Asbestos

By Timothy C. May [1]

California maintained its position as the leading domestic producer of asbestos. Production of asbestos increased 17 percent in quantity and 25 percent in value over that of 1964. Most of the increase in production came from California. The nation ranked sixth among world producers. World production exceeded 3.5 million tons. Canada continued to be the leading free world producer, with an output close to 1.4 million tons in 1965. Imports of asbestos were 3 percent less than 1964. Exports of unmanufactured asbestos in 1965 increased 59 percent in volume over those of 1964.

Legislation and Government Programs.—As of December 31, 1965, the stockpile inventory of specification grade chrysotile was 33 percent below the stockpile objective and amosite was 43 percent in excess. Approximately 850 short tons of subspecification grade chrysotile was authorized as a short-term release from the Defense Production Act inventory. Sales offerings were made but only 6 tons were purchased with a value of $937.

Under the Agricultural Trade Development and Assistance Act of 1954 (Public Law 480, 83d Cong.), the Department of Agriculture, through the Commodity Credit Corporation (CCC), bartered agricultural commodities for 5,681 tons of amosite and 6,146 tons of crocidolite.

[1] Commodity specialist, Division of Minerals.

Table 1.—Salient asbestos statistics

	1956–60 (average)	1961	1962	1963	1964	1965
United States:						
Production (sales) --short tons	43,925	52,814	53,190	66,396	101,092	118,275
Value--------thousands	$4,682	$4,347	$4,677	$5,108	$8,143	$10,162
Exports and reexports (unmanufactured)--------short tons	3,771	3,799	2,949	10,044	27,147	43,126
Value--------thousands	$560	$759	$598	$1,304	$3,199	$5,294
Exports and reexports of asbestos products (value)--thousands	$13,852	$13,825	$14,274	$16,267	$16,288	$19,101
Imports for consumption (unmanufactured) ---short tons	679,903	616,529	675,953	667,860	739,361	719,559
Value--------thousands	$61,742	$58,942	$64,112	$61,739	$72,973	$70,457
Consumption, apparent [1] short tons	720,057	665,544	726,194	724,212	813,306	794,708
World: Production----------do	2,167,000	2,770,000	3,050,000	3,210,000	3,540,000	3,570,000

[1] Measured by quantity produced, plus imports, minus exports.

The stockpile position as of December 31, 1965, was as follows:

Table 2.—Stockpile objective and Government inventories as of December 31, 1965

(Short tons)

	Stockpile objective	National	Supplemental	Commodity Credit Corporation	Defense Production Act	Total
Amosite	40,000	11,705	43,465	2,134	--------	57,304
Chrysotile	13,700	6,072	2,864	199	--------	9,135
(Subspecification)	None	(152)	(3,193)	--------	(2,343)	(5,688)
Crocidolite	None	1,566	44,245	2,243	--------	48,054

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DOMESTIC PRODUCTION

Production of asbestos in California was 36 percent higher than in 1964, accounting for the substantial increase in domestic output.

Vermont Asbestos Mines Division of Ruberoid Co., Lowell mine, near Hyde Park, Vt., continued as the major producer of chrysotile. Production was 7 percent below that of 1964.

Production in Arizona was approximately the same as in 1964. Three companies reported shipments of chrysotile from Gila County, Ariz.; Asbestos Manufacturing Co. from the Phillips mine; Jaquays Mining Corp. from the Regal and Chrysotile Mines; and Metate Asbestos Corp. from the Lucky Seven mine.

Production and shipments were made by the following California companies. Asbestos Bonding Co. from the Phoenix mine, Napa County; Atlas Mineral Corp. from the Rover Pit and Santa Cruz mines, Fresno County; Coalinga Asbestos Co., Inc., Fresno County; Pacific Asbestos Corp. from the Pacific Asbestos mine, Calaveras County; and Union Carbide Corp., Nuclear Division, from the Joe 5 mine, San Benito County.

Powhatan Mining Co., Baltimore, Md., produced anthophyllite asbestos at the Burnsville mine, Yancey County, N.C. Shipments were slightly below those of 1964.

CONSUMPTION AND USES

Total consumption of asbestos in 1965 dropped slightly from that of 1964. Approximately 95 percent of the chrysotile consumed was short fiber of less than spinning length and was used chiefly in the manufacture of building materials. The major uses of asbestos were the following: Asbestos cement products, floor tile, asbestos paper, friction materials and gaskets, textiles, plastics, paints, roof coatings, caulks, and many miscellaneous items.

