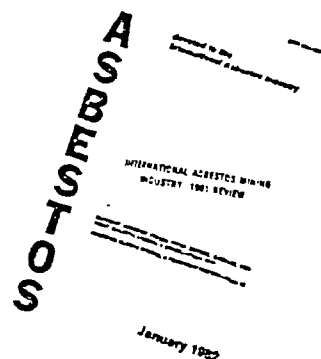


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PLAINTIFF'S EXHIBIT

CAP-406

Major importers of asbestos (tonnes)

	1978	1979	1980
United Kingdom			
Canada	88,037	94,705	71,892
South Africa	21,203	8,422	8,981
Cyprus	5,399	7,313	6,652
Swaziland	480	142	8,181
Italy	1,281	1,031	1,250
Total	117,781	116,669	94,639
France			
Canada	43,185	59,836	67,104
USSR	38,029	24,857	21,552
South Africa	8,330	16,328	16,693
Italy	7,155	7,478	5,902
Total	110,612	126,476	127,124
Denmark			
Canada	12,456	14,082	9,930
West Germany	1,337	1,685	1,027
South Africa	2,405	2,212	817
Cyprus	4,187	7,408	831
USA	167	880	—
Total	21,470	26,865	13,710
Austria			
Canada	13,078	12,060	—
USSR	8,038	3,362	—
South Africa	5,393	5,043	—
Italy	3,828	3,216	—
Total	30,807	23,912	—
Japan			
Canada	111,000	125,552	122,491
South Africa	80,873	104,095	90,658
USSR	17,811	28,524	41,703
USA	11,784	14,029	13,044
Zimbabwe	—	—	14,828
Total	234,901	291,531	305,408
Belgium/Luxembourg			
Canada	19,936	19,154	23,036
South Africa	6,248	7,783	8,237
West Germany	3,798	6,296	15
USSR	14,344	—	—
Total	51,036	50,754	47,861
Netherlands			
Canada	28,027	20,748	12,050
Italy	6,988	3,804	3,266
South Africa	912	209	1,399
USSR	2,327	1,278	1,347
Total	41,357	28,235	19,042
West Germany			
Canada	260,536	305,300	307,505
USSR	32,400	23,019	25,714
South Africa	26,219	31,611	27,863
Italy	22,537	23,769	25,926
Total	345,816	386,118	393,081
Italy			
South Africa	22,959	38,935	32,239
Canada	12,212	25,063	37,283
USSR	7,423	4,490	na
Total	47,152	77,151	86,550
USA			
South Africa:			
amosite	1,153	461	364
chrysotile	5,667	2,613	2,401
crocidolite	16,739	13,461	7,597
Canada	525,181	495,707	315,435
Total	549,606	513,084	327,297

Industrial Minerals March 1981

CAPCO JEN 0000567

owing to the combined adverse effects on trading of the current industrial recession being felt in most industrialised countries since the beginning of 1980, and the negative publicity expressing concern over the asbestos and health issues. It will be some considerable time yet before it will be able to be evaluated just exactly how much of the recent downturn in asbestos consumption is due to recession and how much is due to the environmental health aspect now associated with working with asbestos which has spawned the drive towards alternative materials. The accompanying tables show how the pattern of asbestos consumption has evolved in the UK and the USA during the 1970s which is indicative of the general trend in North America and Western Europe bearing in mind that in continental Europe asbestos from the USSR may account for some variation in consumption patterns.

Canadian asbestos exports (tonnes)

	1978	1979	1980	1981*
Milled fibres (Group 3)				
United Kingdom	4,544	6,342	3,568	2,672
West Germany	598	2,032	1,306	393
Czechoslovakia	877	871	1,375	1,676
Japan	1,293	1,521	1,453	1,676
Brazil	1,258	1,286	730	180
USA	7,848	7,012	3,642	3,577
Total	22,142	26,464	15,233	11,255

Milled fibres (Groups 4 & 5)				
United Kingdom	34,962	38,218	36,459	18,767
Austria	5,903	10,472	9,207	3,807
Belgium/Luxembourg	13,945	10,436	16,711	6,791
France	25,814	38,083	48,388	20,504
West Germany	122,755	119,828	117,467	23,877
Italy	13,223	25,123	28,721	15,321
Spain	18,416	21,005	12,617	11,219
Switzerland	6,281	9,868	8,876	3,699
Yugoslavia	10,947	10,973	10,439	7,694
Egypt	5,466	6,268	5,497	11,851
Nigeria	4,397	3,989	16,786	9,025
India	20,728	29,885	28,451	16,353
Malaysia	14,407	15,630	21,105	13,446
Indonesia	7,621	7,110	11,121	8,020
Japan	31,691	36,838	39,005	21,690
Taiwan	6,014	4,160	10,316	3,944
Australia	24,561	18,187	14,680	13,732
Colombia	9,115	13,218	14,669	6,555
Mexico	34,766	39,802	31,965	22,524
USA	118,544	100,372	58,623	103,167
Total	667,741	692,814	637,808	421,587

Milled fibre (Groups 6-9)				
United Kingdom	48,358	50,763	29,982	17,682
Belgium/Luxembourg	9,171	10,645	8,417	2,381
Denmark	3,432	1,418	214	272
France	12,006	20,115	20,160	12,352
West Germany	27,092	32,025	31,851	51,334
Netherlands	23,711	18,587	9,285	1,675
Spain	6,163	8,394	5,101	2,108
India	3,830	4,875	6,204	4,181
Japan	84,469	97,192	91,428	55,710
Republic of Korea	3,966	3,028	2,114	3,240
Taiwan	4,584	5,602	8,338	6,645
Thailand	5,423	6,249	5,781	4,408
Argentina	4,275	8,827	7,731	2,949
Brazil	12,889	18,509	6,249	3,147
Chile	3,036	2,419	2,995	1,178
Colombia	3,947	4,189	7,271	2,938
Venezuela	5,793	6,907	4,244	3,732
Mexico	8,388	10,318	9,372	9,294
USA	413,256	397,675	262,247	207,096
Total	708,592	742,157	564,232	417,929

Total milled fibre exports (Groups 3-9)	1,398,475	1,461,435	1,217,273	850,771
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* Figures for 1981 are for first 10 months only

UK decline . . .

So far as the UK is concerned there has been a gradual decline in asbestos consumption during the 1970s with 172,500 tonnes consumed in 1973 dropping to 90,200 tonnes in 1980. The most significant factor in UK consumption has been the disappearance of asbestos from the insulation market after 1976 and the fire resistant insulating board market after 1978 in the face of competition from alternative materials such as mica and vermiculite. So far as other sectors of the UK market are concerned there has been a steady fall in demand in asbestos cement building products and pressure pipe, jointings and packings, textiles, and floor tiles during the 1970s. However, it appears that demand for asbestos in the friction materials and reinforcing filler sectors of the market has held its own with a fall in demand recorded for 1980 only, which may just be due to the onset of the deepening recession at that time.

