Asbestos

By Robert A. Clifton [1]

Shipments of asbestos from mines in the United States decreased 12% from those in 1974. There was no decrease in demand for domestic asbestos; all the operating mines were producing at capacity. The decrease in total production was because mines that closed in 1974 had some production that year before closing. Imports were only 70% of those in 1974. The Canadian strike was the principal causative agent for this, but demand also dropped some during the recession.

Canada relinquished, at least temporarily, its claim as the world's primary producer of asbestos. Canadian 1975 production was only 63% of that in 1974 and its shipments to the U.S. only 68% of those in 1974. Imports from the U.S.S.R. were nearly 2% of the total U.S. imports.

Table 1.—Salient asbestos statistics

	1971	1972	1973	1974	1975
United States:					
Production (sales) ____ short tons __	130,882	131,663	150,116	112,533	98,654
Value _____ thousands __	$12,174	$13,409	$16,288	$13,759	$14,220
Exports and reexports (unmanufactured) ___ short tons __	53,678	58,624	66,442	61,723	36,447
Value _____ thousands __	$7,863	$9,051	$9,342	$9,192	$10,667
Exports and reexports of asbestos products (value) _____ thousands __	$31,409	$32,110	$40,777	$60,396	$60,776
Imports for consumption (unmanufactured) ___ short tons __	681,367	735,515	792,473	766,164	538,553
Value _____ thousands __	$80,090	$87,732	$98,914	$123,822	$111,011
Released from stockpile (unmanufactured) ___ short tons __	10,210	13,174	6,761	28,851	6,877
Consumption, apparent [1] _ short tons __	768,781	821,728	882,908	845,825	607,637
World: Production _____ do ____	3,951,373	4,163,675	r 4,613,717	r 4,588,760	4,508,985

r Revised.
[1] Measured by quantity produced, plus imports, plus stockpile release, minus exports.

Legislation and Government Programs.—The event of 1975 with the most potential for impact on the asbestos industry was the proposed regulations published by the Office of Safety and Health Administration (OSHA) on October 9, 1975, in the Federal Register. The proposal contained no mandatory effective date. The most important change in the regulations as proposed would be a reduction in the level of permissible exposure to 0.5 fiber per cubic centimeter of air on a time-weighted average over an 8-hour day. The present permissible level is 5.0 fibers per cubic centimeter due to drop to 2.0 fibers on July 1, 1976.

The proposal excluded those activities where exposure came during construction and provides additional requirements for regulated areas, employee rosters, hygiene facilities, training and information programs, labels and signs, and monitoring and medical surveillance programs.

The asbestos industry applied for and received an extension of the closing time for receipt of comments and raised strong objections to the proposed regulations.

Less than a week after the publication of the OSHA proposal, the Environmental Protection Agency (EPA) promulgated, on

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October 14, new air pollution control regulations. These require generators of asbestos-containing wastes to dispose of them in sanitary landfills. Inactive sites are now regulated and owners must provide such sites with 6 inches of vegetated cover or 2 feet of cover without vegetation. Incineration of asbestos containers is permitted provided that there are no visible emissions.

Drawdown of stockpile inventories continued as shown in table 2. Crocidolite stocks are practically depleted, and there was at least a temporary stop to chrysotile releases.

On September 25 the House of Representatives voted down (209 to 187) H.R. 1287, which would have repealed the Byrd Amendment that permits U.S. purchases of Rhodesian asbestos.

Table 2.—Stockpile objectives and Government inventories as of December 31
(Short tons)

	Stockpile objectives	Total inventories		Released 1975
		1974	1975	
Amosite	None	46,593	42,815	3,778
Chrysotile	1,100	10,455	10,455	--
Subspecification	XX	1,153	500	653
Crocidolite	None	2,478	32	2,446
Total	XX	60,679	53,802	6,877

XX Not applicable.

Environmental Impact.—It is impossible to completely assess the impact on the asbestos industry of environmental regulations. The market shortages occasioned by the Canadian strike, when coupled with increasing regulation, intensified the efforts of several companies to find substitutes for asbestos in their products. The return of a normal market situation may indeed indicate that some market segments are lost to asbestos.

The effects of environmental regulations on the asbestos mining industry are still hard to judge. The Vermont Asbestos Group Inc., expects to be in full compliance with EPA regulations in the spring of 1976 without undue economic hardship. A group of West German and American investors bought and is refurbishing the Copperopolis, Calif., mine closed in 1974 by H. K. Porter Co., Inc. This group, Calaveras Asbestos Ltd., fully expects to operate profitably under full compliance.

