



2019 Minerals Yearbook

VERMICULITE [ADVANCE RELEASE]

VERMICULITE

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In 2019, 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. About 75,000 t of exfoliated vermiculite valued at \$58.0 million was sold or used in the United States in 2019, compared with 76,000 t valued at \$57.9 million in 2018. U.S. exports of vermiculite were estimated to have decreased by 36% to 9,000 t, and imports were estimated to have increased by 5% to 39,000 t from those in 2018 (table 1). World vermiculite production was 393,000 t in 2019, decreasing slightly from that in 2018 (table 4). 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 shades of brown and 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. Production data were rounded to one significant digit to avoid disclosing company proprietary data. Exfoliated data were aggregated for all plants and published in a form that does not reveal 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 2019, 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 operation in Enoree, SC, and by Virginia Vermiculite LLC at its operation in Louisa County, VA. Both companies produced concentrates in finer grade sizes (less than 2 millimeters) from biotite mica ores (Moeller, 2018).

Vermiculite concentrate was shipped to 13 companies operating 16 plants in 10 States for conversion into expanded lightweight products (table 2). In 2019, 75,000 t of exfoliated vermiculite valued at \$58.0 million was sold or used by producers. The average unit value increased slightly to \$773 per metric ton (table 1). Of the 16 exfoliation plants, 4 responded to the canvass, representing approximately 24%

of the estimated sold or used exfoliated vermiculite tonnages listed in tables 1 and 3. Production data for nonrespondents were estimated based upon previous years' reported production levels. States that produced exfoliated vermiculite were Arizona, Arkansas, Florida, Illinois, Massachusetts, New Jersey, New Mexico, Ohio, Pennsylvania, and South Carolina.

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 48% of the exfoliated vermiculite sold or used in the United States in 2019 (table 3). Vermiculite is also 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 other minor nutrients to plants. Vermiculite can absorb liquids, such as fertilizers, herbicides, and insecticides, which then can be transported as free-flowing solids. The quantity of exfoliated vermiculite used in fertilizer was withheld to avoid disclosing proprietary data.

Other significant uses of vermiculite included insulation products and in lightweight aggregate applications (such as general building plasters and concrete products) for its lightweight and thermal insulation properties. These uses accounted for 25% of the exfoliated vermiculite sold or used in the United States in 2019 (table 3). Special plasters, including those used for fire protection and soundproofing, may have used 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, was 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, were used to produce insulation shapes. The ability of vermiculite-base insulation shapes to resist attack by molten aluminum made them especially useful as secondary insulation in the aluminum production process. Other uses included refractory-insulation gunning and castable mixes and vermiculite dispersions. Finer grades of exfoliated vermiculite were 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, remained at \$140 to \$575 per metric ton from 2015 to 2018 (Tanner, 2019). Coarser grained vermiculite with greater thermal expansion commanded a higher price, but virtually none was produced in the United States (Moeller, 2018). In 2018, Industrial Minerals discontinued providing vermiculite prices (Industrial Minerals, 2018). Dicalite announced price increases for vermiculite ore in 2019, but did not disclose the starting prices or how much the prices were to change. Dicalite reported price increases were necessary for capital investments that would improve reliability and efficiency of their Enoree, SC, production plant and allow for better flow to their vermiculite expansion plants (Dicalite Management Group, Inc., 2019).

The average unit value of U.S. exfoliated vermiculite sold or used by producers, using reported and estimated data, was \$773 per metric ton in 2019, a slight increase from \$761 per metric ton in 2018. 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 (HTS) code 2530.10.0000. Domestic exports and imports for consumption of vermiculite were estimated based on information published by the U.S. Census Bureau (table 1). Exports of vermiculite were estimated to have decreased by 36% to 9,000 t in 2019 from those in 2018. Total United States imports of vermiculite—crude and concentrate—were estimated to be 39,000 t, an increase of 5% from an estimated 37,000 t in 2018, with the majority coming from South Africa and Brazil, in decreasing quantity. 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 decreased slightly in 2019 to an estimated 393,000 t (table 4). 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. The Namekara Vermiculite Mine in Uganda may have provided coarser grades of vermiculite. Coarser grades of vermiculite continue to be in short supply as there has been increased demand in recent years. Excess capacity existed for very fine sizes (Moeller, 2018).

