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AIRBORNE CONCENTRATIONS OF ASBESTOS FIBRES IN THE MINE, MILL AND TOWNSITE OF CASSIAR ASBESTOS CORPORATION LIMITED AT CLINTON CREEK YUKON TERRITORY

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We wish to thank Mr. Marcel DeRouin, Mine Manager of the Clinton Creek operation, and the members of his staff for their kind cooperation and assistance which greatly facilitated our work.

AIRBORNE CONCENTRATIONS OF ASBESTOS FIBRES IN THE MINE, MILL AND TOWNSITE OF CASSIAR ASBESTOS CORPORATION LIMITED AT CLINTON CREEK, YUKON TERRITORY

INTRODUCTION

This survey was conducted at Clinton Creek during the period June 18-25, 1974 at the request of the Department of Indian and Northern Affairs.

In June 1974 the Company employed 317 persons at Clinton Creek, distributed as follows:

Administration and services	81
Maintenance	111
Mine	51
Mill	74

The total population of the townsite was 415, including 88 children.

SURVEY PROCEDURE

Sampling

Samples of airborne particulates, including asbestos fibres, were collected on membrane filters which were contained in open-faced plastic holders (Millipore Monitors). Air was drawn through each filter at a known rate, for a measured period of time, by means of a small battery-operated pump connected to the Monitor by rubber tubing.

Two types of samples were collected - personal samples and stationary samples. Personal samples were obtained by fastening a Monitor

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to the front of a worker's shirt collar and clipping a pump to his belt. The worker wore this equipment continuously during the sampling period. This type of sample gave an estimate of the amount of asbestos fibre in the air in the worker's breathing zone. Stationary samples were obtained by fastening a sampling unit (at a height above the floor which approximated a man's breathing level) to a post or other fixed object in a particular area. Such a sample gave an estimate of the amount of asbestos fibre being dispersed into the air by the equipment or processes located in that area; or being carried into that area by air coming from other areas. In many instances, stationary samples were collected in places where no person was regularly stationed; instead, such places would be visited by a worker from time to time, either for routine inspection purposes or to correct some fault or malfunction that had occurred.

In addition to determinations of occupational exposure to asbestos, measurements were also made of the amount of asbestos in the air in the townsite which was about eight miles (13 km) southeast of the mine and mill. Most of such samples were stationary samples, collected over eight-hour periods inside various buildings in the townsite.

Determination of asbestos fibre concentration

The membrane filters were fixed (to prevent fibres being dislodged) and mounted on microscope slides, using the British method ("Hygiene standards for chrysotile asbestos dust." Committee on hygiene standards of the British Occupational Hygiene Society. Published in The Annals of Occupational Hygiene, vol. 11, pp 47-69, April 1968). The asbestos fibres on the slides were then counted using phase-contrast microscopy at

450x magnification.

All the membrane filters were fixed at Clinton Creek. About one-third of these were mounted and counted at Clinton Creek; the remainder were brought back to Ottawa for mounting and counting.

HYGIENE STANDARD FOR CHRYSOTILE ASBESTOS DUST

There is growing agreement among occupational health workers that, for a 7 or 8-hour workday and 40-hour workweek, the time-weighted average concentration of asbestos to which workers are exposed should not exceed 2 fibres per milliliter of air (2 fpml). For purposes of this standard, a fibre is defined as a particle whose length is between 5 micro-meters (μm) and 100 μm and whose length-to-breadth ratio is at least 3:1.

This is the standard with which data here being reported will be compared.

DISCUSSION OF RESULTS

Data for all samples collected are given in Tables A-1, A-2, A-3 (Appendix). Table A-1 lists data for personal samples collected in the mill and mine; Table A-2 for stationary samples collected in the mill; Table A-3 for samples collected in the townsite.

The acceptable level of exposure (2 fpml) refers to a time-weighted average (TWA) concentration based on a 7 or 8-hour working day. This requires that a worker's exposure be measured, as far as possible, over a full working shift. In some cases this could be done by collecting only one sample, taken continuously throughout the shift. However, if a

membrane filter was too heavily loaded with fibres or with dust (particles whose length-to-breadth ratio was less than 3:1, or whose length was less than 5 μm), accurate fibre counting was not possible. To minimize the possibility of such overloading, in many cases where the exposure of a worker was being determined, a series of separate, short-term samples was collected over the full shift and a TWA concentration calculated from the individual results (for example, in Table A-1, Item no.'s 27-31 are individual samples and Item no. 32 is the calculated TWA concentration).

