AIR POLLUTION EMISSIONS AND CONTROL TECHNOLOGY

ASBESTOS MINING AND MILLING INDUSTRY

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ABSTRACT

This study was initiated to evaluate the present and future air pollution by the Canadian asbestos mining and milling industry and to define the best practicable technology to control these air pollution emissions. Emissions from asbestos mining and milling plants consist mostly of particulate matter but contain varying numbers of asbestos fibres. The latter must be closely controlled because asbestos has been classified as a pollutant subject to Section 7 of the Clean Air Act and, as such, will be regulated by Federal emission standards to prevent asbestos causing a significant hazard to the health of the public.

Most asbestos plants control emissions from the major part of the milling process to a point that air from the main mill filters can be recirculated inside the building. Other sources emitting varying amounts of asbestos fibres require added or improved control to reduce emissions.

This report will endeavour to define the average emissions by the industry and the degree of control that can be achieved by the use of best practicable technology so that no possible health hazard exists.

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1 INTRODUCTION

1.1 General

In ancient times, asbestos was termed the magic mineral, having fire resisting qualities when woven into cloth. When Marco Polo returned from what is now Siberia in the thirteenth century, he brought news of a strange cloth which, when put into a fire, was withdrawn unharmed and became white as snow. This characteristic was also known to the Romans and to the people elsewhere in Europe. However, it remained an oddity until about the start of the twentieth century when many new applications in manufactured products were developed. Its fibrous structure, combined with such properties as non-flammability, good flexural and tensile strength, good heat and electrical insulating ability, and good resistance to acids and alkalis has made asbestos one of the most useful industrial minerals.

Asbestos is the name given to a group of many hydrous silicate minerals, of which six common varieties are identified, in order of industrial importance: chrysotile, amosite, crocidolite, anthophyllite, tremolite, and actinolite. Chrysotile asbestos accounts for over 90% of the world's consumption and is the only variety mined in Canada. Canada accounts for about 35% of the world's production or about 65% of the western world, if Russia is excluded. Main mining of other asbestos minerals took place in South Africa and the United States (amosite), South Africa and Australia (crocidolite), and Finland (anthophyllite). Production of anthophyllite has been phased out in Finland and crocidolite is no longer recovered in Australia. Only minor amounts of tremolite and actinolite are produced, which are used for special purposes.

On the basis of crystalline structure, two asbestos groups can be defined: serpentine pyroxene and amphibole. Chrysotile is a hydrous magnesium silicate belonging to the serpentine ~~pyroxene~~ group. Host rocks for asbestos in Canada are peridotite and dunite which have been altered to serpentine by the instrusions of mineral-bearing solutions along fractures created during upheavals. Final injection of solutions dissolved some of the changed rock along the fractures and, on cooling, the dissolved rock was precipitated as fibrous crystals. Eventually, the refilled cracks and crevices became a network of fibrous crystalline veins that ran through the altered masses of the surrounding host rock. This would account for the almost identical chemical composition of the chrysotile veinlets and the adjacent serpentine.

1.2 Scope

This study pertains to air pollution control in the asbestos mining and milling industry during the base year 1970, 1973, with changes projected for 1974. Size and location of plants, products, and relative importance of the industry to the Canadian economy are discussed. Results from a national emission inventory and relevant air quality objectives are included. Cost of pollution control is estimated, based on information found in literature, supplemented by information supplied by the asbestos industry.

1.3 Purpose

The primary purpose of this report is to provide the necessary technical information for the preparation of emission standards for the asbestos industry to protect the Canadian public at large, as required by the Clean Air Act of 1971. Recommended emission standards have evolved from information in this report as well as data collected from other sources, which included emission testing with measurements taken by Environment Canada.

This report will also provide information to update the national emissions inventory published by the Air Pollution Control Directorate and to assist in the development of federal briefs, state-of-the-art reviews, and other documents related to air pollution emanating from asbestos mining and milling operations.

1.4 Information Sources

Personal contacts were established with members of the following Departments of the Federal Government: Energy, Mines and Resources; Industry, Trade and Commerce; and Statistics Canada.

Discussions took place with staff members of EPA in Research Triangle Park, N.C.; Quebec Asbestos Mining Association, Asbestos Information Association, North America; Asbestos Information Committee (U.K.); and various other organizations regarding health hazards of asbestos.

Copies of original articles were obtained from the National Science Library, through the reference section of the Library of the Department of Environment; EPA, OSHA; and other agencies. Articles issued in trade literature were also reviewed.

A questionnaire was then drawn up by the Abatement and Compliance Branch. A draft was sent to regional offices of EPS, federal and provincial government departments, the Quebec Asbestos Mining Association, and Statistics Canada for review and comments. Approval of the final draft was then given by the Air Pollution Control Directorate to distribute the questionnaires to the asbestos industry. Copies available in English and French were mailed to regional offices of EPS, in August, 1974, to be forwarded to the headquarters of the asbestos companies. The English version of the questionnaire is reproduced in Appendix I.

2 INDUSTRY DESCRIPTION

2.1 Size

In 1970, there were thirteen producing asbestos mines in Canada with a total production capacity of 92 400 short tons of ore per day. The largest had a rated capacity of 32 000 tons per day and the smallest, 300 tons per day.(1)

In 1973, there were fourteen producing asbestos mines in Canada with a total rated capacity of 112 000 short tons per day, an increase of 19 600 short tons per day or 21.2%.(2)

A summary of Canadian Asbestos Producers for 1970 and 1973 is shown on Table 1 and Table 2.(1,2)

Canadian producers of asbestos shipped 1862 976 short tons of crude and milled fibres valued at $234 323 000 in 1973. This was an increase of 12.1% from 1 661 644 short tons valued at $208 146 533 shipped in 1970.(1) A breakdown of production by province for the years 1970 and 1972 is shown on Table 3.(1,2)

2.2 Employment

In 1970 there was a total of 6 186 people employed in the Canadian asbestos mining and milling industry. An increase in labour force was experienced by 1973, people employed being 6 430.(3)

A breakdown of employment is shown on Table 4.