DOMESTIC PRODUCTION

U.S. mines shipped only 88% as much asbestos in 1975 as in 1974. The value was 3% higher than the 1974 amount. Four States produced asbestos; California was the leader, followed in order by Vermont, Arizona, and North Carolina. Total output was 98,654 tons valued at $14,220,000.

The California segment of the asbestos industry again reported a decline in production. The full effect of the closing of the Coalinga Asbestos Co.'s Christie mine and that of the Pacific Asbestos Corp. mine was felt in 1975. These mine closures resulted in a production of only 97% of the 1974 State total. However, an increase of 6% over the 1974 dollar value of the fiber was realized. By yearend Calaveras Asbestos Ltd. was successful in the acquisition of the Pacific Asbestos mine. Production was scheduled to begin early in 1976. Yearend mining was limited to the Joaquin Ridge near Coalinga with Atlas Asbestos Corp. working its Santa Cruz mine in Fresno County and Union Carbide Corp. operating its Santa Rita mine in San Benito County.

The Vermont Asbestos Group Inc. mine in Orleans County, Vt., remained the U.S. asbestos mine with the highest production, although its output decreased significantly from that in 1974. This mine was scheduled for closure by GAF Corp. in March of 1975 but was purchased by an employee group, which has been highly successful in efforts to keep it operating. Arizona production in 1975 was 62% above the 1974 level. The Jaquays Mining Corp. mine in Gila County was the only active asbestos

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mine in the State. The mine of North Carolina's Powhatan Mining Co. was inactive, but some 540 tons of anthophyllite were mined and shipped from somewhere in the United States in 1975. Indications are that it was from North Carolina. U.S. asbestos producers and mine sites follow:

State and company	County	Name of mine	Type of asbestos
Arizona: Jaquays Mining Corp	Gila	Chrysotile	Chrysotile.
California:			
Atlas Asbestos Corp	Fresno	Santa Cruz	Do.
Calaveras Asbestos Ltd.[1]	Calaveras	Copperopolis	Do.
Union Carbide Corp	San Benito	Santa Rita	Do.
North Carolina: Powhatan Mining Co.[2]	Yancey	Hippy	Anthophyllite.
Vermont: Vermont Asbestos Group Inc.	Orleans	Lowell	Chrysotile.

[1] Closed during 1975; due to open early 1976.
[2] Inactive.

CONSUMPTION AND USES

Further analysis of the data available from the 1974 asbestos consumption survey reveals that 18,000 tons of asbestos were released from industry stocks and not replaced during 1974 and that the true (rather than apparent) consumption figure for that year would be 864,000 tons. Industry stocks at the end of 1974 were 103,000 tons.

Analysis of the 1975 consumption data reveals the fact that in spite of the very real shortages of 1975, industry stocks were slightly higher at yearend than at the beginning. True consumption would be somewhat less than 600,000 tons.

Comparisons between the end uses for 1974 and 1975 would seem to be an exercise in futility because of the inability to distinguish between decreased asbestos product production caused by fiber shortage and that caused by economic recession. It is extremely interesting to note that "textile fiber" imports in 1975 were only 30% of those in 1974. Whether this is trend indicative or not will have to await data from more normal years.

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Table 3.—Asbestos distribution by end use, grade, and type, 1975

(Short tons)

	Chrysotile								Crocidolite	Amosite	Anthophyllite	Total asbestos
	Group 1 and 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Total chrysotile				
Asbestos cement pipe	--	2,300	90,200	31,700	--	2,500	--	126,700	21,200	5,300	--	153,200
Asbestos cement sheet	--	100	6,000	6,500	19,400	6,500	--	38,500	--	5,400	100	44,000
Flooring products	--	--	--	100	--	135,700	--	135,800	--	--	--	135,800
Roofing products	--	--	1,500	4,300	8,900	31,000	--	45,800	--	600	--	46,400
Packing and gaskets	200	700	3,100	7,600	400	4,800	--	16,800	100	--	--	16,900
Insulation, thermal	--	--	400	300	2,700	700	--	4,100	--	500	--	4,600
Insulation, electrical	--	--	100	100	--	1,200	--	1,400	--	--	--	1,400
Friction products	--	2,900	800	22,000	6,100	23,100	200	65,100	--	500	500	66,100
Coatings and compounds	200	900	800	100	100	29,400	--	31,500	--	--	--	31,500
Plastics	--	200	800	1,000	--	11,700	--	13,700	1,200	--	--	14,900
Textiles	700	5,200	100	100	--	--	--	6,100	--	--	--	6,100
Paper	--	100	5,000	1,400	30,500	28,700	--	65,700	200	--	--	65,900
Other	--	1,300	1,600	2,600	4,700	9,300	--	19,500	--	500	800	20,800
Total	1,100	13,700	110,400	77,800	72,800	294,700	200	570,700	22,700	12,800	1,400	607,600