In spite of these precautions, some samples were found to be overloaded, usually because of the presence of a great deal of fine dust, which obscured the fibres. In such cases, a probable minimum value for the concentration was calculated, on the assumption that there were probably at least 8 fibres per microscope field. This is a conservative assumption; on a filter that was not overloaded with dust, it was possible to count accurately as many as 12-15 fibres per field. In the Tables such concentrations are expressed as "Probably greater than - ".

Within any one occupational group, such as payloader operators, baggers, sewers, floormen, etc., more than one TWA determination was usually made. By averaging all the TWA concentrations obtained for any one occupational group, the overall TWA concentration for that group was obtained. These overall averages are given in the following table:

TABLE 1. Overall Time-Weighted Average Fibre Exposures for Various Occupations in the Mill

Occupation	Number of Values Averaged	Overall Time-Weighted Average Concentration (fpml)
Payloader operator (Dryrock Storage)	2	6.4
Floorman	6	> 5.4 (see "note")
Labourer, tailings area	1	> 4.0
Concentrator (dryer) helper	4	> 3.8
Mill operator	3	3.4
Forklift operator	2	3.1
Mechanic	4	2.9
Shift foreman	2	> 2.8
Foreman	1	2.7
Bagger	10	2.7
Sewer	3	2.5
Concentrator operator	4	2.5
Screen repairman	1	2.4
Palletizer	3	2.1
Foreman, tailings area	1	1.2
Machinist	1	0.6

Note: ">" = greater than.

During mining operations, samples collected on any one day for any particular occupation did not cover a sufficient portion of the day to permit the calculation of a truly representative TWA concentration. A rough estimate of the overall average concentration during a particular operation was therefore obtained by taking a simple average of all the individual, short-term values obtained for that operation throughout the survey. Results are given in Table 2.

TABLE 2. Approximate Average Fibre Concentrations During Mining Operations

Occupation	Number of Sample Values Averaged	Approximate Average Fibre Concentration (fpml)
Drill operator	2	4
Drill helper	4	>3.2
Truck driver	3	0.8
Crusher operator	3	2.7
Crusher helper	3	3.7
Tramline operator	2	0.2
Tramline helper	3	0.4
Bulldozer operator	1	0.7

All the occupations in the mill, except the foreman in the tailings area and the machinists, had exposures in excess of 2 fpml. The approximations given in Table 2 suggest that, in the mining operations, drill operators and helpers and crusher operators and helpers also were exposed to concentrations greater than 2 fpml.

It must be emphasized that respirators were provided to all workers and that, when the occasion seemed to require it, they were worn. For instance, shift foremen, foremen or floormen frequently had to remove asbestos fibre, as quickly as possible, from equipment that had become plugged. In such cases, they usually were observed to wear their respirators.

Results (Table A-2, Appendix) obtained from stationary samples, indicate that concentrations greater than 2 fpml were common throughout the plant, and not just in areas where workers were permanently stationed.

Three samples (Item no.'s 232, 233, 234) were collected in the baghouse. The air being sampled had been filtered and was being recirculated to the mill. Two of these samples (both taken on the same day) showed low concentrations (0.4 and 0.6 fpml respectively) but the third (taken on a different day) had a concentration of 2.4 fpml. Probably this was due to a torn or worn-out bag, or to a loosely-connected bag. The need for more frequent maintenance is indicated.

The value of 8.0 fpml found in the secretary's office in the mill (Item no. 247) is quite inconsistent with values found elsewhere. Possibly the filter was accidentally contaminated. It is suggested that the company should take further samples in this location.

Two samples (Item no.'s 272 and 273) collected while the bus was

travelling between the townsite and the mill gave concentrations of 0.2 and 0.6 fpml, both of which are well below the acceptable level for occupational exposure. One personal sample (Item no. 278) representing the exposure of a man doing janitorial work in one of the bunkhouses indicated an exposure of 0.9 fpml which is also well below the hygiene standard for occupational exposure.

Results (Table A-3, Appendix) of 15 determinations made in the townsite showed concentrations of airborne fibres to range between 0 and 0.04 fpml. As no standard for non-occupational exposure to asbestos has been established to date, the health significance of those findings remains undefined.

Concentrations of asbestos fibre found in the general atmosphere at the tailings pile in the vicinity of the discharge from the Swivel Piler (Table A-2. Item no's 250-260) ranged from 0 to 131 fpml. The wide variations in counts probably were related to variations in wind direction and velocity. Sampling times had to be kept extremely short, so that no single result can be regarded as representative of anything but the concentration at the exact sampling point during the exact sampling period. However, as a group these 11 samples indicate that the outdoor air was being considerably polluted by this process. They are not indicative of any person's exposure because no person worked at that point while the Swivel Piler was discharging material.

