



2013 Minerals Yearbook

VERMICULITE [ADVANCE RELEASE]

VERMICULITE

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In 2013, production of vermiculite concentrate increased by more than 5%, although reportable production remained at an estimated 100,000 metric tons (t) because of rounding to the nearest 100,000 t to avoid disclosing company proprietary data. Worldwide vermiculite production was about 358,000 t in 2013, a 4% decrease from that of 2012. About 64,000 t of exfoliated vermiculite valued at \$50.1 million was sold or used in the United States in 2013, up 8% from 59,000 t in 2012. U.S. exports of vermiculite were estimated to be about 2,000 t, about the same as in 2012, and imports were estimated to be 36,000 t, a decrease of 37% from that of 2012 and about 17% less than the average imports of the previous 5 years (tables 1, 3, and 4).

Production

Vermiculite is a hydrated magnesium-aluminum-iron silicate. Raw vermiculite is mica-like in appearance, 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 of 900 °C or higher, 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 lightweight material is chemically inert, fire resistant, and odorless. Two U.S. producers accounted for all domestic crude vermiculite production. Virginia Vermiculite LLC mined and processed vermiculite concentrate at its operation in Louisa County, VA, and Grace Specialty Vermiculite (subsidiary of W.R. Grace & Co.) did the same at its operations at Enoree and Woodruff, SC. Domestic production (sold or used) data for vermiculite were collected by the U.S. Geological Survey (USGS) from two voluntary canvasses—one for mine-mill (concentrator) operations and the other for exfoliation plants. Each producer responded to its respective surveys, but being proprietary, the data were withheld.

Vermiculite concentrate was shipped to 15 companies operating 18 plants in 11 States for conversion into the expanded lightweight products (table 2). In 2013, the resulting output of about 64,000 t of exfoliated vermiculite sold or used by producers was valued at about \$50.1 million with a slight increase in average unit value (table 1). Of the 18 exfoliation plants, 8 responded to the annual canvass, representing 60% 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, in descending order of estimated output sold or used, New Jersey, South Carolina, Pennsylvania, Florida, Massachusetts, Illinois, Arizona, Arkansas, New Mexico, Texas, and Ohio.

Consumption

Vermiculite has a wide range of uses particularly in the agricultural and construction industries because of its various attributes including fire resistance, low thermal conductivity, high liquid absorption capacity, inertness, and low density. 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" soils (clay-rich) and the water-retention characteristics of sandy soils, reducing the likelihood of compaction, cracking, and crusting of the soil. These two uses accounted for about 45% of the exfoliated vermiculite sold or used in the United States in 2013 (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 major uses of vermiculite are in lightweight aggregate applications as general building plasters and concrete products for its lightweight and thermal insulation properties and as insulation. Special plasters include fire protection and soundproofing through products in which vermiculite is combined with a binder, such as gypsum or portland cement, fillers, and 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, ex-plant, largely dependent on grade sizing, ranged from \$145 to \$565 per metric ton in 2013, an increase from 2012 prices that ranged from \$145 to \$525 per ton. The value of imports

into the United States in 2013, mostly coarser grades, f.o.b. (free on board) barge Gulf Coast port, ranged from \$320 to \$1,020 per ton (Moeller, 2014). Coarser grained vermiculite with greater thermal expansion commands a higher price, but virtually none is produced in the United States.

The average unit value of U.S. exfoliated vermiculite sold or used by producers, using actual and estimated data, was about \$779 per ton in 2013, a nearly 2% increase from \$766 per ton in 2012; this includes exfoliated vermiculite produced from U.S. 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 category “vermiculite, perlite, and chlorite, unexpanded” under Harmonized Tariff Schedule of the United States code 2530.10.0000. Trade data in this report are from PIERS, a U.S. trade database compiled by the Journal of Commerce (United Business Media Global Trade, 2014). Total U.S. exports of vermiculite in 2013 were 2,230 t, with the United Kingdom receiving 58%; Belgium, 13%; the Republic of Korea, 10%; Honduras and Australia, about 4% each; and the remainder to several other countries. Total U.S. imports of vermiculite—crude, concentrate, and exfoliated—(excluding any material from Canada and Mexico) were estimated to be about 36,000 t, the majority coming from Brazil, 51%; South Africa, 34%; and China, 15%. Concentrates of coarser particle size from higher yielding deposits, which have been increasingly scarce in recent years, are imported mostly from China and South Africa.