TABLE 1 CANADIAN ASBESTOS PRODUCERS 1970*

Company	Location	Mill Capacity Short Tons Ore/Day
1. Canadian Johns-Manville Co. Limited-Jeffrey Mine	Asbestos, Quebec	32 000
2. Asbestos Corp. Ltd.		
British Can.Mine	Black Lake, Quebec	11 200
King-Beaver Mine	Thetford Mines, Quebec	8 000
Normandie Mine	Black Lake, Quebec	6 000
3. Bell Asbestos Mines Ltd.	Thetford Mines, Quebec	3 000
4. National Asbestos Mines Ltd.	Thetford Mines, Quebec	3 500
5. Lake Asbestos of Quebec Ltd.	Black Lake, Quebec	6 000
6. Flintkote Mines Ltd.	Thetford Mi es, Quebec	2 000
7. Carey-Canadian Mines Ltd.	East Broughten, Quebec	4 000
8. Advocate Mines Ltd.	Baie Verte, Newfoundland	6 000
9. Cassiar Asbestos Corp. Ltd.		
Cassiar Mine	Cassiar, B.C.	2 400
Clinton Creek Mine	Clinton Creek, Yukon	3 000
10. Johns-Manville Mining and Trading Ltd.		
Reeves Mine	Timmins, Ontario	5 000
11. Hedman Mines Ltd.	Matheson, Ontario	300
	TOTAL	92 400

*Source - Dept. of Energy, Mines & Resources(1)

TABLE 2 CANADIAN ASBESTOS PRODUCERS - 1973*

Company	Location	Mill Capacity Short Tone Ore/Day
1. Canadian Johns-Manville Co. Limited-Jeffrey Mine	Asbestos, Quebec	33 000
2. Asbestos Corp. Ltd.		
British Can. Mine	Black Lake, Quebec	12 400
King Beaver Mine	Thetford Mines, Quebec	12 000
Normandie Mine	Black Lake, Quebec	7 500
Asbestos Hill Mine	Putuniq, Quebec	6 000
3. Bell Asbestos Mines Ltd.	Thetford Mines, Quebec	3 000
4. National Asbestos Mines Ltd.	Thetford Mines, Quebec	3 500
5. Lake Asbestos of Quebec Ltd.	Black Lake, Quebec	9 000
6. Carey-Canadian Mines Ltd.	East Broughten, Quebec	5 500
7. Advocate Mines Ltd.	Baie Verte, Newfoundland	7 500
8. Cassiar Asbestos Corp. Ltd.		
Cassiar Mine	Cassiar, B.C.	3 300
Clinton Creek Mine	Clinton Creek, Yukon	4 000
9. Johns-Manville Mining and Trading Ltd.		
Reeves Mine	Timmins, Ontario	5 000
10. Hedman Mines Ltd.	Matheson, Ontario	300
	TOTAL	112 000

*Source - Dept. of Energy, Mines & Resources.(2) and Canadian Mines Handbook 1974.

TABLE 3 CANADA - ASBESTOS PRODUCTION BY PROVINCE(1,2)

	Production 1970 Short Tons	1970 $	1973 Short Tons	1973 $
Quebec	1 367 524	161 583 510	1 648 000	185 170 000
British Columbia	86 730	16 033 827	113 000	23 182 000
Yukon	105 638	13 927 652	99 000	14 849 000
Newfoundland	62 727	11 669 402	80 000	13 950 000
Ontario	39 025	4 932 142	34 000	3 850 000
TOTAL	1 661 644	208 146 533	1 974 000	241 001 000

TABLE 4 EMPLOYMENT CANADIAN ASBESTOS MINES AND MILLS*

	1970	1972	1973
Male	6 145	6 209	6 379
Female	41	57	51
TOTAL	6 186	6 266	6 430

*Statistics Canada - Catalogue 26-205 Annual 1971, 73.(3)

2.3 Products

The products from asbestos mills are several grades of fibre that are shipped to consumers to be used in the manufacture of various products. The fibre is classified and priced in grades based on fibre length from the longest to the shortest. The fibres may be defined as being in three general categories:

Long Fibres	- Crude #1
	Crude #2
	Group 3 - Spinning
Medium Fibres	- Group 4 - Cement Grades
	Group 5 - Paper, Asbestos,Cement & molded prc
	Group 6 - Stucco, paper & molded products
Short Fibre	Group 7 - Shorts
	Group 8 - Sand
	Group 9 - Gravel & Stone

2.3.1 Quality Control

Early production of chrysotite asbestos was all by mines located in the Eastern Township of Quebec, mostly in crude and groups 3 to 5 milled fibres. Customers were unable to select fibres with similar characteristics from different companies. The Quebec Asbestos Producers Association was formed and standard grades were established. Crude fibres were classified as previously but milled fibres were subjected to the Quebec Standard Test(4) to assure a guaranteed minimum shipping test for the various grades of milled fibre. As more uses were developed for shorter fibres this test was extended to include them and about 34 regular grades were established.

However, the end use of all grades of asbestos fibres has increased from approximately 400 application in 1950 to something over 4,000 in present day industry. Further requirements by consumers resulted in minor variations of the above mentioned categories so that there are now in excess of 100 grades (products tailored to individual customer's specifications). The entry of producers located elsewhere in Canada introduced other fibres having different characteristics. While the Quebec Standard Test is used to give some idea of general grades up to 30 other tests are used in quality control to satisfy customers' requirements. (4) The most common tests are: Quebec Standard Test, Bauer-McNett, Ro-Tap Screen Analysis, Fibre Strength Unit Test, Loose Bulk Density, Wet Bulk Density, etc. Other tests are performed to define special characteristics, for different uses by manufacturers.

2.4 Location & Geographical Distribution

The Canadian Asbestos Mining and Milling Industry is distributed across Canada in four provinces, Newfoundland, Quebec, Ontario and British Columbia. One is also located in the Yukon Territory.

The bulk of the industry, as shown in Figure 1 and Figure 2, is located in the Eastern Townships of Quebec, with this province accounting for approximately 82% of the Canadian chrysotile asbestos production.

2.5 Relative Importance

Because of its unique properties, asbestos is one of the most useful industrial minerals. The most common uses of asbestos, listed in magnitude of consumption by North American manufacturers are: A/C Products Asbestos Latex Sheet, Floor Tile, Asbestos Paper, Friction Materials (brake linings, clutch facings), Asbestos Textiles, Plastics, Joint Cement, with a balance of about 18.5% consumed in undefined miscellaneous products. (5)

3 INDUSTRY PROCESS

3.1 General

The entire asbestos extraction process is a dry milling operation in Canada. Ore from the mine, after being reduced in size by crushing, is dried and delivered to the dry rock storage building. The dried ore is then conveyed to the mill where it enters the rock circuit where it is repeatedly crushed and screened, with the fibres so freed being aspirated at each stage. Final rock and dust rejects go directly to tailings. The asbestos collected in the initial aspiration stage is then further processed in the fibre circuit where it is subjected to repeated stages of screening and grading to remove rock and dust from the fibre and separate grades. The clean fibre is aspirated to bins from which various grades are drawn and packaged for shipment.