It is understood that since the survey was completed, a pug mill has been put into operation so that tailings are no longer discharged as dry, dusty material.

CONCLUSIONS AND RECOMMENDATIONS

Time-weighted average exposures, to asbestos, of most occupational groups in the mill are above the recommended level of 2 fibres per milliliter of air (fpml). Data suggest that, in the mine, drillers and helpers and crusher operators and helpers are also exposed to concentrations of asbestos above this limit.

Reduction in the amounts of asbestos dispersed into the air in the mill could be achieved by some operational and housekeeping changes. For instance, considerable asbestos spills on to the floor behind the bagging machines and is removed by hand shovelling and sweeping. It is recommended that efforts be made to minimize such spillage by eliminating as many of the causes as possible. Floor cleanup, both here and throughout the mill, should be done by a vacuum cleaning system, rather than by shovelling or sweeping.

High fibre counts were obtained in the vicinity of several screens and conveyor belts. Although the screens were enclosed and provided with exhaust ventilation, dust was observed to be leaking from several. Maintaining such equipment in a leak-free condition would reduce contamination of the air in the plant.

Conveyor belts are well known as sources of dust. Concentrations of airborne asbestos, as determined by several stationary samples collected in the vicinity of conveyors in the mill, indicate the need for control measures. Methods that have been used in other plants include enclosure of the top portion of a conveyor, coupled with cleaning of the return belt by scrapers or by rotating brushes that bear against the head pulley; or enclosure of the complete conveyor. The enclosures are usually exhaust-ventilated.

As was mentioned previously, air issuing from the baghouse was not always sufficiently clean, probably due to holes in bags or to loose bag

connections. A more careful and frequent inspection routine would minimize the occurence of such leaks, ensuring that the air being returned to the mill was of acceptable quality.

Exposures of payloader operators in the Dry Rock Storage Shed could be greatly reduced by providing enclosed cabs with filtered air supply systems.

J.P. Windish
Industrial Hygiene Consultant

APPENDIX

TABLE A-1 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- PERSONAL SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
1	36A	20Jun	A	Payloader operator inside Dry Rock storage shed	0956-1101	5.9		Payloader no.85. Door not closed. Sampler fixed to inside of cab at breathing zone level.
2	36B	20Jun	A	""	1136-1303	7.9		Payloader no 84. Door kept closed. Sampler fixed to inside of cab.
3	36C	20Jun	A	""	1304-1408	6.3		""
4	36D	20Jun	A	""	1408-1435	11.4		""
5	36A-36D	20Jun	A	""	0956-1435		7.3	
6	135A	25Jun	B	""	0901-1210	3.1		
7	135B	25Jun	B	""	1212-1320	4.4		
8	135C	25Jun	B	""	1322-1449	11.8		
9	135A- 135C	25Jun	B		0901-1449		5.6	
0	2A	18Jun	C	Shift foreman in mill	0858-1317	1.8		Man was very active in mil
1	2B	18Jun	C	""	1317-1440	1.9		Spent most of time in foreman's office
2	2A-2B	18Jun	C		0858-1440		1.8	

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EM o	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
	48A	20Jun	D	Shift foreman in mill	0907-1011	not countable, probably >5.6		Filter heavily loaded with dust making accurate fibre count impossible
	48B	20Jun	D	""	1111-1448	2.6		Filter contained many very small particles
	48A-48B	20Jun	D	""	0907-1448		probably >3.7	
	47A	20Jun	E	Foreman in mill	0904-1117	2.1		
	47B	20Jun	E	""	1117-1420	3.1		Not much apparent exposure until 1320h. Then went twice to Swivel Piler
	47A-47B	20Jun	E	""	0904-1420		2.7	
	12A	18Jun	F	Bagger & Floorman	0917-1117	2.4		Bagger until 1020H. Than floorman for rest of shift
	12B	18Jun	F	Floorman	1117-1339	4.7		
	12C	18Jun	F	""	1339-1458	4.1		
	12A-12C	18Jun	F	Bagger & floorman	0917-1458		3.8	
	15A	18Jun	G	Floorman	0923-1143	2.8		
	15B	18Jun	G	""	1143-1342	2.4		
	15C	18Jun	G	""	1342-1450	2.4		

