1.74	1218.	Si K , Si K
3.69	230.	Ca K , Ca K
6.41	164.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 17924

23-Jan-1992 08:43:46
Execution time = 6 seconds
22965,0-4,B,#03,RS Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 30 secs

Energy	Counts	X-Ray Lines
1.73	301.	Si K , Si K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 13329

23-Jan-1992 08:59:11
Execution time = 6 seconds
22965,0-4,B,#6,RS Preset= Off
Vert= 500 counts Disp= 1 Elapsed= 27 secs

Energy	Counts	X-Ray Lines
1.25	815.	Mg K , Mg K , Mg K
1.74	3161.	Si K , Si K
3.33	112.	K K , K K
3.69	451.	Ca K , Ca K
6.39	299.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 23602

23-Jan-1992 09:03:57
Execution time = 6 seconds
22965,0-4,B,#8,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 35 secs

Energy	Counts	X-Ray Lines
1.24	399.	Mg K , Mg K
1.48	128.	Al K , Al K
1.74	1197.	Si K , Si K
3.33	244.	K K , K K
6.40	342.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 22124

23-Jan-1992 09:05:23
Execution time = 6 seconds
22965,0-4,B,#9,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 26 secs

Energy	Counts	X-Ray Lines
1.26	126.	Mg K , Mg K , Mg K
1.73	400.	Si K , Si K
3.66	119.	Ca K , Ca K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 12729

23-Jan-1992 09:10:54
Execution time = 7 seconds
22965,0-4,B,#11,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 24 secs

Energy	Counts	X-Ray Lines
1.25	127.	Mg K , Mg K , Mg K
1.75	439.	Si K , Si K
3.70	70.	Ca K , Ca K
6.38	82.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 9710

23-Jan-1992 09:26:18
Execution time = 6 seconds
22965,0-4,B,#19,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 16 secs

Energy	Counts	X-Ray Lines
1.25	767.	Mg K , Mg K , Mg K
1.74	2495.	Si K , Si K
3.30	66.	K K , K K
3.70	643.	Ca K , Ca K
4.02	67.	Ca K , Ca K
6.39	247.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 14659

23-Jan-1992 09:31:48
Execution time = 6 seconds
22965,0-4,B,#24,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 24 secs

Energy	Counts	X-Ray Lines
1.25	404.	Mg K , Mg K , Mg K
1.74	1416.	Si K , Si K
3.69	454.	Ca K , Ca K
4.06	73.	Sc K , Sc K
6.35	79.	Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 15640

23-Jan-1992 09:41:00
Execution time = 7 seconds
22965,0-4,B,#31,RS
Vert= 200 counts Disp= 1

Preset= Off
Elapsed= 23 secs

Energy	Counts	X-Ray Lines
1.24	167.	Mg K , Mg K
1.73	594.	Si K , Si K
3.70	95.	Ca K , Ca K
6.42	65.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 10451

QM ASBESTOS ANALYSIS

MS Lab No. 22465

mple No. SW-0-4

1030 01

MICROSCOPE
600A ☐
600B ☑
HU11E ☐
HU12SE ☐

ANALYSIS

GRID
1 ☑ 3 ☐
2 ☐ 4 ☐

Grid Address C
Screen Magnification 19,400 x
Camera Constant 28.1
Accelerating Voltage 100 KV
Beam Current 12 pa

C

Analyst Kyeong Date 1/23/92

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	1	F	4	124	✓																					EDS #1
	2	F	4	160	✓																					EDS #2
	3	F	3.5	14	✓																					
	4	F	2.5	31													✓				3	10	2	1		EDS #4; Tremolite
	5	F	1.5	16	✓																					
	6	F	15	84													✓				3	10	2	1		EDS #6; Tremolite
	7	F	2	45													✓				3	10	2	1		EDS #7; Tremolite
	8	F	3.5	35											✓											Tremolite
	9	F	6	28	✓																					EDS #9;
	10	F	12	270														✓			3	10	2	1		EDS #10; Tremolite
2	11	F	5	50											✓											Tremolite
	12	F	2	28	✓																					
	13	F	1.5	37	✓																					
	14	F	2	10	✓																					
	15	F	3	12											✓											Tremolite
3	16	F	5	74													✓				3	10	2	1		EDS #16; Tremolite
	17	F	7.5	51	✓																					EDS #17
	18	F	4.5	50													✓				3	10	1	2		EDS #18; Tremolite
	19	F	3	13	✓																					
	20	F	3	12											✓											Tremolite
	21	F	3	12											✓											"
	22	F	3	122													✓				3	10	2	1		EDS #22; Tremolite
	23	F	1	9	✓																					
	24	F	5	23											✓											Tremolite

OBSERVATIONS:

	Clean	Very Light	Light	Moderate	Heavy	Very Heavy
Debris:	☒	☐	☐	☒	☐	☐
Gypsum:	☐	☐	☐	☐	☐	☐

EM ASBESTOS ANALYSIS

MS Lab No. 22965

mple No. SW-0-4

MICROSCOPE
600A ☐
600B ☐
HU11E ☐
HU12SE ☐

ANALYSIS

GRID
1 ☐ 3 ☐
2 ☐ 4 ☐

Grid Address _____
Screen Magnification _____ x
Camera Constant _____
Accelerating Voltage 100 KV
Beam Current _____ pa

Analyst Kyoung Date 1/23/92

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	LF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
3	26	F	5	27	✓																					EDS#26
	26	F	13	102											✓											Tremolite
	27	F	4	40													✓				3	10	2	1		EDS#27; Tremolit
	25	F	5	40											✓											Tremolite

OBSERVATIONS:

Clean ☐

Debris: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

23-Jan-1992 09:15:08
Execution time = 7 seconds
22965,0-4,C,#01,KK Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 28 secs

Energy	Counts	X-Ray Lines
0.51	1072.	O K , O K , V L , V L , V L , V L
1.25	638.	Mg K , Mg K , Mg K
1.74	1994.	Si K , Si K
3.32	102.	K K , K K
3.70	289.	Ca K , Ca K
6.38	264.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 10477

23-Jan-1992 09:29:30 22963,0-4,C,#02,KK

ENERGY	COUNTS	X-RAY LINES
0.51	2155.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.00	205.	Na KA1, Na KA2, Zn LA1, Zn LA2, Zn LB1, Zn LG1
1.25	1363.	Mg KA1, Mg KA2, Mg KB1
1.47	121.	Al KA1, Al KA2
1.74	4789.	Si KA1, Si KA2
3.32	146.	K KA1, K KA2
3.68	597.	Ca KA1, Ca KA2
4.02	93.	Ca KB1, Ca KB3
6.40	705.	Fe KA1, Fe KA2
7.03	104.	Fe KB1, Fe KB3

23-Jan-1992 09:35:28
Execution time = 7 seconds
22965,0-4,C,#04,KK Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 42 secs

Energy	Counts	X-Ray Lines
0.51	532.	O K , O K , V L , V L , V L , V L
1.26	316.	Mg K , Mg K , Mg K
1.48	109.	Al K , Al K
1.74	1044.	Si K , Si K
3.69	200.	Ca K , Ca K
6.41	142.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 6953

23-Jan-1992 09:45:53 22965,0-4,C,#06,KK

ENERGY	COUNTS	X-RAY LINES
0.51	3231.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.25	2211.	Mg KA1, Mg KA2, Mg KB1
1.48	227.	Al KA1, Al KA2
1.74	6582.	Si KA1, Si KA2
3.32	104.	K KA1, K KA2
3.69	1581.	Ca KA1, Ca KA2
4.01	231.	Ca KB1, Ca KB3
6.40	693.	Fe KA1, Fe KA2

23-Jan-1992 09:51:59
Execution time = 6 seconds
22965,0-4,C,#07,KK Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 46 secs

Energy	Counts	X-Ray Lines
0.51	939.	O K , O K , V L , V L , V L , V L
1.25	494.	Mg K , Mg K , Mg K
1.74	1667.	Si K , Si K
3.69	400.	Ca K , Ca K
6.39	205.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral O = 8847

23-Jan-1992 09:56:57 22965,0-4,C,#09,KK

ENERGY	COUNTS	X-RAY LINES
0.51	1741.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.02	278.	Na KA1, Na KA2, Na KB1, Zn LA1, Zn LA2, Zn LB1, Zn LG1
1.25	951.	Mg KA1, Mg KA2, Mg KB1
1.47	144.	Al KA1, Al KA2
1.73	3501.	Si KA1, Si KA2
3.32	160.	K KA1, K KA2
3.69	314.	Ca KA1, Ca KA2
6.40	645.	Fe KA1, Fe KA2

23-Jan-1992 10:11:34
Execution time = 6 seconds
22965,0-4,C,#10,KK Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 20 secs

Energy	Counts	X-Ray Lines
0.51	859.	O K , O K , V L , V L , V L , V L
1.25	537.	Mg K , Mg K , Mg K
1.48	88.	Al K , Al K
1.74	1777.	Si K , Si K
3.69	341.	Ca K , Ca K
6.41	185.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 7594

```
23-Jan-1992 10:30:55
Execution time =     7 seconds
22965,0-4,C,#16,KK                                  Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        19 secs
   Energy  Counts     X-Ray Lines

   0.51     1131.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      688.    Mg K  , Mg K  , Mg K

   1.74     2258.    Si K  , Si K

   3.32       87.    K  K  , K  K

   3.69      425.    Ca K  , Ca K

   4.01       65.    Ca K  , Ca K

   6.39      232.    Fe K  , Fe K
Quantex>
      0.160     Range=    10.230 keV                          10.230
                                          Integral 0  =          9668
23-Jan-1992 10:34:21
Execution time =     6 seconds
22965,0-4,C,#17,KK                                  Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        30 secs
   Energy  Counts     X-Ray Lines

   0.51      808.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.01      114.    Na K  , Na K  , Zn L  , Zn L  , Zn L  ,
                     Zn L

   1.24      418.    Mg K  , Mg K

   1.73     1445.    Si K  , Si K

   3.30       97.    K  K  , K  K

   3.68      131.    Ca K  , Ca K

Quantex>     223.    Fe K  , Fe K
      0.160     Range=    10.230 keV                          10.230
                                          Integral 0  =          7244
```

23-Jan-1992 13:01:28
Execution time = 7 seconds
22965,SW-0-4,C,18,KK Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 20 secs

Energy	Counts	X-Ray Lines
0.52	766.	O K , O K , V L , V L , V L , V L
1.26	423.	Mg K , Mg K , Mg K
1.74	1414.	Si K , Si K
3.70	185.	Ca K , Ca K
6.38	253.	Fe K , Fe K

Quantex)
0.160 Range= 10.230 keV 10.230
Integral 0 = 7615

```
23-Jan-1992 13:11:31
Execution time =     7 seconds
22965,SW-0-4,C,22,KK                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        26 secs
   Energy  Counts     X-Ray Lines

   0.52      905.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      549.    Mg K  , Mg K  , Mg K

   1.74     1750.    Si K  , Si K

   3.68      343.    Ca K  , Ca K

   6.38      184.    Fe K  , Fe K



Quantex>
      0.160     Range=    10.230 keV                          10.230
                                          Integral 0  =          8619
23-Jan-1992 13:17:42
Execution time =     6 seconds
22965,SW-0-4,C,25,KK                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        29 secs
   Energy  Counts     X-Ray Lines

   0.51     1349.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.01      198.    Na K  , Na K  , Zn L  , Zn L  , Zn L  ,
                     Zn L

   1.25      709.    Mg K  , Mg K  , Mg K

   1.73     2509.    Si K  , Si K

   3.31      105.    K  K  , K  K

   3.68      370.    Ca K  , Ca K

Quantex>     301.    Fe K  , Fe K
      0.160     Range=    10.230 keV                          10.230
                                          Integral 0  =         11556
```