Consumption of amosite and crocidolite in 1965, based on imports, was substantially less in 1964. See table 5.

PRICES [2]

Quotations for Arizona asbestos, f.o.b. Globe, were listed as follows:

Grade	*Per short ton*
Crude No. 1	$1,410 to $1,650
Crude No. 2	610 to 900
AAA	800
Group No. 3 (nonferrous filtering and spinning)	425 to 750
Group No. 4 (nonferrous plastic and filtering)	385 to 500
Group No. 5 (plastic and filtering)	$250 to $400
Group No. 7 (refuse and shorts)	58 to 90

Canadian (Quebec) chrysotile, f.o.b. mine, prices changed depending on grade of fiber, as of January 1, 1965.

[2] Asbestos. V. 47, No. 6, December 1965, p. 44.

Canadian (Quebec) chrysotile asbestos prices, f.o.b. mine, were as follows:

Grade	Per short ton	
	1964	Jan. 1, 1965
Crude No. 1	Can $1,410 to $1,475	Can $ ----- $1,410
Crude No. 2, crude run of mine and sundry	610 to 875	640 to 875
No. 3, spinning fiber	350 to 650	345 to 565
No. 4, shingle fiber	180 to 245	190 to 320
No. 5, paper fiber	120 to 150	115 to 156
No. 6, waste, stucco, or plaster	----- 86	----- 95
No. 7, refuse or shorts	40 to 80	40 to 80

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Prices for British Columbia chrysotile asbestos, f.o.b. Vancouver, from Cassiar Asbestos Corp. Ltd., were as follows:

Grade	*Per short ton*
C–1	Can$1,522
AAA	787
AA	625
A	470
AC	325
AD	260
AK	220
AS	181
AX	160
AY	120

Vermont asbestos prices, f.o.b. Hyde Park or Morrisville, were as follows:

Grade	*Per short ton*
Group No. 3, spinning and filtering	$319 to $370
Group No. 4, shingle fiber	176 to 296
Group No. 5, paper fiber	$121 to $144
Group No. 6, waste, stucco, or plaster	88
Group No. 7, shorts and floats	40.50 to 75

Market quotations were not available for African and Australian asbestos because sales were negotiated privately. The following average values were calculated from U.S. Department of Commerce import data:

	Per short ton	
Imports:	*1964*	*1965*
Amosite:		
South Africa, Republic of	$157	$156
Chrysotile:		
Rhodesia, Southern	226	186
South Africa, Republic of	173	177
Crocidolite:		
Australia	197	190
South Africa, Republic of	198	195

FOREIGN TRADE

Exports of manufactured products increased 17 percent over those of 1964. Canada accounted for 25 percent of the total value. The products consisted of asbestos gaskets and packings, asbestos textiles and yarns, clutch facings and linings, brake linings, and manufactures other than friction materials.

Imports of amosite and crocidolite in 1965 decreased 29 and 15 percent, respectively. Imports of low-iron spinning-length chrysotile from British Columbia increased to 6,038 tons from 4,948 tons and imports of all grades increased to 27,392 tons from 18,640 tons in 1964. Of all the chrysotile imported, fiber of less than spinning length amounted to 94 percent.

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Table 3.—U.S. exports and reexports of asbestos and asbestos products

Product	1964		1965	
	Quantity	Value	Quantity	Value
Exports:				
Unmanufactured:				
Crude and spinning fibers---short tons	620	$168,137	1,251	$326,095
Nonspinning fibers---do	12,887	1,881,195	24,221	3,621,528
Waste and refuse---do	13,312	1,112,664	17,523	1,322,501
Total unmanufactured---do	26,819	3,161,996	42,995	5,270,124
Products:				
Brake lining and blocks-molded, semi-molded, and woven	(1)	4,808,497	(1)	4,727,861
Clutch facing and lining---number	2,046,247	1,840,560	2,020,864	1,690,590
Construction materials, n.e.c.--short tons	12,988	3,204,223	11,566	2,684,776
Pipe covering and cement---do	3,951	1,599,039	(2)	(2)
Textiles, yarn, and packing---do	1,520	3,566,507	2,526	5,595,007
Manufactures, n.e.c.	NA	1,235,055	NA	4,388,676
Total products		16,253,881		19,086,910
Reexports:				
Unmanufactured:				
Crude and spinning fibers---short tons	108	17,725	50	10,306
Nonspinning fibers---do	2	660	81	13,075
Waste and refuse---do	218	18,861		
Total unmanufactured	328	37,246	131	23,381
Products:				
Brake lining and blocks-molded, semi-molded, and woven			(1)	1,712
Clutch facing and lining---number			5,000	4,100
Construction materials, n.e.c.--short tons	114	22,496		
Textiles, yarn, and packing---do	(3)	122	(3)	900
Manufactures, n.e.c.	NA	11,870	NA	7,542
Total products		34,488		14,254

NA Not available.
[1] Values have been summarized: quantities not shown.
[2] Effective Jan. 1, 1965, no longer separately classified, included with manufactures, n.e.c.
[3] Less than ½ unit.

