

Vermiculite

By Timothy C. May¹

Production of crude vermiculite in the United States during 1965 was 10 percent higher than in 1964, and value increased 23 percent. The quantity and value of ex-

foliated vermiculite sold or used by producers was approximately the same as in 1964.

Table 1.—Vermiculite production statistics

	1956-60 (average)	1961	1962	1963	1964	1965
United States:						
Production:						
Crude.....thousand short tons..	195	206	205	226	226	249
Value.....thousand dollars..	\$2,813	\$3,350	\$3,293	\$3,572	\$3,613	\$4,460
Average value per ton.....	\$14.43	\$16.26	\$16.06	\$15.81	\$15.99	\$17.91
Exfoliated.....thousand short tons..	156	151	152	172	177	177
Value.....thousand dollars..	\$9,853	\$10,787	\$11,152	\$13,877	\$13,862	\$13,424
Average value per ton.....	\$63.16	\$71.44	\$73.37	\$80.68	\$78.32	\$75.84
World: Production crude..thousand short tons..	255	283	295	329	343	382

DOMESTIC PRODUCTION

Crude Vermiculite.—Three companies in two States reported production in 1965. W. R. Grace & Co., Zonolite Division, with operations in Lincoln County, Mont., and Laurens County, S.C., was the principal producer. American Vermiculite Co., and Patterson Vermiculite Co., Laurens County, S.C., also were producers.

Exfoliated Vermiculite.—Twenty-four companies with 51 plants, 2 less each than last year, in 33 States exfoliated vermiculite in 1965. California and Florida had four

plants each; Illinois, Minnesota, South Carolina, and Texas, three plants each; Missouri, New Jersey, Oregon, and Pennsylvania, two plants each; Alabama, Arizona, Arkansas, Colorado, Georgia, Hawaii, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Montana, Nebraska, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Utah, Washington, and Wisconsin, one plant each. W. R. Grace & Co., Zonolite Division, had 19 plants in 16 States and was by far the largest producer.

CONSUMPTION AND USES

Producers of exfoliated vermiculite reported the following end-use percentages: Aggregates (concrete, plaster, cement) 48 percent; insulation (loose fill, block, pipe

covering, packing) 31 percent; agriculture (horticulture, soil conditioning, fertilizer carrier, litter) 14 percent; and miscellaneous, 7 percent.

PRICES

The average value of crude, screened, and cleaned vermiculite at the mine in 1965 was \$17.91 per short ton. The average

value of the exfoliated product f.o.b. pro-

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ducers' plant was \$75.84 per ton. Over a period of 10 years, 1956-65, the price of crude vermiculite increased 35 percent, and the price of exfoliated vermiculite rose 20 percent.

E&MJ Metal and Mineral Markets quoted nominal yearend prices for crude vermiculite as follows: Per short ton, f.o.b. mines, Montana and South Carolina, \$11.50 to \$24; and South Africa, c.i.f. Atlantic ports, \$29.55 to \$40.15.

WORLD REVIEW

Canada.—All the crude vermiculite exfoliated was imported from the United States and the Republic of South Africa. In 1964, 307,000 cubic yards of exfoliated vermiculite, valued at \$2.4 million, was produced. Five companies exfoliated vermiculite at the 10 following locations in 1964: British Columbia-Vancouver (two); Alberta-Calgary; Saskatchewan-Regina; Manitoba-Winnepeg and St. Boniface; Ontario-Toronto and St. Thomas; and Quebec-Lachine and Montreal. Loose insulation consumed 78 percent of the output; plaster accounted for 12 percent; insulating concrete 6 percent; and 4 percent was used for underground pipe insulation, and for agriculture. Exfoliated vermiculite is marketed in bags of 3 and 4 cubic feet and sold at 25 to 30 cents per cubic foot.²

It was reported that Olympus Mines be-

gan operation of the first large-scale concentrator to treat Canadian mined vermiculite ore. The plant was at Stanleyville, 10 miles southwest of Perth, Ontario. The completed plant was designed to produce 300 tons per day.³

South Africa, Republic of.—Production of crude vermiculite in 1965 was 13 percent higher than in 1964. Vermiculite was produced by the Transvaal Ore Co., Ltd., at Phalaborwa. For the first time, information was not available on exports of crude vermiculite by destination. Total exports were 2 percent lower in volume than in 1964 and 3 percent lower in value.