Estimated consumption of asbestos fibre in the UK (tonnes)

Consuming area	1973	1976	1978	1980	1980 %
Asbestos cement building products	55,600	42,900	38,300	31,000	34.4
Asbestos cement pressure pipes	9,600	8,100	5,000	3,000	3.3
Fire resistant insulating board	22,500	14,500	8,000	—	—
Insulation products	4,000	400	—	—	—
Jointings and packings	11,400	10,000	10,000	8,000	8.9
Friction materials	17,000	15,650	16,300	12,000	13.3
Textile products	8,300	6,300	4,600	4,000	4.4
Floor tiles	16,200	15,800	13,800	10,000	11.1
Moulded plastics & battery boxes	2,800	1,200	600	200	0.2
Fillers, reinforcements (including felts, mill-board paper, filters, underseals, mastics, adhesive paints etc.)	25,700	28,450	28,700	22,000	24.4
Total asbestos usage	172,500	143,300	125,800	90,200	100.0

Estimates for 1973 include 24,000 tonnes of amosite — 1,200 tonnes for pressure pipe, 19,500 tonnes for fire resistant insulation board, 2,700 tonnes for insulation products, and 600 tonnes for moulded plastics. Some 300 tonnes of anthophyllite is included in the last item for 1973. In 1978 about 700 tonnes of amosite is included for pressure pipe and about 2,000 tonnes for fire resistant insulating board. In 1976 about 500 tonnes of amosite was used in asbestos cement building products on an experimental basis.

. . . and drastic fall in the USA

In the USA asbestos consumption in 1973 reached the record level of 795,000 tonnes but since, demand fell to 561,000 tonnes in 1979 before plummeting to a record low of some 360,000 tonnes in 1980 with all sectors of the market recording drastically reduced levels of demand. Although preliminary figures for asbestos consumption, published by the US Bureau of Mines, for 1981 indicate a slight recovery to just over 400,000 tonnes it is understood that the greater part of this tonnage was consumed in the earlier part of the year with a tail-off towards the year-end filtering through into 1982. This further dip in demand in the latter part of 1981 and the beginning of 1982 has been expressed in the form of short working, high inventories, and depressed prices at the Canadian mines. Most probably this across-the-board downturn in demand has more to do with the current recession combined with the prevailing high interest rates in Europe and North America, which have had a dramatic effect on the construction and automobile industries, than it has to do with environmental concern which tends to be more selective in its effect on end-use markets. It

has been estimated that construction products of all types account for around 70% of Canadian fibre output whilst the friction materials market accounts for up to 10% of output. As such any revival in asbestos mining relies heavily on a resurgence in the construction and automobile industries — at least in the more immediate future. So far as the medium to longer term outlook is concerned the major producing companies in Canada are placing greater emphasis on marketing to the developing Third World countries where the rates of economic growth are measurably higher than in western world countries and where the clamour for asbestos substitutes has not taken place. Large projects in the Middle East, India, and Mexico for irrigation and cheap housing provided buoyant markets for asbestos cement products during 1981 which helped to offset some of the gloom in the industry.

Although the drop in demand for asbestos has plunged the Canadian industry as a whole into its deepest recession for

more than 30 years, individual producers have felt the icy wind of depression to varying degrees. Those companies heavily dependent on markets in the USA and Europe — Johns-Manville and Carey Canada Inc. — have been struggling with the situation for longer than others, with short-time working and closures. Those with more widely diversified markets spread through Latin America, Asia, and Africa in addition to the developed countries — Lake Asbestos Inc., Bell Asbestos, and Asbestos Corp. — have been able to weather the storm more successfully although both Asbestos Corp. and Lake have felt the effects through having to compete more aggressively with one another in an attempt to retain sales in the face of falling demand gradually spreading throughout the market. A factor to consider with respect to the Canadian producers is that each of the mining companies produce different grades of asbestos although there is, of course, considerable overlap allowing a fair degree of competition. In this respect those

Pattern of US demand for asbestos ('000 tonnes)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981(p)
Flooring products	167	173	183	198	139	123	104	140	126	121	90	100
Asbestos cement pipe	128	131	140	151	202	139	127	145	217	213	144	160
Roofing products	66	69	79	73	69	42	231	57	62	66	27	28
Friction products	60	62	66	72	73	60	58	83	74	61	44	48
Asbestos cement sheet	46	48	52	58	86	40	21	40	36	11	8	8
Packing and gaskets	20	21	22	24	26	15	18	25	31	19	12	12
Insulation	20	21	22	23	13	6	8	18	7	15	9	8
Paper products	14	14	15	16	57	60	28	22	9	1	1	1
Textiles	14	13	14	16	18	5	6	9	3	6	2	4
Other	133	137	147	158	85	62	59	70	54	48	22	32
Total demand	666	689	734	795	768	552	660	609	619	561	360	401

US asbestos consumption by end use, grade, and type in 1980 (tonnes)

	Grades 1 and 2	Grade 3	Grade 4	Chrysotile Grade 5	Grade 6	Grade 7	Grade 8	Total chrysotile	Crocidolite	Amosite	Anthrophyllite	Total asbestos
1980:												
Asbestos cement pipe	—	—	81,700	29,800	4,300	3,900	—	119,700	24,100	200	—	144,000
Asbestos cement sheet	—	—	—	100	4,300	3,500	—	7,900	—	—	—	7,900
Flooring products	—	100	—	35,900	200	53,800	—	90,000	—	200	—	90,200
Roofing products	—	100	300	100	3,900	22,100	—	26,500	—	—	—	26,500
Packing and gaskets	—	800	2,300	6,200	100	2,800	—	12,200	100	—	—	12,300
Insulation: thermal	—	—	100	—	700	5,200	—	6,000	—	—	—	6,000
electrical	—	200	—	100	—	2,600	—	2,900	—	—	—	2,900
Friction products	—	400	2,100	14,200	4,700	22,300	—	43,700	—	—	—	43,700
Coatings and compounds	—	—	100	—	100	10,700	—	10,900	—	—	—	10,900
Plastics	200	—	—	400	—	800	—	1,400	100	—	—	1,500
Textiles	200	1,700	—	—	—	—	—	1,900	—	—	—	1,900
Paper	—	100	—	200	100	—	—	400	100	—	—	500
Other	—	200	300	2,500	1,500	4,600	—	9,100	—	1,300	—	10,400
Total	400	3,600	86,900	89,500	19,900	132,300	—	332,600	24,400	1,700	—	358,700
1979	100	8,800	162,100	105,300	52,800	193,900	—	523,000	35,700	1,500	300	560,500

Source: US Bureau of Mines p—preliminary

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companies whose sales consist of a high proportion of the shorter grades of fibre — Carey Canada in particular — have felt the recession more than the others and also have been more vulnerable to the concern expressed on the adverse health aspects of asbestos. The other companies with a significant output of short fibre include Johns-Manville and Lake Asbestos from its National operation.

The overall effect of the recession on the Canadian mining industry is demonstrated in the accompanying table of Canadian exports for the year 1978 to 1980 and the first 10 months of 1981 which indicate that total exports for 1981 may reach about 1.02m. tonnes — some 16% down on 1980 figures and around 30% down on 1979 figures. Actual production of fibre in the first 10 months of 1981 was 929,000 tonnes compared with 1,072,500 tonnes and 1,323,000 tonnes in the same period for 1980 and 1979 respectively.