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						Individual sample	Time-weighted average	
26	15A-15C	18Jun	G	Floorman	0923-1450		2.6	
27	7A	18Jun	H	""	0908-1011	4.0		
28	7B	18Jun	H	""	1012-1107	0		
29	7C	18Jun	H	""	1107-1214	4.9		
30	7D	18Jun	H	""	1214-1345	3.4		
31	7E	18Jun	H	""	1345-1457	3.6		
32	7A-7E	18Jun	H	""	0908-1457		3.3	
33	37A	20Jun	J	Floorman	0837-1046	5.2		
34	37B	20Jun	J	""	1046-1231	4.6		
35	37C	20Jun	J	""	1231-1429	3.5		
36	37A-37C	20Jun	J	""	0837-1429		4.5	
37	50	20Jun	K	Floorman	0913-1020	4.8		Man went home at 1020
38	117A	24Jun	J	""	0937-1218	not countable probably > 4.5		Filter was so overloaded that there was loose material in the filter holder
39	117B	24Jun	J	""	1218-1345	10.6		
40	117C	24Jun	J	""	1347-1444	5.7		

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						Individual sample	Time-weighted average	
41	117A-117C	24Jun	J	Floorman	0937-1444		probably > 6.5	
42	118	24Jun	L	" "	0943-1027	11.6		Went home at 1027
43	132	24Jun	M	" "	1318-1608	4.1		Worked outdoors behind loading area for bagged products for first two hours. Operated pay-loader last hour.
44	9A	18Jun	N	Shift labour/Bagger	0912-1007	7.7		Air did not appear dusty
45	9B	18Jun	N	" "	1008-1100	2.6		Air did not appear dusty
46	9C	18Jun	N	" "	1101-1207	2.1		
47	9D	18Jun	N	" "	1207-1453	2.0		
48	9A-9D	18Jun	N	" "	0912-1453		3.0	
49	13A	18Jun	P	" "	0919-1015	11		Spent most of time cleani up around bagging machir Air seemed very dusty
50	13B	18Jun	P	" "	1015-1102	4.0		" "
51	13C	18Jun	P	" "	1102-1204	8.2		" "
52	13D	18Jun	P	" "	1204-1300	2.7		
53	13E	18Jun	P	" "	1304-1452	3.0		

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						Individual sample	Time-weighted average	
54	13A-13E	18Jun	P	Shift Labor/ bagger	0919-1452		5.4	
55	5A	18Jun	Q	"	0904-1311	1.8		
56	5B	18Jun	Q	"	1311-1456	1.8		
57	5A-5B	18Jun	Q	"	0904-1456		1.8	
58	6A	18Jun	R	"	0906-1306	3.8		
59	6B	18Jun	R	"	1306-1455	6.1		
60	6A-6B	18Jun	R	"	0906-1455		4.5	
61	3A	18Jun	T	"	0900-1323	3.2		
62	3B	18Jun	T	"	1323-1453	1.8		
63	3A-3B	18Jun	T	"	0900-1453		2.8	
64	39A	20Jun	V	"	0843-1036	1.9		
65	39B	20Jun	V	"	1039-1301	1.8		
66	39C	20Jun	V	"	1304-1451	2.6		
67	39A-39C	20Jun	V	"	0843-1451		2.1	
68	40A	20Jun	W	"	0845-1040	1.5		
69	40B	20Jun	"	"	1042-1242	1.8		

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						Individual sample	Time-weighted average	
0	40C	20Jun	W	Shift Labor/Bagger	1244-1444	1.5		
1	40A-40C	20Jun	W	" "	0845-1444		1.6	
2	41	20Jun	X	" "	0849-1025	1.2		
3	42A	20Jun	Y	" "	0853-1045	1.7		
4	42B	20Jun	Y	" "	1046-1335	1.5		
5	42C	20Jun	Y	" "	1337-1449	2.3		
6	42A-42C	20Jun	Y	" "	0849-1449		1.7	
7	45A	20Jun	Z	" "	0858-1050	2.7		
8	45B	20Jun	Z	" "	1052-1258	3.9		
9	45C	20Jun	Z	" "	1300-1452	1.6		
0	45A-45C	20Jun	Z	" "	0858-1452		2.8	
1	119	24Jun	Z	Shift Labor/ Bagger & Sewer	0916-1446	1.4	1.4	
2	4A	18Jun	S	Shift Labor/ Sewer	0902-1330	1.9		
3	4B	18Jun	S	" "	1330-1449	3.6		
4	4A-4B	18Jun	S	" "	0902-1449		2.3	

