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2018 Minerals Yearbook

VERMICULITE [ADVANCE RELEASE]

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Vermiculite

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In 2018, U.S. production of vermiculite concentrate decreased slightly, although reportable production remained at an estimated 100,000 metric tons (t) because of rounding to one significant digit to avoid disclosing company proprietary data. Worldwide vermiculite production was 421,000 t in 2018, increasing by about 10% from that in 2017 (tables 1, 4). About 76,000 t of exfoliated vermiculite valued at $57.9 million was sold or used in the United States in 2018, representing a nearly 6% increase in quantity with a 9% decrease in value from those in 2017 (tables 1, 3). U.S. exports of vermiculite were estimated to have decreased by 13% to 14,000 t, and imports were estimated to have increased by 32% to 37,000 t from those in 2017 (table 1). Percentages in this report were calculated using unrounded data.

Vermiculite is a hydrated magnesium-aluminum-iron silicate. Raw vermiculite is similar in appearance to mica, contains water molecules within its internal structure, and ranges in color from black to various shades of brown to yellow. When vermiculite flakes are heated rapidly to a temperature above 870 degrees Celsius (°C), the intermolecular water flashes into steam, and the flakes expand into accordion-like particles, which are gold or bronze in color. This expansion process is called exfoliation, and the resulting ultralightweight aggregate is chemically inert, fire-resistant, and odorless.

Production

Domestic production (sold or used) data for vermiculite are collected annually by the U.S. Geological Survey through two voluntary canvasses—one is sent to mine and mill (concentrator) operations and the second to exfoliation plants. All individual company data from these canvasses were withheld from publication to avoid disclosing company proprietary data.

Production data for vermiculite concentrate were derived from responses from two U.S. producers, accounting for all domestic crude vermiculite mine production. In 2018, production of vermiculite concentrate decreased slightly. Domestic vermiculite concentrate was mined and processed by Specialty Vermiculite Corp. (a subsidiary of Dicalite Management Group, Inc.) at its operations at Enoree and Woodruff, SC, and by Virginia Vermiculite LLC at its operation in Louisa County, VA. Both companies produced concentrates in fine grade sizes (less than 2 millimeters) from biotite mica ores (Moeller, 2018).

Vermiculite concentrate was shipped to 14 companies operating 17 plants in 11 States for conversion into expanded lightweight products (table 2). In 2018, 76,000 t of exfoliated vermiculite sold or used by producers was valued at $57.9 million with a 14% decrease in average unit value (table 1). Of the 17 exfoliation plants, 5 responded to the canvass, representing approximately 30% of the estimated sold or used exfoliated vermiculite tonnages listed in tables 1 and 3. Production data for nonrespondents were estimated on the basis of previous years' reported production levels. States that produced exfoliated vermiculite were, in descending order of tonnage, South Carolina, New Jersey, Arizona, Pennsylvania, Massachusetts, Illinois, Florida, Texas, Arkansas, Ohio, and New Mexico.

Consumption

Vermiculite has a wide range of uses, particularly in the agricultural and construction industries, because of its attributes, including fire resistance, high liquid-absorption capacity, inertness, low density, and low thermal conductivity. In horticulture, vermiculite mixed with peat or other composted materials, such as pine bark, produces a soil-like material well suited as a growing medium for plants. To condition soil, vermiculite can improve the aeration of "sticky" (clay-rich) soils and the water-retention characteristics of sandy soils, reducing the likelihood of compaction, cracking, and crusting of the soil. Use in horticulture and soil conditioning accounted for 46% of the exfoliated vermiculite sold or used in the United States in 2018 (table 3). Vermiculite also is used in the fertilizer and pesticide markets because of its ability to act as a bulking agent, carrier, and extender while providing some potassium, magnesium, and minor elements to plants. Vermiculite can absorb liquids, such as fertilizers, herbicides, and insecticides, which can then be transported as free-flowing solids.

Other significant uses of vermiculite include insulation products and lightweight aggregate applications, such as general building plasters and concrete products, for its lightweight and thermal insulation properties. These uses accounted for 27% of the exfoliated vermiculite sold or used in the United States in 2018 (table 3). Special plasters, including those used for fire protection and soundproofing, may use vermiculite combined with a binder, such as gypsum or portland cement, fillers, and other specialized additives. As insulation, exfoliated vermiculite, in some applications treated with a water repellent, is used to fill pores and cavities in hollow blockwork and masonry construction to enhance acoustic properties, fire rating, and insulation performance. Finer grades of exfoliated vermiculite, combined with potassium or sodium silicate, are used to produce insulation shapes. The ability of vermiculite-base insulation shapes to resist attack by molten aluminum makes them especially useful as secondary insulation in the aluminum production process. Other uses include refractory-insulation gunning and castable mixes and vermiculite dispersions. Finer grades of exfoliated vermiculite are used to partially replace asbestos in brake linings, primarily for the automotive market.