Brazil.—In 2019, Brazil was estimated to have produced 50,000 t of vermiculite (table 4). Brazil’s estimated exports of vermiculite products in 2019 were 27,000 t, with the United States (45%), the United Arab Emirates (13%), and

Mexico (12%) being the leading destinations (United Nations Statistics Division, undated). Although the HTS code included vermiculite, perlite and chlorites, Brazil was a major producer of only vermiculite.

Brasil Minérios Ltd., Brazil’s leading vermiculite producer, operated the Morro Pelado Mine and its primary processing plant in Sao Luis de Montes Belos municipality near Goiania in the State of Goias in central Brazil. The mine had an estimated production capacity of 50,000 metric tons per year (t/yr) of vermiculite ore with estimated reserves of 1.3 million metric tons (Mt). Brasil Minérios’ total production at full capacity was expected to be 200,000 t/yr (Torrise 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. Brazil Minérios also owned the mining rights to vermiculite deposits near Brasilia in Catalao, Goias State, containing estimated vermiculite reserves of 3.3 Mt (Brasil Minérios Ltd., 2018). The company also operates two vermiculite exfoliation plants in Sanclerlandia, Goias State, and in Cosmopolis, Sao Paulo State (J. Mendo Consultoria, 2009, p. 11; Brasil Minérios Ltd., 2018).

Bulgaria.—Wolff & Müller Minerals Bulgaria OOD, a joint venture between companies from Bulgaria and Germany, mined vermiculite ore from its Belitza Mine. The company also 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 production in 2016 was likely substantially greater than 110,000 t based on an estimate made by the Vermiculite Association that China annually exported 110,000 t of vermiculite (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 company produced 30,000 cubic meters (estimated 3,000 to 4,000 t) 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, localities, and regions such as Australia, Europe, 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 2019, South Africa continued to be the world’s leading producer and exporter of vermiculite, accounting for about 40% of estimated world production (table 4). In 2019, 158,000 t was produced, an 12% increase from the revised 2018 production. Most vermiculite in South Africa was mined by Palabora Mining Co. Ltd. from its mine in Limpopo Province.

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 had a capacity to produce 1.5 Mt of

ore and yield 170,000 t of vermiculite concentrate annually. The company expanded the operation to extend the mine life through 2033 (Industrial Minerals, 2016). 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 (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 Greece-based S&B Industrial Minerals S.A. [a subsidiary of Imerys SA (Paris, France)], mined vermiculite from the Karakoc vermiculite deposit in Sivas in central Turkey. The deposit, discovered by Turkey's Government Exploration Co. in the 1990s, was thought to hold resources of about 2.8 Mt of high-quality vermiculite and 2.5 Mt of lower quality vermiculite (Industrial Minerals, 2015). The mine had a capacity of 10,000 t/yr of vermiculite concentrate, including coarse, medium, fine, and superfine grades (Yildirim, 2020).

Uganda.—The Namekara Vermiculite Mine in eastern Uganda close to the border with Kenya was the only commercial vermiculite mine in Uganda. The vermiculite deposit contained 62 Mt of inferred resources with a grade of 18.2% vermiculite, or about 11 Mt of vermiculite (Iannucci, 2016). Namekara Mining Co. Ltd. was the sole owner of the 30,000-t/yr mine (Namekara Mining Co. Ltd., 2019).

Zimbabwe.—In 2019, Zimbabwe produced an estimated 30,000 t of vermiculite (table 4). In 2018, the most recent year in which production data were reported, Minerals Marketing Corp. of Zimbabwe reported exports of 33,200 t of vermiculite concentrate valued at \$3.79 million (Minerals Marketing Corp. of Zimbabwe, 2019, p. 17).

Samrec Vermiculite (Pvt.) Ltd. [another subsidiary of Imerys], the leading vermiculite producer in Zimbabwe, produced vermiculite concentrate at the Shawa Mine, about 300 kilometers southeast of the capital of Harare. The 40,000-t/yr surface mining operation had an expected mine life of more than 30 years from one of the largest vermiculite deposits in the world. The ore, which included a significant portion of large flake vermiculite, was processed into concentrates (Lismore-Scott, 2014).

In 2018, the Dinhidza Vermiculite Mine in Buhera was listed as nonoperational and available for investors in the Transitional Stabilisation Programme developed for economic recovery by the Government of Zimbabwe (Ministry of Finance and Economic Development, 2018, p. 174, 356). In 2015, Wickbury Investments Ltd. invested in production facilities at the mine and marketed its product mainly to Zimbabwe's farming industry (Dickson, 2015).