World Review

Vermiculite production decreased by 4% globally in 2013 to 358,000 t (table 4), mainly owing to decreases in production from Gulf Industrials Ltd.’s Namekara Mine in Uganda and the world’s leading producer, Palabora Mining Co. Inc. in South Africa. Although mines and prospects in Brazil, South Africa, and Uganda might increase the availability of medium to coarser grades, expected production increases in 2013, especially of coarser grades, did not materialize. After mid-year, prices for finer grades tended to decrease slightly in Europe where demand declined mostly owing to a continued sluggishness in the region’s construction industry. Coarser and more expensive grades, increasingly in higher demand in recent years, continued to be in short supply (Palabora Mining Co. Ltd., 2013a, p. 51). Imerys Industrial Minerals conducted intermittent mining operations at Samrec Vermiculite Ltd.’s Shawa Mine, in Shawa, Zimbabwe (Moeller, 2014).

Brazil.—With reserves estimated at 1.2 million metric tons (Mt) of vermiculite ore, Brasil Minérios Ltd. had an estimated annual production capacity of nearly 80,000 t of vermiculite at its São Luís De Montes Belos Mine near Goiania in central Brazil. Brasil Minérios reported production of 40,000 cubic meters (m³) of expanded vermiculite in 2013. About 60% of its vermiculite products were exported, 50% of which were coarse grades and 50% fine grades, with sales in North America (50%),

Europe (35%), and Asia (15%) (Elliott, 2012b; Moeller, 2013; 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 2 Mt (Elliott, 2011b). The company planned to begin production at the Catalão Mine by 2016, bringing Brasil Minérios’ total production capacity, including the São Luís Mine, up to 200,000 t/yr in 2016 (Elliott, 2012b; Torrisi and Patel, 2014). Brasil Minérios expected to meet the domestic demand for vermiculite for 50 years, as well as export. Brasil Minérios has two exfoliation plants—one in Sanclerlandia, Goias State, and another in Cosmopolis, Sao Paulo State—with combined installed capacity of 15,000 cubic meters per month (Brasil Minérios Ltd., 2013).

China.—Xinjiang Yuli Xinlong Vermiculite Co. Ltd. produced vermiculite at the company’s Xinlong Mine in the Bazhou area of Xinjiang Province. From vermiculite ore produced at the Xinlong Mine, the leading vermiculite mine in the country, the company had an annual production capacity of 120,000 t of vermiculite concentrate and 30,000 m³ of exfoliated vermiculite. The company’s leading product was a scale-shaped flake vermiculite concentrate ranging in size from 0.3 millimeter to 8.0 millimeters. The company exported most of its products, typically to developed countries and regions such as Europe, Hong Kong, Japan, the Republic of Korea, Taiwan, and the United States, but also sold domestically (Xinjiang Yuli Xinlong Vermiculite Co., Ltd., 2014).

South Africa.—In 2013, South Africa was the world’s leading producer and exporter of vermiculite, accounting for about 36% of estimated world production (table 4). From 2000–12, on average, 88% of the vermiculite produced in South Africa was exported (Directorate Mineral Economics, 2013, p. 18).