Prices

Published prices for vermiculite serve only as a general guide because of variations in application, quantity, source, and other factors. U.S. domestic prices for vermiculite concentrate, mostly

dependent on grade sizing, ranged from $140 to $575 per metric ton in 2018, unchanged since 2015 (Tanner, 2019). Coarser grained vermiculite with greater thermal expansion commands a higher price, but virtually none is produced in the United States (Moeller, 2018). Dicalite Management Group, Inc. announced price increases for vermiculite ore in 2018 but did not disclose the starting prices or how much the prices were to change (Lismore-Scott, 2018).

The average unit value of U.S. exfoliated vermiculite sold or used by producers, using actual and estimated data, was about $761 per metric ton in 2018, down by 14% from $885 per metric ton in 2017. These data were composite values of exfoliated vermiculite produced from domestic and imported concentrate (table 1).

Foreign Trade

Trade data for vermiculite concentrate are not collected as a separate category by the U.S. Census Bureau but are included within the group "vermiculite, perlite, and chlorites, unexpanded" under Harmonized Tariff Schedule of the United States code 2530.10.0000. Domestic exports and imports for consumption of vermiculite were estimated on the basis of information published by the U.S. Census Bureau (table 1). Exports of vermiculite were estimated to have decreased by 13% to 14,000 t in 2018 from those in 2017. Total United States imports of vermiculite—crude and concentrate—were estimated to be 37,000 t, an increase of 32% from an estimated 28,000 t in 2017, with most in 2018 coming from South Africa and Brazil. Concentrates of coarser-than-medium particle size from high-yielding deposits, which have been declining in availability in recent years, were imported mostly from China and South Africa.

World Review

Global vermiculite production increased by about 10% in 2018 to an estimated 421,000 t (table 4), owing to incremental increases in production from several countries and an estimated 15,000-t increase in output at the Namekara Vermiculite Mine in Uganda. Data for vermiculite production in China, which may have produced significant quantities of vermiculite, were unavailable. Although mines and prospects in Brazil and South Africa had the potential to increase the production of medium to coarse grades, expected production increases had yet to materialize significantly. Production at the Namekara Vermiculite Mine in Uganda may provide some needed quantities of coarser grades; however, coarser and more expensive grades, increasingly in high demand in recent years, continued to be in short supply. Excess capacity existed for very fine sizes (Moeller, 2018; Tanner, 2019).

Brazil.—In 2018, Brazil was estimated to have produced 50,000 t of vermiculite, most of which was mined by Brasil Minérios Ltd., by far the leading vermiculite producer in Brazil (table 4). The company's largest mine was the Morro Pelado Mine in Sao Luis de Montes Belos municipality near Goiania in the State of Goias in central Brazil, and its primary processing plant was in Sao Luis. The mine had an estimated production capacity of 50,000 metric tons per year (t/yr) of vermiculite ore with reserves estimated in 2012 of 1.2 million metric tons (Mt) of vermiculite ore (Brasil Minérios Ltd., 2018). With the expansion of its mining operations continuing, Brasil Minérios produced about 48,700 t of vermiculite concentrate in 2017 (most recent year for which data were available) (Departamento Nacional de Produção Mineral, 2018, p. 237). About 60% of Brazil's vermiculite products were exported, with sales in North America (50% of all exports), Europe (35%), and Asia (15%) (Elliott, 2012; Torrisi and Patel, 2014).

Near Brasilia in Catalao, Goias State, Brasil Minérios owned the mining rights to vermiculite deposits containing estimated vermiculite ore reserves of 3.3 Mt (Elliott, 2011; Brasil Minérios Ltd., 2018). Brasil Minérios' total production capacity was expected to increase to 200,000 t/yr when the Catalão Mine reached full capacity during the next several years (Torrisi and Patel, 2014; Moeller, 2018). Brasil Minérios expected to meet Brazil's domestic demand for vermiculite for 50 years while continuing to be a significant exporter of the mineral. The company also expanded capacity by 15,000 t/yr of vermiculite at its exfoliation plants in Sanclerlandia, Goias State, and in Cosmopolis, Sao Paulo State (J. Mendo Consultoria, 2009, p. 11; Brasil Minérios Ltd., 2018).