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In 1975 asbestos cement pipe was still the largest single use for asbestos with better than 25% of the consumption. Asbestos cement sheet was the sixth largest use at over 7%. Flooring products at 22% was second. If the near 8% used in roofing products is added to the previously mentioned three uses, these construction industry products still account for nearly two-thirds of U.S. asbestos use. The other major asbestos-containing end products are friction materials at 10.9%, paper at 10.8%, and coatings and compounds at 5.2%. Plastics used better than 2% of the asbestos total.

PRICES

Quoted prices for Quebec asbestos rose more than 23% during 1975 with the last rise effective on December 1, 1975. British Columbia asbestos prices rose more than 30% during the year in two steps, the last one effective August 1, 1975.

Prices for some grades of Arizona chrysotile asbestos were raised on April 17, 1975. Quotations, f.o.b. Globe, were as follows:

Grade	Description	Per short ton
Group No. 1	Crude	$2,000
Group No. 2	---- do	1,500
AAA		1,100
Group No. 3	Nonferrous filtering and spinning	$715– 800
Group No. 4	Nonferrous plastic and filtering	700– 800
Group No. 7	White shorts	100– 200

As of June 16, 1975, Vermont chrysotile asbestos, f.o.b. Morrisville, was priced as follows:

Grade	Description	Per short ton
4A through 4T	Fiber	$360–$608
5D through 5R	---- do	238– 280
6D	Waste	173
7D through 7T	Shorts	77– 150
7TF	Floats (shorts)	66
8S	Shorts	53
Hooker No. 1	Packaged in 50-pound woven polyvinyl bags	850
Hooker No. 2	Packaged in 100-pound woven polyvinyl bags	425

Quotations for Canadian (Quebec) chrysotile, f.o.b. mine, were as follows, as of December 1, 1975:

Grade	Description	Per short ton
Group No. 1	Crude	Can$3,496
Group No. 2	---- do	1,879
Group No. 3	Spinning fiber	Can$891–1,463
Group No. 4	Asbestos-cement fiber	492– 829
Group No. 5	Paper fiber	278– 392
Group No. 6	Waste, stucco, or plaster	236– 244
Group No. 7	Refuse or shorts	89– 198

Prices for British Columbia and Yukon Territory, Canada, chrysotile asbestos were effective August 1, 1975. Quotations, f.o.b. Vancouver, were as follows:

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Grade	Description	Per short ton
Cassiar mine:		
C–1	Crude	Can $2,916
AAA	Nonferrous spinning fiber	1,685
AA	---- do	1,340
A	---- do	1,020
AC	---- do	785
AK	Asbestos cement fiber	524
AS	---- do	454
AX	---- do	416
AY	---- do	292
AZ	---- do	216
Clinton mine:		
CP	---- do	492
CT	---- do	445
CY	---- do	292
CZ	---- do	216

African asbestos producers privately negotiate sales and this rules out market quotations. The following are averages, regardless of grade, of the values of South African imports, calculated from U.S. Department of Commerce data:

Type	Per short ton				
	1971	1972	1973	1974	1975
Amosite	$164	$187	$188	$228	$395
Crocidolite	212	211	213	251	427
Chrysotile	120	202	234	282	940

The increased demand for and unavailability of asbestos in all categories plus increased mining costs resulted in price increases almost across the board. Other price rises are expected early in 1976.

FOREIGN TRADE

The value of exports of asbestos products manufactured in the United States showed little change from 1974 to 1975. This is noteworthy when numbers of articles exported decreased. There were more than 1,000,000 fewer clutch facings shipped abroad in 1975 than in 1974.

Major groupings of exported products and their share of the total value were friction products (36%), packing and gaskets (20%), asbestos cement products (13%), textiles and yarns (12%), and insulation products (8%).

In 1975, 64% of the cost of imported asbestos was recovered by the exporting and reexporting of fibers and products.