A recognised problem

It has long been established and is now fully accepted by industry that there is a serious health hazard associated with the indiscriminate handling of all forms of asbestos from mineral extraction to the fabrication of asbestos-containing products. However, now that the problem has been recognised, in its varying degrees, all sectors of the asbestos industry in most countries are achieving measurable success in controlling asbestos dust especially in the milling and fabricating stages where the problem has been most acute. In this regard the various regulations which have been recommended and imposed in North America and Europe, in particular, have largely been welcomed by industry in its campaign to re-assure the general public that with proper care and handling there is no longer any significant danger from using asbestos especially where the mineral is locked-in to the product — gaskets, cement, floor tiles, brake linings etc. Nevertheless the trend in public opinion, particularly in continental European countries such as Sweden and Denmark, has increasingly expressed a desire for asbestos usage to be reduced to the absolute necessary minimum, and in some quarters for the mineral to be banned altogether, in favour of substitutes with no track record of a health related problem. The recent agreement made between the West German asbestos industry and the Federal Minister of the Interior to reduce the asbestos fibre content of asbestos cement products within the next three to five years in favour of substitutes underlines the point. It is expected that the West German industry will fully cooperate with the government directive on a voluntary basis although it is understood that the Minister is looking for a 40% reduction in the proportion of asbestos fibre used. Several West German members of the European parliament recently made an appeal for a total ban on the use of asbestos to be achieved over the next five to ten years in which time research into substitute materials and protection measures should be stepped up. At the same time a request was made for an immediate ban on the use of crocidolite which is still used in the manufacture of large diameter pressure pipe in West Germany although a voluntary industry ban in the UK has effectively been in force since 1969.

To include a detailed discussion of the mountain of research that has been performed on the asbestos and health problem is beyond the scope of this article but it is relevant to highlight some of the more recent conclusions. A 1977 EEC report concluded that there was "suggestive evidence", based upon epidemiological studies, for a threshold limit for exposure to asbestos dust below which the risk of cancer is either small or non-existent, but that there was not sufficient adequate data to establish what such a limit should be. So far as mesothelioma is concerned the report indicated that peak levels of exposure are relevant to contracting the disease and as such it would be almost impossible to assess what actually is the significant exposure level. An important conclusion from the report relates to exposure of low levels of chrysotile dust where the epidemiolo-

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gical studies indicate that the probability of contracting cancer is exceedingly small even if, as is the case with other established carcinogens, no actual threshold limit can be defined. In any discussion on this issue one must never lose sight of the fact that there is an extremely long time scale involved (the latent period which may be 20-50 years) between the time when an individual is first exposed to the problem to the time when the first symptoms of either asbestosis, lung cancer, or mesothelioma are detected. This implies that if this order of time scale is applicable to the general problem, which is regarded by many as one of physical and dimensional characteristics of the mineral being fibrous, then it is of great importance from the point of view of physically similar mineral or synthetic substitutes. Such substitutes that are gaining ground in the market place have not the same history of application as asbestos across such a wide spectrum of end uses and so have not been around long enough for any potential health related problems to show through. However, it is significant that modern practice recognises the potential hazards associated with heavily dust laden atmospheres in the work-place, no matter what the mineral concerned may be, and as such controls today are far more stringent than they were some 20-50 years ago when the seeds for the contemporary asbestos problem were first sown. Studies have shown that in Quebec, where workers have been exposed to chrysotile dust, there was an increase in total mortality especially in deaths caused by lung cancer and asbestosis but only in those exposed to unacceptable dust concentrations by modern standards.

It is generally accepted that for the three principal types of commercially used asbestos there is greater risk of contracting lung cancer or mesothelioma when exposed to crocidolite than amosite, and less risk associated with chrysotile, although in most applications where amphibole asbestos is used it is in blended form with chrysotile. Consequently a definitive assessment of the risks associated with each fibre type is com-

plicated but the general consensus of the various findings is that crocidolite is considerably more carcinogenic than chrysotile. The most controversial aspect of the asbestos and health problem, however, is perhaps the claim that even brief exposure may be harmful especially if sufficiently intense. Claims that mesotheliomas have been induced after only a day working with asbestos have with, understandable reason, spawned shock horror for those concerned, but always the evidence has been inconclusive. Certainly there has been, and still is, cause for concern as expressed in the various legislative measures and proposals but it should also be appreciated that the asbestos industry is in the forefront of technology in controlling potentially fibrous dusty atmospheres in the work-place to safe levels.

So much for industry, but the argument against asbestos continues through to the consumer and its presence in the environment especially in various types of construction products where the unaware do-it-yourself enthusiast may be particularly at risk. The EEC report, referred to earlier, concluded that air concentrations in the region of 1,000 times lower than those in industry was an acceptable safety margin and this level is apparently in line with the general findings on prevailing atmospheric levels. Quite rightly the report emphasises that levels should be kept as low as possible with the aid of good industrial practice and education but this should be achieved in a non-alarmist fashion. Two excellent articles summarising the asbestos-pollution-health problem by D. Gloag appeared in the British Medical Journal, 14 and 21 February 1981.

A clean bill of health?

The possibility of a health risk associated with the presence of asbestos fibres in water, beverages, or food arose some years ago in the wake of the recognised occupational health hazard

connected with the prolonged inhalation of excessive quantities of asbestos dust. In particular most concern has been expressed with respect to the conveyance of drinking water through asbestos-cement pipe where particles of asbestos fibre may be taken into suspension in the flow of water owing to erosion of the inner walls of the pipe especially where any turbulence may occur at junctions in the pipe etc. However, it appears that from the outset there was no positive evidence to suggest that asbestos causes gastro-intestinal cancer although there was every reason to believe that if there was any risk at all it would be dose-related and more likely to be restricted to occupational exposure and not likely to cause a more general environmental problem for the population as a whole. Nevertheless the negative evidence was not sufficient and further research has been carried out.

Perhaps the latest findings relevant to this problem are those published in 1981 by the US Public Health Service Department of Health and Human Services concerning tests carried out by the Carcinogenesis Testing Program which is part of the National Toxicology Program, sponsored, amongst others, by NIOSH (National Institute of Occupational Safety and Hygiene). A carcinogenic bioassay of Syrian golden hamsters fed on a diet of 1% chrysotile asbestos for their entire lifetime starting with the mothers of the test animals revealed that there was no adverse effect on body weight gain or survival by chrysotile — in fact, both weight gain and survival seemed to be enhanced. By way of explanation the report suggested that the observed positive effects of increase in weight gain and survival characteristics were possibly caused by the increase in fibre content in the diet. A parallel study under exactly similar conditions was carried out using amosite but again there was no adverse effect on body weight gain or survival and again the survival rate was significantly better in hamsters of both gender when compared with the control group of animals. The median survival of the control female group was 55 weeks compared with 81 weeks for the control group of male hamsters which

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contrasted with 60 weeks and 84 weeks for amosite treated females and males respectively. The results of these studies published by the US government's National Toxicology Program, however preliminary in nature, must surely blow some fresh air through the North American asbestos industry especially as the asbestos cement market constitutes the single most important sector for the industry.

Crocidolite blues . . .