Bulgaria.—In 2018, Wolff & Müller Minerals Bulgaria OOD, a joint venture between companies from Bulgaria and Germany, mined vermiculite ore from its Belitza opencast mine and had limited production at, and continued development of, the nearby Verona vermiculite deposit in southwestern Bulgaria near the capital of Sofia. The company processed the crude vermiculite ore into a concentrate in superfine- and micron-sized products at its 20,000-t/yr vermiculite concentration plant (Moeller, 2018; Wolff & Müller Minerals Bulgaria OOD, undated).

China.—Production levels of vermiculite in China were not available, but based on a 2016 estimate made by the Vermiculite Association that China annually exports 110,000 t of vermiculite, the country's annual production likely was greater than 110,000 t (Ghilotti, 2016). Production increases in China continued to be constrained by increased enforcement of environmental regulations (Lismore-Scott, 2018).

Xinjiang Yuli Xinlong Vermiculite Co., Ltd. mined vermiculite ore from its Xinlong Mine in the Bazhou area of Xinjiang Uyghur Autonomous Region. The 120,000-t/yr vermiculite concentrate Xinlong Mine was the top-producing vermiculite mine in China, from which the company produced 30,000 cubic meters per year of exfoliated vermiculite. The company's leading product was a flake vermiculite concentrate ranging in size from 0.3 to 8.0 millimeters. The company exported most of its products, typically to developed countries and regions such as Europe, Australia, Hong Kong, Japan, the Republic of Korea, Russia, Taiwan, and the United States, but also sold products domestically (Xinjiang Yuli Xinlong Vermiculite Co., Ltd., undated).

South Africa.—In 2018, South Africa continued to be the world's leading producer and exporter of vermiculite, accounting for about 43% of estimated world production (table 4). In 2018, 180,000 t was produced, most of which was mined by Palabora Mining Co. Ltd. (table 4).

Under the ownership of a consortium consisting of entities from South Africa and China led by the Industrial Development Corp. of South Africa Ltd. and China's Hebei Iron & Steel

Group, Palabora Mining increased production in 2018 by more than 8% from that in 2017 from its mine in the Limpopo Province (table 4). Nearby, the company was preparing for the opencast mining of ore that was equally rich in high-purity vermiculite. The new mine was designed to produce 1.5 million metric tons per year of ore and yield 170,000 t/yr of vermiculite concentrate, extending the company's total mine life through 2031 (Industrial Minerals, 2016; Palabora Mining Co. Ltd., 2018, p. 5). Because of grade constraints and lower recovery rates from portions of the vermiculite ore body, the vermiculite product has continued to shift toward fine and superfine grades. Palabora Mining continued to face increased competition in the global vermiculite market, including from Brazil and Uganda, but it regained some of its market share lost in the past few years, in part through competitive pricing (Palabora Mining Co. Ltd., 2014, p. 12–13, 38; Ghilotti, 2016).

Palabora Mining marketed its vermiculite products through the company's Singapore office to its three international subsidiaries in Australia, Europe, and North America (Palabora Mining Co. Ltd., 2014, p. 38).

Turkey.—Organik Madencilik A.Ş., a 50–50 joint venture of Turkey's Yildirim Group and the Greek mining group S&B [a subsidiary of Imerys SA (Paris, France)] has completed plant construction and started producing from the country's first vermiculite mine at the Karakoc vermiculite deposit in Sivas in central Turkey. The deposit, discovered by Turkey's Government Exploration Co. in the 1990s, is thought to hold resources of about 2.8 Mt of high-quality vermiculite and 2.5 Mt of lower quality vermiculite (Organik Madencilik A.Ş., 2017a; Lismore-Scott, 2018). The mine had a capacity of 10,000 t/yr of vermiculite concentrate, which includes a significant quantity of coarse and medium grades. An unspecified portion of production was further processed by exfoliation (Organik Madencilik A.Ş., 2017b). Sales of vermiculite concentrate and of exfoliated vermiculite were planned to go through Imerys' established network (Industrial Minerals, 2015).