In 1975 the United States imported 89% of its asbestos consumption. This was below the 1974 percentage. Canada provided better than 93% of the imports, the Republic of South Africa provided 3%, the U.S.S.R. 2%, and nine other countries provided the remainder. Chrysotile, with 97%, dominated the imported types. The dollar value of imported fibers was 90% of that in 1974.

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Table 4.—U.S. exports and reexports of asbestos and asbestos products

Products	1974 Quantity	1974 Value (thousands)	1975 Quantity	1975 Value (thousands)
EXPORTS				
Unmanufactured:				
Crude and spinning and nonspinning fibers short tons	22,633	$6,069	15,173	$6,067
Waste and refuse do	32,481	2,574	19,748	3,992
Total do	55,114	8,643	34,921	10,059
Products:				
Gaskets and packing do	3,235	12,582	2,643	12,401
Brake linings do	5,924	10,136	4,856	9,374
Clutch facings, including linings number	2,429,537	2,503	1,359,914	1,598
Textiles and Yarn short tons	9,465	8,408	5,732	7,284
Shingles and clapboard do	12,345	3,348	14,277	4,649
Articles of asbestos cement do	31,275	7,715	18,952	7,628
Protective clothing	NA	556	NA	810
Insulation, heat and sound	NA	4,541	NA	5,072
Manufactures, n.e.c	NA	10,467	NA	11,740
Total	XX	60,256	XX	60,556
REEXPORTS				
Unmanufactured:				
Crude and spinning and nonspinning fibers short tons	2,129	548	1,391	573
Waste and refuse do	4,480	1	135	35
Total do	6,609	549	1,526	608
Products:				
Gaskets and packing do	5	17	2	21
Brake linings do	34	39	127	145
Clutch facings, including linings number	14,504	21	27,645	16
Textiles and yarn short tons	47	12	1	11
Shingles and clapboard do	28	8	--	--
Articles of asbestos cement do	45	5	NA	6
Manufactures, n.e.c	NA	38	NA	21
Total	XX	140	XX	220

NA Not available. XX Not applicable.

Table 5.—U.S. imports for consumption of asbestos from specified countries, by grade

(Short tons)

Grade	1974 Canada	1974 Southern Rhodesia	1974 Republic of South Africa	1975 Canada	1975 Southern Rhodesia	1975 Republic of South Africa
Chrysotile:						
Crudes	115	1,717	987	71	1,633	940
Spinning fibers	26,768	4	66	7,637	382	115
All other	712,228	--	3,291	495,837	608	1,457
Crocidolite (blue)	--	--	11,302	--	--	11,570
Amosite	--	--	8,018	--	--	3,894
Total	739,111	1,721	23,664	503,545	2,623	17,976

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Table 6.—U.S. imports for consumption of asbestos (unmanufactured), by class and country

Year and country	Crude (including blue fiber)		Textile fiber		All other		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1974								
Brazil	--	--	--	--	20	$2	20	$2
Canada	115	$13	26,768	$10,416	712,228	106,085	739,111	116,514
Finland	--	--	--	--	557	74	557	74
Germany, West	99	35	--	--	1	1	100	36
Italy	--	--	1	4	--	--	1	4
Mexico	--	--	--	--	55	11	55	11
Portugal	--	--	--	--	4	2	4	2
Rhodesia, Southern	1,717	1,010	4	2	--	--	1,721	1,012
South Africa, Republic of	20,307	5,157	66	16	3,291	510	23,664	5,683
Swaziland	480	361	--	--	--	--	480	361
U.S.S.R	--	--	--	--	451	123	451	123
Total	22,718	6,576	26,839	10,438	716,607	106,808	766,164	123,822
1975								
Belgium-Luxembourg	22	3	--	--	48	5	70	8
Canada	71	9	7,637	5,772	495,837	91,791	503,545	97,572
Finland	--	--	--	--	329	33	329	33
Gaza Strip	--	--	--	--	152	26	152	26
Italy	--	--	--	--	197	37	197	37
Mexico	--	--	--	--	73	15	73	15
Mozambique	118	16	--	--	--	--	118	16
Rhodesia, Southern	1,633	1,521	382	369	608	380	2,623	2,270
South Africa, Republic of	16,404	7,147	115	100	1,457	459	17,976	7,706
Swaziland	2,756	952	--	--	--	--	2,756	952
U.S.S.R	4,525	921	--	--	5,854	1,361	10,379	2,282
United Kingdom	277	83	--	--	58	11	335	94
Total	25,806	10,652	8,134	6,241	504,613	94,118	538,553	111,011