23-Jan-1992 13:21:41
Execution time = 6 seconds
22965,SW-0-4,C,27,KK Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 42 secs

Energy	Counts	X-Ray Lines
0.51	782.	O K , O K , V L , V L , V L , V L
1.24	521.	Mg K , Mg K
1.73	1563.	Si K , Si K
3.69	356.	Ca K , Ca K
6.38	115.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 8547

TABLE 3. CLASSIFICATION OF FIBERS WITH TUBULAR MORPHOLOGY

TM	-	Tubular Morphology not sufficiently characteristic for classification as chrysotile
CM	-	Characteristic Chrysotile Morphology
CD	-	Chrysotile SAED pattern
CQ	-	Chrysotile composition by Quantitative EDXA
CMQ	-	Chrysotile Morphology and composition by Quantitative EDXA
CDQ	-	Chrysotile SAED pattern and composition by Quantitative EDXA
NAM	-	Non-Asbestos Mineral

TABLE 4. CLASSIFICATION OF FIBERS WITHOUT TUBULAR MORPHOLOGY

UF	-	Unidentified Fiber
AD	-	Amphibole by random orientation SAED (shows layer pattern of 0.53 nm spacing)
AX	-	Amphibole by qualitative EDXA. Spectrum has elemental components consistent with amphibole
ADX	-	Amphibole by random orientation SAED and Qualitative EDXA
AQ	-	Amphibole by Quantitative EDXA
AZ	-	Amphibole by one Zone Axis SAED
ADQ	-	Amphibole by random orientation SAED and Quantitative EDXA
AZQ	-	Amphibole by one Zone Axis SAED pattern and Quantitative EDXA
AZZ	-	Amphibole by two Zone Axis SAED patterns with consistent inter-axial angle
AZZQ	-	Amphibole by two Zone Axis SAED patterns, consistent inter-axial angle and Quantitative EDXA
NAM	-	Non-Asbestos Mineral

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-83-043)

EMS No.	22965	Client	SCHAFER & ASSOC.
Sample No.	SW-0-4		
Date	1/3/92		

Total Asbestos Fibers	1.5	MFL
Chrysotile Fibers	*BDL	MFL
Amphibole Fibers	1.5	MFL
> 5 Micron length (chrysotile)	*BDL	MFL
> 5 Micron length (amphibole)	1.2	MFL
Mass (Chrysotile)	*BDL	µg/L
Mass (amphibole)	9	µg/L
More/Less than 5 Chrysotile Fibers in Sample	LESS	
More/Less than 5 Amphibole Fibers in Sample	LESS	
Poisson 95% Confidence Interval	0.5 to 3.5	MFL
Detection Limit	0.3	MFL

* BDL : Below Detection Limit; MFL: Million Fibers per Liter

Size Distribution (Chrysotile and Amphibole)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	1	0	0	0	4

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	0	1	0	1	3

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
2	0	2	0	0	1

7-Jan-1992 15:04:48
Execution time = 6 seconds
22965-0-4,A,#01,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 23 secs

Energy	Counts	X-Ray Lines
1.25	568.	Mg K , Mg K , Mg K
1.74	2269.	Si K , Si K
3.30	54.	K K , K K
3.69	446.	Ca K , Ca K
4.02	56.	Ca K , Ca K
6.40	293.	Fe K , Fe K
7.02	62.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 13497

7-Jan-1992 15:07:51
Execution time = 7 seconds
22965-0-4,A,#02,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 22 secs

Energy	Counts	X-Ray Lines
1.25	461.	Mg K , Mg K , Mg K
1.74	1747.	Si K , Si K
3.69	356.	Ca K , Ca K
6.39	207.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral 0 = 9900

TEM ASBESTOS ANALYSIS

EMS Lab No. 22965
Client Scholl & Associates
Sample No. SW-0-4

RECEIVING

METHOD OF ANALYSIS
- EPA Yamate Level I ☐
- Level II ☐
- Level III ☐
- AHERA ☐

LENGTHS
- All Sizes (EPA) ☐
- (µm): ≥0.5 ☐
- ≥1.0 ☐
- ≥5.0 ☐
- ≥10.0 ☐
- PCM Range* ☐ (*≥0.25 µm width, ≥5.0 µm length)

ASPECT RATIO 3:1 ☐ 5:1 ☐

Approved By _____ Date _____

FILTER TYPE/AREA (mm²)
- MCE/385 ☐
- MCN/960 ☐
- MCE/960 ☑
- Other ☐

TYPE OF SAMPLE
- Air ☐ Water ☑
- Soil ☐ Wipe ☐
- Bulk ☐ Other ☐
- Dust/Microvac ☐

PORE SIZE
- 0.45 µm ☐
- 0.8 µm ☐
- .1 µm ☑
- .22 µm ☐
- Other ☐

G.O. Area (mm²) 0.0 062
No. of G.O. to Analyze 20
Filter Lot No. _____

PREP

- DIRECT PREP ☑
- INDIRECT PREP ☐

Volume _____ liters
Working Volume 25 ml
Weight _____ grams
Ashed Area _____ %
Prepared By FG

ANALYSIS

GRID
- 1 ☒ 3 ☐
- 2 ☐ 4 ☐

MICROSCOPE
- 600A ☒
- 600B ☒
- HU11E ☐
- HU12SE ☐

Grid Address 1A
Screen Magnification 19500 x
Camera Constant 30.9
Accelerating Voltage 100 KV
Beam Current 10 µa

Analyst S. Ahmed Date 12/19/9

A

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CQ	CMQ	CDQ	UF	AD	AX	ADX	AQ	ADQ	AZQ	AZZ	EDS Na	Mg	Si	Ca	Fe	Id	Comments
1	NSD																									
2	1	F	65	145													✓									EDS #1
	2	F	2	270													✓									EDS #2
3	3		20	160													✓									EDS #3
4	3	F	1.5	22	✓																					
5	NSD																									
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean ☐
Debris: ☒ Very Light ☐ Light ☐ Moderate ☒ Heavy ☐ Very Heavy ☐
Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐
Other ☐

EM ASBESTOS ANALYSIS

MS Lab No. 22465

mple No. SW-0-4

RECEIVING

ANALYSIS

GRID
1 ☐ 3 ☐
2 ☒ 4 ☐

Grid Address FB
Screen Magnification 19.3W x
Camera Constant 28.4
Accelerating Voltage 100 KV
Beam Current 10 μa

MICROSCOPE
600A ☐
600B ☒
HU11E ☐
HU125E ☐

B

Analyst

Date 1/3/94

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1	NSD																									
2	NSD																									
3		F	4	14													✓				3	10	1	1		EDS
		F	15	135	✓																					EDS
		F	3	250	✓																					
4	NSD																									
5			3	40	✓																					
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean ☐					
Debris: ☐	Very Light ☐	Light ☐	Moderate ☒	Heavy ☐	Very Heavy ☐
Gypsum: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐

17-Dec-1991 11:02:51
Execution time = 6 seconds
22965,04,B,01,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 20 secs

Energy	Counts	X-Ray Lines
0.52	379.	O K , O K , V L , V L , V L , V L
1.26	265.	Mg K , Mg K , Mg K
1.74	892.	Si K , Si K
3.69	74.	Ca K , Ca K
6.39	76.	Fe K , Fe K

Quantex>
0.160 Range= 10.230 keV

17-Dec-1991 11:08:00
Execution time = 5 seconds
22965,04,B,02,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 32 secs

Energy	Counts	X-Ray Lines
0.52	189.	O K , O K , V L , V L , V L , V L
1.26	112.	Mg K , Mg K , Mg K
1.74	374.	Si K , Si K

Quantex>
0.160 Range= 10.230 keV 10.230
Integral_8 = 67

03-Jan-1992 10:09:34 22965,0,A,#02,RS

ENERGY	COUNTS	X-RAY LINES
1.03	183.	Na KA1, Na KA2, Na KB1, Zn LA1, Zn LA2, Zn LB1, Zn LG1
2.01	3280.	P KA1, P KA2
2.59	97.	Cl KA1, Cl KA2
3.32	319.	K KA1, K KA2
3.69	771.	Ca KA1, Ca KA2
4.01	104.	Ca KB1, Ca KB3
5.89	145.	Mn KA1, Mn KA2
6.40	6277.	Fe KA1, Fe KA2
7.05	793.	Fe KB1, Fe KB3

ASBESTOS ANALYSIS

Lab No. 22965

ple No. SW-0-4

MICROSCOPE
- 600A ☐
- 600B ☑
- HU11E ☐
- HU125E ☐

ANALYSIS

GRID
- 1 ☐ 3 ☒
- 2 ☐ 4 ☐

Grid Address 1-C

Screen Magnification 1950x

Camera Constant 28.4

Accelerating Voltage 100 KV

Beam Current 10 pa

C

Analyst Radha Sim Date 12/8

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1			1	20	✓																					
2	2	F	10	220									✓								3	10	3	0.6		Tremolite
3	NSD																									
4	NSD																									
5	NSD																									
6			1.5	16	✓																					
7	NSD																									