As previously indicated South African production of crocidolite has recently been rationalised with Gencor's subsidiary, Gefco, now accounting for virtually all of the country's crocidolite production capacity (apart from about 10,000 tpa production from Lonrho's operations at Wandrag and Emmarentia). Although occurrences of crocidolite are known in other parts of the world, South Africa accounts for virtually all the world's present commercial production. Small scale crocidolite production began in Western Australia in 1933 and reached significant levels in 1944. However, the mines at Wittenoom Gorge, the Colonial Mine and the Wittenoom Mine, which were responsible for virtually all of the country's output, closed in 1966 after a total of some 138,000 tonnes had been shipped. In recent years crocidolite production from South Africa has been in decline largely owing to concern over the adverse health effects associated with working with crocidolite. This led to severe competition in the marketing of crocidolite by the South African producers — Cape Industries until 1979 and then Transvaal Consolidated Land and Exploration, Eternit, and Gefco — which was the major reason for the recent re-organisation of production under one umbrella. Record production of over 200,000 tonnes of crocidolite in 1977 fell drastically in 1978 to just over 137,000 tonnes and to around 118,000 tonnes in the following two years. For the first

eleven months of 1981 some 94,609 tonnes of crocidolite was produced thus suggesting that output for the year will bottom out at around 103,000 tonnes — the lowest level of production since 1964 when 91,873 tonnes was produced from the Cape and also the Transvaal (output from the Transvaal ceased in 1978).

. . . but a strong role to play

With the move towards a statutory ban on the import of crocidolite into the EEC nations fast gaining momentum the shrinking crocidolite market is virtually restricted to the USA (somewhat ironically in view of the fervour of the anti-asbestos lobby in the USA), the USSR, other eastern European countries, and some Third World nations. However, US crocidolite imports have fallen from 16,739 tonnes in 1978 to just 7,597 tonnes in 1980 and although detailed statistics for the other importing countries are not available it is evident that demand in recent years has not been particularly bright. The principal application for crocidolite is in the manufacture of asbestos cement products where it is used in conjunction with chrysotile fibres, especially the shorter grades, to impart strength to the product. It is now generally accepted that more short chrysotile asbestos fibre may be used when crocidolite is incorporated in the formulation — the more crocidolite, then in general the more short chrysotile that can be tolerated. In this way it has been possible to produce asbestos cement more economically owing to less of the more expensive long chrysotile grades being needed in the formulation. This is possible owing to crocidolite being the strongest natural mineral fibre known with reinforcing properties superior to any other form of asbestos. From this viewpoint the production of large diameter asbestos cement pressure pipes in particular relies on the incorporation of strong reinforcing fibre — either the expensive long chrysotile types of fibre or less expensive long crocidolite fibres which enable the use of a higher proportion of short chrysotile in

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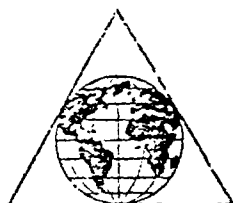
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the formulation. Also for large diameter pressure pipe the use of a proportion of crocidolite lowers the amount of time required in the manufacturing of the pipe as the pipe attains the required strength to be removed from the mandril at a faster rate than if crocidolite were not used. Hence the capacity for pipe production is enhanced. An example of the type of fibre formulation which may be used for medium diameter/medium pressure asbestos pipe would be 35% short chrysotile, 40% ML6 grade crocidolite, 25% group 4 chrysotile. For larger diameters and higher pressures the amount of short chrysotile would be reduced and a longer grade of crocidolite, such as L6, used in combination with a longer chrysotile fibre. Correspondingly for ordinary asbestos cement pipe not subject to use under pressure less of the longer fibre types need be used and a greater quantity of short fibre may be incorporated. In summary the use of crocidolite in all types of asbestos cement products enables a greater quantity of less expensive short chrysotile fibre to be used thus reducing the cost of the product. This has become more important in recent years since pipes made from other materials such as cast iron, PVC, etc. have become more competitive on the market particularly in the USA. Another factor to be considered is that in the USSR there is a reported shortage of the very long chrysotile fibres thus necessitating a greater use of crocidolite.

Alternatives and the Achilles heel

A natural consequence of the prolonged public concern and debate on the health hazards associated with asbestos has been the growth of interest and development of alternative substitutes for asbestos in the many end-products in which asbestos is used. In many respects it may be considered that asbestos has been rather fortunate in the past when compared with other industrial minerals such as talc, mica, wollastonite, kaolin, etc., where considerable overlap of end-use in the market has

existed. That asbestos has enjoyed a virtual monopoly in the markets in which it has served over the years does, however, indicate the versatility of the mineral which is also able to be produced on a large scale comparatively inexpensively when compared to the costs of production associated with some of its latter-day rivals. Nevertheless the growth in the search for alternative materials for asbestos during the last decade has been unprecedented in the mining industry. This has been highlighted in a number of reports, publications, and conferences such as the 1976 Fulmer Research Institute report in the UK (see "IM" October 1976) and the 1980 National Workshop on Substitutes for Asbestos held in Arlington, Virginia (see "IM" September 1980).

Not only have producers of other minerals such as those mentioned above been able to take the opportunity of marketing their products into traditional end-uses for asbestos — witness the demise of the insulation market for asbestos in the UK in favour of mica and vermiculite and other materials — but the leading asbestos producers themselves have taken heed of the shift in the market away from asbestos. Owing to the self-imposed industry ban on imports of crocidolite into the UK in the early 1970s Cape Industries began to use other materials for its manufactured products and gradually became more and more divorced from its South African mining interests. This culminated in the sale of its mining operations in 1979. Johns-Manville, the western world's largest producer of chrysotile in Canada, began to look at alternative materials and at fibreglass in particular.

However, the cry for substitution provides a far from simple solution to the so-called asbestos problem as it raises a number of other problems. There is no such thing as a substitute for asbestos which may be conveniently slotted into the existing technology. Alternatives can and have been found for a number of applications but often a new system has to be devised in order to use the alternative — in most cases an expensive procedure. Additionally, whilst the health-related problem of asbestos has



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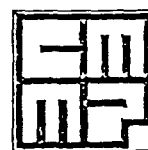
been identified and is being dealt with, any such problems which may relate to any of the alternatives (such as fibreglass) remain to be discovered. In this sense it may well be said that the asbestos industry is pioneering the technology necessary to deal with the problem and as such should not be dismissed from the commercial world as many in the USA and Europe would wish.