WORLD REVIEW

The following quote,[2] from an in-depth article in a Canadian mining periodical, fairly well describes what happened to Canadian production in 1975, which left much of the world demand unsatisfied:

"Inflation, recession, landslides and strikes have contributed to a troubled year for a large segment of the asbestos industry. Environmentalists and the media have damaged the image of this extremely important mineral. In spite of all this, the industry is shaking off the effects of these unforeseen mishaps and conditions and should end the year alive and well—and in a position to resume a normal growth pattern."

"Canada's position as the world's leading producer has not been challenged and there is no serious rival in sight. This is due, for the most part, to the quality of the chrysotile fibre which makes up the bulk of our production, and the high standard of the marketed products."

Another magazine[3] with worldwide distribution and a less parochial viewpoint put this in context with the world supply-demand situation of the last few years when it said at the beginning of its lead article in June:

"In common with many other industrial minerals (and many other commodities), asbestos experienced extremely strong demand throughout 1974, which was reflected in higher prices, shortages in certain areas, and producers operating at capacity levels. This year's recession in Western industry appears to have taken the heat out of the majority of mineral markets, however, with significant falls in both demand and prices. Not so asbestos! Demand continues to exceed supply, and after price rises averaging over 50% between the end of 1973 and the beginning of 1976, yet another rise is expected shortly—and all this even though two of asbestos' major consuming areas—the construction and the motor manufacturing industries—are operating at low levels. This paradox cannot be explained simply. The continuing short supply has in fact been brought about

[2] Northern Miner. Asbestos Weathers Storm. V. 61, No. 37, Nov. 27, 1975, p. B–12.
[3] Industrial Minerals. Asbestos. No. 93, June 1975, pp. 19–24, 26–31, 33.

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by a combination of factors—producer problems, ranging from a fire and landslide to strikes and other political pressures; supply problems, such as shipping difficulties and the like; and continuing strong demand, particularly from the developing countries. In addition, the whole industry from mining to manufacturing, is undergoing extensive changes as new and wider controls are introduced to counter the much-publicized health hazards associated with asbestos usage."

As expected there were significant price increases for asbestos in 1975 led by an approximate 23% rise in the published prices of Quebec fibers.

Australia.—The Woodsreef mine seems to be turning the corner toward solvency. There was very little deficit in the quarter ended October 31, 1975. If production were maintained at that quarter's rate, the annual production of asbestos fibers would near 60,000 tons. The company has identified four other asbestos prospects in New South Wales and applied for exploration licenses for them.

Canada.—Canadian asbestos production (all chrysotile) during 1975 was only 63% of that during 1974. The economic recession of that year was not to blame as producers sold all of their production that was available after a fire, a landslide, and a strike.

The bad year began, actually, in December 1974 when the fire that destroyed the King-Beaver mill of Asbestos Corp. Ltd. in Thetford Mines reduced that company's capacity for fiber production from 150,000 to 100,000 tons per year in that locality. Reserve updating was necessary prior to mill replacement planning. As a strike prevented the needed drilling for 7 months, no decision had been made by yearend. The Asbestos Hill mine of Asbestos Corp. Ltd. in Ungava was not bothered by the Thetford Mines misfortunes. It produced 42% more fiber concentrate than in 1974 and shipped 48% more of the concentrate to the mill at Nordenham, West Germany.

The Jeffrey mine of Canadian Johns-Manville Co. suffered a major landslide in January of 1975, which cut shipments for the year to 93% of the 650,000 tons of fiber shipped in 1974. A return to full production was reached in October with record high shipments and another record was set in December. Although the labor contract between Johns-Manville and their employees expired at approximately the same March date as that of other asbestos producers in the area, the union and management agreed to terms before a strike was called.

In March the 3,500 employees of the four companies producing asbestos in the Thetford Mines area struck for higher wages and better working conditions. Although two unions were representing the workers of Asbestos Corp., Ltd., Bell Asbestos Mines Lt., Carey-Canadian Mines, Ltd., and Lake Asbestos of Quebec, Ltd., they had unanimity of purpose and remained on strike for 7 months. The basic hourly wage rose immediately from $3.73 to $5.21 and to $6.59 by September 1, 1977. The Quebec Asbestos Mining Association estimated that the total package would come to about a 45% to 50% increase over the 2-year tenure of the contract.