OBSERVATIONS: Clean ☐ Heavy ☐ Very Heavy ☐

18-Dec-1991 09:11:48

22965, SW-0-4, C, # 2

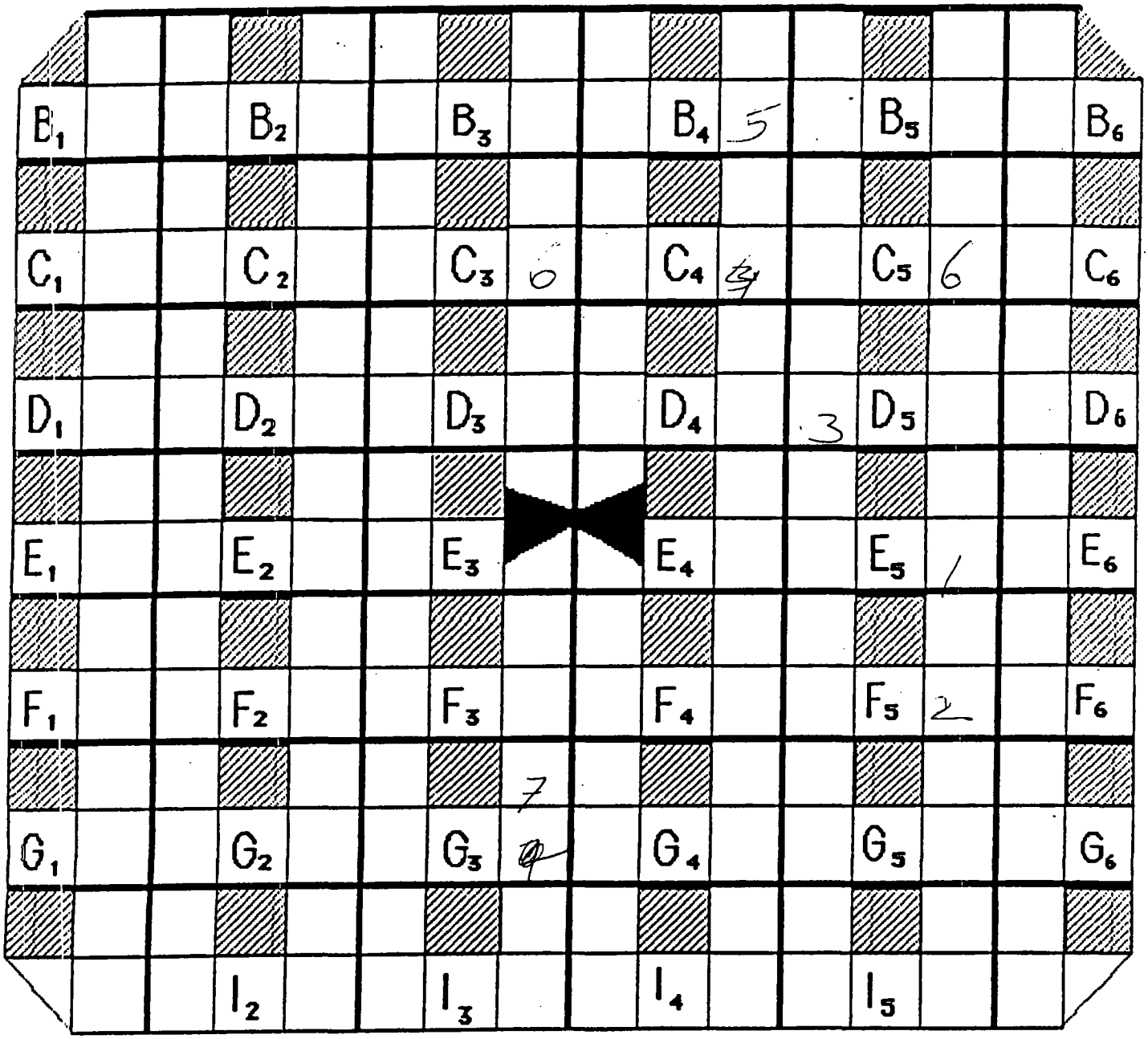
ENERGY	COUNTS	X-RAY LINES
0.52	3402.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.26	2363.	Mg KA1, Mg KA2, Mg KB1
1.49	50.	Al KA1, Al KA2
1.74	6845.	Si KA1, Si KA2
2.66	60.	Cl KA1, Cl KA2
3.70	2039.	Ca KA1, Ca KA2
4.03	223.	Ca KB1, Ca KB3
6.41	464.	Fe KA1, Fe KA2
7.05	71.	Fe KB1, Fe KB3

EMS No 22965

Sample ID SW-0-4

Grid No 6

Microscopist RL



07-Jan-1992 15:10:59 22965-0-4,A,#03,SA

ENERGY	COUNTS	X-RAY LINES
0.54	34.	O KA1, O KA2, V LA1, Cr LA1, V LA2, Cr LA2, V LB1, Cr LB1, V LB3, V LB4, V LG1, Cr LG1 Cr LL1
0.99	46.	Zn LA1, Zn LA2, Zn LB1
1.25	1747.	Mg KA1, Mg KA2, Mg KB1
1.74	7791.	Si KA1, Si KA2
2.59	31.	Cl KA1, Cl KA2
2.82	69.	Cl KB1
3.30	189.	K KA1, K KA2
3.70	950.	Ca KA1, Ca KA2
4.05	120.	Sc KA1, Sc KA2, Ca KB1, Ca KB3
4.94	40.	V KA1, V KA2
6.40	1312.	Fe KA1, Fe KA2
7.05	179.	Fe KB1, Fe KB3

TABLE 3. CLASSIFICATION OF FIBERS WITH TUBULAR MORPHOLOGY

TM	-	Tubular Morphology not sufficiently characteristic for classification as chrysotile
CM	-	Characteristic Chrysotile Morphology
CD	-	Chrysotile SAED pattern
CQ	-	Chrysotile composition by Quantitative EDXA
CMQ	-	Chrysotile Morphology and composition by Quantitative EDXA
CDQ	-	Chrysotile SAED pattern and composition by Quantitative EDXA
NAM	-	Non-Asbestos Mineral

TABLE 4. CLASSIFICATION OF FIBERS WITHOUT TUBULAR MORPHOLOGY

UF	-	Unidentified Fiber
AD	-	Amphibole by random orientation SAED (shows layer pattern of 0.53 nm spacing)
AX	-	Amphibole by qualitative EDXA. Spectrum has elemental components consistent with amphibole
ADX	-	Amphibole by random orientation SAED and Qualitative EDXA
AQ	-	Amphibole by Quantitative EDXA
AZ	-	Amphibole by one Zone Axis SAED
ADQ	-	Amphibole by random orientation SAED and Quantitative EDXA
AZQ	-	Amphibole by one Zone Axis SAED pattern and Quantitative EDXA
AZZ	-	Amphibole by two Zone Axis SAED patterns with consistent inter-axial angle
AZZQ	-	Amphibole by two Zone Axis SAED patterns, consistent inter-axial angle and Quantitative EDXA
NAM	-	Non-Asbestos Mineral

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-83-043)

EMS No.	22965	Client	SCHAFER & ASSOC.
Sample No.	SW-11-4		
Date	12/29/91		

Total Asbestos Fibers	*BDL	MFL
Chrysotile Fibers	*BDL	MFL
Amphibole Fibers	*BDL	MFL
> 5 Micron length (chrysotile)	*BDL	MFL
> 5 Micron length (amphibole)	*BDL	MFL
Mass (Chrysotile)	*BDL	µg/L
Mass (amphibole)	*BDL	µg/L
More/Less than 5 Chrysotile Fibers in Sample	LESS	
More/Less than 5 Amphibole Fibers in Sample	LESS	
Poisson 95% Confidence Interval	0 to 0.3	MFL
Detection Limit	0.07	MFL

* BDL : Below Detection Limit; MFL: Million Fibers per Liter

Size Distribution (Chrysotile and Amphibole)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	0	0	0	0	0

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	0	0	0	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
0	0	0	0	0	0

TEM ASBESTOS ANALYSIS

EMS Lab No. 22965
Client Schaffer & Associates
Sample No. SW-11-4

RECEIVING

METHOD OF ANALYSIS
- EPA Yamate Level I ☐
- Level II ☐
- Level III ☐
- AHERA ☐

LENGTHS
- All Sizes (EPA) ☐
- (µm): ≥0.5 ☐
- ≥1.0 ☐
- ≥5.0 ☐
- ≥10.0 ☐
- PCM Range* ☐ (*≥0.25 µm width, 25.0 µm length)

ASPECT RATIO 3:1 ☐ 5:1 ☐

Approved By _____ Date _____

PREP

FILTER TYPE/AREA (mm²)
- MCE/385 ☐
- MCN/960 ☐
- MCE/960 ☑
- Other ☐

TYPE OF SAMPLE
- Air ☐ Water ☑
- Soil ☐ Wipe ☐
- Bulk ☐ Other ☐
- Dust/Microvac ☐

PORE SIZE
- 0.45 µm ☐
- 0.8 µm ☐
- .1 µm ☑
- .22 µm ☐
- Other ☐

G.O. Area (mm²) 0.0062
No. of G.O. to Analyze 20
Filter Lot No. _____

DIRECT PREP ☑
INDIRECT PREP ☐

Volume _____ liters
Working Volume 100 ml
Weight _____ grams
Ashed Area _____ %

Prepared By FG

ANALYSIS

GRID
- 1 ☐ 3 ☐
- 2 ☐ 4 ☐

Grid Address 1-A
Screen Magnification 19300 x
Camera Constant 20.5
Accelerating Voltage 100 KV
Beam Current 10 µa

Analyst Radha Sip Date 12-2-94

MICROSCOPE
- 600A ☑
- 600B ☐
- HU11E ☐
- HU125E ☐

Page 1 of 1

A

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1			1.5	12	✓																					
2	NSD																									
3			1	9	✓																					
4	NSD																									
5	NSD																									
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean ☐

Debris: ☐	Very Light ☐	Light ☐	Moderate ☑	Heavy ☐	Very Heavy ☐
Gypsum: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐
Other ☐					

QM ASBESTOS ANALYSIS

MS Lab No. 22965

ample No. SW-11-4

KEEPING

ANALYSIS

GRID
1 ☑ 3 ☐
2 ☒ 4 ☐

Grid Address 1B
Screen Magnification 19300 x
Camera Constant 30.5
Accelerating Voltage 100 KV
Beam Current 13 µa

MICROSCOPE
600A ☒
600B ☐
HU11E ☐
HU125E ☐

B

Analyst S. Ahmed Date 11/27/

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	NSD																									
2	NSD																									
3	1	F	1	19	✓																					
	2	F	1	10	✓																					
4	3	F	1	15	✓																					
	4	F	1	15	✓																					
5	NSD																									
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean ☐					
Debris: ☒	Very Light ☐	Light ☒	Moderate ☒	Heavy ☐	Very Heavy ☐
Gypsum: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐

EM ASBESTOS ANALYSIS

MS Lab No. 22965

ample No. SW-11-4

RECEIVING

Page of

MICROSCOPE
600A [X]
600B [X]
HU11E [ ]
HU125E [ ]

ANALYSIS

GRID
1 [ ] 3 [X]
2 [ ] 4 [ ]

Grid Address 1C
Screen Magnification 19300 x
Camera Constant 30.5
Accelerating Voltage 100 KV
Beam Current 10 µa

C

Analyst S. Ahmed Date 11/2-7

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1	NSD																									
2	NSD																									
3	NSD																									
4	1	F	1	21	✓																					
5	NSD																									
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean [ ]					
Debris: [X]	Very Light [ ]	Light [X]	Moderate [X]	Heavy [ ]	Very Heavy [ ]
Gypsum: [ ]	Very Light [ ]	Light [ ]	Moderate [ ]	Heavy [ ]	Very Heavy [ ]

TABLE 3. CLASSIFICATION OF FIBERS WITH TUBULAR MORPHOLOGY

TM	-	Tubular Morphology not sufficiently characteristic for classification as chrysotile
CM	-	Characteristic Chrysotile Morphology
CD	-	Chrysotile SAED pattern
CQ	-	Chrysotile composition by Quantitative EDXA
CMQ	-	Chrysotile Morphology and composition by Quantitative EDXA
CDQ	-	Chrysotile SAED pattern and composition by Quantitative EDXA
NAM	-	Non-Asbestos Mineral

TABLE 4. CLASSIFICATION OF FIBERS WITHOUT TUBULAR MORPHOLOGY

UF	-	Unidentified Fiber
AD	-	Amphibole by random orientation SAED (shows layer pattern of 0.53 nm spacing)
AX	-	Amphibole by qualitative EDXA. Spectrum has elemental components consistent with amphibole
ADX	-	Amphibole by random orientation SAED and Qualitative EDXA
AQ	-	Amphibole by Quantitative EDXA
AZ	-	Amphibole by one Zone Axis SAED
ADQ	-	Amphibole by random orientation SAED and Quantitative EDXA
AZQ	-	Amphibole by one Zone Axis SAED pattern and Quantitative EDXA
AZZ	-	Amphibole by two Zone Axis SAED patterns with consistent inter-axial angle
AZZQ	-	Amphibole by two Zone Axis SAED patterns, consistent inter-axial angle and Quantitative EDXA
NAM	-	Non-Asbestos Mineral

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-83-043)

EMS No. 22965 | Client SCHAFER & ASSOC.