In July, the sale of Palabora Mining Co. Ltd. by Rio Tinto plc and Anglo American plc to a consortium comprised of South African and Chinese entities led by the Industrial Development Corporation (IDC) of South Africa Limited and China’s Hebei Iron & Steel Group was complete (Palabora Mining Co., Ltd., 2013b). From its mine in Limpopo Province, Palabora reported that in the first 6 months of 2013, production decreased by 4% to 73,000 t of vermiculite compared with 76,000 t for the same period in 2012 (Palabora Mining Co., Ltd., 2013c). Although total production in 2013 was down by 2% to 130,000 t, sales actually increased more than 5% to 121,500 t. The company faced increased competition in the global vermiculite market, including competition in the South American market, and reduced demand in Europe, which was affected significantly by the European debt crisis. Owing to grade constraints and lower recovery rates from the vermiculite ore body, Palabora’s vermiculite product has continued to shift toward the fine and superfine grades (Palabora Mining Co. Ltd., 2013a, p. 51, 149; 2013c. p. 4). Management began making improvements in mine planning with more efficient recovery to produce the grades and quantities in demand by the market and planned to return to producing 150,000 t/yr by the end of 2015. Production of all grades of vermiculite at Palabora’s current South African deposit have decreased in the past few years, and production of sufficient quantities of coarse-grained grades to meet the

substantially increasing world demand has become increasingly challenging for the company. Based upon the company's latest exploration of nearby properties, Palabora had recently determined that it could double annual vermiculite production and exceed the previous expected mine life of 24 years (Elliott, 2011c, 2012a; Torrisi and Patel, 2014).

Uganda.—Gulf Industrials Ltd.'s (Sydney, New South Wales, Australia) Namekara Vermiculite Mine Project in the Manafwa district of eastern Uganda remained on a care-and-maintenance basis owing to oversupply and sluggish market conditions in Europe, its largest market. The Namekara deposit has about 55 Mt of inferred resources—including significant quantities of coarse and medium grades of about 30% each—and has sufficient resources to operate for more than 50 years at planned rates of production (Elliot, 2011a; Gulf Industrials Ltd., 2013).

United Kingdom.—The development of E2v Technologies plc's ProWave™ microwave processing system continued in collaboration with the National Centre for Industrial Microwave Processing of Nottingham, United Kingdom. According to the company, 12 m³ of exfoliated vermiculite is produced per ton of concentrate as compared with 9 cubic meters per ton of concentrate produced in a blast furnace; energy consumption may be reduced by as much as 90% and carbon dioxide emissions cut by about 85% by using ProWave™ processing instead of the traditional method; and the final product is cooler (150 °C), allowing packaging to be accomplished more quickly (Torrisi and Patel, 2014).

Outlook

Exploration and development of vermiculite deposits containing medium to premium coarse grades (mostly in China and South Africa) are likely to continue to be driven by the increasing 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 medium to small grades.

Although increased demand and tight supplies for coarser grades of vermiculite continued globally, prices for vermiculite, which stabilized somewhat in 2012–13 following the price hikes of 2011, are expected to be mixed through 2014 even with less-than-expected production in South Africa and Uganda.

With supplies of finer grades far exceeding coarse grades, producers will continue to look for more ways to use finer grades in existing products, as a functional filler in coatings, fireproofing, friction brake applications, and insulation, and also as an intumescent in coatings and binders that form high-tensile-strength films in order to stabilize the price. 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 zeolite in ion-exchange columns, purify wastewater, or serve to contain or remove nuclear waste. Innovative approaches to existing technologies, such as Brazil Minérios Ltd.'s unique hybrid wash screen–dry winnower, hold promise for high-quality, cost-effective improvements in processing vermiculite concentrate using conventional technologies (Moeller, 2014; Torrisi and Patel, 2014).

As a result of the energy-intensive process associated with the exfoliation of vermiculite in traditional blast furnaces, prices for exfoliated vermiculite are likely to continue to be affected by the volatility of natural gas costs (Elliott, 2012b). Because a portion of the vermiculite is not fully exfoliated in traditional blast furnace processing, new technologies, such as the new microwave technology for processing vermiculite, which has a more consistent heating of all the vermiculite flakes, could increase yield and substantially reduce the energy needed to exfoliate vermiculite concentrate. The microwave exfoliator system was expected to be commercially available in early 2015. Successful development of microwave technology could alter the way that vermiculite is exfoliated worldwide (Moeller, 2014).