Outlook

Although the world vermiculite production capacity continues to exceed consumption, 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. Production from the Namekara Vermiculite Mine in Uganda will also be providing coarser grades to the market. Operations in Brazil and the United States are expected to continue as leading producers of fine, superfine, and micron grades.

With supplies of finer grades in excess capacity and far exceeding those of coarse grades for several decades, producers will continue to investigate 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 intumescent, 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- 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 (Torrise and Patel, 2014). New and innovative ideas for uses of vermiculite in the construction industry are thought 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 STATISTICS¹

(Thousand metric tons and thousand dollars unless otherwise specified)

	2015	2016	2017	2018	2019	
United States:						
Production, concentrate ^{e,2}	100	100	100	100	100	
Exfoliated:						
Quantity	65	68	72	76	75	
Value	60,800	62,300	63,500	57,900	58,000	
Average value	dollars per metric ton	936 ^r	916 ^r	882 ^r	761	773
Exports ^{e,3}	19	21	16	14	9	
Imports for consumption ^{e,3}	25	36	28	37	39	
World, production	382	398	379 ^r	401 ^r	393 ^e	

^eEstimated. ^rRevised.

¹Table includes data available through December 15, 2020. Data are rounded to no more than three significant digits unless otherwise specified.

²Concentrate, sold or used by producers, rounded to one significant digit to avoid disclosing company proprietary data.

³Source: U.S. Census Bureau adjusted by U.S. Geological Survey. Data are for “vermiculite, perlite and chlorites, unexpanded,” Harmonized Tariff Schedule of the United States code 2530.10.0000. May include both crude and concentrate.

TABLE 2
ACTIVE VERMICULITE EXFOLIATION PLANTS IN THE UNITED STATES IN 2019

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.
Whittemore Co., Inc.	Essex	Massachusetts.
Do. Ditto.		

TABLE 3
ESTIMATED EXFOLIATED VERMICULITE SOLD OR
USED IN THE UNITED STATES, BY END USE¹

(Metric tons)

	2018	2019
Aggregates ²	12,900	10,900
Insulation ³	7,730	8,110
Agricultural:		
Horticultural	28,600	29,400
Soil conditioning	6,180	6,640
Fertilizer carrier	W	W
Other ⁴	W	W
Total ⁵	76,000	75,000

W Withheld to avoid disclosing company proprietary data; included in "Total."

¹Table includes data available through December 15, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes concrete, plaster, and premixes (acoustic insulation, fireproofing, and texturizing uses).

³Includes loose-fill, block, and other (high-temperature and packing insulation and sealants).

⁴Includes various industrial and other uses not specified.

⁵Rounded to two significant digits because of estimated data.

TABLE 4
VERMICULITE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY¹

(Metric tons)

Country or locality ²	2015	2016	2017	2018	2019
Argentina	90	60	--	-- ^e	-- ^e
Brazil, concentrate	70,000	58,000	50,050	50,000 ^e	50,000 ^e
Bulgaria, concentrate ^e	10,000	10,000	10,000	10,500 ^r	10,500
Egypt ^e	8,190	8,000	8,000	8,000	8,000
India	13,250	8,058	5,315	5,159 ^r	2,232
Iran ^e	1,000	1,000	1,000	1,000	1,000
Kenya	410	--	-- ^e	-- ^e	-- ^e
Mexico	299	310	464 ^r	244 ^r	330 ^e
Russia	8,282	12,363	9,262 ^r	25,904 ^r	25,000 ^e
South Africa	138,290	166,483	166,084	141,346 ^r	158,013
Turkey	425	1,050	1,618	18,183 ^r	1,370
Uganda	1,118	3,294	4,119	7,200 ^{r,e}	7,000 ^e
United States, concentrate ^{e,3}	100,000	100,000	100,000	100,000	100,000
Zimbabwe	30,868	29,020	23,302	33,161 ^r	30,000 ^e
Total	382,000	398,000	379,000 ^r	401,000 ^r	393,000 ^e

^eEstimated. ^rRevised. -- Zero.

¹Table includes data available through October 30, 2020. 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.

²In 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.

³Concentrate, sold or used by producers, rounded to one significant digit to avoid disclosing company proprietary data.