Sample No. SW-1-4

Date Analyzed 11/28/91

Fibers (chrysotile)	BDL*	MFL
Fibers > 5 μm in length (chrysotile)	BDL*	MFL
Fibers > 10 μm in length (chrysotile)	BDL*	MFL
Mass (chrysotile)	0	ug/L
More/Less than 5 Fibers in Sample (chrysotile)	LESS	
Poisson 95% Confidence Interval	0 to 0.3	MFL
Detection Limit	0.07	MFL

* BDL : Below Detection Limit; MFL: Million Fibers per Liter

Particle Size Distribution (Chrysotile)

Particle Length - Microns

0 -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 - 4.99	5.00 - 9.99	10 & UP
0	0	0	0	0	0	0	0

Particle Width - Microns

0 - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 - .49	.50 - .99	1 & UP
0	0	0	0	0	0	0	0

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 - 99	100 - 199	200 & UP
0	0	0	0	0	0	0	0

TEM ASBESTOS ANALYSIS

Page ___ of ___

EMS Lab No. 22965

Client Schafer & Associates

Sample No. SW-1-4

RECEIVING

METHOD OF ANALYSIS
- EPA Yamate Level I ☐
- Level II ☐
- Level III ☐
- AHERA ☐

LENGTHS
- All Sizes (EPA) ☐
- (µm):≥0.5 ☐
- ≥1.0 ☐
- ≥5.0 ☐
- ≥10.0 ☐
- PCM Range* ☐ *(≥0.25 µm width, ≥5.0 µm length)

ASPECT RATIO 3:1 ☐ 5:1 ☐

Approved By _____ Date _____

FILTER TYPE/AREA (mm²)
- MCE/385 ☐
- MCN/960 ☐
- MCE/960 ☑
- Other ☐

TYPE OF SAMPLE
- Air ☐ Water ☑
- Soil ☐ Wipe ☐
- Bulk ☐ Other ☐
- Dust/Microvac ☐

PORE SIZE
- 0.45 µm ☐
- 0.8 µm ☐
- .1 µm ☑
- .22 µm ☐
- Other ☐

G.O. Area (mm²) 0.0 062

No. of G.O. to Analyze 20

Filter Lot No. _____

PREP

DIRECT PREP ☑

INDIRECT PREP ☐

Volume _____ liters

Working Volume 100 ml

Weight _____ grams

Ashed Area _____ %

Prepared By FG

ANALYSIS

GRID
- 1 ☒ 3 ☐
- 2 ☐ 4 ☐

Grid Address 1-A

Screen Magnification 19300 x

Camera Constant 30.5

Accelerating Voltage 100 KV

Beam Current 10 µa

Analyst Radlaffy Date 11-26

MICROSCOPE
- 600A ☒
- 600B ☐
- HU11E ☐
- HU125E ☐

A

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CQ	CMQ	CDQ	UF	AD	AX	ADX	AQ	ADQ	AZQ	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1	NSD																									
2	NSD																									
3	NSD																									
4	NSD																									
5	NSD																									
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean ☐					
Debris: ☐	Very Light ☐	Light ☒	Moderate ☒	Heavy ☐	Very Heavy ☐
Gypsum: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐
Other ☐					

EM ASBESTOS ANALYSIS

MS Lab No. 22965

mple No. SW-1-4

RECEIVING

ANALYSIS

GRID
1 ☐ 3 ☐
2 ☒ 4 ☐

MICROSCOPE
600A ☐
600B ☒
HU11E ☐
HU125E ☐

Grid Address 1B
Screen Magnification 19300x
Camera Constant 28.4
Accelerating Voltage 100 KV
Beam Current 10 µa

B

Analyst S. Ahmed Date 11/26/

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1	NSD																									
2	NSD																									
3	NSD																									
4	NSD																									
5	NSD																									
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean ☐					
Debris: ☒	Very Light ☐	Light ☒	Moderate ☒	Heavy ☐	Very Heavy ☐
Gypsum: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐

TEM ASBESTOS ANALYSIS

EMS Lab No. 22965

Sample No. SW-1-4

Page ___ of ___

MICROSCOPE
600A [X]
600B [ ]
HU11E [ ]
HU125E [ ]

RECEIVING

ANALYSIS

GRID
1 [ ] 3 [X]
2 [X] 4 [ ]

Grid Address 1C
Screen Magnification 19300 x
Camera Constant 3014
Accelerating Voltage 100 KV
Beam Current 10 µa

Analyst S. Ahmed Date 11/26/

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CQ	CMQ	CDQ	UF	AD	AX	ADX	AQ	ADQ	AZQ	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
1	NSD																									
2	NSD																									
3	NSD																									
4	NSD																									
5	NSD																									
6	NSD																									
7	NSD																									

OBSERVATIONS:

Clean [ ]					
Debris: [X]	Very Light [ ]	Light [X]	Moderate [X]	Heavy [ ]	Very Heavy [ ]
Gypsum: [ ]	Very Light [ ]	Light [ ]	Moderate [ ]	Heavy [ ]	Very Heavy [ ]
Other [ ]					

EMS LABORATORIES

TABLE 3. CLASSIFICATION OF FIBERS WITH TUBULAR MORPHOLOGY

TM	-	Tubular Morphology not sufficiently characteristic for classification as chrysotile
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CD	-	Chrysotile SAED pattern
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ADX	-	Amphibole by random orientation SAED and Qualitative EDXA
AQ	-	Amphibole by Quantitative EDXA
AZ	-	Amphibole by one Zone Axis SAED
ADQ	-	Amphibole by random orientation SAED and Quantitative EDXA
AZQ	-	Amphibole by one Zone Axis SAED pattern and Quantitative EDXA
AZZ	-	Amphibole by two Zone Axis SAED patterns with consistent inter-axial angle
AZZQ	-	Amphibole by two Zone Axis SAED patterns, consistent inter-axial angle and Quantitative EDXA
NAM	-	Non-Asbestos Mineral

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-83-043)

EMS No.	22965	Client	SCHAFER & ASSOC.
Sample No.	SW-2-4		
Date	11/26/91		

Total Asbestos Fibers	4	MFL
Chrysotile Fibers	*BDL	MFL
Amphibole Fibers	4	MFL
> 5 Micron length (chrysotile)	*BDL	MFL
> 5 Micron length (amphibole)	0.9	MFL
Mass (Chrysotile)	*BDL	µg/L
Mass (amphibole)	24	µg/L
More/Less than 5 Chrysotile Fibers in Sample	LESS	
More/Less than 5 Amphibole Fibers in Sample	MORE	
Poisson 95% Confidence Interval	3 to 5.2	MFL
Detection Limit	0.07	MFL

* BDL : Below Detection Limit; MFL: Million Fibers per Liter

Size Distribution (Chrysotile and Amphibole)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	1	11	6	10	26

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	0	8	9	10	27

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
23	15	7	7	0	2

TEM ASBESTOS ANALYSIS

EMS Lab No. 22965
Client Schafer + Associates
Sample No. SW-2-4

Page ___ of ___

RECEIVING

METHOD OF ANALYSIS
- EPA Yamate Level I ☐
- Level II ☐
- Level III ☐
- AHERA ☐

LENGTHS
- All Sizes (EPA) ☐
- (µm):≥0.5 ☐
- ≥1.0 ☐
- ≥5.0 ☐
- ≥10.0 ☐
- PCM Range* ☐
- *(≥0.25 µm width, ≥5.0 µm length)

ASPECT RATIO 3:1 ☐ 5:1 ☐

Approved By _____ Date _____

FILTER TYPE/AREA (mm²)
- MCE/385 ☐
- MCN/960 ☐
- MCE/960 ☑
- Other ☐

TYPE OF SAMPLE
- Air ☐ Water ☑
- Soil ☐ Wipe ☐
- Bulk ☐ Other ☐
- Dust/Microvac ☐

PORE SIZE
- 0.45 µm ☐
- 0.8 µm ☐
- .1 µm ☑
- .22 µm ☐
- Other ☐

G.O. Area (mm²) 0.0 062
No. of G.O. to Analyze 20
Filter Lot No. _____

PREP

DIRECT PREP ☑
INDIRECT PREP ☐

Volume _____ liters
Working Volume 100 ml
Weight _____ grams
Ashed Area _____ %
Prepared By FG

ANALYSIS

GRID
1 ☒ 3 ☐
2 ☐ 4 ☐

MICROSCOPE
- 600A ☑
- 600B ☐
- HU11E ☐
- HU125E ☐

Grid Address 1-A
Screen Magnification 1930
Camera Constant 30.5
Accelerating Voltage 100 KV
Beam Current 10 µa

Analyst Radhadeyla Date 11.26

A

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMQ	CDQ	UF	AD	AX	ADX	AQ	ADQ	AZQ	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	1		40	340												✓					4	10	3	1		e Tremolite
	2		4.5	38												✓					3	10	7	1		"
	3		1	10	✓																					
2	4		4	75													✓				3	10	3	1		#3579 tremolite
	5		8	125													✓				4	10	3	1		tremolite
	6		2	110	✓																					#3580
	7		1.5	12	✓																					
3	8		3	25	✓																					
	9		3	68												✓					3	10	0	3		
	10		2	75												✓					1	10	1	3		fiber is inside the deb
4	11		7	68													✓				3	10	1	1		#3581 tremolite
	12		2	45	✓																					
	13		3	25													✓				5	10	3	0		#3582
	14		5	25												✓					3	10	1	1		[illegible] tremolite
5	15		10	1350												✓					6	10	3	1		"
	16		3	18	✓																					
	17		1.5	42	✓																					
	18		7	240											✓	✓					3	10	2	1		tremolite
	19		10	230	✓																					
	20		6	45												✓					3	10	3	1		tremolite
6	21		2	22												✓					5	10	3	0		
	22		2	75												✓					2	10	1	2		inside debris
	23		2	22	✓											✓					2	10	2	0		inside debris
	24		1	12	✓																					

OBSERVATIONS:
- Clean ☐
- Debris: ☐ Very Light ☐ Light ☐ Moderate ☒ Heavy ☐ Very Heavy ☐
- Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐
- Other ☐

EM ASBESTOS ANALYSIS

MS Lab No. 22965

Achater & Associates.

ample No. SW-2-4

RECEIVING

ANALYSIS

GRID 1 ☐ 2 ☐ 3 ☐ 4 ☐

MICROSCOPE 600A ☐ 600B ☐ HU11E ☐ HU125E ☐

Grid Address _____

Screen Magnification _____ x

Camera Constant _____

Accelerating Voltage 100 KV

Beam Current _____ µa

Analyst [signature] Date 11-26

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
6	25		3	40												✓					3	10	2	1		Tremolite.
	26		2-5	35	✓																					
7	ND																									