The International Monetary Fund expected the global economy to increase by about 3.6% in 2014 and 3.9% in 2015, with emerging and developing economies continuing to increase by more than twice the percentage as that of the advanced economies (International Monetary Fund, 2014). Continued improvement in the global economy may result in increased activity in vermiculite markets in 2014–15, especially in regions where the construction industry is expanding.

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TABLE 1
 SALIENT VERMICULITE STATISTICS¹

(Thousand metric tons and thousand dollars unless otherwise specified)

	2009	2010	2011	2012	2013
United States:					
Production, concentrate ^{e, 2, 3}	100	100	100	100	100
Exfoliated: ^e					
Quantity	63 ^r	67 ^r	62 ^r	59 ^r	64
Value ^e	33,600 ^r	38,200 ^r	42,100 ^r	45,400 ^r	50,100
Average value ^e dollars per metric ton	536 ^r	571 ^r	673 ^r	766 ^r	779
Exports ^e	3	2	2	2	2
Imports for consumption ⁴	39	29	53	57	36
World, production	409	424 ^r	412 ^r	374 ^r	358 ^e

^eEstimated. ^rRevised.

¹Data are rounded to no more than three significant digits unless otherwise specified.

²Sold or used by producers.

³Rounded to the nearest 100,000 metric tons to avoid disclosing company proprietary data.

⁴Source: United Business Media Global Trade (a division of United Business Media Ltd.), 2014.

TABLE 2
 ACTIVE VERMICULITE EXFOLIATION PLANTS IN THE UNITED STATES IN 2013

Company	County	State
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.
Southwest Vermiculite Co., Inc.	Bernalillo	New Mexico.
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.
Verlite Co.	Hillsborough	Florida.
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 USE¹

(Metric tons)

	2012	2013
Aggregates ²	9,870	9,870
Insulation ³	3,260	3,510
Agricultural:		
Horticultural	20,000	19,300
Soil conditioning	10,100	10,100
Fertilizer carrier	W	W
Total	W	W
Other ⁴	W	W
Grand total ⁵	59,000 ^r	64,000

^rRevised. W Withheld to avoid disclosing company proprietary data; included in "Grand total."

¹Data 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^{1,2}

(Metric tons)

Country ³	2009	2010	2011	2012 ^e	2013 ^e
Argentina	2,150	2,500	1,000	320 ^{r,4}	500
Brazil, concentrate	50,438	49,976	55,000	50,000	55,000
Bulgaria ^e	--	3,000	15,000	18,600	18,600
China ^e	12,000	15,000	15,000	15,000	15,000
Egypt	4,500	2,865	3,000	3,000	3,000
India	11,909 ^r	17,342 ^r	12,119 ^r	11,000 ^r	11,000
Japan ^e	6,000	6,000	6,200 ^r	6,200 ^r	6,200
Kenya	315	395	515	457 ^{r,4}	460
Russia ^e	25,000	25,000	25,000	25,000	20,000
South Africa	193,334	199,285	170,571	132,886 ^{r,4}	127,658 ⁴
Uganda	--	2,475 ^r	8,426 ^r	11,251 ^r	243 ⁴
United States, concentrate, sold and used by producers ^{e,5}	100,000	100,000	100,000	100,000	100,000
Zimbabwe ^e	3,211 ⁴	--	--	--	--
Total	409,000	424,000 ^r	412,000 ^r	374,000 ^r	358,000

^eEstimated. ^rRevised. -- Zero.

¹World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Includes data available through June 15, 2014.

³In addition to the countries listed, Australia produced vermiculite, but available information is inadequate for the formulation of reliable estimates.

⁴Reported figure.

⁵Rounded to one significant digit to avoid disclosing company proprietary data.