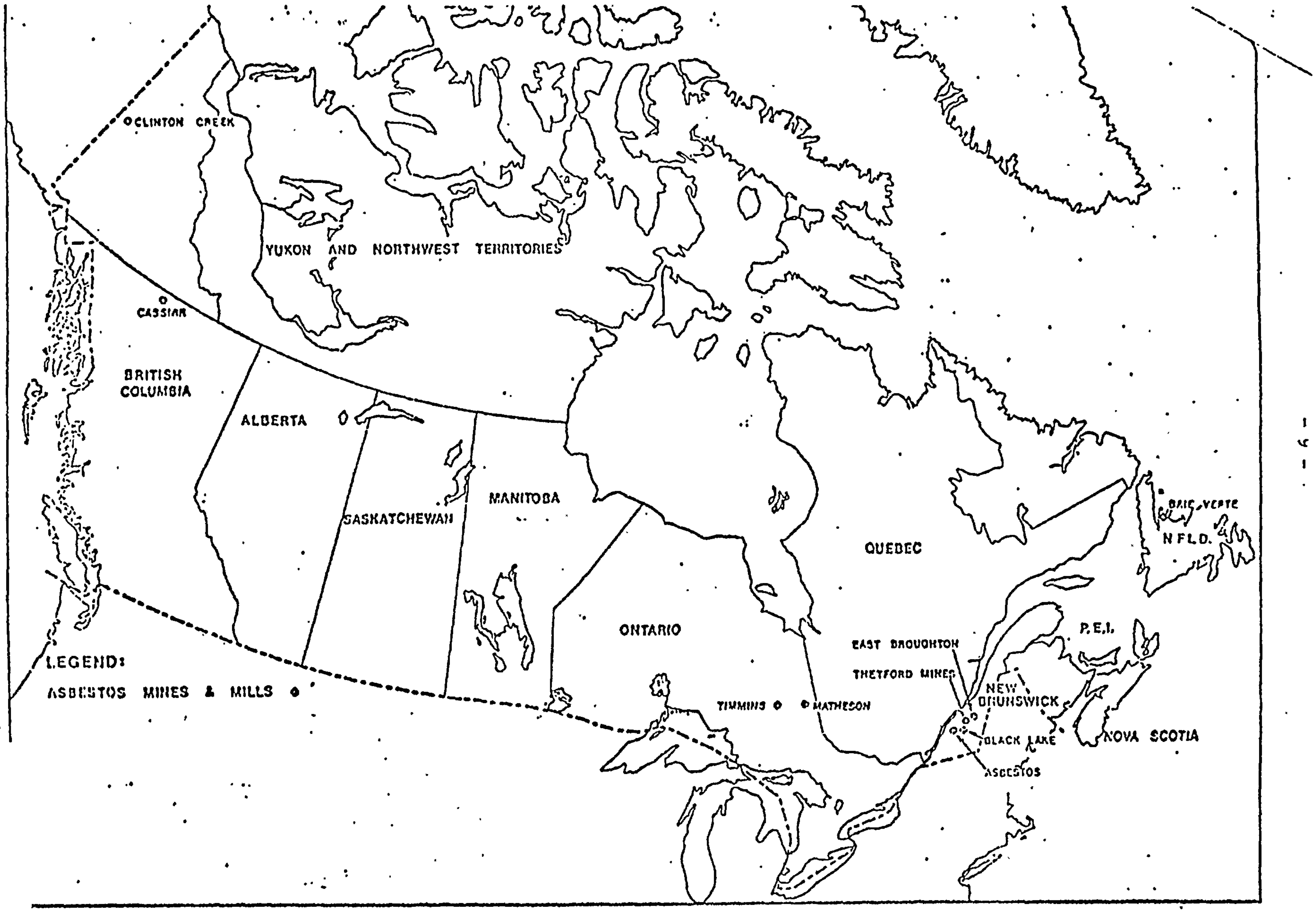

FIGURE 1   1970 ASBESTOS MINES & MILLS

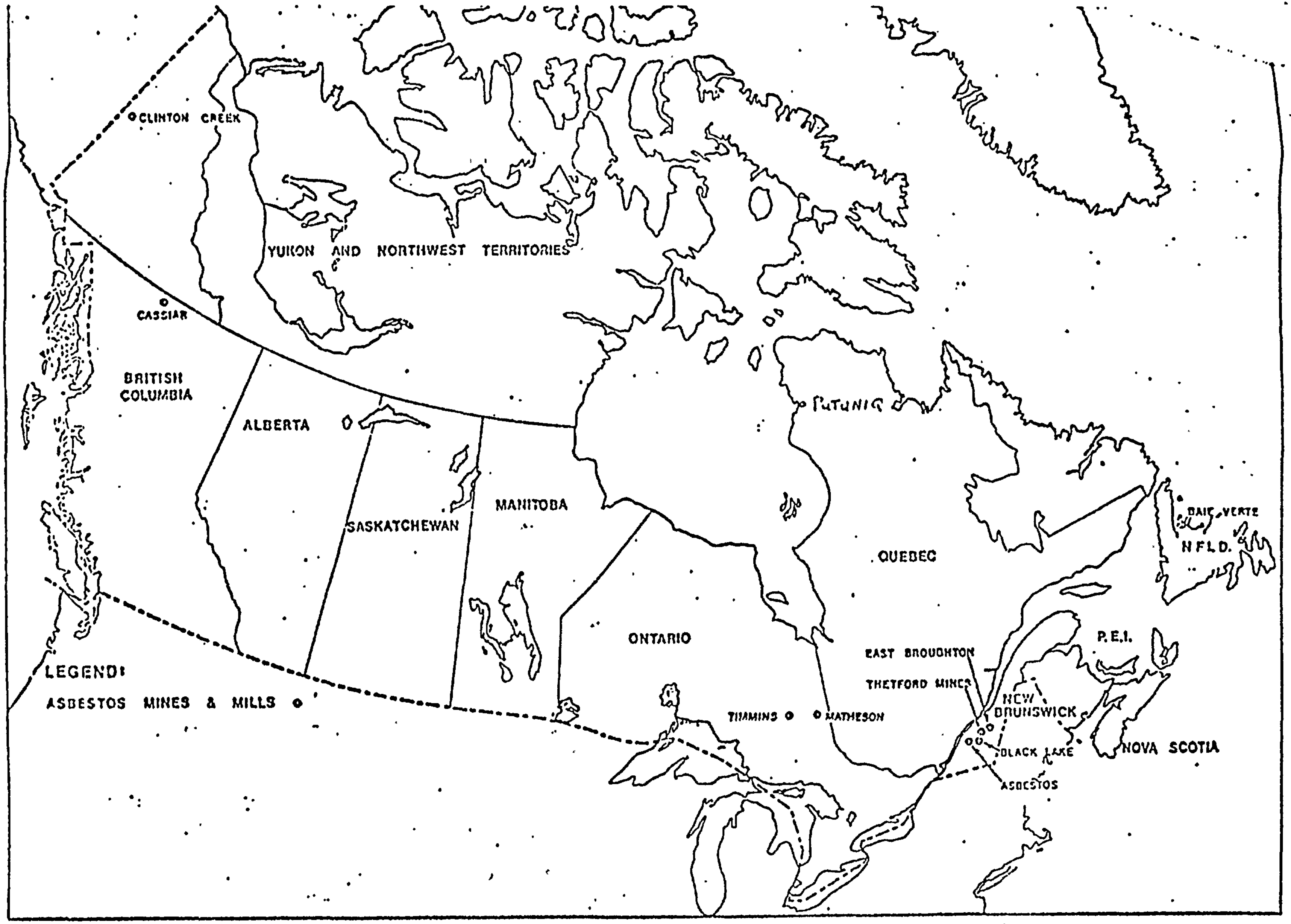

FIGURE 2 197? ASBESTOS MINES & MILLS

3.2 Flowsheet

The flow of ore through a typical asbestos mill is shown in Figure 3.