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Table 4.—U.S. imports for consumption of asbestos (unmanufactured), by classes and countries

Year and country	Crude (including blue fiber)		Textile fiber		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1964:								
Australia	475	$94,022	---	---	---	---	475	$94,022
Bolivia	3	4,800	---	---	---	---	3	4,800
Canada	4,466	795,546	13,881	$5,380,633	648,626	$54,404,684	666,973	60,580,863
Finland	117	4,400	---	---	934	42,522	1,051	46,922
Italy	---	---	---	---	6	7,395	6	7,395
Mexico	---	---	---	---	304	32,995	304	32,995
Mozambique	---	---	90	37,273	239	41,921	329	79,194
Portugal	---	---	---	---	5	560	5	560
Portuguese Western Africa, n.e.c.	---	---	---	---	130	10,386	130	10,386
Rhodesia and Malawi [1]	7,633	1,518,126	90	35,719	6,271	1,330,350	13,994	2,884,195
South Africa, Republic of	49,607	8,843,905	---	---	924	169,208	50,531	9,013,113
Spain	---	---	---	---	50	8,374	50	8,374
U.S.S.R.	---	---	---	---	20	732	20	732
Venezuela	---	---	---	---	624	26,996	624	26,996
Yugoslavia	2,785	107,148	---	---	2,081	74,977	4,866	182,125
Total	65,086	11,367,947	14,061	5,453,625	660,214	56,151,100	739,361	72,972,672
1965:								
Australia	260	49,669	---	---	---	---	260	49,669
Bolivia	7	5,260	---	---	---	---	7	5,260
Canada	4,210	680,991	17,105	6,138,587	636,734	53,560,020	658,049	60,379,598
Chile	2	1,640	---	---	---	---	2	1,640
Finland	50	5,175	---	---	2,475	150,859	2,525	156,034
Italy	---	---	---	---	2	2,550	2	2,550
Mozambique	---	---	30	12,391	51	21,925	81	34,316
Portugal	959	33,289	---	---	45	4,213	1,004	37,502
Rhodesia and Malawi [1]	6,482	1,111,691	223	91,098	5,482	1,116,122	12,187	2,318,911
South Africa, Republic of	40,011	7,124,938	11	2,542	911	181,715	40,933	7,309,195
U.S.S.R.	---	---	---	---	33	3,637	33	3,637
Yugoslavia	3,461	122,762	---	---	1,015	36,156	4,476	158,918
Total	55,442	9,135,415	17,369	6,244,618	646,748	55,077,197	719,559	70,457,230

[1] All believed to be from Southern Rhodesia.

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

(Short tons)

Grade	1964			1965		
	Canada	Southern Rhodesia [1]	Republic of South Africa	Canada	Southern Rhodesia [1]	Republic of South Africa
Chrysotile:						
Crudes	4,466	7,633	817	4,210	6,482	1,804
Spinning and textile	13,881	90	---	17,105	223	11
All other	648,626	6,271	924	636,734	5,482	911
Crocidolite (blue)	---	---	24,858	---	---	21,165
Amosite	---	---	23,932	---	---	17,042
Total	666,973	13,994	50,531	658,049	12,187	40,933

[1] Reported by the Bureau of the Census as Rhodesia and Malawi.

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WORLD REVIEW

NORTH AMERICA

Canada.—For the first time since 1958 production (measured by sales) of asbestos decreased. The decline was due in part to large shipments late in 1964 to consumers who anticipated a price increase that became effective January 1, 1965. Production in 1965 was 3 percent less than in 1964 and value was 4 percent lower. Production in Newfoundland and British Columbia increased 10 and 27 percent, respectively, while production in Quebec, the largest producing Province, decreased 4 percent from that of 1964. During the first 9 months, the value of asbestos exports was Can$108.3 million, an increase of 1 percent over that of 1964; however, the quantity decreased to 918,257 tons from 926,740 tons in 1964.