² Wilson, S. H. *Lightweight Aggregates*, 1964. Dept. Mines and Tech. Surveys, Ottawa, Canada, April 1965, 6 pp.

³ Canadian Mining Journal (Quebec). Canadian Developments. V. 86, No. 6, June 1965, p. 10.

Table 2.—Free world production of vermiculite by countries ^{1,2}
(Short tons)

Country ¹	1961	1962	1963	1964	1965 ³
Argentina.....	r 3,919	2,962	r 3,064	r 4,031	e 4,100
India.....	697	r 477	746	r 473	806
Kenya.....	—	22	101	r 37	24
South Africa, Republic of.....	71,118	85,534	98,758	111,872	126,911
Sudan.....	55	55	—	—	—
Tanzania.....	157	72	30	144	108
United Arab Republic (Egypt) ²	85	313	33	459	639
United States (sold or used by producers).....	206,637	205,747	226,278	226,299	249,352
Free world total ^{1,2}	r 282,668	r 295,182	r 329,010	r 343,315	381,940

e Estimate. p Preliminary. r Revised.

¹ Vermiculite is produced in Brazil, but data are not available, and no estimate of production is included in the total.

² Includes mica.

³ Compiled mostly from data available July 1966.

TECHNOLOGY

Research headed the program of the 24th annual meeting of the Vermiculite Institute of Chicago held at Point Clear, Ala., April 24 to 29, 1965. Papers presented included one on the development of Cornel Mix, a synthetic soil in which vermiculite is a major ingredient. The mix is used commercially as a medium for germinating and growing vegetable and flower crops.⁴

A micaceous vein in close association with a massive chromite deposit in the Twin Sisters Mountains, Wash., was found to be composed exclusively of vermiculite. The geologic setting, physical properties, chemical data, differential thermal analysis,

⁴ Pit and Quarry. Vermiculite Institute Convention Stresses Expanding Markets. V. 57, No. 12, June 1965, pp. 108-109.

Table 3.—Republic of South Africa: Exports of crude vermiculite by countries
(Short tons)

Destination	1963	1964	1965
Australia.....	2,031	2,932	} NA
Belgium.....	794	1,442	
Canada.....	4,839	2,879	
Denmark.....	1,313	866	
France.....	7,413	10,343	
Germany, West.....	7,599	9,922	
Italy.....	15,721	18,239	
Japan.....	924	1,637	
Netherlands.....	1,647	1,127	
Spain.....	1,368	2,287	
Sweden.....	585	587	
United Kingdom.....	28,308	34,502	
United States.....	14,337	18,417	
Other countries.....	3,908	2,574	
Total.....	90,787	107,854	
Total value ¹	\$1,723,365	\$2,026,972	\$1,964,385
Average value.....	\$18.98	\$18.79	\$18.54

NA Not available.

¹ Converted to U.S. currency at the rate of one rand equals US\$1.3948 (1963) US\$1.3909 (1964) and US\$1.3927 (1965).

Source: Quarterly Information Circular on Minerals for the Republic of South Africa and the Territory of South-West Africa.