3.3 Process Sequence

3.3.1 Mining. Over 95% of all asbestos ore in Canada is mined in open pit operations. After drilling and blasting, broken ore is loaded by large shovels into trucks ranging in capacity from 35 tons up to 200 tons and is hauled to the primary crusher. Overburden and waste rock removed in development of open pits is loaded in a like manner and hauled to waste dumps.

A minor amount of ore is mined by underground caving methods below former open pits, crushed and hoisted to surface, after which it is treated as ore mined in surface operations.

3.3.2 Crushing and Screening. Primary crushing reduces ore to about 6 inches in size. Ore is screened and oversize is reduced to a maximum size of approximately 3 inches after which it is conveyed to wet rock storage or directly to the dryer building.

3.3.3 Drying. Ore delivered by conveyor from wet rock storage or the primary crusher is screened, with the undersize going directly to the dryers. In some instances, a middle cut is made which may go to the drying circuit or which might bypass the dryers and subsequently join the dried ore stream. The oversize from this screening operation is further crushed and may or may not be concentrated before rejoining the ore stream. Drying of ore is done in fluid bed, vertical or rotary dryers, the last being the most common. The fuel used is coal, oil or natural gas. Ore, prior to drying, might contain from 3% up to 18% moisture, depending upon seasons. Drying time ranges from one minute to 15 minutes with inlet air temperatures of 900°F to 2 000°F. Outlet gas temperatures are maintained between 150°F and 400°F to prevent damage to bags in dust collector units. Ore from the dryers is joined by any ore that bypassed the dryers and conveyed to the dry rock storage building where the residual heat in the ore is sufficient to complete the drying process. The capacity of dry rock storage facilities range from that necessary for one day's operation to more than a week's supply of mill feed.

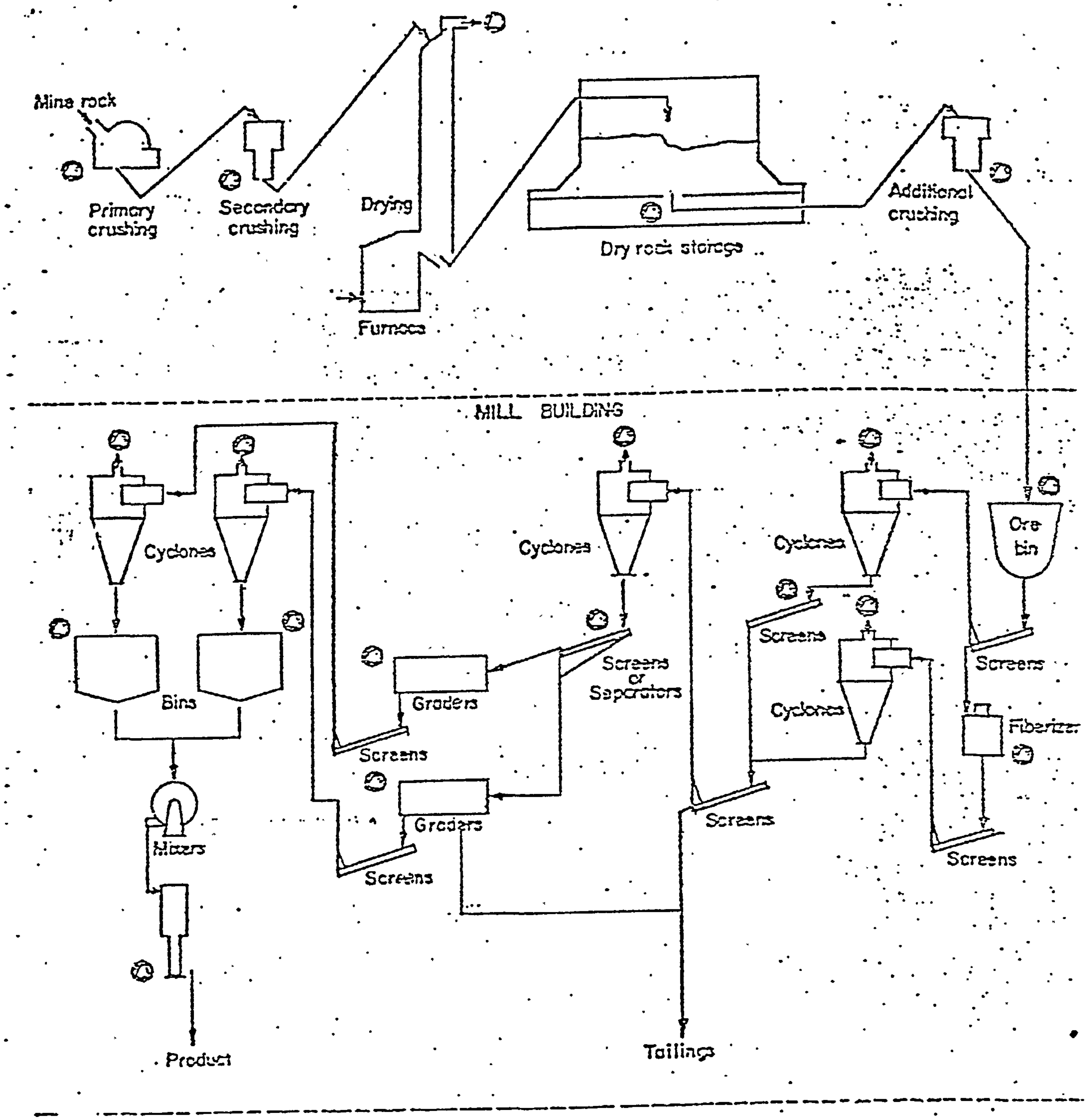

FIGURE 3. FLOW DIAGRAM FOR MILLING OF ASBESTOS ORES

3.3.4 Rock Circuit. Ore from dry rock storage is run over shaking screens equipped with aspiration hoods at the discharge end. The shaking action of the screen separates the freed fibre from the rock, which is then lifted by air suction under the hood. The fibre is pneumatically conveyed to a cyclone separator where it is removed from the air stream for further processing. The undersize or thrus from this screening operation may be further processed in a fibreizer and additional freed fibre removed by subsequent screening. The oversize or rock passing over the end of the screen, after aspiration of fibre, is subjected to further crushing to free more fibre for removal in a similar screening operation. This process is repeated, preferably using impact breakers, some of which are air swept to minimize fibre damage, until all the remaining rock going over the final screen is reduced to minus $\frac{1}{4}$ inch. The difference between crushers and impact breakers or fibreizers should be noted. A crusher breaks the rock by pinching and compressing it, whereas impact breakers and fibreizers reduce the rock size by impact, with no attrition to reduce the length of, or weaken the fibres released in the process.

3.3.5 Fibre Circuit. The asbestos recovered in the initial separation achieved in the rock circuit contains much dust, rock particles and some unopened fibre bundles. This is passed over cleaning screens and the fibre is aspirated. The undersize dust is discarded to tailings. The discharge of coarser material, consisting of unopened fibre bundles and rock particles are treated in a fibreizer, rescreened and fibre aspirated before final discard to tailings.

The fibre collected is run through rotary tromel dusters and/or over cleaning screens. The longest fibre is separated by different grading methods, run over a screen, aspirated and collected for bagging. Successives stages separate the remaining fibre into its respective classes by length, which are collected in other bins.

collected in other bins.