In the September 1980 issue of Industrial Minerals a report of the Arlington, Virginia meeting on asbestos substitutes was published entitled "What's new after asbestos" in which the various end-uses for asbestos were described from the alternative materials point of view. In the sphere of paper products which contain asbestos a number of alternative materials have been tried including aramid, graphite/TFE composite, TFE, carbon, and graphite. Within this market sector are products which are expected to be able to withstand temperatures of up to 538°C and pressures of 2,500 psi. In roofing applications alternatives are organic felt, fibreglass felt, and singly-ply membrane of which the first is the cheapest material to install but has the least strength. Asbestos used in pipeline wrapping materials to prevent corrosion of the iron pipe in the ground is facing competition from fibreglass although there are technical problems as the use of fibreglass has the effect of actually promoting decay should be pipe become exposed to the weather. Again in textiles fibreglass appears to be the main alternative to asbestos although certain ceramic fibres, polymers, and also carbon compete for use in this area of application. In the reinforcing filler applications in floor tiles and plastics, platey talc, various clays, wollastonite, and mica are achieving considerable success in replacing asbestos in the USA. Other alternative materials for filler applications include 'hedmanite', a non-asbestiform form of serpentine produced by Hedman Mines in Ontario, and processed mineral fibre made from blast furnace slag by Jim Walter Corporation. In the field of friction materials considerable progress has been made in replacing asbestos particularly in the USA although it is understood that no alternative has so far proved to be as effective as the traditional asbestos-based friction materials. Alternatives being explored include fibreglass, mineral wool, potassium titanate fibres, graphite and carbon fibres, and aramid fibres — all of which are more costly than asbestos. Efforts to produce drum brakes based on alternative materials proved not to be possible without re-designing the braking system. To a considerable degree this has been achieved in the USA through the development of semi-metallics which began in the early 1950s and which now accounts for around 60% of all new vehicles in the USA. Perhaps the principal area where alternative materials have not made significant impact is in asbestos cement sheet or pipe and as this constitutes the single most important market sector by volume for the asbestos industry it may be regarded as the industry's Achilles heel. If a viable and cheap alternative did emerge on a worldwide scale then with the present prevailing climate of public opinion in the Western World this would surely spell out the downfall of the industry. The only possible alternative to emerge so far has been fibreglass — glass reinforced concrete — but the snag here, besides cost, is that the glass undergoes chemical alteration when in contact with the alkalis in the cement which leads to spalling in application. This problem has to some extent been solved by the development of alkali-resistant fibre but asbestos cement has a significant price advantage and is able to perform in environments of high temperature. So far as asbestos cement pipe is concerned the main competitors are other pipes made from completely different materials such as ductile iron, PVC, steel, and reinforced concrete but the cheapness of asbestos cement pipe compared with the alternatives will maintain its market share particularly in the developing world. A major advantage in this respect is the comparatively simple technology which is required to manufacture asbestos cement pipe — a factor of over-riding significance in the developing world where the need for housing, water, sanitation, sewerage facilities far outweighs any potential health hazard.

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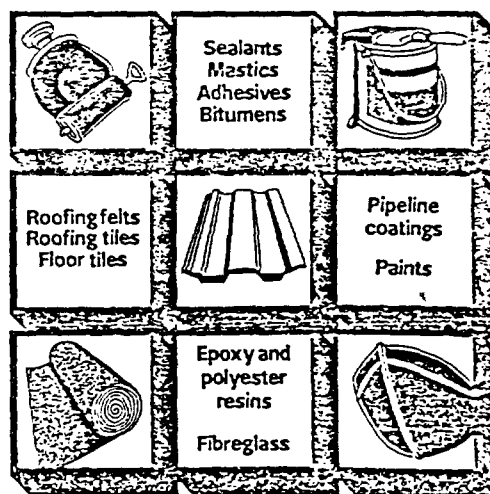
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Major world asbestos producers

<i>Company</i>	<i>Ownership</i>	<i>Mine/plant location</i>	<i>Products/capacity</i>	<i>Remarks</i>
THE AMERICAS				
Canada				
Asbestos Corporation Ltd.	General Dynamics Canada Ltd. — 54.65%.	King-Beaver open pit, Thetford Mines, Quebec	All chrysotile 2.1m. tpa of ore	Total chrysotile fibre production capacity — 292,300 tpa
	Through Société Nationale de l'Amiante the Quebec government has purchased 51% of the voting shares in GDC	Normandie mill, Vimy Ridge, Quebec	83,800 tpa of fibre Groups 3-7	Group 3 — 4,100 tpa Group 4 — 162,000 tpa Group 5 — 73,300 tpa Group 6 — 29,400 tpa Group 7 — 23,500 tpa
		King-Beaver w/g mine, Thetford Mines, Quebec	1.1m. tpa of ore	
		Brit. Can. mill No.1, Black Lake, Quebec	54,700 tpa of fibre Groups 3-6	Predominantly used for asbestos cement but also textiles (Group 3 only), brake linings, tiles, paper, gaskets, and filler
		Brit. Can. open pit, Black Lake, Quebec	3.2m. tpa of ore	
		Brit. Can. mill No.2, Black Lake, Quebec	65,300 tpa of fibre Groups 3-7	
		Asbestos Hill open pit, Ungava, Quebec	1.4m. tpa of ore. 265,000 tpa ungraded fibre	All shipped via Deception Bay to Nordenham, West Germany
Asbestos Corporation GmbH	Wholly-owned subsidiary in West Germany	Nordenham mill, West Germany	Chrysotile 88,500 tpa of fibre. Groups 4-7	All used for asbestos cement
Bell Asbestos Mines Ltd.	Société Nationale de l'Amiante (acquired from Turner and Newall Ltd. in May 1980)	Underground mine and mill in Thetford Mines, Quebec	Chrysotile 825,000 tpa of ore. 75,000 tpa of fibre Groups 3-7	Specialise in output of longer fibres 70% Groups 3-5 and 30% Groups 6-7
Brinco Mining Ltd. (newly formed early 1981)	Olympia and York Investments Ltd. (50.1%) and Rio Tinto Zinc Corp. (22%) in Brinco Ltd. the direct parent company	Cassiar open pit and mill, McDame Mountain, north-central British Columbia	Chrysotile 1.3m. tpa of ore. 110,000 tpa of fibre Groups 3-6	Primarily Group 4 fibre produced, 70% of output for asbestos cement. Mine acquired from Cassiar-Asbestos Corp. in 1980
Carey Canada Inc.	Jim Walter Corporation	Open pit and mill at East Broughton Station, Quebec	Chrysotile 225,000 tpa of fibre. Groups 4-7	Specialises in medium to short fibre — 70% Group 7 and 30% Groups 4-6. Maximum output of 234,000 tonnes in 1973
Johns-Manville Canada Inc.	Manville Corporation	Jeffrey open pit and 6 mill complex at Asbestos, Quebec	Chrysotile 9.25m. tpa of ore 630,000 tpa of fibre Groups 3-7	Western World's largest asbestos mining operation
Lac d'Amiante du Quebec Ltée	Asarco Inc.	Black Lake open pit and mill, Black Lake, Quebec	Chrysotile 13,600 tpd of ore 165,000 tpa of fibre Groups 3-6	Mined under a 99-year lease from United Asbestos Inc. in return for share in net profits
		National open pit and mill near Thetford Mines, Quebec	7,260 tpd of ore 100,000 tpa of fibre	Principally Group 7
USA				
Calaveras Asbestos Corporation	—	Open pit mine and mill at Copperopolis, California	Chrysotile 3,600 tpd of ore 40,000 tpa of fibre Groups 4-6	Leading producer of asbestos in the USA and one of few mines to have expanded production in recent years
Union Carbide Corporation	—	Open pit mine and mill at Santa Rita, San Benito County, California	Chrysotile 35,000 tpa of fibre Group 7 mainly	Specialises in short fibres and modified asbestos products for filler reinforcing applications
Vermont Asbestos Group	Cooperative	Open pit mine and mill at Lowell, Vermont	Chrysotile 35,000 tpa of fibre Groups 3-8 1.1m. tpa of ore	Current production is around 23,000 tpa of fibre
The Jaquays Mining Corp.	—	Open pit mine and mill in Gila County, Arizona	Chrysotile 1,200 tpa of fibre Groups 3, 4 and 7	
Brazil				
SA Mineração de Amianto	—	Cana Brava mine and mill, Uruaçu, Goiás state	Chrysotile 180,000 tpa of fibre Grades 3-7	Only recent attempts to enter world trade. Some 167,000 tonnes produced in 1980