OBSERVATIONS: Clean ☐ Debris: ☐ Gypsum: ☐ Very Light ☐ Very Light ☐ Light ☐ Light ☐ Moderate ☐ Moderate ☐ Heavy ☐ Heavy ☐ Very Heavy ☐ Very Heavy ☐

```
26-Nov-1991 11:02:30
Execution time =     8 seconds
22956-2,A,#01,RS                                    Preset=  Off
Vert=     1000 counts  Disp= 1                      Elapsed=        24 secs
   Energy  Counts     X-Ray Lines

   0.52     1199.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      951.    Mg K  , Mg K  , Mg K

   1.74     2599.    Si K  , Si K

   3.32       98.    K  K  , K  K

   3.69      702.    Ca K  , Ca K

   4.01       81.    Ca K  , Ca K

   6.39      260.    Fe K  , Fe K
Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =        20379
26-Nov-1991 11:08:20
Execution time =     7 seconds
22956-2,A,#02,RS                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        24 secs
   Energy  Counts     X-Ray Lines

   0.52      302.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.26      198.    Mg K  , Mg K  , Mg K

   1.75      608.    Si K  , Si K

   3.69      405.    Ca K  , Ca K

   4.03       67.    Ca K  , Ca K

   6.38       67.    Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =         7249
```

```
26-Nov-1991 11:11:39
Execution time =     6 seconds
22956-2,A,#04,RS                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        24 secs
   Energy  Counts     X-Ray Lines

   0.51      500.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      291.    Mg K  , Mg K  , Mg K

   1.74      876.    Si K  , Si K

   3.70      243.    Ca K  , Ca K

   6.43      101.    Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =          5388
26-Nov-1991 11:13:24
Execution time =     6 seconds
22956-2,A,#05,RS                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        20 secs
   Energy  Counts     X-Ray Lines

   0.52      758.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      579.    Mg K  , Mg K  , Mg K

   1.73     1413.    Si K  , Si K

   3.69      436.    Ca K  , Ca K

   6.42      132.    Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =          7430
```

```
26-Nov-1991 11:14:45
Execution time =     5 seconds
22956-2,A,#06,RS                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        32 secs
   Energy  Counts    X-Ray Lines

   0.49      103.    O  K  , O  K  , Ti L  , V  L  , Ti L  ,
                     V  L  , Ti L  , V  L  , Ti L  , V  L  ,
                     V  L

   1.74      210.    Si K  , Si K
```

```
Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =          3024
26-Nov-1991 11:17:18
Execution time =     6 seconds
22956-2,A,#08,RS                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        35 secs
   Energy  Counts    X-Ray Lines

   0.52      174.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.73      415.    Si K  , Si K

   6.38      103.    Fe K  , Fe K
```

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 3843
26-Nov-1991 11:19:17
Execution time = 7 seconds
22956-2,A,#09,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 33 secs

Energy	Counts	X-Ray Lines
0.51	158.	O K , O K , V L , V L , V L , V L
1.24	85.	Mg K , Mg K
1.74	276.	Si K , Si K
6.39	69.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 3589

26-Nov-1991 11:23:36
Execution time = 8 seconds

22956-2,A,#10,RS
Vert= 200 counts Disp= 1

Preset= Off
Elapsed= 35 secs

Energy	Counts	X-Ray Lines
0.52	140.	O K , O K , V L , V L , V L , V L
1.25	25.	Mg K , Mg K , Mg K
1.74	297.	Si K , Si K
2.62	24.	Cl K , Cl K
3.66	24.	Ca K , Ca K
6.40	85.	Fe K , Fe K

Quantex>P
0.120 Range= 10.230 keV 10.230
Integral 0 = 7158

26-Nov-1991 11:36:15
Execution time = 6 seconds
22956-2,A,#11,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 24 secs

Energy	Counts	X-Ray Lines
0.52	343.	O K , O K , V L , V L , V L , V L
1.26	195.	Mg K , Mg K , Mg K
1.73	717.	Si K , Si K
3.69	80.	Ca K , Ca K
6.40	74.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 3876

26-Nov-1991 11:32:18
Execution time = 6 seconds
22956-2,A,#12,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 25 secs

Energy	Counts	X-Ray Lines
0.52	103.	O K , O K , V L , V L , V L , V L
1.74	156.	Si K , Si K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 2052

26-Nov-1991 11:29:26
Execution time = 7 seconds
22956-2,A,#13,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 51 secs

Energy	Counts	X-Ray Lines
0.51	214.	O K , O K , V L , V L , V L , V L
1.25	209.	Mg K , Mg K , Mg K
1.74	443.	Si K , Si K
3.67	131.	Ca K , Ca K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 5121

26-Nov-1991 11:30:50
Execution time = 7 seconds
22956-2,A,#14,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 31 secs

Energy	Counts	X-Ray Lines
0.51	568.	O K , O K , V L , V L , V L , V L
1.25	352.	Mg K , Mg K , Mg K
1.74	1321.	Si K , Si K
3.66	188.	Ca K , Ca K
6.39	134.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 8153

26-Nov-1991 11:38:25
Execution time = 8 seconds
22956-2,A,#15,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 37 secs

Energy	Counts	X-Ray Lines
0.51	650.	O K , O K , V L , V L , V L , V L
1.25	530.	Mg K , Mg K , Mg K
1.74	1492.	Si K , Si K
3.69	398.	Ca K , Ca K
6.38	120.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 9950

26-Nov-1991 11:45:30
Execution time = 7 seconds
22956-2,A,#18,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 25 secs

Energy	Counts	X-Ray Lines
0.52	608.	O K , O K , V L , V L , V L , V L
1.25	492.	Mg K , Mg K , Mg K
1.74	1417.	Si K , Si K
3.70	262.	Ca K , Ca K
6.39	116.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 7187

26-Nov-1991 11:47:25
Execution time = 6 seconds
22956-2,A,#19,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 34 secs

Energy	Counts	X-Ray Lines
1.74	187.	Si K , Si K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 2860

26-Nov-1991 11:48:45
Execution time = 5 seconds
22956-2,A,#20,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 21 secs

Energy	Counts	X-Ray Lines
0.51	456.	O K , O K , V L , V L , V L , V L
1.25	328.	Mg K , Mg K , Mg K
1.73	943.	Si K , Si K
3.69	253.	Ca K , Ca K
6.38	80.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 5410

```
26-Nov-1991 12:04:28
Execution time =     5 seconds
22956-2,A,#21,RS                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        21 secs
   Energy  Counts     X-Ray Lines

   0.50       89.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.24      103.    Mg K  , Mg K

   1.73      202.    Si K  , Si K

   3.69       57.    Ca K  , Ca K



Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =        2225
26-Nov-1991 12:05:48
Execution time =     6 seconds
22956-2,A,#22,RS                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        19 secs
   Energy  Counts     X-Ray Lines

   0.52      315.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25       93.    Mg K  , Mg K  , Mg K

   1.74      524.    Si K  , Si K

   3.67       54.    Ca K  , Ca K

   6.36       92.    Fe K  , Fe K



Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =        3275
```

26-Nov-1991 12:08:13
Execution time = 6 seconds
22956-2,A,#23,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 39 secs

Energy	Counts	X-Ray Lines
0.51	366.	O K , O K , V L , V L , V L , V L
1.25	163.	Mg K , Mg K , Mg K
1.74	717.	Si K , Si K
6.39	133.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 5398

26-Nov-1991 11:52:00
Execution time = 5 seconds
22956-2,A,#25,RS Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 22 secs

Energy	Counts	X-Ray Lines
0.52	291.	O K , O K , V L , V L , V L , V L
1.26	220.	Mg K , Mg K , Mg K
1.73	677.	Si K , Si K
3.70	148.	Ca K , Ca K
6.38	77.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 3707

EM ASBESTOS ANALYSIS

MS Lab No. 22465

ample No. SW-2-4

KEEP ANY

ANALYSIS

GRID: 1 ☐ 3 ☐ 2 ☒ 4 ☐

Grid Address 16

Screen Magnification 19300 x

Camera Constant 28.4

Accelerating Voltage 100 KV

Beam Current 10 μa

Analyst S. Ahmed

MICROSCOPE: 600A ☐ 600B ☒ HU11E ☐ HU125E ☐

B

Date 11/26/91

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	1	F	1	15	✓											✓										
2	2	F	2	41													✓	✓			3	10	1	2		EDS #2 Possible Tr
3	3	F	4	36												✓	✓				3	10	3	1		EDS #3 "
	4	F	5	330												✓	✓				3	10	1	2		EDS #4 "
	5	F	2.2	300												✓	✓			.16	2	10		3		EDS #5 possible C
	6	F	3	40												✓	✓				3	10	2			EDS #6 possible Tr
	7	F	2.5	40												✓	✓				3	10	2	1		EDS #7 "
4	8	F	5	46												✓	✓				3	10	2	1		EDS #8 "
5	9	F	4	38		✓										✓	✓				3	10	2	1		EDS #9 "
	10	MO	1	25	✓																					
	11	F	5	75	✓																					
6	12	F	4	20												✓	✓				3	10	2			EDS #12 "
	13	F	5	24												✓	✓				3	10	3			EDS #13 "
	14	F	5	175												✓	✓				3	10	2	1		EDS #14 "
	15	F	5	85												✓	✓				3	10	3	1		EDS #15 "
	16	F	12	330												✓	✓				3	10	2	1		EDS #16 "
7	NSD																									

OBSERVATIONS:

Clean ☐

Debris: ☐ Very Light ☐ Light ☐ Moderate ☒ Heavy ☐ Very Heavy ☐

Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

26-Nov-1991 09:28:14
Execution time = 6 seconds
22956-2,B,#02,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 53 secs

Energy	Counts	X-Ray Lines
0.52	630.	O K , O K , V L , V L , V L , V L
1.25	398.	Mg K , Mg K , Mg K
1.73	1363.	Si K , Si K
3.69	148.	Ca K , Ca K
6.40	212.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 7919

26-Nov-1991 09:33:03
Execution time = 6 seconds
22956-2,B,#03,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 43 secs

Energy	Counts	X-Ray Lines
0.52	897.	O K , O K , V L , V L , V L , V L
1.25	680.	Mg K , Mg K , Mg K
1.74	1905.	Si K , Si K
3.68	586.	Ca K , Ca K
6.40	196.	Fe K , Fe K

```
26-Nov-1991 09:44:10
Execution time =     6 seconds
22956-2,B,#04,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        30 secs
   Energy  Counts     X-Ray Lines

   0.52      854.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      455.    Mg K  , Mg K  , Mg K

   1.74     1642.    Si K  , Si K

   3.70      168.    Ca K  , Ca K

   6.40      380.    Fe K  , Fe K



Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        8758
26-Nov-1991 09:47:21
Execution time =     7 seconds
22956-2,B,#05,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        52 secs
   Energy  Counts     X-Ray Lines

   0.52     1873.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.02      265.    Na K  , Na K  , Na K  , Zn L  , Zn L  ,
                     Zn L  , Zn L

   1.25      861.    Mg K  , Mg K  , Mg K

   1.74     4131.    Si K  , Si K

   6.39     1120.    Fe K  , Fe K

   7.06      153.    Fe K  , Fe K

Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =       29124
```

26-Nov-1991 09:53:21
Execution time = 5 seconds
22956-2,B,#06,SA
Vert= 200 counts Disp= 1 Preset= Off
Elapsed= 73 secs

Energy	Counts	X-Ray Lines
0.51	506.	O K , O K , V L , V L , V L , V L
1.25	337.	Mg K , Mg K , Mg K
1.74	958.	Si K , Si K
3.68	231.	Ca K , Ca K