Advocate Mines, Ltd., announced the finding of a possible asbestos ore body 12 miles from its Baie Verte operation. Diamond drilling was being expedited.

Cassiar Asbestos Corp. Ltd. started operating a new tramline and primary crusher plant at its Cassiar, British Columbia, mine in September. This mine was also the scene of a 3-week strike in early winter of some 400 workers over health and safety conditions.

At yearend the new mine and mill of United Asbestos Inc. at Midlothian Township in Ontario had reached the tuneup stage. Brinco Ltd. at that time had reached a new $260 million estimate of the capital costs of bringing into production the Abitibi Asbestos Mining Co. property in Maizerete Township, Quebec. It was estimated that it would take 3 years to enter full production once the decision to proceed was made. Evaluation and testing of the Chibougamau, Quebec, deposit of the McAdam Mining Corp. were continued by Rio Algom Limited.

On December 15, Acting Environment Minister Romer LeBlanc announced a federal limit of 2 fibers per cubic centimeter in the air surrounding asbestos mining, milling, and dry rock storage areas. He cited the Clean Air Act as authorization.

China, People's Republic of.—An article in a Chinese newspaper[4] describes the Shiehmien (meaning asbestos) mine in Szechwan Province. The mine is described

[4] Takungpao. Asbestos in Szechwan. Aug. 31, 1974, p. 8.

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as having an ore body 6,300 meters long by 350 meters wide containing more than 28 million tons of ore grading over 2%. The use of modern techniques and machinery such as aerial tramways and trucks have increased production from 50 tons to "tens of thousands of tons" (could be per month). The article claims that more than half of the fibers exceed 2 millimeters (0.08 inch) in length. During 1975 China started advertising the availability of such asbestos-containing articles as yarn, packing, lagging, and cloth.

Cyprus.—The 1973 troubles on the Island failed to disrupt Cyprus' production and export of asbestos. The 1974 export figure was nearly 13% above that of 1973.

Finland.—After 58 years of operation the Paakkila anthophyllite mine of Paaristen Kalkki Oy was closed in January. Marketing problems and labor shortages were among the determining factors. The mill remained open through June. Some African anthophyllite mines have developed grades corresponding to the Finnish ones and these are available on the world market.

India.—With assistance from the United Nations Development Program, a new asbestos processing facility was scheduled to be under construction by late 1975 in India. The site was at the Cuddapah area of Andra Pradesh where there was estimated to be reserves of 27,000 tons.

South Africa, Republic of.—Some intriguing indications are to be found in the preliminary 1975 statement of Griqualand Exploration and Finance Co. (Gefco). Their Kiruman mine in Cape Province is reportedly the world's largest source of blue (crocidolite) asbestos with a nominal 55,000-ton annual production in the last few years. They claim a worldwide shortage of "blue" in spite of no sales in the United Kingdom, a looming ban in Canada, and many environmentalists calling crocidolite the most unhealthy of fibers. Gefco shows an astounding 49% rise in unit cost of production, but it is clear that sales have risen substantially over 1974.

Sweden.—Sweden's industrial health board banned the use of asbestos in building insulation, soundproofing, and most other purposes except fireproofing, effective October 1. Action followed findings that eight lung cancer deaths among workers at the Nohab Machine Works in Trollhattan between 1959 and 1969 were attributable to the fact that Nohab used asbestos as an insulating material for locomotive-engine exhaust pipes.

U.S.S.R.—In 1975, asbestos production (six grades) in the U.S.S.R. passed the 2-million-short-ton mark for the first time, surpassed Canadian production for the first time, and the estimated 600,000 tons exported exceeded Canada's exports for the first time. More than half of the exports were to countries other than those with centrally controlled economies in spite of a domestic deficit of an estimated 110,000 tons.

The U.S.S.R. asbestos industry is centered in the Urals, Kazakhstan, and Tuva A.S.S.R. The Uralasbest complex produced an estimated 1.4 million tons in 1975. In the southern Urals the development of the Kiembayev deposit in Oranburg Oblast continued. This effort, underwritten by seven Council for Mutual Economic Assistance (Comecon) members, has a design capacity of 550,000 tons and the first of two equal construction stages is due to begin operation in 1978. Output will be shared with the participating Comecon members.

Kazakhstan has the U.S.S.R.'s second largest asbestos deposit, Dzhetygara, in Kustanay Oblast. Renovation of the No. 1 mill and commissioning of the new No. 2 mill permitted production of about two-thirds of a million tons in 1975.