Uganda.—In 2018, Black Mountain Resources Ltd. of Australia completed a company restructuring that included selling its interest in the Namekara Vermiculite Mine in the Manafwa district of eastern Uganda in exchange for debt relief (Hipo Resources Ltd., 2018, p. 6). Black Mountain withdrew from the joint venture developing the Namekara Vermiculite Mine citing inconsistent vermiculite sales that resulted in reduced cash flow and the company's inability to service its debt obligations (Iannucci, 2018; Mbanga, 2018). Namekara Mining Co. Ltd. became the 100% owner of the Namekara Vermiculite Mine and continued mining operations. The large vermiculite deposit had almost 62 Mt of inferred resources with a grade of 18.2% vermiculite and containing 11 Mt of vermiculite (Iannucci, 2016). The mine had an estimated production capacity of 30,000 t/yr of vermiculite concentrate, which includes significant quantities of coarse and medium grades, and enough resources to operate for more than 50 years at previously announced rates of production (Namekara Mining Co. Ltd., 2019). Black Mountain had considered a production expansion up to 80,000 t/yr, but Namekara Mining has not announced plans for expansion (Black Mountain Resources Ltd., 2017, p. 7; Tanner, 2019).

Zimbabwe.—Samrec Vermiculite (Pvt.) Ltd. [a subsidiary of Imerys SA (Paris, France)], the leading vermiculite producer in the country, produced vermiculite concentrate at the Shawa Mine, which is about 300 kilometers southeast of the capital of Harare. The surface mining operation with ore to a depth of 40 meters had a capacity of 40,000 t/yr of vermiculite concentrate and an expected mine life of more than 30 years in one of the largest vermiculite deposits in the world. The ore, which included a significant portion of large flake vermiculite, was processed into concentrates, the majority of which was exported to Asia, Europe, the Middle East, and the United States (Lismore-Scott, 2014; Tanner, 2019).

The Minerals Marketing Corp. of Zimbabwe, which was responsible for marketing and selling the country's industrial minerals, reported exports of 33,200 t of vermiculite concentrate at a value of $3.79 million in 2018, representing a 42% increase in quantity with a 12% increase in value from about 23,300 t at a value of $3.38 million in 2017. The company cited that the strong U.S. dollar and increased inland costs to sea ports had made the local product prices uncompetitive on the international market (Minerals Marketing Corp. of Zimbabwe, 2019, p. 17, 20).

In 2018, the Government of Zimbabwe launched a Transitional Stabilisation Programme, set to run from October 2018 to December 2020, for economic recovery. The Zimbabwe-based Wickbury Investments (Pvt.) Ltd.'s Dinhidza Vermiculite Mine in Buhera was listed with a nonoperational status and as available for investors (Ministry of Finance and Economic Development, 2018, p. 174, 356). Wickbury Investments, which in 2015 had invested in its production facilities at the mine, marketed its product mainly to Zimbabwe's farming industry as a soil amendment to slow the leaching of fertilizers from soil after excessive rainfall while also promoting the mineral's slow release of fertilizer to the soils. In drier areas, farmers would benefit from the mineral's ability to swell and store water, increase soil aeration, and transport and store nutrients. In both instances, use of vermiculite would improve the long-term fertility of soils (Dickson, 2015).

Outlook

Exploration and development of vermiculite deposits containing medium, large, and premium (coarser) grades (mostly in China and South Africa) are likely to continue because of the higher demand for these larger grades. During the next several years, operations in Brazil and the United States are expected to help maintain regional and global supplies of fine, superfine, and micron grades. Sustained production at the Namekara Vermiculite Mine in Uganda may provide some of the needed supplies of coarser grades in the market.

With supplies of finer grades in excess capacity and far exceeding those of coarse grades for several decades, producers will continue to investigate more ways to increase the use of the finer grades in higher value markets and in existing products, such as functional filler in coatings, fireproofing, friction brake applications, and insulation. To increase fire resistance in coatings and binders that form high-tensile-strength films, finer grades of vermiculite concentrate may be

used as intumescents, the concentrate swelling (expanding) and promoting a less dense, passive barrier upon exposure to heat. Product lines may be developed for new uses, such as fine-sized to micron-sized grades of vermiculite to control air pollution and absorb water in mines, replace zeolites in ion-exchange columns, purify wastewater, or serve to contain or remove nuclear waste (Torrisi and Patel, 2014). New and innovative ideas for uses of vermiculite in the construction industry was suggested by a major producer to have the potential to lower the carbon footprint and increase the energy efficiency of new buildings (Pengelly, 2017). A company in the United Kingdom was marketing vermiculite dispersion products that it had developed to suppress fires in lithium-ion batteries. In research and development activities, work included flexible polyamide composite foams for thermal and fire suppression and catalysts for the production of synthetic natural gas (Moeller, 2018).