3.3.6 Tailings Disposal. Tailings are made up of rejects from various points in the milling circuit and vary widely in particle size. The finest, and most readily airborne, is dust from the large baghouses serving the main mills. This is made up of floats from fibre aspiration mixed with all the dust collected in the dust control system throughout the plant. To this is added dust (thrus) from the fibre circuit, dust from screening in the rock circuit, rock particles from cleaning, rock rejects or overs from the final fibre screens in the rock circuit, and finally any coarse rock discarded in early ore concentration before milling. This is transported by belt conveyor to the tailings pile or hauled to a disposal area by mechanical means.

3.3.7 Bagging and Shipping. The graded fibre is drawn from its respective lines and delivered to the bagging area where it might be loose packed in multiwall paper bags or pressure packed in units of one hundred pounds net weight. Most fibre is pressure packed. Pressure packed fibre is sealed in multiwall paper, poly or coated woven poly bags. The packaged fibre is then palletized in units of one or two tons each and stockpiled in the fibre storage warehouse for subsequent shipment by rail or transport to customers.

4 POLLUTION ASPECTS

The main pollution problem for asbestos mining and milling operations is the emission of particulates which contain varying amounts of asbestos fibres, depending upon where, in the extraction process, emissions occur.

Nearly all the asbestos-bearing ore mined in Canada is by open pit mining which results in a source of dust from drilling, blasting and hauling ore to the mill.

Since the extraction of fibre is by a completely dry process, dust is generated in various phases of the operation, which must be well controlled.

The main sources of emissions are from aspiration of fibre in the mill, drying of ore, dust control in the mill, bagging, crushing ore prior to drying, tailings disposal, and mining operations.

Possible sources of particulate emissions, listed in production sequence are:

1. Open Pit Operations
   - (a) Drilling
   - (b) Blasting
   - (c) Loading broken rock
   - (d) Transporting ore to primary crusher or waste to dump.

2. Crushing Ore
   - (a) Unloading ore from open pit
   - (b) Primary crushing
   - (c) Screening ore
   - (d) Secondary crushing
   - (e) Conveying and stockpiling wet ore

3. Drying Ore
   - (a) Conveying ore to dryer building
   - (b) Screening ore
   - (c) Drying ore
   - (d) Tertiary crushing
   - (e) Conveying ore to dry rock storage building
   - (f) Dry rock storage

4. Milling *
   - (a) Conveying ore from dry rock storage to mill rock circuit
   - (b) Screening
   - (c) Fine reduction of rock in impact breakers and/or fibreizers
   - (d) Aspiration of fibre
   - (e) Cleaning screens
   - (f) Graders
   - (g) Aspiration of fibre products
   - (h) Conveying fibres to bagging facilities
   - (i) Bagging operations

5. Shipping
   (a) Transporting bagged fibre, to fibre storage warehouse
   (b) Loading products from fibre storage warehouse into railroad cars or transports

6. Tailings Disposal
   (a) Conveying or hauling tailings to tailings pile or disposal area
   (b) Tailings conveyor discharge

7. Fugitive Dust

* Confined to mill building, no direct emissions from milling operations, all dust collected and mill air passed through high efficiency fabric filters before exhausting to atmosphere.

5 HEALTH

It has been determined that prolonged continued exposure to particulates containing asbestos fibres may, in some persons, result in the development of asbestosis, a bronchial or asthmatic disorder. More recent research has disclosed a connection with certain types of lung cancer. While there is some evidence that crocidolite and other types of asbestos fibres might be more harmful than chrysotile, there is insufficient data available to reach any conclusion as to the relative danger of exposure to different forms of asbestos. The asbestos industry has done much to improve the in-plant working environment at mines in Canada. Dust control in working areas of the plants was much improved and emissions to atmosphere were greatly reduced. The concern for the health of employees and the public has been the main object of a continuous program dating back to the initial detailed study on the hazard of airborne asbestos to health, undertaken by the Quebec Asbestos Association in 1956.

Section 7 of the Clean Air Act authorizes Governor-in-Council to prescribe national emission standards where the emissions "would constitute a significant danger to health of persons". National Health and Welfare concluded that it would not be prudent to permit uncontrolled contamination of the public environment with asbestos and that if the continued use of this mineral is to procee with minimal risks to the public, the major sources of man-made asbestos emitted the atmosphere should be subject to control. As a result of the statement by the Department of Health and Welfare, the asbestos mining and milling industry will be subject to a National Asbestos Emission Standard Regulation under Section 7 of the Clean Air Act. This is set by the Federal Government, after reviewing recommendations from the Industry-Government task force.

6 NATIONAL EMISSION INVENTORY DATA - PARTICULATES

6.1 <u>Data Previously Published</u>. Emissions of particulates from all heavy industry during 1970 amounted to 1 309 000 tons or 7.6% of the total emissions of major pollutants in Canada, as reported in a national inventory of air pollution emissions. Table 6 shows the number of tons of particulate emitted by heavy industry during 1970. It shows that the emissions of particulates containing some asbestos amounted to 80 000 tons in 1970.

TABLE 5 PARTICULATE EMISSIONS FROM INDUSTRIAL PROCESSES, 1970(7)

Industry	Emissions (tons/year)*
Iron and steel	153 000
Other primary metals	111 000
Metallurgical coke	11 000
Petroleum refineries	1 000
Cement	248 000
Lime	54 000
Kraft pulp mills	86 000
Asbestos**	80 000
Stone, sand, gravel	401 000
Grain handling	83 000
Grain mills	4 000
Other	77 000

* These figures were based on the results of a paper search of published information from various sources.

** It must be noted that only part of the particulates consist of asbestos fibres.

TABLE 6 1970 ASBESTOS EMISSIONS IN CANADA

Source	Emissions		Emission-Factor (lb/ton asbestos)
	Tons	Percent	EPS 1970 study
PRODUCTION			
Asbestos mining	6 620	40.4	8
Asbestos milling	9 673	59.0	11.7
Production total	16 293	99.4	
MANUFACTURING			
Asbestos-cement products	1.88	0.01	0.15
Floor tile industry	0.75	*	0.15
Paving	0.44	*	0.15
Coating, caulks, sealants	0.42	*	0.15
Insulation	0.57	*	0.30
Friction materials	0.99	*	0.90
Plastics	0.09	*	0.15
Textiles	0.11	*	0.30
Paper	0.05	*	0.15
Miscellaneous	0.13	*	0.15
Manufacturing total	5.43	0.03	
CONSUMPTION			
Construction industry	0.90	*	0.15
Sprayed insulation	2.18	0.02	10.00
Brake linings			
Installation	18.00	0.11	10
Wear	72.00	0.44	40
Consumption total	93.08	0.57	
TOTAL	16 391.51	100.00	

* Negligible (less than 0.01%).

— Nonexistent.

Asbestos emissions related to production, manufacturing and consumption as shown in Table 6 is an excerpt of figures given in an Internal Report of the Air Pollution Control Directorate, APCD 73-4, National Inventory of Sources and Emissions of Asbestos 1970 (8).