The high quality, long fiber, deposit at Aktourak in Tuva A.S.S.R. produced about 38,000 tons of asbestos in 1975.

Design of the complex to exploit the Molodeshny deposit in Buryat A.S.S.R. was completed in 1974, but construction will not be started until completion of the western section of the Kaykal-Amur railroad.

Yugoslavia.—Ore from the Stragari mine of Stragari Asbest located at Stragari, Serbia, was tested in the laboratories of the Mining Institute in Zemun during 1975. The new fiber recovery technology developed is being installed and should be in use in 1976. Design production capacity is 5,000 tons of fiber per year.

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Table 7.—Asbestos: World production, by country
(Short tons)

Country [1]	1973	1974	1975 [p]
North America:			
Canada (sales)	1,862,976	1,824,000	1,140,000
Mexico	17	6	29
United States (sold or used by producers)	150,116	112,533	98,654
Latin America:			
Argentina	683	988	[e] 1,000
Brazil	[r] 49,458	68,201	[e] 72,000
Europe:			
Bulgaria	[r e] 14,000	28,000	24,000
Finland [2]	6,985	6,165	3,073
Italy	[r] 165,629	163,251	162,018
Portugal	[e] 140	198	[e] 220
U.S.S.R. [e]	[r] 1,410,000	1,500,000	2,090,000
Yugoslavia	10,352	13,500	14,330
Africa:			
Egypt	363	312	528
Mozambique	624	209	--
Rhodesia, Southern [e]	[r] 180,000	[r] 180,000	[r] 180,000
South Africa, Republic of	[r] 368,435	367,369	391,000
Swaziland	40,675	35,738	41,447
Asia:			
China, People's Republic of [e]	230,000	[r] 165,000	165,000
Cyprus	34,950	30,959	34,835
India	[r] 13,735	21,310	22,654
Japan	9,100	5,710	5,084
Korea, Republic of	6,291	6,294	4,030
Taiwan	5,851	3,964	1,915
Thailand	91	[e] 110	[e] 110
Turkey	[r] 5,264	17,181	17,058
Oceania: Australia	[r] 47,982	37,762	[e] 40,000
Total	[r] 4,613,717	[r] 4,588,760	4,508,985

[e] Estimate. [p] Preliminary. [r] Revised.
[1] In addition to the countries listed, Czechoslovakia, North Korea, and Romania also produce asbestos, but available information is inadequate to make reliable estimates of output levels.
[2] Includes asbestos flour.

TECHNOLOGY

The shortages of asbestos resulting from the Quebec strike, the price increases resulting from this and other inflationary pressures, and the very real problems associated with environmental control of exposure to asbestos put added pressure on the perennial search for asbestos substitutes.

These things were discussed in a national magazine,[5] excerpts from which appear below:

"Our suppliers have a 'spear your friends' policy," said a midwest friction products manufacturer. "Because of that policy many of our materials costs have doubled in the past 12 months."

A New England producer of packing and seals ". . . is studying the use of Teflon and graphite fibers as substitutes for asbestos. He admits 'for the time being asbestos is still a critical material for this company's products.'"

A midwest boiler gasket producer asserts, "Asbestos is close to pricing itself out of the market. Ceramic materials have been around for some time that would replace asbestos in some applications, but in the past they were too expensive. Now they are looking a lot more attractive."

A western manufacturer tried substituting mineral wool and fiberglass in flooring materials but, "We found there's really no replacement for asbestos."

Although the aforementioned article cited the fears of one asbestos cement pipe manufacturer about the convergence of costs of competing products, there is a factor probably overlooked: Energy. An extract in a trade magazine [6] covers the situation well: ". . . recent statistical evaluations carried out in the United States showed that the production of asbestos-cement pipes required only one-eighth of the energy needed to produce a similar length of cast iron pipes and one-quarter of the energy needed for PVC pipes. In

[5] Business Week. The Seller's Market in Asbestos. No. 2411, Dec. 15, 1975, p. 49.
[6] International Asbestos Cement Review. Asbestos-Cement—An Industry in Decline or Facing Further Expansion. Declan Grehan, v. 20, No. 1, January 1975, pp. 27–30.

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this calculation the entire energy consumption was taken into account, that used in the mining of asbestos, crushing and purifying the ore, transporting it and that of asbestos-cement manufacture up to the factory stockyard."