26-Nov-1991 10:08:33
Execution time = 7 seconds
22956-2,B,#07,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 85 secs

Energy	Counts	X-Ray Lines
0.52	996.	O K , O K , V L , V L , V L , V L
1.25	517.	Mg K , Mg K , Mg K
1.74	1739.	Si K , Si K
3.69	306.	Ca K , Ca K
6.39	177.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 23833

26-Nov-1991 10:15:31
Execution time = 6 seconds
22956-2,B,#08,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 55 secs

Energy	Counts	X-Ray Lines
0.52	1874.	O K , O K , V L , V L , V L , V L
1.25	1196.	Mg K , Mg K , Mg K
1.74	3801.	Si K , Si K
3.69	700.	Ca K , Ca K
6.39	471.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 22646

```
26-Nov-1991 10:22:51
Execution time =     6 seconds
22956-2,B,#09,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        54 secs
   Energy  Counts    X-Ray Lines

   0.51     1663.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      992.   Mg K  , Mg K  , Mg K

   1.74     3094.   Si K  , Si K

   3.69      608.   Ca K  , Ca K

   6.40      312.   Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =        15139
26-Nov-1991 10:39:15
Execution time =     7 seconds
22956-2,B,#12,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        77 secs
   Energy  Counts    X-Ray Lines

   0.52      690.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.24      425.   Mg K  , Mg K

   1.73     1294.   Si K  , Si K

   3.70      322.   Ca K  , Ca K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =        15709
```

```
26-Nov-1991 10:42:10
Execution time =     7 seconds
22956-2,B,#13,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        72 secs
   Energy  Counts     X-Ray Lines

   0.51      737.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      407.    Mg K  , Mg K  , Mg K

   1.74     1346.    Si K  , Si K

   3.69      445.    Ca K  , Ca K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        10992
26-Nov-1991 10:44:59
Execution time =     6 seconds
22956-2,B,#14,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        54 secs
   Energy  Counts     X-Ray Lines

   0.51     1161.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      643.    Mg K  , Mg K  , Mg K

   1.74     2461.    Si K  , Si K

   3.69      403.    Ca K  , Ca K

   6.39      268.    Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        13135
```

```
26-Nov-1991 10:47:32
Execution time =     6 seconds
22956-2,B,#16,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        51 secs
   Energy  Counts    X-Ray Lines

   0.51     1342.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      973.   Mg K  , Mg K  , Mg K

   1.73     2813.   Si K  , Si K

   3.69      728.   Ca K  , Ca K

   6.39      162.   Fe K  , Fe K


Quantex>
      0.120    Range=   10.230 keV                        10.230
                                          Integral 0  =        15097
26-Nov-1991 10:49:50
Execution time =     8 seconds
22956-2,B,#16,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        36 secs
   Energy  Counts    X-Ray Lines

   0.52     1109.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      680.   Mg K  , Mg K  , Mg K

   1.74     2221.   Si K  , Si K

   3.69      520.   Ca K  , Ca K

   4.03       64.   Ca K  , Ca K

   6.40      245.   Fe K  , Fe K


Quantex>
      0.120    Range=   10.230 keV                        10.230
                                          Integral 0  =        17467
```

EM ASBESTOS ANALYSIS

MS Lab No. 22965

mple No. SW-2-4

RECEIVING

ANALYSIS

GRID
1 ☐ 3 ☑
2 ☐ 4 ☐

Grid Address 1-C
Screen Magnification 19300x
Camera Constant 28.4
Accelerating Voltage 100 KV
Beam Current 10 μa

MICROSCOPE
600A ☐
600B ☑
HU11E ☐
HU125E ☐

C

Analyst E.M. Date 11/26/91

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	01	F	5	18												✓					4	10	3	1		EDS Tremolite
	02	F	8	185												✓					3	10	2			EDS
	03	F	6	30												✓					3	10	4			EDS
	04	F	2.5	30	✓																					
	05	F	3	90													✓				3	10	2	1		EDS, SAED #38%
	06	F	4	30									✓													
	07	F	6	220												✓					3	10	2	1		EDS Tremolite
	08	F	2	23									✓		✓											
2	NSD																									
3	09	F	5	140												✓					3	10	2	1		EDS Tremolite
	10	F	5	25											✓											
	11	F	4	55											✓											
	12	F	5	35											✓											
4	13	F/D	5	42											✓											
	14	F	3	45												✓					3	10	2	2		EDS
5	15	F	3	28												✓										EDS
	16	F	3	70												✓					2	10		3		EDS
6	17	F	4	25												✓					3	10	1	2		EDS
	18	F	5	40											✓											
	19	F	4	115												✓				1	2	10		3		EDS
	20	F	10	58												✓				1	3	10	1	1		EDS Tremolite
	21	F	2	25											✓											
	22	F	10	50												✓					4	10	3	1		EDS

OBSERVATIONS:

Clean ☐
Debris: ☑ Very Light ☐ Light ☐ Moderate ☑ Heavy ☐ Very Heavy ☐
Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

EM ASBESTOS ANALYSIS

MS Lab No. 22965

ample No. SW-2-4

RECEIVING

Page 2 of

MICROSCOPE
600A ☐
600B ☐
HU11E ☐
HU125E ☐

ANALYSIS

GRID
1 ☐ 3 ☑
2 ☐ 4 ☐

Grid Address 1-C

Screen Magnification _____ x

Camera Constant _____

Accelerating Voltage 100 KV

Beam Current _____ μa

Analyst F. M.

Date _____

Grid opening	Str #	Str	Dimensions (mm) Width	Length	Fiber Classification NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	EDS Analysis Na	Mg	Si	Ca	Fe	Id	Comments
7	23	F	5	45											✓											
	24	F	8	80												✓					4	10		1		EDS
	25	F	3	90												✓				1	4	10	1	2		EDS
	26	F/D	4	50											✓											

OBSERVATIONS:

Clean ☐
Debris: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐
Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

```
26-Nov-1991 15:00:34
Execution time =     6 seconds
22965,SW2-4,1-C,01,FM                          Preset=  Off
Vert=      200 counts  Disp= 1                 Elapsed=        35 secs
   Energy  Counts    X-Ray Lines

   0.51    1465.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                   V  L

   1.25    1069.   Mg K  , Mg K  , Mg K

   1.74    2863.   Si K  , Si K

   3.69     844.   Ca K  , Ca K

   6.41     228.   Fe K  , Fe K


Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =        15616
26-Nov-1991 15:14:39
Execution time =     0 seconds
22965,SW2-4,1C,02,FM                           Preset=  Off
Vert=      200 counts  Disp= 1                 Elapsed=        25 secs
   7.08      68.   Fe K  , Fe K


Quantex>ID/PR
   No modifiers.
Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =        23405
```

26-Nov-1991 15:15:34 22965,SW2-4,1C,02,FM

ENERGY	COUNTS	X-RAY LINES
0.51	2635.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.25	1822.	Mg KA1, Mg KA2, Mg KB1
1.73	5407.	Si KA1, Si KA2
3.30	187.	K KA1, K KA2
3.69	1026.	Ca KA1, Ca KA2
4.03	133.	Ca KB1, Ca KB3
6.39	513.	Fe KA1, Fe KA2
7.08	68.	Fe KB1, Fe KB3

26-Nov-1991 15:21:25
Execution time = 6 seconds
22965,SW2-4,1C,03,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 31 secs

Energy	Counts	X-Ray Lines
0.51	1451.	O K , O K , V L , V L , V L , V L
1.25	1012.	Mg K , Mg K , Mg K
1.73	2948.	Si K , Si K
3.69	1092.	Ca K , Ca K
4.02	146.	Ca K , Ca K
6.44	99.	Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 14769

```
26-Nov-1991 15:34:48
Execution time =     6 seconds
22965,SW2-4,1C,05,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        34 secs
   Energy  Counts     X-Ray Lines

   0.51     1430.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.24      886.    Mg K  , Mg K

   1.74     2560.    Si K  , Si K

   3.69      622.    Ca K  , Ca K

   6.40      235.    Fe K  , Fe K



Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        14297
26-Nov-1991 15:42:03
Execution time =     6 seconds
22965,SW2-4,1C,07,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        42 secs
   Energy  Counts     X-Ray Lines

   0.51     1985.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25     1314.    Mg K  , Mg K  , Mg K

   1.74     4282.    Si K  , Si K

   3.32      135.    K  K  , K  K

   3.69      727.    Ca K  , Ca K

   6.39      575.    Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        21068
```

```
26-Nov-1991 15:53:46
Execution time =     6 seconds
22965,SW2-4,1C,09,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        31 secs
   Energy  Counts    X-Ray Lines

   0.52     1408.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.26      849.   Mg K  , Mg K  , Mg K

   1.74     3020.   Si K  , Si K

   3.31      121.   K  K  , K  K

   3.69      451.   Ca K  , Ca K

   4.03       88.   Ca K  , Ca K

   6.40      421.   Fe K  , Fe K
Quantex>
      0.120     Range=   10.230 keV                          10.230
                                          Integral 0  =        17369

26-Nov-1991 16:08:28
Execution time =     6 seconds
22965,SW2-4,1C,14,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        31 secs
   Energy  Counts    X-Ray Lines

   0.52      699.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      373.   Mg K  , Mg K  , Mg K

   1.74     1201.   Si K  , Si K

   3.69      199.   Ca K  , Ca K

   6.39      182.   Fe K  , Fe K


Quantex>
      0.120     Range=   10.230 keV                          10.230
                                          Integral 0  =         8776
```

```
26-Nov-1991 16:15:37
Execution time =     6 seconds
22965,SW2-4,1C,15,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        36 secs
   Energy  Counts     X-Ray Lines

   0.51      707.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      311.    Mg K  , Mg K  , Mg K

   1.73     1478.    Si K  , Si K

   6.39      500.    Fe K  , Fe K



Quantex>
      0.120     Range=    10.230 keV                                10.230
                                                  Integral 0  =        10024
26-Nov-1991 16:18:43
Execution time =     6 seconds
22965,SW2-4,1C,16,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        40 secs
   Energy  Counts     X-Ray Lines

   0.51     1058.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.26      573.    Mg K  , Mg K  , Mg K

   1.73     1978.    Si K  , Si K

   3.68      244.    Ca K  , Ca K

   6.40      364.    Fe K  , Fe K



Quantex>
      0.120     Range=    10.230 keV                                10.230
                                                  Integral 0  =        12238


26-Nov-1991 16:24:29
Execution time =     6 seconds
22965,SW2-4,1C,17,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        30 secs
   Energy  Counts     X-Ray Lines

   0.52     1075.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      630.    Mg K  , Mg K  , Mg K
```

Quantex>

0.120 Range= 10.230 keV 10.230

Integral 0 = 12238

26-Nov-1991 16:24:29

Execution time = 6 seconds

22965,SW2-4,1C,17,FM Preset= Off

Vert= 200 counts Disp= 1 Elapsed= 30 sec

Energy	Counts	X-Ray Lines
0.52	1075.	O K , O K , V L , V L , V L , V L
1.25	630.	Mg K , Mg K , Mg K
1.74	2166.	Si K , Si K
2.63	82.	Cl K , Cl K
3.69	277.	Ca K , Ca K
6.39	358.	Fe K , Fe K