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						Individual sample	Time-weighted average	
5	8A	18Jun	U	Shift Labor/ Sewer	0910-1323	4.0		
6	8B	18Jun	U	" "	1323-1448	1.6		
7	8A-8B	18Jun	U	" "	0910-1448		3.4	
8	43A	20Jun	B	" "	0855-1245	1.9		
9	43B	20Jun	B	" "	1246-1410	1.4		
10	43A-43B	20Jun	B	" "	0855-1410		1.8	
11	10A	18Jun	A	Shift Labor/Palletizer	0913-1112	1.3		
12	10B	18Jun	A	" "	1113-1313	2.4		
13	10C	18Jun	A	" "	1313-1451	2.2		
14	10A-10C	18Jun	A	" "	0913-1451		1.9	
15	46	20Jun	AA	" "	0901-1449	1-1	1.1	
16	11A	18Jun	AB	" "	0915-1015	2.2		
17	11B	18Jun	AB	" "	1017-1116	1.9		
18	11C	18Jun	AB	" "	1118-1217	3.3		
19	11D	18Jun	AB	" "	1219-1319	4.2		

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						Individual sample	Time-weighted average	
13	1C	18Jun	AE	Mill operator	1100-1200	2.4		
14	1D	18Jun	AE	"	1200-1304	3.6		
15	1E	18Jun	AE	"	1304-1348	5.5		
16	1F	18Jun	AE	"	1348-1440	3.3		
17	1A -1F	18Jun	AE	"	0853-1440		4.1	
118	38A	20Jun	AF	"	0841-1042	2.3		
119	38B	20Jun	AF	"	1042-1235	2.6		
120	38C	20Jun	AF	"	1235-1310	14.0		
121	38A-38C	20Jun	AF	"	0841-1310		3.8	
122	55	20Jun	M	"	1211-1443	2.8		
123	134A	25Jun	AF	"	0954-1235	3.1		
124	134B	25Jun	AF	"	1238-1552	1.6		Changed screen on IC screen during this period
125	134A-134B	25Jun	AF	"	0954-1552		2.3	
126	21A	19Jun	AG	Concentrator (dryer) helper	0909-1110	not countable probably > 5.9		inside dryer shed from 1100-1130H

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expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
100	11E	18Jun	AB	Shift Labor/Palletizer	1319-1420	4.8		
101	11A-11E	18Jun	AB	""	0915-1420		3.3	
102	14A	18Jun	AC	Shift Labor/Forklift operator in mill	0921-1021	2.3		
103	14B	18Jun	AC	""	1023-1106	3.5		
104	14C	18Jun	AC	""	1123-1210	3.5		
105	14D	18Jun	AC	""	1221-1321	4.4		
106	14E	18Jun	AC	""	1321-1508	3.2		
107	14A-14E	18Jun	AC	""	0921-1508		3.3	
108	49A	20Jun	AD	""	0910-1310	2.7		
109	49B	20Jun	AD	""	1312-1451	3.5		
110	49A-49B	20Jun	AD	""	0910-1451		2.9	
111	1A	18Jun	AE	Mill operator	0853-0957	4.0		
112	1B	18Jun	AE	""	1000-1058	6.2		

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expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
127	21B	19Jun	AG	Concentrator (dryer) helper	1113-1232	4.1		
128	21C	19Jun	AG	""	1233-1334	12.6		
129	21D	19Jun	AG	""	1336-1459	4.1		
130	21A-21D	19Jun	AG	""	0909-1459		probably >6.3	
131	22A	19Jun	AH	Concentrator operator	0919-1115	~ 2.6		Inside dryer shed from from 1100-1130h
132	22B	19Jun	AH	""	1117-1235	~ 4.1		
133	22C	19Jun	AH	""	1238-1338	~ 3.4		
134	22D	19Jun	AH	""	1342-1458	8.8		
135	22A-22D	19Jun	AH	""	0919-1458		4.5	
136	97	23Jun	AJ	""	1004-1452	1.4	1.4	Inside dryer shed for ½ H Dryer shut down approx. 1230-1245H
137	98A	23Jun	AK	Concentrator helper	not countable 1011-1058	not countable probably >15		In # 8 conveyor (dusty) from 1015 to 1100h.
138	98B	23Jun	AK	""	1059-1308	1.3		Sweeping floor
139	98C	23Jun	AK	""	1310-1441	2.9		
140	98A-98B	23Jun	AK	""	1011-1441		probably >4.3	

TABLE A-1 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- PERSONAL SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
141	120A	24Jun	AK	Concentrator helper	0903-1047	3.4		
142	120B	24Jun	AK	""	1047-1353	1.9		
143	120C	24Jun	AK	""	1355-1442	4.6		
144	120A-120C	24Jun	AK	""	0903-1442		2.7	
145	121A	24Jun	AJ	Concentrator operator	0855-1207	1.4		
146	121B	24Jun	AJ	""	1208-1447	2.2		
147	121A-121B	24Jun	AJ	""	0855-1447		1.8	
148	133A	25Jun	AJ	""	0845-1159	1.9		Very light dust in air area
149	133B	25Jun	AJ	""	1202-1453	3.0		
150	133A-133B	25Jun	AJ	""	0845-1453		2.4	
151	136A	25Jun	AK	Concentrator helper	0919-1204	1.0		
152	136B	25Jun	AK	""	1206-1332	3.0		
153	136C	25Jun	AK	""	1335-1448	3.3		
154	136A-136C	25Jun	AK	""	0919-1448		2.0	