6.2 Data Obtained from Asbestos Questionnaires, 1974

Major production of asbestos is by mines located in the Province of Quebec, as shown in Table 7.

TABLE 7 DISTRIBUTION BY PROVINCE OF ASBESTOS INDUSTRY FOR 1970 and 1973

	1970 **		1973	
Province	Plant Capacity tons/day	Ore Processed tons/yr	Plant Capacity tons/day	Ore Processe tons/yr
Newfoundland	6 000	2 201 655	7 500	2 173 70
Quebec	75 700	30 713 727	91 900	31 101 37
Ontario	5 300	1 251 545	5 300	853 60
British Columbia*	5 400	2 516 570	7 300	2 872 51
TOTAL	92 400	36 683 497	112 000	37 001 1[illegible]

*Includes Clinton Creek Mine, Yukon Territory.
**Data from Canadian Mineral Survey 1970 E.M.R. (1)

Data reported resulted in the compilation of total particulate and asbestos emissions from the Canadian Asbestos Mining and Milling Industry, as shown in Table 8 for the years 1973 and 197

TABLE 8

SUMMARY OF EMISSIONS

ASBESTOS MINING & MILLING INDUSTRY

Year / Location	Fibre produced (all grades)	EMISSIONS SHORT TONS PER YEAR: Crushing		Drying		Dry Rock Storage		Milling		Total Asbestos I		Tailings *		Grand Total	
		Tot. Part	Asbestos	Tot. Part	Asbestos	Tot. Part	Asbestos	Tot. Part	Asbestos	Total Part	Asbestos	Tot. Part	Asbestos	Total Part	Asbe
1973															
QUEBEC	1470340	1934	125	22298	2097	105	8	14065	4268	38402	6498	120195	777	158597	72
BALANCE CANADA	324709	1985	190	13082	651	27	2	656	57	15750	900	55515	713	71265	16
TOTAL CANADA	1795049	3919	315	35380	2748	132	10	14721	4325	54152	7398	175710	1490	229862	88
1974															
QUEBEC	1510354	2354	156	11416	571	103	5	17219	5327	31092	6059	124739	746	155831	68
BALANCE CANADA	290622	1869	159	9454	402	25	1	629	51	11977	613	39060	456	51037	10
TOTAL CANADA	1800976	4223	315	20870	973	128	6	17848	5378	43069	6672	163799	1202	206868	78

Data obtained from questionnaires, APCD 1974

*Estimate only (Tailings)

Asbestos emissions are estimates only, obtained from an assumed percentage of asbestos in particulates

If all sources had been fully controlled by the application of "Best Available Technology" the overall emission of total particulates would have been 73.8% less, as shown in Table 9.

TABLE 9 ESTIMATE OF PARTICULATE EMISSIONS IF BEST AVAILABLE TECHNOLOGY APPLIED TO 1974 EMISSIONS

	Quebec		Balance of Canada		Total Canada	
	Total Particulate (tons)	% Reduct	Total Particulate (tons)	% Reduct	Total Particulate (tons)	% Reduct
Crushing	47.64	98.0	13.82	99.3	61.46	98.5
Drying	180.70	98.4	34.30	99.6	215.00	99.0
Dry Rock Storage	32.27	68.5	5.04	80.0	37.31	70.8
Milling	1258.92	92.7	257.39	59.1	1516.31	91.5
Tailings	42548.85	65.9	9926.38	74.6	52475.23	68.0
Total	44068.38	71.7	10236.93	79.9	54305.31	73.8

7 EXISTING CONTROL METHODS

7.1 General. Emissions of asbestos fibre contained in the particulate matter are the most significant air pollution problems faced by the asbestos mining and milling industry, especially those released from drying operations. Technology exists to reduce such emissions to low levels and has already been used at some locations. Particulates emitted at other points in the asbestos fibre extraction process are controlled to varying degrees by dust collection systems using mechnical collectors and/or baghouses, generally, the latter giving a better degree of control.

7.2 Existing Installations

7.2.1 Open Pit Mining. Dust control, while drilling, can be achieved by mounting collectors on the drills. Emissions, when blasting, are uncontrolled but, because blasting is infrequent and of short duration, emissions are usually insignificant. It is to be noted, however, that the total emissions from several small blasts might be much less than that from a very large blast. Dust generated while loading trucks and hauling to the primary crusher, stockpile or waste dump is not controlled but is considered minor. Fugitive dust raised from roads is controlled by wetting the travel surface during dry weather.

7.2.2 Crushing. Pit run ore is reduced in size by crushing before being conveyed to the wet ore stockpile or the dryer building. Dust generated in primary crushing, screening, and secondary crushing is controlled by high efficiency cyclones and/or baghouses. Baghouses, which have extremely high efficiency, are more common in modern plants.

7.2.3 Drying Operations. Ore is delivered to the dryer building by conveyor from the wet ore stockpile or the crusher building. The ore is split by screening, the undersize going directly to the dryers. The oversize is reduced in size by tertiary crushing and joins the ore stream, before or after drying depending upon which plant is considered. Fluid bed, vertical, and kiln-type rotary dryers are used to reduce the moisture content of the ore from 3 to 18%, depending upon season and weather conditions, to something less than 1.5%. Large volumes of hot air are used for this purpose and uncontrolled emissions of particulates, containing some asbestos fibres, would be quite high. The exhaust gases are passed through cyclone separators or cyclone separators followed by wet scrubber, electrostatic precipitator, or baghouse to reduce emissions. Modern plants utilize baghouses, alone or following cyclone separators. Some older plants are adding baghouses after cyclones to reduce emissions from this source.

7.2.4 Dry Rock Storage. Ore from the dryers, mixed with ore fractions that by-passed the dryers, is conveyed to the dry rock storage building where residual heat completes the drying of ore to a uniform moisture content of less than 1.5%. Some emissions occur through louvers in the roof of this building. In two instances, a baghouse has been installed to prevent emissions from this source and installation of baghouses is being considered at other locations.

7.2.5 Milling. Milling of asbestos ore is a completely dry process. Extraction of asbestos fibres is achieved by successive stages of reduction in size of ore, using crushers, impact breakers, and fibreizers to release fibre, followed by screening and aspiration of freed fibre. All air used in aspiration and pneumatic conveying of fibre passes through cyclone collectors to remove the fibre after which the air is passed through the main mill baghouse, which may be under positive or negative pressure. The mill dust control system to eliminate dust from screens, crushers, impact breakers, fibreizers, conveyor transfer points, bagging area, or any other areas in the mill, is also connected to the main baghouse. Some central vacuum cleaning systems have been installed which have their own baghouse. Large fans may exhaust air from the clean air side of the baghouse to the atmosphere during summer months or may be recirculated in the mill to conserve heat during cold weather.

7.2.6 Conveyor Galleries. At better controlled plants, emissions of dust from outside galleries in which ore or tailings is conveyed are eliminated by installing baghouse units at all transfer points.

7.2.7 Tailings Disposal. This has always been a bothersome source of dust, considered more or less of a fugitive nature, over which some control is necessary to minimize the contamination of the ambient air by dust and contained free asbestos fibres emanating from tailings disposal operations.