That there is still ongoing effort to substitute glass fiber for asbestos in reinforced cement products is evidenced by the recent agreement between Pilkington Brothers Ltd. of England and Owens-Corning Fibreglas Corp. of the United States. Under the agreement Pilkington will share its know-how of its alkali-resistant glass fiber with its American ally.

The Du Pont Corp. is diligently seeking new markets for its aramid fiber "Nomex," which already has wide acceptance in the protective clothing field and some acceptance as a tire fiber.

According to Chemical Engineering [7] the Japanese Government's decision to outlaw mercury cells in chlor-alkali plants has pushed two companies (one presently using Du Pont's Nafion membranes) into developing their own synthetic membrane diaphragms to replace the asbestos diaphragms of the mercury cells. The fast developing technology is apparently economical as well as environmentally preferable. This market for asbestos fibers may be slowly closing.

A whole family of ceramic fibers is now available according to a national magazine [8] and for temperatures above 1,000° F (811 K) they are excellent insulation materials. Some of the newer ones have service temperatures up to 3,000° F (1,922 K). They are lightweight, flexible, longlived, and expensive. Prices range from $.65 to $25 per pound. Typical properties are shown in table 8.

Not all technological advances have been in the area of asbestos substitutes. Raybestos-Manhattan, Inc. announced a processing sequence that keeps asbestos immersed throughout production of its "Novatex" asbestos yarns. This suppresses

Table 8.—Typical properties of ceramic fibers

Property	Alumina [1]	Alumina-boria-silica [2]	Alumina-chromia-silica [3]	Alumina-silicate [4]	Silica [5]	Zirconia-silica [6]	Zirconia [7]
Specific gravity	3.5	2.5	2.8	2.56	2.0–2.2	3.7	5.5
Melting point ° F	3,600	3,300	3,200	3,200	3,100	3,650	4,900
Melting point K	2,255	2,089	2,033	2,033	1,977	2,283	2,977
Maximum use temperature ° F	2,750	2,370	2,550	2,300	2,400	1,830	2,750
Maximum use temperature K	1,783	1,573	1,673	1,533	1,589	1,273	1,783
Specific heat Btu/lb F	.25	--	--	[8]255	[9]26	--	.14
Specific heat j/kg	1,046	--	--	1,066.9	1,087.8	--	585.8
Tensile strength 1,000 psi	150	250	200	190	100	150	100
Tensile strength MPa	1,034	1,723.8	1,379	1,310.1	689.5	1,034	689.5
Tensile modulus 10^6 psi	15.0	22.0	23.0	16.8	--	14.0	15.0
Tensile modulus 10^5 MPa	1.034	1.52	1.58	1.158	--	.965	1.034
Elongation at break %	--	1.2	1.2	--	--	1.1	--
Mean diameter μm	3	11	10	2.8	10	14	3
Mean diameter 10^{-6} m	3	11	10	2.8	10	14	3
Surface area 10^3 sq ft/lb	7.2	4.8	--	--	--	4.8	12.0
Surface area sq m/kg	1.5	1.0	--	--	--	1.0	2.5

[1] Saffil (Imperial Chemical Industries, Ltd.).
[2] AB–312 (3M Co.).
[3] AC–02 (3M Co.).
[4] Kaowool (Babcock and Wilcox).
[5] Refrasil (Hitco).
[6] ZS–11 (3M Co.).
[7] Saffil (Imperial Chemical Industries, Ltd.).
[8] At 1,800° F (1,255 K) mean.
[9] At 2,000° F (1,366 K).

Source: Materials Engineering, June 1975.

process dust and contains a binder that will keep the fibers locked in during further processing. The same company has a new British patent on a method of preparation of asbestos containing synthetic yarns.

The Bureau of Mines has developed, at its Boulder City, Nev., Metallurgy Research Laboratory, a new high-strength, corrosion-resistant material composed of asbestos fiber reinforcing silica flour bonded together with plasticized sulfur. It is suitable for handling corrosive liquids such as sewage, acid leach solutions, mine waste water, and salt solutions.

[7] Chemical Engineering. Japanese Developed Synthetic Membranes for Use in Chlor-Alkali Diaphragm Cells. V. 82, No. 13, June 23, 1975, p. 75.

[8] Houston, A.M., Ceramic Fibers Fight Heat in Difficult Environments. Materials Engineering, v. 81, No. 6, June 1975, pp. 33–35.

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