TABLE A-1 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- PERSONAL SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
155	51A	20Jun	AL	Screen repairman	0915-1037	3.1		
156	51B	20Jun	AL	""	1038-1342	2.0		
157	51C	20Jun	AL	""	1342-1445	2.7		
158	51A-51C	20Jun	AL	""	0915-1445		2.4	
159	18A	19Jun	AM	Mechanic/Ground floor near dryers	0852-1148	2.7		working on conveyor. Air seemed dusty
160	18B	19Jun	AM	""	1148-1455	1.4		
161	18C	19Jun	AM	""	1457-1541	5.5		
162	18A-18C	19Jun	AM	""	0852-1541		2.4	
163	19A	19Jun	AN	Greaser (oiler)/Power separator	0856-1250	1.2		
164	19B	19Jun	AN	""	1250-1558	1.1		
165	19A-19B	19Jun	AN	""	0856-1558		1.2	
166	20A	19Jun	AP	Mechanic/Ground and 6th level	0907-1304	2.4		Changing motor on ground level. Working on conveyor #28 on 6th level
167	20B	19Jun	AP	Mechanic/ 3rd level	1307-1555	2.6		

TABLE A-1 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- PERSONAL SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
168	20A-20B	19Jun	AP	Mechanic/Ground,3rd & 6th levels	0907-1555		2.5	
169	23A	19Jun	AQ	Mechanic/3rd level fiberizer	0918-1313	1.8		
170	23B	19Jun	AQ	Mechanic/6th level	1314-1535	3.9		
171	23A-23B	19Jun	AQ	Mechanic/ 3rd & 6th Levels	0918-1535		2.6	
172	31	19Jun	AM	Maintenance mechanic/ Worked at mine until 1400h. then at main garage near office	1143-1547	1.3		
173	124	24Jun	AR	Machinist/Inside machine shop all day	0913-1548	0.6	0.6	
174	28	19Jun	AS	Driller's helper/Mine	1112-1225	3.0		Just starting hole in hig grade ore as sampling started. Was in and out of cab frequently. Windo & door of cab were open
175	34	19Jun	AT	Driller's helper/Mine	1239-1527	1.8		During sampling period drilled 6½-40' holes in very high-grade ore.
176	35	19Jun	AU	Drill operator/Mine	1243-1524	0.44		Just starting hole as sampling started. Drille 6½-40' holes in very high grade ore

TABLE A-1 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- PERSONAL SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
177	88	22Jun	AV	Driller's helper/Mine	1259-1543	0.58		
178	155	25Jun	AW	Drill operator/Mine	1342-1511	not countable probably>8		Drilled 2½-40' holes
179	156	25Jun	AX	Driller's helper/Mine	1347-1522	not countable probably>6.8		Worn by AX until 1450h. then left running in mine office until 1522, at which time floor was being swept
180	29	19Jun	AY	Truck Driver/Hauling ore from mine to crusher	1129-1435	1.2		
181	80	22Jun	AY	" "	1008-1402	0.5		
182	81	22Jun	AZ	" "	1012-1443	0.6	0.6	
183	30	19Jun	BB	Crusher operator/Mine	1133-1432	2.8	2.8	
184	33A	19Jun	BC	" "	1204-1307	8.7		
185	33B	19Jun	BC	" "	1307-1433	4.2		

TABLE A-1 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- PERSONAL SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
186	33A-33B	19Jun	BC	Crusher helper/Mine	1204-1433		6.1	
187	82A	22Jun	BC	""	1025-1204	4.6		
188	82B	22Jun	BC	""	1206-1402	2.3		
189	82C	22Jun	BC	""	1404-1456	4.2		
190	82A-82C	22Jun	BC	""	1025-1456		3.5	
191	82	22Jun	BB	Crusher operator/Mine	1032-1458	2.3	2.3	
192	153	25Jun	BB	""	1238-1442	2.9		In control cabin most of time except for about 10 minutes. Little apparer dust exposure
193	154	25Jun	BC	Crusher helper/Mine	1242-1446	1.5		Sweeping & shovelling in crusher basement for abou 1¾ hours. Seemed very dusty
194	87	22Jun	BD	Bulldozer operator/Mine	1252-1541	0.7		
195	32A	19Jun	BE	Tramline helper/Mine	1149-1300	0.2		