X-ray diffraction analysis, and proposed genesis of the Twin Sisters vermiculite were discussed.⁵

The advantages of using vermiculite in concrete mix was mentioned. Requirements for the components, proportioning, and installation of poured-in-place vermiculite concrete for roofs and slabs-on-grade, as they appear in a new American Standard, are described.⁶

Vermiculite concrete was used as a cushioning material in a setup, used for dynamic testing of composite members. The cushioning material was used between the falling mass and the specimen to shape the load pulse transmitted to the specimen. A schematic diagram illustrates the beam setup for dynamic loads.⁷

The insulating properties of vermiculite, particularly as applied to the insulation of industrial chimneys, was covered in a release published by Mandoval Ltd., London, under the management of Rio Tinto-Zinc Group and distributors of crude vermiculite. Technical and specification details, as well as sectional drawings illustrate how vermiculite is used.⁸

The surface morphology of vermiculites from several sources was studied by electron microscopy. Unlike the smooth surfaces of micas, the vermiculite surfaces show micromorphological structural variations, such as small humps, prominent crystallographic steps on the basal cleavage planes, marginal rolling of the layers, and layer buckling.⁹

Results on fusion studies of the mineral vermiculite, the leaching characteristics of the fused mass, and the volume reduction ratios are given. The fixation of spent vermiculite, incinerator ashes, and chemical sludges in vitreous matrices was described. The apparatus for studying volatilization loss was included.¹⁰

A patent was issued for the use of exfoliated vermiculite in the coating of the exposed surface of bituminous roofing and siding material.¹¹

A patent was granted for the production of a flowable, fire-retardant composition that includes exfoliated vermiculite as one of the materials. The composition is used

⁵ Gaudette, Henri. Magnesium Vermiculite From the Twin Sisters Mountains, Washington. *The Am. Miner.*, v. 49, Nos. 11 and 12, November-December 1964, pp. 1754-1763.

⁶ Barron, L. A. Up-to-the Minute Requirements for Vermiculite Concrete. *Mag. of Standards*, v. 36, No. 7, July 1965, pp. 208-211.

⁷ Perry, E. S. Simple Setup for Applying Impact Loads. *Mat. and Res. Standards*, v. 5, No. 10, October 1965, pp. 515-516.

⁸ Chemical Age (London). Vermiculite for Insulation of Industrial Chimneys. V. 93, No. 2384, Mar. 20, 1965, p. 462.

⁹ Raman, K. V., and M. L. Jackson. Vermiculite Surface Morphology. *Clays and Clay Minerals*, Proc. 12th Nat. Conf., Clays and Clay Minerals, 1963, pp. 423-429; The MacMillan Co., New York 1964.

¹⁰ Rastogi, R. C., J. D. Sehgal, and K. T. Thomas. Investigation of Materials and Methods for Fixation of Low and Medium Level Radioactive Waste in Stable Solid Media. *Nuclear Sci. Abs.*, v. 19, No. 16, Aug. 31, 1965, Abs. 31618.

¹¹ Klimboff, M. (assigned to Flintkote Co.). Bituminous Roofing and Siding Material Coated with Exfoliated Vermiculite. U.S. Pat. 3,207,619, Sept. 21, 1965.

in the manufacture of extra thick shingles on a conventional asphalt roofing machine.¹²

British patents were issued for the following: A method of making precast lightweight insulating composite structural blocks¹³ and a composition consisting of exfoliated vermiculite, expanded perlite, or other low-density silicate which has been treated with a fatty acid, for use in protecting and insulating underground pipes.¹⁴

A French patent was issued on a method for using vermiculite in the casting ingots of high-melting metals. The vermiculite is introduced into the mold, and the molten

metal is then poured around the vermiculite particles.¹⁵

A German patent was granted for a method that removes oil, benzene, or other liquid hydrocarbon from water. The contaminated water is passed through a container that is loosely filled with exfoliated vermiculite or expanded perlite.¹⁶

¹² Walker, R. T., and C. C. Schuetz (assigned to U.S. Gypsum Co.). Fire Resistant Asphalt Coating Composition and Shingle. U.S. Pat. 3,180,783, Apr. 27, 1965.

¹³ Hewitt, F. (assigned to F. & D. M. Hewitt, Ltd.). British Pat. 994,306. June 2, 1965.

¹⁴ Frey, L. (assigned to Protexulate Ltd.). British Pat. 997,795, July 7, 1965.

¹⁵ French Pat. 1,365,243, May 19, 1964.

¹⁶ German Pat. 1,167,278, Apr. 2, 1964.