2.63	82.	Cl K , Cl K
3.69	277.	Ca K , Ca K
6.39	358.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 11904

26-Nov-1991 16:30:19
Execution time = 6 seconds
22965,SW2-4,1C,19,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 32 secs

Energy	Counts	X-Ray Lines
0.51	1072.	O K , O K , V L , V L , V L , V L
1.02	166.	Na K , Na K , Na K , Zn L , Zn L , Zn L , Zn L
1.25	395.	Mg K , Mg K , Mg K
1.73	1937.	Si K , Si K
6.39	612.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 11009

26-Nov-1991 16:36:10 22965,SW2-4,1C,20,FM

ENERGY	COUNTS	X-RAY LINES
0.52	2636.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.01	204.	Na KA1, Na KA2, Zn LA1, Zn LA2, Zn LB1, Zn LG1
1.25	1592.	Mg KA1, Mg KA2, Mg KB1
1.74	5566.	Si KA1, Si KA2
3.31	361.	K KA1, K KA2
3.69	775.	Ca KA1, Ca KA2
4.03	66.	Ca KB1, Ca KB3
6.40	550.	Fe KA1, Fe KA2
7.06	71.	Fe KB1, Fe KB3

26-Nov-1991 16:40:27
Execution time = 6 seconds
22965,SW2-4,1C,22,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 30 secs

Energy	Counts	X-Ray Lines
0.51	1983.	O K , O K , V L , V L , V L , V L
1.25	1373.	Mg K , Mg K , Mg K
1.74	3826.	Si K , Si K
3.29	79.	K K , K K
3.69	887.	Ca K , Ca K
4.02	105.	Ca K , Ca K
6.39	334.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 16929

26-Nov-1991 16:47:49
Execution time = 6 seconds
22965,SW2-4,1C,24,FM Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 38 secs

Energy	Counts	X-Ray Lines
0.52	1671.	O K , O K , V L , V L , V L , V L
1.25	1270.	Mg K , Mg K , Mg K

```
26-Nov-1991 16:48:35
Execution time =     6 seconds
22965,SW2-4,1C,24,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        38 secs
   Energy  Counts     X-Ray Lines

   0.52     1671.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25     1270.    Mg K  , Mg K  , Mg K

   1.74     3051.    Si K  , Si K

   6.39      158.    Fe K  , Fe K



Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        13558
26-Nov-1991 16:50:35
Execution time =     7 seconds
22965,SW2-4,1C,25,FM                                  Preset=  Off
Vert=      200 counts  Disp= 1                        Elapsed=        34 secs
   Energy  Counts     X-Ray Lines

   0.51     1076.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.00      118.    Na K  , Na K  , Zn L  , Zn L  , Zn L  ,
                     Zn L

   1.25      755.    Mg K  , Mg K  , Mg K

   1.73     2138.    Si K  , Si K

   3.69      266.    Ca K  , Ca K

   6.39      398.    Fe K  , Fe K

Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        11702
```

TABLE 3. CLASSIFICATION OF FIBERS WITH TUBULAR MORPHOLOGY

TM	-	Tubular Morphology not sufficiently characteristic for classification as chrysotile
CM	-	Characteristic Chrysotile Morphology
CD	-	Chrysotile SAED pattern
CQ	-	Chrysotile composition by Quantitative EDXA
CMQ	-	Chrysotile Morphology and composition by Quantitative EDXA
CDQ	-	Chrysotile SAED pattern and composition by Quantitative EDXA
NAM	-	Non-Asbestos Mineral

TABLE 4. CLASSIFICATION OF FIBERS WITHOUT TUBULAR MORPHOLOGY

UF	-	Unidentified Fiber
AD	-	Amphibole by random orientation SAED (shows layer pattern of 0.53 nm spacing)
AX	-	Amphibole by qualitative EDXA. Spectrum has elemental components consistent with amphibole
ADX	-	Amphibole by random orientation SAED and Qualitative EDXA
AQ	-	Amphibole by Quantitative EDXA
AZ	-	Amphibole by one Zone Axis SAED
ADQ	-	Amphibole by random orientation SAED and Quantitative EDXA
AZQ	-	Amphibole by one Zone Axis SAED pattern and Quantitative EDXA
AZZ	-	Amphibole by two Zone Axis SAED patterns with consistent inter-axial angle
AZZQ	-	Amphibole by two Zone Axis SAED patterns, consistent inter-axial angle and Quantitative EDXA
NAM	-	Non-Asbestos Mineral

Analysis of Water by Transmission Electron Microscopy
(EPA-600/4-83-043)

EMS No.	22965	Client	SCHAFER & ASSOC.
Sample No.	SW-3-4		
Date	12/5/91		

Total Asbestos Fibers	15	MFL
Chrysotile Fibers	*BDL	MFL
Amphibole Fibers	15	MFL
> 5 Micron length (chrysotile)	*BDL	MFL
> 5 Micron length (amphibole)	6	MFL
Mass (Chrysotile)	*BDL	µg/L
Mass (amphibole)	42	µg/L
More/Less than 5 Chrysotile Fibers in Sample	LESS	
More/Less than 5 Amphibole Fibers in Sample	MORE	
Poisson 95% Confidence Interval	12 to 19	MFL
Detection Limit	0.2	MFL

* BDL : Below Detection Limit; MFL: Million Fibers per Liter

Size Distribution (Chrysotile and Amphibole)

Particle Length - Microns

O -0.49	0.50 - 0.99	1.00 - 1.49	1.50 - 1.99	2.00 - 2.49	2.5 & UP
0	7	8	5	7	51

Particle Width - Microns

O - .04	.05 - .09	.1 - .14	.15 - .19	.2 - .24	.25 & UP
0	6	8	13	13	38

Aspect Ratio L/W

0 - 9.9	10 - 19.9	20 - 29.9	30 - 39.9	40 - 49.9	50 & UP
23	26	15	6	2	6

TEM ASBESTOS ANALYSIS

Page ___ of ___

EMS Lab No. 22965
Client Schafer & Associates
Sample No. SW-3-4

RECEIVING

METHOD OF ANALYSIS: EPA Yamate Level I ☐ Level II ☐ Level III ☐ AHERA ☐

LENGTHS: All Sizes (EPA) ☑ (µm): ≥0.5 ☐ ≥1.0 ☐ ≥5.0 ☐ ≥10.0 ☐ PCM Range* ☐ (*≥0.25 µm width, ≥5.0 µm length)

ASPECT RATIO 3:1 ☐ 5:1 ☐

Approved By ___ Date ___

PREP

FILTER TYPE/AREA (mm²): MCE/385 ☐ MCN/960 ☐ MCE/960 ☑ Other ☐

TYPE OF SAMPLE: Air ☐ Water ☑ Soil ☐ Wipe ☐ Bulk ☐ Other ☐ Dust/Microvac ☐

PORE SIZE: 0.45 µm ☐ 0.8 µm ☐ .1 µm ☑ .22 µm ☐ Other ☐

G.O. Area (mm²) 0.0 062
No. of G.O. to Analyze 10
Filter Lot No. ___

DIRECT PREP ☑ INDIRECT PREP ☐

Volume ___ liters
Working Volume 50 ml
Weight ___ grams
Ashed Area ___ %
Prepared By FG

ANALYSIS

GRID: 1 ☒ 2 ☐ 3 ☐ 4 ☐

MICROSCOPE: 600A ☐ 600B ☒ HU11E ☐ HU125E ☐

Grid Address 1A
Screen Magnification 19300 x
Camera Constant 28.4
Accelerating Voltage 100 KV
Beam Current 10 µa

Analyst S. Ahmed Date 11/26/9

A

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	1	F	4	25										✓		✓	✓				3	10	2	2		EDS #1
	2	F	10	90										✓		✓	✓				3	10	2	1		EDS #2
	3	F	4	55										✓		✓	✓				3	10	2	1		EDS #3
2	4	F	1.5	75										✓		✓	✓				3	10	2	1		EDS #4
	5	F	6	86										✓		✓	✓				3	10	2	1		EDS #5
	6	F	20	180										✓		✓	✓				3	10	2	1		EDS #6
3	7	MD	1.5	60	✓																					
	8	F	2	112	✓																					
	9	F	4	44										✓		✓	✓				3	10	2	1		EDS #9
	10	F	8	56										✓		✓	✓				4	10	3	1		EDS #10
	11	MD	4	55										✓		✓	✓				3	10	3	1		EDS #11
4	12	MD	10	180	ambiguous																					
	13	F	8	260										✓		✓	✓				3	10	1	2		EDS #13
	14	F	15	280										✓		✓	✓				3	10	2	1		EDS #14
	15	F	6	115										✓		✓	✓				3	10	2	1		EDS #15
	16	F	18	250										✓		✓	✓				3	10	1	1		EDS #16
	17	F	6	240										✓		✓										
	18	F	5	85										✓		✓	✓				3	10	2	1		EDS #18
5	19	F	10	540										✓		✓	✓				3	10	2	1		EDS #19
	20	F	5	25										✓		✓										
	21	F	2	45	✓																					
	22	F	5	130	✓																					
	23	F	9.5	515										✓		✓	✓				3	10	2	1		EDS #23
	24	F	10	55	✓ ambiguous																3	10	1	2		EDS #24

OBSERVATIONS:

Clean ☐
Debris: ☑ Very Light ☐ Light ☐ Moderate ☑ Heavy ☐ Very Heavy ☐
Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐
Other ☐ all amphibole fibers are tremolite

EM ASBESTOS ANALYSIS

MS Lab No. 22965

ample No. SW-3-4

SCREENING

ANALYSIS

GRID 1 [X] 2 [ ] 3 [ ] 4 [ ]

Grid Address 1A

Screen Magnification 19300x

Camera Constant 28-4

Accelerating Voltage 100 KV

Beam Current 10 µa

MICROSCOPE 600A [ ] 600B [X] HU11E [ ] HU125E [ ]

A

Analyst S. Ahmed Date 11/20

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	EDS Na	Mg	Si	Ca	Fe	Id	Comments
6	24	F	5	50										✓	✓		✓				3	10	2	1		
	25	F	15	185												✓	✓				3					EDS #25
	26	F	3	70										✓	✓											
7	27	F	1.5	115	✓																					
	28	F	15	350										✓	✓		✓				3	10	2	1		EDS #28
	29	F	6	75	✓	no pattern																				

OBSERVATIONS: Clean [ ]

Debris: [X] Very Light [ ] Light [ ] Moderate [X] Heavy [ ] Very Heavy [ ]