Rejects from asbestos milling operations might contain up to 50 or 60% plus ½ inch material from early concentration and rejects from initial rock circuits. To this are added fines from the rock circuit, dust from the fibre circuit and very fine dust (floats) from the main mill baghouses or baghouses on dust control systems, which could account for four to six percent of the total rejects. At one location all tailings are less than 3/8" and different methods to control emissions may be used.

The very fine dust (floats) from the main mill baghouses is most readily airborne and contains more asbestos fibres since most of it is removed from process air used in aspiration, transportation and separation of fibres released in milling ore. Experiments at one plant have shown that if - 30 mesh material is agglomerated to form +30 mesh particles over 90% of the outside dust problem can be eliminated. Further experimental work is required to determine how variations of this procedure might be used at other properties to reduce emissions from tailings operations.

Two companies transport tailings from mill to the tailings disposal area by railroad cars.

At one location, tailings collected from various points in the milling circuit, combined with dry material from the baghouses, is conveyed to a storage silo having a live capacity of 1000 tons. From here it is loaded into thirty ton side dump railroad cars and transported to the dump. As the face of the dump becomes full, the track is moved sideways and the procedure is repeated. This company plans to change over to hauling tailings, using 35 ton rear dump trucks with low profile conveyor unloading to minimize dust during dumping.

At the second location, tailings are collected in a similar manner and conveyed to two large storage silos. Baghouses are installed at transfer points of the belt conveyor system. The railroad cars are chute loaded from these bins and loads are lightly sprayed with water in summer months to minimize airborne dust while being hauled to the final disposal area, some three miles distant in a valley, to a dump of low profile. Cars are dumped by remote control from the air conditioned cab of the locomotive. Dumped tailings are levelled by rubber tired bulldozers with air conditioned cabs. It is planned to use a water truck to wet down new tailings before and after levelling. Various plans are also being considered to pug fine tailings with water before conveying to the storage bins to further reduce airborne dust.

All other companies convey tailings from mills to tailings dumps nearby by belt conveyors inclined at + 14°. These tailings piles, at point of discharge, could be up to 500 feet above ground elevation. Some conveying systems have no dust control at transfer points or at the point of discharge. High speed stackers or flingers operating at up to 2800 feet per minute are still used at a few properties to reduce the number of times that the final conveyor has to be moved. These create a great deal of dust and their use should be discouraged. Elsewhere, tailings are discharged from standard low profile conveyors and levelled by mechanical means before a build-up of the piles make it necessary to move the final conveyors. Some transfer points have cyclone collectors to protect mechanical equipment from dust but exert little control of emissions to atmosphere. The present trend is to install small baghouses at all transfer points to eliminate emissions from these sources.

Several procedures are presently used to reduce dust emissions from tailings handling operations and others are in the planning stage.

(1) At the location where all rejects are minus 3/8 inch in size, the belt conveyor system discharges into an open bottom screw conveyor which pushes the tailings over the crest of the dump, eliminating any fall and minimizing dust created at the discharge. It is planned to install a water spray system around the point of discharge. This system cannot be applied at any other mine where rejects can contain fragments up to 1 inch or more in size.

(2) Floats and rejects of various sizes are collected on a common belt conveyor and then run over a screen to segregate coarser waste rock rejects for use in surfacing pit roads. This precludes any treatment of floats or fine rejects prior to this point. Water is then sprayed on the first tailings conveyor following this screening operation. After spraying, the belt run under a plow which aids in mixing and wetting dry tailings. Further mixing takes place at transfer points. High speed stackers are used at mines treating tailings in this manner but will be replaced by low profile regular belt conveyors, at point of final discharge.

(3) Fine dust and floats from mill baghouses are pugged with water all the time. When weather permits, the first conveyor belt is sprayed with water after the addition of fine and medium rejects. Coarse rejects from ore concentration are added last and no further water sprays are used. More intimate mixing and wetting occurs when passing through transfer points on the tailings conveyor system. Small baghouses are installed at all transfer points to eliminate emissions. A standard low profile conveyor is used at the final discharge point to the tailings pile. Buildup is levelled by mechanical means to minimize the number of times this final conveyor has to be relocated. Icing conditions on belts and at transfer points prevents the use of water sprays during extreme cold weather.

(4) All tailings except coarse rejects from the rock circuit are treated with water. Dust and floats from the mill baghouses are combined with fine rejects from milling and pugged with water. This treated material is then joined by coarse rejects from the rock circuit and conveyed to the tailings dump where it is discharged on the pile by a low profile standard belt conveyor. Buildups are levelled by mechanical means.. Some problems occur during very cold weather, around transfer points and icing of belts. Conveyor galleries are presently being closed in and insulated and it is planned to exhaust some hot air from the mill up these galleries to prevent such occurences. Baghouses will also be installed at all transfer points.

(5) All tailings except coarse rock rejects from the concentrator circuit are pugged with water before being combined with the coarse material and conveyed to the tailings dump. This gives reasonable control of emissions from tailings handling. However, the pugging operation has to be shut down during winter weather because of buildup of frozen material at transfer points and icing of the conveyor belts. All flights of the tailings conveying system except the first one are open and hooded. Dust is not controlled at transfer points. Final discharge is from a high speed stacker (flinger) conveyer. This undesirable piece of equipment will be replaced by a low profile standard conveyor to reduce emissions. It is also planned to close in the conveyor galleries and install small baghouses at transfer points.

Various means are being considered to make the pugging system operative at all times.

7.3 New Technology. In the past, several attempts were made to simplify or shorten the extraction process with little success. An attempt to separate rock, dust, and aspirate fibre in one machine resulted in complete failure.

Various methods for initial concentration have been developed to reduce the amount of ore that must be completely milled for fibre recovery.

One new method of separating fibre, rock and dust shows promise of reducing the total number of screens in the milling circuit.

Most other work has been directed towards improving operation and dust control by more efficient application of known technology.

Armstrong
CORK COMPANY

L. J. BIBRI
Vice President and
Director of Employee Relations

LANCASTER, PA. 17604

RECEIVED
MAR 1 1976
K. WAGNELSCH

February 10, 1976

Docket Officer
U. S. Department of Labor
Room N-3620
200 Constitution Avenue, N.W.
Washington, DC 20210

Dear Sir:

Subject: Docket H-033

We ask that this letter be entered into the record in connection with the proposed revision of 29 CFR 1910.1001, the standard for occupational exposure to asbestos, as described in the Federal Register, Vol. 40, No. 197, pp. 47660-47665.

Further, we respectfully submit that hearings on the proposed 0.5-fiber/cc standard are an absolute necessity, and we request the opportunity for a representative of the Armstrong Cork Company to testify in such hearings. Prior to hearings, however, we believe those affected by a manufacturing industry standard on asbestos exposure should have the opportunity to review the asbestos exposure standard that OSHA intends to issue for the construction industry. Citing the Bureau of Mines Mineral Yearbook, 1973, the Federal Register for October 9, 1975 says that approximately 77 percent of asbestos products consumed in 1972 was used in the construction industry. Consequently, the interests and concerns of construction and manufacturing are closely related regarding asbestos exposure standards. Those of us in manufacturing obviously need to know what effect the construction industry standard might have on the continued use of asbestos-containing products in construction, just as the construction industry needs to know if those products will continue to be available.