In 1965 the market price for Canadian asbestos increased for the first time during the past 4 years.

Table 6.—World production of asbestos, by countries [1]
(Short tons)

Country [1]	1961	1962	1963	1964	1965 [p 2]
North America:					
Canada (sales)	1,173,695	1,215,814	[r] 1,275,530	[r] 1,420,769	1,387,555
United States (sold or used by producers)	52,814	53,190	66,396	101,092	118,275
South America:					
Argentina	----------	[r] 203	[r] 365	[r] 542	[e] 550
Bolivia (exports)	57	56	10	[r] 7	3
Brazil	[e 3] 3,400	[e 3] 4,900	[4] 1,440	NA	[4] 1,204
Venezuela	650	----------	----------	----------	----------
Europe:					
Austria	564	503	638	----------	----------
Bulgaria	1,213	[e] 1,100	[e] 1,100	[e] 1,100	[e] 1,100
Finland [5]	10,340	10,869	10,108	11,611	[3] 13,307
France	30,746	28,364	26,645	24,250	7,716
Italy	62,804	[r] 60,860	[r] 63,016	75,573	79,214
Portugal	21	----------	29	----------	33
Spain	11	----------	----------	----------	----------
U.S.S.R.	880,000	1,100,000	1,200,000	1,300,000	1,300,000
Yugoslavia	6,709	7,401	9,074	9,280	10,585
Africa:					
Bechuanaland	1,924	2,375	2,368	2,161	888
Kenya	151	212	78	204	136
Mozambique	162	370	----------	----------	----------
Rhodesia, Southern	161,610	142,196	142,255	153,450	[e] 172,400
South Africa, Republic of	194,834	221,302	205,744	215,592	240,752
Swaziland	30,792	32,830	33,350	39,862	40,884
United Arab Republic (Egypt)	254	606	192	[r] 1,739	3,225
Asia:					
China [e]	100,000	100,000	110,000	130,000	140,000
Cyprus	16,207	22,391	19,962	[r] 13,755	15,733
India	1,624	1,865	2,989	3,271	4,989
Japan	18,799	15,407	18,210	17,979	[e] 18,000
Korea, South	341	1,333	2,120	[r] 1,402	[e] 2,000
Philippines	83	1,037	421	586	[e] 600
Taiwan	44	525	604	526	883
Turkey	496	709	408	[r] 1,291	1,376
Oceania:					
Australia	16,746	18,416	13,374	[r] 13,545	11,647
New Zealand	373	457	439	[6]	----------
World total (estimate) [1]	2,770,000	3,050,000	3,210,000	3,540,000	3,570,000

[e] Estimate. [p] Preliminary. [r] Revised.
[1] Asbestos also is produced in Czechoslovakia, Eritrea, Greece, North Korea, and Rumania. No estimates for these countries are included in the total, as production is believed to be negligible.
[2] Compiled from data available June 1966.
[3] Data represents fiber.
[4] Bahia only.
[5] Includes asbestos flour.
[6] Revised to none.

It was reported that the Canadian Government would provide financial assistance towards the development of an asbestos mine at Clinton Creek, about 70 miles northwest of Dawson in the Yukon Territory, owned by Cassiar Asbestos Corp. With Government aid the initial 37 miles of the Dawson-Alaska boundary road will

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be reconstructed and a new road and river bridge from the boundary road to the mine will be constructed.[3]

The history of the development of Advocate Mines Ltd. Baie Verte mine was traced from discovery through initial exploration, financing, ore body delineation and evaluation, construction of the plant, construction of deep-sea shipping facilities, provision of a closed shipping season, through to realization of full production capacity. The mine began production in 1963. It is at the north end of the Burlington Peninsula, White Bay District, Newfoundland, 3.8 miles from the town of Baie Verte.[4]

As the result of the shutdown of the Johns-Manville Co. Ltd. plant at Matheson, Ontario, asbestos production decreased to less than $80,000 from $2.2 million in 1964.

It was announced that McAdam Mining Corp. expects to have its Chibougamau area asbestos property in production by 1967. Total cost of bringing the property to production was estimated to be Can-$17.5 million.[5]

The Quebec Asbestos Mining Association issued a "Handbook of Canadian Asbestos Products." The brochure was prepared to provide architects and engineers with general information about the Canadian asbestos industry. The handbook is published both in English and French.[6]

SOUTH AMERICA

Bolivia.—The crocidolite deposits of Bolivia were geologically mapped by the Bolivian National Department of Geology (Denageo). The main deposits, close to the Espiritu Santo River at an elevation of 500 meters, are in the Alto Chapare region on the eastern slopes of the Cordillera de Cochabamba. The largest mines operate sporadically.[7]

EUROPE

United Kingdom.—Turner & Newall Ltd., Manchester, issued a booklet on the history and activities of its organization. The companies of Turner & Newall Ltd., operate more than 20 factories and 40 sales offices and employ approximately 39,000 people. Interests of the group cover asbestos, chemicals, and plastic materials.