TABLE A-1 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- PERSONAL SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
96	32B	19Jun	BE	Tramline helper/Mine	1300-1448	0.1		
97	32A-32B	19Jun	BE	""	1149-1448		0.7	
98	84	22Jun	BE	""	1042-1458	0.2		
99	85	22Jun	BF	Tramline operator/Mine	1044-1459	0.3		
00	151	25Jun	BF	""	1240-1445	0.2		
01	152	25Jun	BE	Tramline helper/Mine	1245-1447	0.4		Cleaning up aroung buckets Wore a dust respirator
202	122	24Jun	E	Foreman/Tailings area	0844-1508	1.2	1.2	Mainly at tailings pile all day.
203	123A	24Jun	BG	General laborer/ Tailings area	0846-1140	not countable probably > 4.1		In tailings area full time
204	123B	24Jun	BG	""	1143-1416	2.9		""
205	123C	24Jun	BG	""	1418-1501	7.4		""
206	123A-123C	24Jun	BG	""	0846-1501		Probably > 4.0	""

TABLE A-2 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS-STATIONARY SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
207	25A	19Jun		milling area next to "C" conveyor near dryer shed	1326-1346	12.3		
208	25B	19Jun		""	1346-1426	5.7		
209	25C	19Jun		""	1426-1526	3.8		
210	25A-25C	19Jun		""	1326-1526		5.8	
211	90A	23Jun		Behind dryer shed in mill	0836-1139	not countable probably > 3.9		Filter was heavily overloaded
212	90B	23Jun		""	1141-1320	not countable Probably > 7.0		""
213	90C	23Jun		""	1321-1506	not countable probably > 6.6		""
214	90A-90C	23Jun		""	0836-1506		probably > 5.4	
215	91	23Jun		In front of dryer shed	0907-1511	not countable	probably > 1.6	
216	95	23Jun		about 40' from location of sample #91(item #215) opposite fire station #2118	0928-1516	0.7	0.7	
217	127A	24Jun		Behind dryer shed	1042-1322	2.0		
218	127B	24Jun		""	1322-1510	2.2		

TABLE A-2 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- STATIONARY SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
19	127A-127B	24Jun		Behind dryer shed	1042-1510		2.1	
20	141A	25Jun		" "	1158-1350	2.2		
21	141B	25Jun		" "	1352-1531	2.3		
22	141C	25Jun		" "	1532-1545	9.6		
23	141A-141C	25Jun		" "	1158-1545		2.7	
224	53	20Jun		Mill Laboratory	1059-1529	0.9	0.9	
225	71	21Jun		" "	1020-1426	1.0	1.0	
226	125	24Jun		" "	0943-1423	0.7	0.7	
227	59	21Jun		Behind Bagging machines	0915-1449	2.4	2.4	
228	139	25Jun		Ground floor next to Tecs (Bauer separators)#24D and conveyor 5A,about center of floor opposite fire station # 2123	1040-1555	0.6	0.6	
229	54	20Jun		2nd level,next to Screen 5A	1201-1515	not countable	probably >4.0	

TABLE A-.2 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS-STATIONARY SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
230	64	21Jun		2nd level,next to Screen 5A	0952-1457	not countable	probably > 2.5	
231	138	25Jun		3rd level between Screens 20B-20C	1020-1423	1.4	1.4	
232	68	21Jun		Inside baghouse at top of bags	1040-1507	2.4	2.4	This air was being circulated into the mill.
233	92	23Jun		3rd Level. Inside baghouse at top of bags beside open doorway	0920-1455	0.4	0.4	"
234	93	23Jun		Inside baghouse at bottom of bags beside open doorway	0928-1458	0.6	0.6	"
235	66	21Jun		4th level at top of CZ filters and two screens	1025-1506	3.2	3.2	
236	67	21Jun		4th level at 4D,4C; 6B & 6C Screens	1030-1502	1.8	1.8	
237	131	24Jun		4th level near CT bin	1258-1527	2.8		
238	56	21Jun		5th level near 24A cyclone screw conveyor	0907-1501	1.4	1.4	Inspection port on convey was open