For the past 29 years, asbestos has been an important raw material for finished products made at five of Armstrong's U.S. plants. These plants employ more than 3,700 men and women. During this period, we have made major capital investments in engineering and installing equipment designed to reduce employee exposure to asbestos and other airborne contaminants.

Asbestos provides physical properties for key Armstrong products that we have not yet been able to obtain from any other raw material, and we have invested heavily in order to continue using it in a safe manner. In the last four years alone, Armstrong has spent over $3.5 million on capital equipment in the effort to meet the requirements of the 2-fiber/cc standard scheduled to become effective in July 1976. Despite the professional engineering time, the management effort and the cash outlays expended since 1972, it remains doubtful that we will be in total compliance with the 2-fiber standard in all our asbestos-using facilities by July.

The Department of Labor's announcement of the proposed 0.5-fiber standard on October 9, 1975 came to us, and we assume to many others, as a complete surprise. Despite intensive work by a series of engineering and management task forces since the proposed new standard's announcement, we have been unable to conceive of the technology it would take to do the engineering work necessary to get all production facilities in compliance with an 0.5-fiber standard.

Clearly, the objective of everyone concerned with this proposed standard is the development of a standard that will assure the health and safety of employees while permitting industrial users of asbestos to continue their operations without jeopardizing employee job security, causing employees inconvenience or hardships in their work, or adding an undue inflationary burden to the American marketplace.

Before the standard reaches its final form, we believe serious consideration should be given to the following factors:

1. <u>The problems with monitoring techniques prescribed by the proposed standard</u>. This is the method developed by NIOSH for measuring airborne concentrations of asbestos fibers in the range of 100 fibers/cc. In our experience, results under this method vary considerably under differing circumstances. Further, results become distorted as fiber concentrations approach zero, and at the 0.5-fiber level are subject to serious doubt.

2. <u>Inflationary impact</u>. As noted previously, since 1972 Armstrong has spent more than $3.5 million on equipment to control airborne asbestos fibers in the attempt to comply with the 2-fiber standard. We cannot realistically estimate the cost of capital equipment needed for compliance with the proposed 0.5-fiber standard because any such equipment will be based upon engineering concepts that have yet to be developed.

3. <u>The desirability of adding an "action level" to the asbestos exposure standard</u>. This concept, which has been adopted by OSHA in connection with other hazardous material standards, would serve a useful purpose in the asbestos standard. It should be incorporated in the final standard.

We intend to elaborate on each of the foregoing factors in testimony presented at a hearing on the proposed standard. In the event no hearing is scheduled, we will submit a supplemental statement dealing with these matters.

In addition to the concerns expressed above, we recommend the following revisions to provisions of the proposed standard:

1. <u>1910.1001 (d)</u> - The use of the words "may be" appearing on line two is indefinite and confusing. They should be replaced by the word "is."

2. <u>1910.1001 (e)(1)</u> - The words "may be" should be deleted as being too indefinite and replaced by the word "are."

3. <u>1910.1001 (e)(4)(i)</u> - Notification of all employees subject to exposure should be limited to notification of employees subject to excessive exposure to reduce the clerical requirements within the short period of time available. This paragraph should be amended to read:

   Within five (5) working days after the receipt of the measurement results, the employer shall notify each employee in writing of the results concerning the employee's exposure whenever such exposure is in excess of the limits prescribed in paragraph (c) of this section.

4. <u>1910.1001 (f)(6)</u> - Changes in production process or control are continuous and should allow for some degree of control by the employer. Add the following to the second line from the end of this paragraph after the word "might":

   ...reasonably result in an adverse change in employee exposure.

5. <u>1910.1001 (g)(3)(iii)</u> - To clarify any ambiguity that may exist in this paragraph, it is recommended that the following be added to the end of this paragraph after the word "use":

   ...at a frequency to be determined by the employer.

6. 1910.1001 (g)(3)(iv) - The filling of job opportunities, rates of pay, and similar decisions should either be a management decision or subject to union-management agreement. Therefore, the last sentence should be amended to read as follows:

   Such an employee may be given the opportunity to transfer to another job whose duties he is able to perform, with the same employer, in the same geographical area.

7. 1910.1001 (h)(1) - A number of situations may exist in which an employee need not be provided and required to use protective clothing to cover his entire body including hands and feet, etc. Subject to the exposure involved, a degree of variance should be available for the convenience and comfort of the employee. Add to the end of the last sentence of this paragraph after the word "section" the following:

   ...where such protective clothing is reasonably necessary for the protection of the employee.

8. 1910.1001 (h)(4)&(5) - The word "assure" appearing after the word "shall" should be deleted and replaced with the word "require," since the employer may not be able to assure the conditions requested herein but could require them as a condition of continued employment.

9. 1910.1001 (i)(1) - Provision should be made for the use of disposable protective clothing and equipment. After the word "for" and before the word "protective" at the third line from the bottom, add the word "nondisposable."

10. 1910.1001 (i)(2) - There are many reasons why it may be inadvisable or unnecessary for an employee to take a shower after work, especially when he wears protective clothing. Mandatory showering requirements have proved unenforceable and are viewed with extreme disfavor by many employees at our production facilities. The second line of this paragraph should be amended by deleting the words "be required" and adding the words "be given the opportunity."

11. 1910.1001 (i)(3) - Policing a requirement such as this would be virtually impossible. This paragraph should be revised by deleting the words "be required" after the word "shall" in the second line and adding the words "notified and given the opportunity."

12. 1910.1001 (i)(6) - This paragraph should be amended to correct an apparent typographical error as well as to reflect the realization that non-food chewing should not be necessarily prohibited within regulated areas because of the extreme difficulty of enforcement and the remote likelihood of contamination. The paragraph should be revised to read as follows:

    The presence or consumption of food or beverages shall be prohibited in regulated areas. Smoking shall be prohibited in regulated areas except where specific facilities have been designated for that purpose.

13. 1910.1001 (j)(1) - An employer can only require as a condition of employment that an employee obtain a written statement. Delete the word "obtain" from the fifth line from the end of the paragraph and substitute the word "require."

14. 1910.1001 (j)(6)(ii) - The employer and employee should not be prohibited from learning of health problems that may be known to a physician. This paragraph should be deleted in its entirety and paragraph (iii) should be renumbered to (ii).

15. 1910.1001 (o)(2)(i) - Since an employer can require only that certain activities be performed as conditions of employment, delete the word "shall" from the eighth line of this paragraph and add the words "required to."

In view of the considerations I have touched upon here, it is clear that the proposed 0.5-fiber standard presents a formidable obstacle to the asbestos-using segment of industry. Further, it may well be unwarranted insofar as adequate protection of occupational health is concerned. There is obviously the need for a judicious review of all relevant data before a reasonable and prudent standard can evolve.

Very truly yours,

MK