It was announced that Turner Asbestos Cement Co. Ltd., opened the first asbestos-cement factory in Northern Ireland and the eighth Turner asbestos-cement factory in the United Kingdom.[8]

Italy.—Production, imports, and exports of asbestos increased substantially in 1964. most of the imported product was high-grade long fiber. Imports of 48,380 tons was 13 percent higher than 1963, and exports of 9,939 tons was 41 percent more than in 1963.[9]

U.S.S.R.—U.S.S.R. exports of asbestos in 1964 were 233,908 tons compared with 198,524 tons in 1963. Asbestos was shipped to 25 countries with East Germany accounting for 12 percent; West Germany and France, 11 percent each; Poland, 9 percent; Czechoslovakia and Japan, 8 percent each; Hungary, 7 percent; India, 6 percent; and the remainder was distributed among 17 countries.[10]

AFRICA

South Africa, Republic of.—Production of asbestos in 1965 consisted of 80,735 tons of amosite, 121,122 tons of crocidolite, and 38,895 tons of chrysotile. Exports were as follows: Amosite, 75,981 tons; crocidolite, 108,279; and chrysotile, 25,299. The total volume of local sales of asbestos was 22,428 tons, almost twice that of 1964.[11]

It was reported that Griqualand Exploration & Finance Ltd., acquired the Hans Merensky Trust asbestos interests in the Kuruman area of Cape Province. Two producing mines at Eldorado and Coretse South were equipped with a modern mill, having a capacity of 7,000 tons of fiber.[12]

Rhodesia, Southern.—Following the Unilateral Declaration of Independence on November 11, 1965, the United Kingdom

[3] Northern Miner (Toronto). Federal Program to Aid Cassiar. No. 22, Aug. 19, 1965, p. 32.
[4] Hutcheson, J. R. M. Canada's Newest Asbestos Producer—Advocate Mines Ltd. Canadian Min. and Met. Bull. (Montreal), v. 58, No. 642, October 1965, pp. 1070–1076.
[5] Northern Miner (Toronto). No. 51, Mar. 11, 1965, p. 4.
[6] Quebec Asbestos Mining Association (Quebec). Handbook of Canadian Asbestos Products. 1963, 44 pp.
[7] World Mining. Bolivia's Blue Asbestos Deposits. V. 18, No. 6, June 1965, pp. 33, 55.
[8] Steel Times (London). V. 191, No. 5063, July 30, 1965, p. 134.
[9] Bureau of Mines. Mineral Trade Notes. V. 61, No. 5, November 1965, p. 5.
[10] Metal Bulletin (London). No. 5051, Nov. 26, 1965, p. 28.
[11] Republic of South Africa (Pretoria). Minerals Dept. of Mines Quarterly Inf. Circ. October–December 1965, pp. 36, 38, 41.
[12] South Africa Mining and Engineering Journal (Johannesburg). V. 76, pt. 2, No. 3800, Dec. 3, 1965, p. 2843.

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on December 1, issued stringent economic and financial measures against Rhodesia which included embargo on imports of chrysotile asbestos.

The rate of asbestos production in Southern Rhodesia is governed by the export demand. In 1964 output increased to 153,450 tons having a value 14 percent more than 1963 output. Exports went to 52 countries and included all grades of fiber. The largest market was the United Kingdom, which purchased 46,364 tons of asbestos from Rhodesia, out of total asbestos exports of 177,821 tons. Production of chrysotile was approximately 12 percent more than in 1964. Exports were at about the same level as in 1964.

Most of the Rhodesian material came from the substantial mining interests of Turner & Newall Ltd., which controls the largest Rhodesian producer, the Shabanie Mine. This mine employs 3,800 people.