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TABLE 1
SALIENT VERMICULITE STATISTICS[1]

(Thousand metric tons and thousand dollars unless otherwise specified)

		2014	2015	2016	2017	2018
United States:						
Production, concentrate[e, 2, 3]		100	100	100	100	100
Exfoliated:						
Quantity		63	65	68	72	76
Value		52,000	60,800	62,300	63,500	57,900
Average value	dollars per metric ton	800	930	910	885	761
Exports[e, 4]		22 [r]	19 [r]	21 [r]	16 [r]	14
Imports for consumption[e, 4]		39 [r]	25 [r]	36 [r]	28 [r]	37
World, production		385 [r]	382 [r]	398 [r]	381 [r]	421 [e]

[e]Estimated. [r]Revised.
[1]Table includes data available through April 20, 2020. Data are rounded to no more than three significant digits.
[2]Sold or used by producers.
[3]Rounded to the nearest 100,000 metric tons to avoid disclosing company proprietary data.
[4]Source: U.S. Census Bureau.

TABLE 2
ACTIVE VERMICULITE EXFOLIATION PLANTS IN THE UNITED STATES IN 2018

Company	County	State
Fireproofing Products, Inc.	Bernalillo	New Mexico.
Isolatek International Inc.	Sussex	New Jersey.
J.P. Austin Associates Inc.	Beaver	Pennsylvania.
Palmetto Vermiculite Co. Inc.	Spartanburg	South Carolina.
P.V.P. Industries, Inc.	Trumbull	Ohio.
Schundler Co., The	Middlesex	New Jersey.
Specialty Vermiculite Corp.	Maricopa	Arizona.
Do.	Broward	Florida.
Do.	Laurens	South Carolina.
Sun Gro Horticulture Canada Ltd.	Jefferson	Arkansas.
Do.	LaSalle	Illinois.
Thermal Ceramics Inc.	Macoupin	Do.
Therm-O-Rock East, Inc.	Washington	Pennsylvania.
Therm-O-Rock West, Inc.	Maricopa	Arizona.
Vermiculite Industrial Corp.	Allegheny	Pennsylvania.
Vermiculite Products Inc.	Harris	Texas.
Whittemore Co., Inc.	Essex	Massachusetts.

Do. Ditto.

TABLE 3
ESTIMATED EXFOLIATED VERMICULITE SOLD OR USED IN THE UNITED STATES, BY END USE[1]

(Metric tons)

	2017	2018
Aggregates[2]	13,800	12,900
Insulation[3]	5,960	7,730
Agricultural:		
Horticultural	27,100	28,600
Soil conditioning	5,990	6,180
Fertilizer carrier	W	W
Total	W	W
Other[4]	W	W
Grand total[5]	72,000	76,000

W Withheld to avoid disclosing company proprietary data; included in "Grand total."
[1]Table includes data available through April 20, 2020. Data rounded to no more than three significant digits; may not add to totals shown.
[2]Includes concrete, plaster, and premixes (acoustic insulation, fireproofing, and texturizing uses).
[3]Includes loose-fill, block, and other (high-temperature and packing insulation and sealants).
[4]Includes various industrial and other uses not specified.
[5]Rounded to two significant digits because of estimated data.

TABLE 4
VERMICULITE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Metric tons)

Country or locality[2]	2014	2015	2016	2017	2018
Argentina	90	90	60	-- r	-- e
Brazil, concentrate	56,444	70,000 r	58,000 r	50,050 r	50,000 e
Bulgaria, concentrate e	10,000	10,000	10,000	10,000	10,000
Egypt e	3,000	8,190	8,000	8,000	8,000
India	16,384	13,250	8,058	5,315	10,000 e
Iran	1,200	1,000	1,000 e	1,000 e	1,000 e
Kenya	440	410	--	-- r, e	-- e
Mexico	226	299	310	-- r, e	-- e
Russia	21,000 e	8,282	12,363	11,900 r, e	10,000 e
South Africa	143,007	138,290	166,483	166,084 r	180,000 e
Turkey	716	425	1,050	1,618	1,500 e
Uganda	2,620	1,118	3,294	4,119 r	20,000 e
United States, concentrate[3]	100,000	100,000	100,000	100,000	100,000
Zimbabwe	29,767	30,868	29,020 r	23,302 r	30,000 e
Total	385,000 r	382,000 r	398,000 r	381,000 r	421,000 e

eEstimated. rRevised. -- Zero.
[1]Table includes data available through July 9, 2019. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]In addition to the countries and (or) localities listed, Australia, China, and Japan may have produced vermiculite, but available information was inadequate to make reliable estimates of output.
[3]Concentrate, sold and used by producers. Rounded to one significant digit to avoid disclosing company proprietary data.