<i>Company</i>	<i>Ownership</i>	<i>Mine/plant location</i>	<i>Products/capacity</i>	<i>Remarks</i>
Sano SA Industria e Comercio	Sano Group	Mine and mill in Piaui state	Chrysotile 2,400 tpa of fibre Group 4 only	Production totally consumed within the Sano Group
Colombia Asbestos Colombianos SA	Eternit Colombiana 70% Minero Emmo 30%	Las Brisas mine and mill, near Campamento	Chrysotile 20,000 tpa of fibre Groups 4-6	Production began during 1981 at initial rate of 11,000 tpa
AFRICA South Africa The Griqualand Exploration and Finance Company Ltd. (Gefco)	General Mining Union Corporation Ltd. 43.80% Sentrust Ltd. 13.16%	Elcor mines, mill and blending plant, Kuruman district, North Cape Province	Crocidolite 48,000 tpa of fibre	Wholly-owned Elcor Investments, through its Merencor Asbestos Mines (Pty) Ltd. and Coretsi Asbestos (Pty) Ltd. owns operating mines at Eldoret and Coretsi in the Kuruman district
		Riries blending plant supported by Asbes, Bretby, and Riries mills taking ore from a number of small mines	Crocidolite 32,000 tpa of fibre Elcor and Riries blending plants produce 4 grades of crocidolite — long, medium-long, medium, and medium short (5mm to 25mm)	Wholly-owned Griqualand Asbestos (Pty) Ltd. works an asbestos mine near Kuruman and its subsidiary Griqualand Chrysotile Mines (Pty) Ltd. bought the Bute mine near Vryburg from Dublin Consolidated Asbestos Mines (Pty) Ltd.
		Whitebank mine and mill supplying the Central blending plant, Cape Province	Crocidolite 30,000 tpa of fibre	Whitebank and Klipfontein operations recently acquired from Asbestos Investments, a subsidiary of the Belgium-based Eternit group, which operated under the name Kuruman Cape Blue Asbestos (Pty) Ltd.
		Klipfontein mine and mill supplying the Owendale blending plant, Cape Province	Crocidolite 18,000 tpa of fibre	
		Pomfret mine, mill, and blending plant, northern Cape Province	Crocidolite 70,000 tpa of fibre	Pomfret and Penge operations recently acquired from Transvaal Consolidated Land and Exploration Co. Ltd.
		Penge mine, mill, and blending plant, eastern Transvaal	Amosite 90,000 tpa of fibre	These mines were respectively operated by Cape Blue Mines Ltd. and Egnep Ltd.
Msauli Asbestos Ltd.	General Mining Union Corporation Ltd.	Msauli mine, mill, and blending plant, Msauli, Barberton district, eastern Transvaal	Chrysotile 100,000 tpa of fibre Groups 5-7 but mainly Group 6	African Chrysotile Asbestos Corporation is Gencor's wholly-owned holding company for Msauli Asbestos
Duiker Exploration Ltd.	Lonrho Ltd.	Wandrag mine and mill, Kuruman district, Cape Province	Crocidolite 9,000 tpa of fibre	
		Emmarentia mine and mill, Cape Province	Crocidolite 1,000 tpa of fibre	
Kaapsehoop Asbestos (Pty) Ltd.	—	Mine at Joubertsdal in Nelspruit district	Chrysotile 10,000 tpa of fibre Grades 3, 4T, 5R	Small independent operation with sales by Southern Asbestos Sales (Pty) Ltd.
Anglo Dutch Exploration and Mining Co. (Pty) Ltd.	—	Stella mine near Kaapsehoop in Nelspruit District	Chrysotile 4,200 tpa of fibre Grades 6D and shorter	Small operation for local market — friction materials, paints, floor tiles, filtration
Zimbabwe Shabanie and Mashaba (Pvt) Ltd. (SMM)	Turner and Newall Ltd.	Shabanie mine and mill, Shabanie, Victoria Gaths mine and Temeraire mill, Mashaba, Victoria	Chrysotile 2.4m. tpa of ore 2.44m. tpa of ore	Combined chrysotile production capacity is around 250/300,000 tpa of fibre. Production predominantly comprises Groups 3 and 4 grades of fibre. Approximately 50% of world textile asbestos fibre comes from these mines
DSO Asbestos (Pvt) Ltd.	Industrial Development Corporation	King mine and mill, Mashaba, Victoria		
		Mashaba, Victoria	Chrysotile 6,000 tpa of fibre Groups 4 and 5	Underground mining ceased in 1978. Current output is based on ore dumps from SMM