Gypsum: [ ] Very Light [ ] Light [ ] Moderate [ ] Heavy [ ] Very Heavy [ ]

```
26-Nov-1991 13:02:25
Execution time =     5 seconds
22956-3,A,#01,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        44 secs
   Energy  Counts    X-Ray Lines

   0.52      423.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      259.   Mg K  , Mg K  , Mg K

   1.73      853.   Si K  , Si K

   3.70      164.   Ca K  , Ca K

   6.40      177.   Fe K  , Fe K



Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =        8780
26-Nov-1991 13:04:47
Execution time =     7 seconds
22956-3,A,#02,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        21 secs
   Energy  Counts    X-Ray Lines

   0.51     1409.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      995.   Mg K  , Mg K  , Mg K

   1.73     2915.   Si K  , Si K

   2.62       56.   Cl K  , Cl K

   3.69      705.   Ca K  , Ca K

   6.40      242.   Fe K  , Fe K


Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =       15070
```

```
26-Nov-1991 13:05:57
Execution time =     6 seconds
22956-3,A,#03,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        22 secs
   Energy  Counts     X-Ray Lines

   0.52      572.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      424.    Mg K  , Mg K  , Mg K

   1.74     1297.    Si K  , Si K

   3.70      303.    Ca K  , Ca K

   6.40      156.    Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =          8739
26-Nov-1991 13:08:22
Execution time =     5 seconds
22956-3,A,#04,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        46 secs
   Energy  Counts     X-Ray Lines

   0.52      432.    O  K  , O  K  , V  L  , V  L  , V  L  ,
                     V  L

   1.25      311.    Mg K  , Mg K  , Mg K

   1.73      995.    Si K  , Si K

   3.68      214.    Ca K  , Ca K

   6.39      170.    Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                          Integral 0  =         12918
```

26-Nov-1991 13:10:42
Execution time = 5 seconds
22956-3,A,#05,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 27 secs

Energy	Counts	X-Ray Lines
0.51	491.	O K , O K , V L , V L , V L , V L
1.24	436.	Mg K , Mg K
1.74	1260.	Si K , Si K
3.35	72.	K K , K K
3.68	198.	Ca K , Ca K
6.37	86.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral O = 8309

26-Nov-1991 13:15:01 22956-3,A,#06,SA

ENERGY	COUNTS	X-RAY LINES
0.51	744.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.25	576.	Mg KA1, Mg KA2, Mg KB1
1.74	1657.	Si KA1, Si KA2
3.35	32.	K KA1, K KA2
3.68	412.	Ca KA1, Ca KA2
4.03	40.	Ca KB1, Ca KB3
5.37	23.	Cr KA1, Cr KA2
6.39	141.	Fe KA1, Fe KA2
7.01	31.	Fe KB1, Fe KB3

26-Nov-1991 13:22:40
Execution time = 6 seconds
22956-3,A,#09,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 28 secs

Energy	Counts	X-Ray Lines
0.51	712.	O K , O K , V L , V L , V L , V L
1.26	412.	Mg K , Mg K , Mg K
1.74	1400.	Si K , Si K
3.68	313.	Ca K , Ca K
6.38	165.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 8572

```
26-Nov-1991 13:24:24
Execution time =     6 seconds
22956-3,A,#10,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        24 secs
   Energy  Counts    X-Ray Lines

   0.51     1818.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25     1456.   Mg K  , Mg K  , Mg K

   1.74     3832.   Si K  , Si K

   3.68     1022.   Ca K  , Ca K

   4.01      109.   Ca K  , Ca K

   6.40      222.   Fe K  , Fe K


Quantex>
      0.120     Range=   10.230 keV                          10.230
                                          Integral 0  =        16345
26-Nov-1991 13:25:39
Execution time =     6 seconds
22956-3,A,#11,SA                                    Preset=  Off
Vert=      200 counts  Disp= 1                      Elapsed=        23 secs
   Energy  Counts    X-Ray Lines

   0.51      805.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      409.   Mg K  , Mg K  , Mg K

   1.74     1479.   Si K  , Si K

   3.68      239.   Ca K  , Ca K

   6.41      143.   Fe K  , Fe K



Quantex>
      0.120     Range=   10.230 keV                          10.230
                                          Integral 0  =         7830
```

```
26-Nov-1991 13:34:47
Execution time =     7 seconds
22956-3,A,#13,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        39 secs
   Energy  Counts    X-Ray Lines

   0.51      640.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      330.   Mg K  , Mg K  , Mg K

   1.74     1297.   Si K  , Si K

   3.69      157.   Ca K  , Ca K

   6.39      263.   Fe K  , Fe K



Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =         9732
26-Nov-1991 13:37:25
Execution time =     8 seconds
22956-3,A,#14,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        36 secs
   Energy  Counts    X-Ray Lines

   0.51     1520.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25     1201.   Mg K  , Mg K  , Mg K

   1.74     3209.   Si K  , Si K

   3.69      986.   Ca K  , Ca K

   4.02      127.   Ca K  , Ca K

   6.41      177.   Fe K  , Fe K


Quantex>
      0.120    Range=   10.230 keV                          10.230
                                          Integral 0  =        17442
```

```
26-Nov-1991 13:40:06
Execution time =     6 seconds
22956-3,A,#15,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        25 secs
   Energy  Counts    X-Ray Lines

   0.51      872.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      557.   Mg K  , Mg K  , Mg K

   1.74     1951.   Si K  , Si K

   3.32       66.   K  K  , K  K

   3.69      249.   Ca K  , Ca K

   6.40      349.   Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =        9226
26-Nov-1991 13:44:05
Execution time =     6 seconds
22956-3,A,#16,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        35 secs
   Energy  Counts    X-Ray Lines

   0.52     1220.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      800.   Mg K  , Mg K  , Mg K

   1.74     2553.   Si K  , Si K

   3.31      150.   K  K  , K  K

   3.69      280.   Ca K  , Ca K

   6.38      273.   Fe K  , Fe K


Quantex>
      0.120     Range=    10.230 keV                          10.230
                                                Integral 0  =       11657
26-Nov-1991 13:55:23
Execution time =     8 seconds
22956-3,A,#18,SA                                  Preset=  Off
Vert=      200 counts  Disp= 1                    Elapsed=        32 secs
   Energy  Counts    X-Ray Lines

   0.51      562.   O  K  , O  K  , V  L  , V  L  , V  L  ,
                    V  L

   1.25      273.   Mg K  , Mg K  , Mg K

   1.74     1014.   Si K  , Si K

   3.69      222.   Ca K  . Ca K
```

6.40 100. Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 7815
26-Nov-1991 13:59:03
Execution time = 8 seconds
22956-3,A,#19,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 35 secs

Energy	Counts	X-Ray Lines
0.52	996.	O K , O K , V L , V L , V L , V L
1.25	580.	Mg K , Mg K , Mg K
1.74	2239.	Si K , Si K
3.69	459.	Ca K , Ca K
6.40	192.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 14842

26-Nov-1991 14:03:51
Execution time = 6 seconds
22956-3,A,#23,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 20 secs

Energy	Counts	X-Ray Lines
0.51	694.	O K , O K , V L , V L , V L , V L
1.25	500.	Mg K , Mg K , Mg K
1.74	1553.	Si K , Si K
3.69	240.	Ca K , Ca K
6.37	155.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral O = 8590

26-Nov-1991 14:06:04 22956-3,A,#24,SA

ENERGY	COUNTS	X-RAY LINES
0.52	1240.	O KA1, O KA2, V LA1, V LA2, V LB1, V LG1
1.00	67.	Na KA1, Na KA2, Zn LA1, Zn LA2, Zn LB1, Zn LG1
1.25	813.	Mg KA1, Mg KA2, Mg KB1
1.73	2464.	Si KA1, Si KA2
3.31	108.	K KA1, K KA2
3.67	245.	Ca KA1, Ca KA2
6.39	512.	Fe KA1, Fe KA2
7.04	77.	Fe KB1, Fe KB3

26-Nov-1991 14:15:06
Execution time = 7 seconds
22956-3,A,#25,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 28 secs

Energy	Counts	X-Ray Lines
0.51	695.	O K , O K , V L , V L , V L , V L
1.25	418.	Mg K , Mg K , Mg K
1.73	1599.	Si K , Si K
3.68	215.	Ca K , Ca K
6.39	218.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral 0 = 11217

26-Nov-1991 14:26:12
Execution time = 7 seconds
22956-3,A,#28,SA Preset= Off
Vert= 200 counts Disp= 1 Elapsed= 26 secs

Energy	Counts	X-Ray Lines
0.52	442.	O K , O K , V L , V L , V L , V L
1.25	300.	Mg K , Mg K , Mg K
1.74	733.	Si K , Si K
3.33	51.	K K , K K
3.69	121.	Ca K , Ca K
6.41	71.	Fe K , Fe K

Quantex>
0.120 Range= 10.230 keV 10.230
Integral O = 6940

EM ASBESTOS ANALYSIS

MS Lab No. 22965

Sample No. SW-3-4

ANALYSIS

GRID: 1 ☐ 2 ☒ 3 ☐ 4 ☐

Grid Address: C-B

Screen Magnification: 19300

Camera Constant: 28.9

Accelerating Voltage: 100 kV

Beam Current: 10 μa

Analyst: Radlalip

Date: 12-5-9

MICROSCOPE: 600A ☐ 600B ☒ 1011E ☐ 1012SE ☐

B

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
1	1		1.5	200	✓																					
	2		4	40													✓				3	10	1	1		Tremolite
	3		12	98													✓				3	10	2	1		"
	4		6	230													✓				3	10	2	1		"
	5		4	100	✓												✓				4	10	3	1		"
2	6		1.5	22																						
	7		5	190													✓				2	10	1	2		Slightly coated with
	8		2	43													✓				3	10	2	0		filler
	9		6	175													✓				3	10	3	0		"
3	10		3	38													✓				3	10	3	0		"
	11		4	55													✓				3	10	2	1		"
	12		2	24													✓									
	13		9	190													✓									
4	14		3	32													✓									
	15		5	140													✓									
	16		2	15																						
	17		3	43													✓									
	18		7	180													✓									
	19		12	68													✓				4	10	2	1		Tremolite
	20		3	45													✓									
	21		10	165													✓									
	22		3	20													✓									
	23		3	110													✓									
5	24		3	120													✓									"

OBSERVATIONS:

Clean ☐

Debris: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

Gypsum: ☐ Very Light ☐ Light ☐ Moderate ☐ Heavy ☐ Very Heavy ☐

EM ASBESTOS ANALYSIS

MS Lab No. 22965

mple No. SW-3-4

MICROSCOPE
600A ☐
600B ☐
HU11E ☐
HU125E ☐

ANALYSIS

GRID
1 ☐ 3 ☐
2 ☒ 4 ☐

Grid Address 1-B
Screen Magnification 1930
Camera Constant 28.4
Accelerating Voltage 100 KV
Beam Current 10 pa

B

Analyst Radha Sip Date 12/5

Grid opening	Str #	Str	Dimensions (mm) Width	Length	NAM	TM	CM	CD	CO	CMO	CDO	UF	AD	AX	ADX	AO	ADO	AZO	AZZ	Na	Mg	Si	Ca	Fe	Id	Comments
5	25		5	38													✓									[illegible]
	26		1.5	15													/									
	27		4	38													/				3	10	2	1		Tremo
	28		4	42													/									"
	29		1.5	125													/									"
	30		3	160													/									"
	31		4	100													/									"
	32		12	75													/									"
	33		5	112													/									"
6	34		4	28	✓												✓									"
	35		1	45																						"
	36		10	112													/				3	10	1	1		Tremo
	37		11	200													/									"
	38		5	40													/									"
	39		1.5	100													/									"
	40		5	25													/									"
7	41		6	185													/									"
	42		8	70													/									"
	43		5	24													/				3	10	2	1		Tremo.
	44		3	22													/									"
	45		1.5	12													/									"
	46																									
	47																									
	48																									

OBSERVATIONS:

Clean ☐					
Debris: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐
Gypsum: ☐	Very Light ☐	Light ☐	Moderate ☐	Heavy ☐	Very Heavy ☐