TABLE A-2 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- STATIONARY SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
239	57	21Jun		5th level near bucket elevator 2B in IC screens area	0900-1450	1.4	1.4	
240	62	21Jun		5th level at 1B screen and transfer slot	0958-1458	not countable	probably >2.2	
241	63	21Jun		5th level at bottom of 9A cone	1003-1500	2.0	2.0	
242	96	23Jun		5th level near Screens 1C & 1D	0943-1457	3.4	3.4	
243	137	25Jun		5th level between Screens IC and ID	0947-1518	2.3	2.3	
244	140	25Jun		5th level near conveyor 12A from cyclone 12A	1144-1501	3.5		
245	58	21Jun		6th level at 24B cyclone near stairwell	0915-1451	1.4	1.4	
246	129	24Jun		6th level, at post IA	1117-1520	4.2	4.2	
247	52	20Jun		Ground floor in secretary's office in mill near foreman's office	1028-1522	8.0	8.0	
248	126	24Jun		Receptionist's office in Administration Bldg.	1005-1542	0.2	0.2	
249	130	24Jun		Outdoors on fence adjacent to foreman's office	1241-1533	2.8		

TABLE A-2 AIRBORNE ASBESTOS FIBRE CONCENTRATIONS DURING MILL AND MINE OPERATIONS- STATIONARY SAMPLES

expressed as fibres per milliliter of air (fpml)

ITEM No	SAMPLE No	DATE	WORKER	JOB TITLE/WORKING PLACE	SAMPLING PERIOD (24 hour clock)	ASBESTOS CONC. (fpml)		REMARKS
						Individual sample	Time-weighted average	
250	101	23Jun		At top of tailings pile head pulley area	5 min. Sample	7.3	7.3	Tailings being discharged by Swivel Piler. No pers worked at the sampling point. The samples provi an estimate of the amount of fibres being dispersed into the outdoor atmosphe by the process. The wide variations in fibre count probably are related to variations in wind direct and velocity
251	102	23Jun			1 min.	0	0	
252	103	23Jun			1 min.	131	131	
253	104	23Jun			2 min.	53	53	
254	105	23Jun			4 min.	16	16	
255	106	23Jun			4 min.	4.4	4.4	
256	107	23Jun			6 min.	33	33	
257	108	23Jun			6 min.	9.0	9.0	
258	109	23Jun			8 min.	8.2	8.2	
259	110	23Jun			2 min.	22	22	
260	111	23Jun			10 min.	7.2	7.2	

TABLE A-3 ASBESTOS FIBRE CONCENTRATIONS IN THE TOWNSITE

ITEM No	SAMPLE No	DATE	SAMPLING LOCATION	SAMPLING PERIOD (24 hour clock	ASBESTOS CONC (fom1)	REMARKS
261	16A	18Jun	In kitchen of staff house where we did our microscope work.	0700-1613	0.02	Stationary sample
262	16B	19Jun	""	0755-1607	0.04	""
263	16C	20Jun	""	0813-1604	0.02	""
264	16D	21Jun	""	0755-1555	0.04	""
265	16E	22Jun	""	0938-1654	0.04	""
266	72	22Jun	Various places in townsite, both indoors and outdoors.	0955-1758	0.04	Sampler worn continuously day by surveyor while walking about town inspection stationary sampl at other sites. Very little win all day
267	73	22Jun	Inside hospital waiting room	1018-1700	0	Very little wind all day
268	74A	22Jun	Inside cafereria	1032-1832	0.02	Stationary sample. Doors & windows open all day
269	75	22Jun	Inside the living room of 106 Connell Street	1047-1847	0.0	Stationary sample
270	76	22Jun	Inside the living room of 706 Cormacks Street	1125-1925	0.0	""
271	16F	23Jun	In kitchen of staff house	0830-1630	0.01	""

TABLE A-3 ASBESTOS FIBRE CONCENTRATIONS IN THE TOWNSITE

ITEM No	SAMPLE No	DATE	SAMPLING LOCATION	SAMPLING PERIOD (24 hour clock	ASBESTOS CONC (fom1)-	REMARKS
72	99A	23Jun	Riding bus from town to mill. Sampling started as people started boarding bus and ended as last person was leaving	1431-1456	0.2	Two windows were open across from each other, two rows in from of sampling point
73	99B	23Jun	Riding bus from mill to townsite, sampling started as first person boarded bus and ended ¾ minute after last person had left bus.	1459-1519	0.5	Sames as for sample 99A
74	74B	23Jun	Inside cafereria, persons began coming in for dinner at 1715h. Cafeteria was empty by 1915h.	1719-1928	0.0	Doors & windows were open
75	74C	23Jun	Inside cafeteria, one person was removing trays from tables	1932-2129	0.0	Stationary samole
76	74D	23Jun	Inside cafeteria. Mine shift came directly from mine to cafeteria at 2130h. Mill shift came directly from mill to cafeteria at 2319h.	2129-2359	0.0	""
77	16G	24Jun	In kitchen of staff house	0754-1705	0.01	""