<i>Company</i>	<i>Ownership</i>	<i>Mine/plant location</i>	<i>Products/capacity</i>	<i>Remarks</i>
Swaziland Havelock Asbestos Mines (Swaziland) Ltd.	Turner and Newall Ltd. 60%, Swaziland govern- ment 40%	Mine and mill at Bulembu, northwest Swaziland	Chrysotile 35,000 tpa of fibre High proportion of Groups 3 and 4 plus some shorter fibre	Milled fibre product is sent via 22 km long cable to South Africa Barberton and exports sent through Maputo or Durban
EUROPE				
Italy Amiantifera di Balangero SpA	Eternit Group of Switzerland	The Balangero open pit and mill, San Vittore, northwest of Turin	Chrysotile 200,000 tpa of fibre Groups 4-7	Leading producer of asbestos in Europe
Greece Asbestos Mines of Northern Greece SA	Hellenic Industrial Development Bank (ETBA) 91.5%, IFC 8.5%	Mine and mill at Zidani, south of Kozani town	Chrysotile 5m. tpa of ore 100,000 tpa of fibre Groups 4-7	Finally started production in late 1981 and expect to pro- duce 75,000 tonnes in 1982 of which 29% will be sold in Greece
Cyprus The Cyprus Asbestos Mines Ltd	—	Open pit mine and mill at Pano Amiandos in the Troodos Mountains	Chrysotile 35,000 tpa of fibre Groups 4-7 but mainly 4 and 5	Production in 1980 was 34,000 tonnes and about 27,000 tonnes in 1981
Yugoslavia Mines and Industry of Asbestos-Chemical Products "Jugoazbest"	State	The Korlace mine	Chrysotile 4,000 tpa of fibre	Mine undergoing recon- struction to increase output to 12,500 tpa
Stragari Asbest mine	State	Operation located at Bogutoyo, Stragari, Serbia	Chrysotile 15,000 tpa of fibre	
Turkey Bilfer Maden Ltd.	Bilgin Group	Cavdar mine, Sivas, eastern Turkey	Chrysotile 1,500 tpa of fibre Groups 4-7	Essentially a pilot plant operation being increased to 5,000 tpa during 1982 to supply domestic asbestos cement market. By 1984 Bilfer hopes to start on a 80-100,000 tpa project. Pro- duction to date — 300 tons
Amyant Sanayi AS	Unimeks Yatirim ve Finansman AS	Mine and mill at Mihalliççik Tatarcik, Eskişehir	Tremolite asbestos 30,000 tpa of ore 3,000 tpa of fibre Groups 5-7	Current production is around one third capacity for floor covering, adhesives, and insulation
ASIA				
India Hyderabad Asbestos Cement Products Ltd.	—	Mine and mill at Roro, Bihar state	Chrysotile 2,000 tpa of fibre Groups 5-7	Supply domestic market and manufactures asbestos cement products
Pratap Commercial Co. (Pvt) Ltd.	—	Nine mines in Udaipur and Beawer Districts of Rajasthan (open pit and underground)	Anthophyllite and tremolite asbestos 4,000 tpa of fibre Equivalent to Groups 4-7	Output in 1980 approxi- mately 2,500 tonnes
South Korea		Kwangchon and Hong- song mines, Hongsong- gun, 90 miles east of Seoul	Chrysotile 14,000 tpa of fibre Average 5mm in length	
Japan Nozawa Asbestos Cement Company	—	Furano, Hokkaido	Chrysotile 18,000 tpa Mainly short fibres	For asbestos cement production
Yamabe Asbestos Company Ltd.	—	Yamabe, Hokkaido	Chrysotile 4,500 tpa of fibre Groups 6-7	For asbestos cement production. Current output from Japanese mines is around 8,000 tpa
Australia Woodsreef Mines Ltd.	Transpacific Asbestos Inc. 58.57% (formerly Woodsreef Minerals Ltd. of Alberta, Canada)	Wood's Reef mine and mill, near Barraba, New South Wales	Chrysotile 95,000 tpa of fibre Groups 4-7	Operations are carried out by wholly-owned Chrysotile Corporation of Australia Pty Ltd. Output in 1980 — 83,466 tonnes

<i>Company</i>	<i>Ownership</i>	<i>Mine/plant location</i>	<i>Products capacity</i>	<i>Remarks</i>
USSR Uralsbest Combine	State	Asbest, about 30 miles east of Sverdlovsk in the south-central Urals. Mine and 6 mill complex	Chrysotile 1.56m. tpa of fibre Accounts for about 51% of Soviet capacity (reported to have lost 500,000 tpa capacity at 2 mills during 1980)	Construction of another mill with a reported capacity of 340,000 tpa is being planned. Output in 1980 — 1.27m. tonnes
Dzhetygara Combine	State	Dzhetygara, northwest Kazakhstan, about 300 miles south of Sverdlovsk in southern Urals	Chrysotile 750,000 tpa of fibre Accounts for about 25% of Soviet capacity	Two mills in operation — the first built in 1965 with 350,000 tpa capacity and the second built 1975 with 400,000 tpa capacity. Output in 1980 — 640,000 tonnes
Kiembay Combine	State in conjunction with 33% financial participation from Bulgaria, Hungary, East Germany, Poland, Rumania, and Czechoslovakia	Located about 90 miles east-south-east of Orsk in Orenburg Province in the southern Urals	Chrysotile 500,000 tpa of fibre Accounts for about 16% of Soviet capacity	Two mills recently built, the first in 1979 which produced 130,000 tonnes in 1980 and the second was completed at end of 1980. 12 annual instalments of 170,000 tonnes to be sent to the 6 participating nations, and possibly for a further 10 years
Tuvaasbest Combine	State	Located near Ak-Dovurak in south-central	Chrysotile 240,000 tpa of fibre Accounts for about 8% of Soviet capacity	Two mills with equal capacity of 120,000 tpa each constructed in 1964 and 1976. Output in 1980 — 110,000 tonnes

China

The majority of Chinese chrysotile asbestos production is accounted for by nine mines of which the Shimien open pit and underground operation in Sichuan Province is the largest. Close to Shimien is another large deposit at Pengshien. The next largest mining area is in the district of Laiyuan, Hebei Province where open pit mining is carried out. Other mines are the open pit mine at Mangai, Quinghai Province; underground operations at Jinzhou and Chaoyong, Liaoning Province; open pit workings at Shennan in Shensi Province and underground and open pit operations at Lilang, also in Shensi Province. Another asbestos mine is worked at Taan in Shaanxi Province. Although production capacities of these various operations are not known total production of asbestos in China in 1980 was around 250,000 tonnes, all of which was apparently of the chrysotile variety.

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Table 3.—U.S. asbestos consumption by end use, grade, and type
(Metric tons)

	Chrysotile										Total asbestos
	Grade 1 and 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Total chrysotile	Crocidolite	Anthro- phyllite	
1959	100	8,800	16,200	107,300	52,800	131,000		322,000	35,700	1,500	369,200
Asbestos-cement pipe			81,700	29,800	4,300	3,900		119,700	21,100	200	141,000
Asbestos-cement sheet				100	4,200	3,500		7,900			7,900
Friction products		100		31,500	200	51,500		83,300			83,300
Refractory products		100	300	100	3,900	27,100		32,400		300	33,000
Packing and gaskets		800	2,300	6,200	100	2,800		12,200	110		12,300
Insulation											
Thermal			100	100	700	3,300		4,100			4,100
Electrical		200				2,600		2,800			2,800
Friction products		500	2,100	11,200	4,700	22,000		40,500			40,500
Coatings and compounds			100		100	10,000		10,200			10,200
Plastics	200			400		800		1,400	100		1,500
Refractories	200	1,700						1,900			1,900
Other		200	300	2,500	100	4,600		9,100	100		9,200
Total	100	3,000	80,900	89,500	19,800	172,300		392,600	21,400	1,700	415,700

Table 3.—U.S. asbestos distribution by end use, grade, and type, 1977
(Short tons)

	Chrysotile							Total chrysotile	Crocidolite	Amosite	Antho- phyllite	Total asbestos
	Grade 1 & 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8					
Asbestos-cement pipe	---	---	86,500	41,000	3,000	---	---	131,100	25,400	3,000	---	159,500
Asbestos-cement sheet	---	---	6,000	14,100	11,200	---	---	42,300	---	1,200	---	43,500
Flooring products	2,700	---	---	67,500	100	84,103	---	154,400	---	---	---	154,400
Roofing products	---	---	300	3,500	14,900	41,500	---	63,200	100	---	---	63,400
Packing and gaskets	300	3,100	3,900	13,800	1,500	5,000	---	27,600	100	---	---	27,700
Insulation	---	---	---	---	---	---	---	---	---	---	---	---
Thermal	---	---	1,700	500	400	8,400	5,500	16,500	---	---	---	16,500
Electrical	---	---	200	2,200	1,000	300	---	3,700	---	---	---	3,700
Friction products	100	1,000	2,500	30,100	10,900	45,400	300	90,900	---	---	700	91,600
Coatings and compounds	---	---	200	400	1,100	31,100	---	32,800	---	---	---	32,800
Textiles	---	---	100	---	---	5,900	---	6,000	900	---	---	6,900
Tramp	1,100	8,400	200	1,500	16,700	4,500	---	32,800	---	---	---	32,800
Paper	---	---	---	---	---	---	---	---	500	---	---	500
Other	100	200	1,000	4,000	7,000	19,500	---	31,300	---	---	2,000	33,300
Total	4,300	15,800	101,800	180,000	75,300	227,600	300	637,600	27,000	4,200	2,700	671,500