One of Rhodesia's largest customers was the cement piping and sheeting industry of Western Europe. The Pangani mine near Filabusi is being reopened and equipped to produce a grade of fiber suitable for export to asbestos cement manufacturers.[13]

ASIA

Japan.—Asbestos was mined exclusively in Hokkaido, although it occurs in several other widely scattered areas in Japan. The Hokkaido deposits in the Yamabe District are chrysotile, but some amphibole has been produced in the past particularly in Kyushu. Mine production in 1964 was 17,979 tons, slightly lower than the record 18,210 short tons set in 1963. However, demand increased in all segments of industry and brought on a rise of 24.7 percent in imports over those of the previous year. Canada provided about 60 percent of the imports.[14]

OCEANIA

Australia.—Total exports of crocidolite in 1964 were 7,280 tons. Of this amount almost 50 percent was exported to Malaysia, 14 percent to Japan, 6 percent to Italy, 5 percent to the United States, and the remainder to other countries. There were no exports of chrysotile in 1964. Imports of chrysotile in 1964 was 32,075 tons. Canada supplied 96 percent of the total. Imports of amosite were 6,677 tons, and crocidolite 27 tons.

The principal use of asbestos fiber was in the manufacture of asbestos cement products. Other uses include manufacture of plastic floor and wall tiles, friction materials, insulating materials and mill board.[15]

TECHNOLOGY

Major advances in the design of asbestos mills were discussed. Particular reference was made to the new Advocate asbestos mill in Baie Verte, Newfoundland, and the Johns-Manville Jeffrey mill at Asbestos, Quebec. The mill buildings themselves and the air process systems which constitute the fiber aspirating and dust collection operations were discussed.[16]

A new system of asbestos fiber extraction was developed. A full-scale plant incorporating the latest principles was commissioned at the crocidolite property of Merencor Asbestos mines on the farm Eldoret in the Kuruman District, Northern Cape, Republic of South Africa. The general method of fiber separation used was discussed.[17]

A patent was issued covering a method for removing contaminants from milled chrysotile asbestos fiber, so as to produce a fiber product suitable for use as a filter material in the food preparation industry.[18]

A method for defiberizing asbestos fiber bundles was patented.[19]

The development and application of a computer program to an open pit mine design problem was described. An automatic mill control system including remotely operated feeders, automatic sam-

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[13] Mining Journal (London). Embargoes on Rhodesian Minerals. V. 265, No. 6799, Dec. 10, 1965, pp. 421–422.

[14] Bureau of Mines. Mineral Trade Notes. V. 60, No. 2, February 1965, p. 6.

[15] Department of National Development, Bureau of Mineral Resources, Geology, and Geophysics. The Australian Mineral Industry, 1964 Review. Canberra City, A.C.T., Australia, 1965, 343 pp.

[16] Hahn, J., J. Lemberg, and K. Deksnis. Designing an Asbestos Mill. Canadian Min. Jour. (Quebec), July 1965, pp. 37–42.

[17] South African Mining and Engineering Journal (Johannesburg). V. 76, pt. 2, No. 3786, Oct. 22, 1965, pp. 2470–2474.

[18] de Lisle, A. L. Production of Improved Asbestos Fiber. U.S. Pat. 3,184,288, May 18, 1965.

[19] Oesterheld, K. A. A Method of Dressing Crude Asbestos. U.S. Pat. 3,170,834, Feb. 23, 1965.

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pling of fiber being processed, and a closed-circuit television system went into operation in the mill of National Asbestos Mines Ltd.[20]

Drilling and blasting methods employed at the Cassiar mine in British Columbia near the Yukon border were discussed. Specific problems such as working in frozen ground were mentioned, and the breaking characteristics of the various rock formations were outlined.[21]

The different mining systems used in asbestos mining, including underground methods in massive deposits, shrinkage stoping, sublevel and panel stoping, caving systems, and underground methods in tabular deposits were mentioned.[22]

Patents were also issued for the following: Rodmill and milling method for defiberizing mine-run asbestos ore or asbestos fiber bundles;[23] a method for making an improved process and apparatus for the manufacture of articles from a water slurry of asbestos fiber and portland cement;[24] and improved apparatus for shaping and compressing roofing tiles or other sheets formed from an aqueous mixture of asbestos fiber and portland cement.[25]

The proceedings of the New York Academy of Sciences on the biological effects of asbestos were published. Papers included the following subjects: Asbestos materials in modern technology; lung tissue and mineral matter; human exposure to asbestos; clinical studies of pulmonary asbestosis; asbestos and neoplasia; and problems and perspectives.[26]

Investigations were undertaken to determine whether mesothelioma of the pleura and peritoneum had any important relation with asbestos exposure. Materials and methods used and the results obtained were described.[27]

The decomposition of amosite was discussed. When amosite is heated in argon or nitrogen physically combined water is lost up to 500° to 700° C. Above 500° C (static) of 700° C (dynamic) dehydroxylation occurs endothermically, giving a pyroxene as the main product.[28]

The use of crocidolite as a component of asbestos-reinforced plastic pipe was described. Crocidolite has excellent heat resistance, high modulus of elasticity, exceptional strength, and resists acids, alkalis, neutral salts, and organic solvents.[29]

Asphalt asbestos curbing is currently included in State specifications or alternates in five States: Massachusetts, New Hampshire, Maine, Delaware, and New York.[30]

Greater use of asbestos in asphalt hot mixes for paving was reported. The use of asbestos in asphalt mixes provides a tougher surface, increased resistance to indentation under heavy load and high temperatures, plus better flexibility and improved resistance to weather.[31]

The extension skirt for the second-stage engine of Gemini 4 space rocket was made of asbestos felt impregnated with a specially developed phenolic resin. The extension skirt weighing 650 pounds directs the flow of gases from the two second-stage exhaust nozzles.[32]

It was reported that asbestos phenolic materials are used in aerospace applications. These materials include tape-wrapped backup insulation, rocket motor liners, ablation-resistant structures, and insulator panels. They are resistant to flames, chemicals, and water. Also, they have a high modulus of elasticity and strength at all environmental temperatures.[33]

It was reported that the body of the Corvette automobile is made of panels of reinforced plastic attached to a steel "bird cage" frame. Powdered asbestos is used

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[20] O'Brien, N., and F. J. Nowak. An Application of a Computer to Open-Pit Mine Design. Canadian Min. and Met. Bull. (Montreal), v. 58, No. 638, June 1965, pp. 649–654.

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[23] Bacher, J. P. (assigned to F. L. Smidth & Co., New York). Method and Apparatus for Defibration of Fibrous Materials. U.S. Pat. 3,186,647, June 1, 1965.

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[25] Marchioli, G., and G. Gremigni. British Pat. 985,563, Mar. 10, 1965.

[26] Annals of the New York Academy of Sciences. Biological Effects of Asbestos. V. 132, art. 1, December 1965, 766 pp.

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[29] Cryor, R. E. Asbestos-Reinforced Plastic Pipe. Chem. Eng., v. 72, No. 16, Aug. 2, 1965, pp. 134–136.

[30] Roads and Streets. Asbestos-Asphalt Curbing. V. 108, No. 12, December 1965, pp. 75, 81.

[31] Chemical Week. Asbestos Bright Spot. V. 96, No. 7, Feb. 13, 1965, p. 82.

[32] Asbestos. V. 47, No. 2, August 1965, p. 16.

[33] Materials in Designing Engineering. Asbestos Phenolics. V. 61, No. 6, June 1965, p. 4.

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as the reinforcing agent in the joining of the various reinforced plastic parts.[34]

A method was patented for preparing a homogeneous, well-dispersed mass of asbestos fiber and a molding solution by projecting a fluffy asbestos into mixing blades which are turning in the molding solution and continuing the mixing while adding more fibers.[35]

A method for the use of asbestos (amosite, chrysotile, or crocidolite) fiber as a base or matrix to be coated with a ceramic frit and then with a thermosetting resin on the other face was patented.[36]

A patent was granted on a method for upgrading the filtration rate of asbestos fiber to provide fast-filtering asbestos fiber product slurries or feed stocks for use in wet-process asbestos-cement or like manufacturing procedures.[37]

Patents were issued for the use of microdimensional chrysotile asbestos fiber as a cosuspending agent in a pesticidal composition;[38] for improved porous, flexible, high-bulk asbestos-glass fiber paper or felt for saturation with plastic molding compositions;[39] for use of asbestos in grease-resistant floor tiles;[40] for production of asbestos fiber-vinyl halide resin compositions that are resistant to the deteriorating effects of heat;[41] for use of asbestos fiber in latex-bonded sheet materials;[42] for a method for making aluminum phosphate-bonded laminated asbestos sheets of increased dielectric strength;[43] for a method to prevent discoloration in resin-base floor tiles caused by use of iron-containing asbestos therein;[44] and for a method to prevent iron-induced degradation of vinyl halide resin-base floor tile or like materials.[45]