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Table 4.-U.S. asbestos consumption by end use, grade, and type (Revised Dec. 82)
(100 metric tons)

	Grades 1 2 3	Chrysotile							Total	Crocidolite	Amosite	Total asbestos
		Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10				
1977:												
Asbestos-cement pipe-----	--	--	681	328	24	--	--	--	1,033	112	5	1,150
Asbestos-cement sheet-----	--	--	51	89	71	58	--	--	269	--	1	270
Flooring products-----	26	--	--	656	1	817	--	--	1,500	--	--	1,500
Roofing products-----	--	--	3	40	165	492	--	--	700	--	--	700
Packing and gaskets-----	3	31	39	139	15	50	--	--	277	--	--	277
Insulation:												
Thermal-----	--	17	5	4	84	55	--	--	165	--	--	165
Electrical-----	--	2	--	22	10	3	--	--	37	--	--	37
Friction products-----	1	11	15	189	69	285	--	--	570	--	--	570
Coatings and compounds-----	--	--	2	4	11	341	--	--	358	--	--	358
Plastics-----	--	1	--	11	--	63	--	--	75	5	--	80
Textiles-----	11	84	2	--	--	97	--	--	97	--	--	97
Paper-----	--	--	5	3	48	14	--	--	70	3	--	73
Other-----	3	12	281	376	280	486	--	--	1,438	--	--	1,438
Total-----	44	158	1,084	1,861	778	2,864	6,589	120	6	6,715		

Table 4.-U.S. asbestos consumption by end use, grade, and type (Revised Dec. 82)
(100 metric tons)

	Chrysotile							Crocidolite	Amosite	Total asbestos
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7			
1970:										
Asbestos-cement pipe-----	--	--	--	587	283	20	--	890	158	10
Asbestos-cement sheet-----	--	--	--	46	81	65	53	245	--	2
Flooring products-----	24	--	--	--	603	1	752	1,380	--	1,058
Roofing products-----	--	--	--	2	37	152	452	643	--	247
Packing and gaskets-----	3	--	28	36	127	14	46	254	--	1,380
Insulation:										643
Thermal-----	--	--	16	5	4	79	51	155	--	254
Electrical-----	--	--	2	--	22	10	3	37	--	155
Friction products-----	1	--	10	14	175	64	262	526	--	37
Coatings and compounds-----	--	--	--	2	4	10	312	328	--	526
Plastics-----	--	--	1	--	10	--	56	67	7	328
Textiles-----	10	--	75	2	--	--	--	87	--	74
Paper-----	--	--	--	4	3	44	13	64	--	87
Other-----	4	--	12	293	345	250	426	1,330	4	68
									--	1,330
Total-----	42	144	991	1,694	709	2,426	169	6,006	12	6,187

Table 4.-U.S. asbestos consumption by end use, grade, and type (Revised Dec. 82)
(100 metric tons)

	Chrysotile							Crocidolite	Amosite	Total asbestos
	Grade									
	1 & 2	3	4	5	6	7	Total			
1979:										
Asbestos-cement pipe-----	--	--	545	263	19	--	827	127	4	959
Asbestos-cement sheet-----	--	--	42	74	59	48	223	--	1	224
Flooring products-----	21	--	--	546	1	682	1,250	--	--	1,250
Roofing products-----	--	--	2	33	138	410	583	--	--	583
Packing and gaskets-----	3	26	32	115	12	42	230	--	--	230
Insulation:										
Thermal-----	--	14	4	3	72	47	140	--	--	140
Electrical-----	--	2	--	20	9	3	34	--	--	34
Friction products-----	1	9	12	158	58	238	476	--	--	476
Coatings and compounds-----	--	--	2	3	9	283	297	--	--	297
Plastics-----	--	1	--	9	--	51	61	6	--	67
Textiles-----	9	67	2	--	--	--	78	--	--	78
Paper-----	--	--	4	3	40	12	59	3	--	62
Other-----	4	12	257	314	228	391	1,206	--	--	1,206
Total-----	38	131	902	1,541	645	2,207	5,464	136	5	5,605

Table 4.-U.S. asbestos consumption by end use, grade, and type (Revised Dec. 82)
(100 metric tons)

	Chrysotile							Total	Amosite	Total asbestos
	Grade 1 & 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 7			
1980:										
Asbestos-cement pipe-----	--	--	215	79	13	9	316	71	3	390
Asbestos-cement sheet-----	--	--	--	3	125	101	229	--	1	230
Flooring products-----	--	1	--	279	1	419	700	--	--	700
Roofing products-----	--	1	3	1	35	200	240	--	--	240
Packing and gaskets-----	--	8	23	63	1	28	123	--	--	123
Insulation:										
Thermal-----	--	--	1	--	7	52	60	--	--	60
Electrical-----	--	2	--	1	--	26	29	--	--	29
Friction products-----	--	5	25	169	56	265	520	--	--	520
Coatings and compounds-----	--	--	1	--	1	107	109	--	--	109
Plastics-----	2	--	--	3	--	7	12	3	--	15
Textiles-----	2	17	--	--	--	--	19	--	--	19
Paper-----	--	--	--	2	1	--	3	2	--	5
Other-----	--	5	647	343	10	142	1,147	--	--	1,147
Total-----	4	19	915	943	250	1,355	3,507	76	4	3,587

Table 4.-U.S. asbestos consumption by end use, grade, and type (Revised Dec. 82)
(100 metric tons)

	Chrysotile							Crocidolite	Amosite	Total asbestos
	Grades 1 & 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Total			
1981:										
Asbestos-cement pipe-----	--	--	203	74	3	--	280	70	--	350
Asbestos-cement sheet-----	--	1	3	28	28	136	196	3	1	200
Flooring products-----	--	--	--	4	--	666	670	--	--	670
Roofing products-----	--	1	2	6	37	114	160	--	--	160
Packing and gaskets-----	--	10	16	52	1	114	193	--	--	193
Insulation:										
Thermal-----	--	--	2	--	--	58	60	--	--	60
Electrical-----	--	3	--	--	--	3	6	--	--	6
Friction products-----	--	--	12	151	62	285	510	--	--	510
Coatings and compounds-----	--	--	1	3	11	116	131	--	--	131
Plastics-----	1	1	--	3	--	6	11	--	--	11
Textiles-----	--	17	--	--	--	--	17	--	--	17
Paper-----	--	1	--	4	9	3	17	2	--	19
Other-----	--	4	576	224	54	297	1,155	--	6	1,161
Total-----	1	38	815	549	205	1,798	3,406	75	7	3,488