The following patents were granted for asbestos-cement products: Method of making ceramic-glazed sheets from an aqueous mixture of asbestos fibers and portland cement;[46] method for forming sharp corners and irregular contours and cross-sectional shapes in products manufactured from an aqueous slurry of asbestos fibers and portland cement;[47] production of improved articles from an aqueous mixture of portland cement and a blend of amosite and chrysotile asbestos fibers;[48] method for inhibiting growth of fungus organisms in products manufactured from a slurry of asbestos fiber and portland cement;[49] a composition for use in forming good-quality, cured asbestos-cement products;[50] method for producing asbestos-cement articles, whereby dry asbestos fiber and dry particulate portland cement are tumbled together in a mixing zone while being sprayed with water;[51] an improved method for corrugating relatively thick sheets formed from an aqueous mixture of asbestos fiber and portland cement;[52] method

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[34] Siegrist, Fred L. Assembly of Reinforced Plastic Automobile Bodies. Metal Prog., v. 88, No. 4, October 1965, pp. 239, 241, 250, 252, 254.

[35] Gouveia, A. P. (assigned to Johns-Manville Corp., New York). Method and Apparatus for Preparing a Fiber-Reinforced Molding Composition. U.S. Pat. 3,175,807, Mar. 30, 1965.

[36] Shaines, A. (assigned to American Radiator & Standard Sanitary Corp., New York). Method of Coating Resin On Ceramic. U.S. Pat. 3,172,775, Mar. 9, 1965.

[37] Pundsack, F. L., and G. P. Reimschussel (assigned to Johns-Manville Corp., New York). Method of Improving the Filtration Characteristics of Asbestos. U.S. Pat. 3,173,831, Mar. 16, 1965.

[38] McCoy, F. C., and H. C. Knowles (assigned to Texaco Inc., New York). U.S. Pat. 3,171,779, Mar. 2, 1965.

[39] Quinn, R. G. (assigned to Johns-Manville Corp., New York). Asbestos-Glass Fiber Saturating Paper Containing Thermoplastic Resin and Aluminum Acid Phosphate. U.S. Pat. 3,212,960, Oct. 19, 1965.

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[41] Scullin, J. P. (assigned to Tenneco Chemicals, Inc., a corporation of Delaware). Stabilized Asbestos Containing Vinyl Halide Resin Compositions. U.S. Pat. 3,194,786, July 13, 1965.

[42] Eisenberg, B. J. (assigned to U.S. Rubber Co., New York). Latex Bonded Asbestos Fiber Sheet Material. U.S. Pat. 3,193,446, July 6, 1965.

[43] Bolton, M. J., G. A. Joyner, Jr., and R. H. Lux (assigned to General Electric Co., Schnectady, N.Y.). Method of Making Insulation, and Products Formed Thereby. U.S. Pat. 3,177,107, Apr. 6, 1965.

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[47] French, C. V. (assigned to Johns-Manville Corp., New York). Method of Manufacturing Asbestos-Cement Articles. U.S. Pat. 3,197,536, July 27, 1965.

[48] Snyder, W. H. (assigned to Johns-Manville Corp., New York). Asbestos-Cement Products. U.S. Pat. 3,169,878, Feb. 16, 1965.

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[52] Oesterheld, K. A. (assigned to Eurasbest, A. G., Besel, Switzerland). Method for Corrugating Sheets of Asbestos Cement. U.S. Pat. 3,173,828, Mar. 16, 1965.

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for forming in situ on a sloping roof a series of cast Bermuda-type concrete roof tiles, using an aqueous mixture of chysotile asbestos floats, portland cement, and either a heavy sandstone aggregate or preferably a lightweight aggregate.[53]

The anthophyllite mineralization in the area is localized in the zones of enstatite-anthophyllite and talc-carbonate rocks. Rich asbestos mineralization is related to the enstatite-anthophyllite rocks having a coarse crystalline texture.[54]

Using molten salt bath and vapor deposition methods, whiskers exceeding 25 mm in length were grown; three different aluminum borate compositions were identified by X-ray and chemical analyses.[55]

Density measurements were made on 23 bulk specimens of chrysotile and 7 massive serpentine samples, both by using mercury and by coating and by coating the samples with paraffin and immersing them in water. Arizona chrysotile had a density lower than Canadian chrysotile. Arizona massive serpentine blocks had less porosity.[56]

A booklet entitled "Fire Protection of Sturctures" was issued by Turner Asbestos Cement Co. Ltd., Manchester, England. The publication includes an interpretation of the 1965 building regulations for England and Wales in relation to asbestos and asbestos-cement materials. The importance of asbestos and asbestos-cement products when constructing buildings that will minimize the risk of heavy losses by fire is described. Details and photographs are included.[57]

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