

VERMICULITE

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Vermiculite is a hydrated magnesium-aluminum-iron silicate, with a generalized formula of $(\text{Mg,Fe}^{+2},\text{Al})_3(\text{Al,Si})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$ (Fleischer and Mandarino, 1991, p. 211). Flakes of raw vermiculite concentrate are mica-like in appearance and contain water molecules within their internal structure. When the flakes are heated rapidly at a temperature of 900° C or higher, the water flashes into steam, and the flakes expand into accordion-like particles. The color, which can range from black and various shades of brown to yellow for the raw flakes, changes upon expansion to gold or bronze. This expansion process is called exfoliation, and the resulting lightweight material is chemically inert, fire resistant, and odorless. In lightweight plaster and concrete, vermiculite provides good thermal insulation. Vermiculite can absorb such liquids as fertilizers, herbicides, and insecticides, which can then be transported as free-flowing solids (Harben and Kuzvart, 1996).

Production

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. Data were not available for the three mine-mill operations. The two U.S. producers of vermiculite concentrate were Virginia Vermiculite Ltd. with operations near Woodruff, SC, and in Louisa County, VA; and W.R. Grace & Co. from its operation at Enoree, SC.

Vermiculite concentrate was shipped to exfoliating plants for conversion into lightweight material. Output of exfoliated vermiculite sold or used in 2003, using actual and estimated data, was 95,000 metric tons (t) (table 1). Domestic production of exfoliated vermiculite sold or used was by 15 companies operating 19 plants in 11 States (table 2). Of the 19 exfoliation plants, 11 responded, representing 71% of the estimated sold or used exfoliated vermiculite listed in tables 1 and 3. Data for the remaining operations were estimated from previous years' reported and estimated production levels. States that produced exfoliated vermiculite, in descending order of estimated output sold or used, were South Carolina, New Jersey, Ohio, Arizona, Pennsylvania, Florida, Arkansas, Illinois, Texas, Massachusetts, and New Mexico.

Legislation and Government Programs

The U.S. Environmental Protection Agency and the Agency for Toxic Substances and Disease Registry initiated a consumer awareness program to educate homeowners about older vermiculite insulations that may contain asbestos. The mine that

supplied vermiculite for the insulation was shut down in 1990 (U.S. Environmental Protection Agency, 2003§¹).

Consumption

Vermiculite has a wide range of uses that take advantage of its various attributes of fire resistance, good insulation, high liquid absorption capacity, inertness, and low density. Vermiculite is used in general building plasters, either in its own formulations or combined with such other lightweight aggregates as perlite. Special plasters include fire protection and acoustic products in which vermiculite is combined with a binder, such as gypsum or portland cement, and fillers and rheological aids (Roskill Information Services Ltd., 1999, p. 72-76).

Exfoliated vermiculite treated with a water repellent is used to fill pores and cavities in masonry construction (especially hollow blockwork) to enhance acoustic, fire rating, and insulation performance. Finer grades of exfoliated vermiculite are used to produce insulation shapes. The manufacturing process is very similar to that used for the production of silicate-bound building boards (Roskill Information Services Ltd., 1999, p. 84). Vermiculite-base insulation shapes can be used in lower temperature metal-melting-processing industries; vermiculite can be used in contact with molten metal up to 1,200° C. Vermiculite shapes are used in the aluminum industry, in particular, because vermiculite is said to have a nonwetting characteristic with aluminum (Russell, 2000, p. 16).

In horticulture, exfoliated vermiculite improves soil aeration and moisture retention. When vermiculite is mixed with peat or other composted materials, such as pine bark, the resulting product provides a good growing medium for plant propagation. As a soil conditioner, exfoliated vermiculite can improve the aeration of "sticky" soils (containing clay) and the water-holding characteristics of sandy soils. This allows for easier watering and reduces the likelihood of compaction, cracking, and crusting of the soil. Vermiculite is used in the fertilizer/pesticide market because of its ability to act as a carrier, bulking agent, and extender (Roskill Information Services Ltd., 1999, p. 81, 90-91).

Finer grades of exfoliated vermiculite are used to partially replace asbestos in brake linings primarily for the automotive market (Roskill Information Services Ltd., 1999, p. 84).

Prices

Published prices for vermiculite serve only as a general guide because of application, quantity, variations in source, and other

¹References that include a section mark (§) are found in the Internet References Cited section.

factors. Published prices for raw (unexpanded) U.S. vermiculite concentrate, bulk, ex-mill were unchanged from those of 2002—between \$143 and \$220 per metric ton, depending on particle size (Industrial Minerals, 2003b).

The average unit value of U.S. exfoliated vermiculite sold or used by producers, using actual and estimated data, was about \$370 per ton, which was a composite value that included both U.S. and imported material (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 basket category “vermiculite, perlite, and chlorite, unexpanded” under Harmonized Tariff Schedule of the United States code 2530.10.0000. Total U.S. imports of vermiculite in 2003 were about 37,100 t (Port Import/Export Reporting Service, unpub. data, 2003). South Africa supplied about 68% of the tonnage, and China, about 30%.

World Review

Australia.—Flinders Diamonds Ltd., based in Norwood, South Australia, conducted a drilling evaluation program at its Mount Bleechmore vermiculite prospect in Northern Territory. The property is located 100 kilometers (km) northeast of Alice Springs and 20 km north of Australia’s only producing vermiculite mine operated by Australian Vermiculite Industries Pty. Ltd. at Mud Tank. The next stage of exploration was to obtain reserve and resource information. If results are favorable, then a mining operation prefeasibility study would be undertaken (Industrial Minerals, 2003a).

Uganda.—IBI Corp. announced the signing of a contract for the fabrication and purchase of a proprietary Canmin exfoliator. Canmin Resources Ltd. (IBI’s Ugandan subsidiary) fabricated and field-tested the exfoliator with design and specifications to meet the requirements of its unique Namekara vermiculite. Other prospective customers had expressed interest in the Canmin exfoliator (Advice for Investors, 2003§).

Outlook

U.S. vermiculite markets for 2003 may now be steady, with producers and importers looking at ways to regain markets or develop new ones for the future (Dickson, 2003). Some uses for vermiculite are finding increased applications in the market place, including finely ground material as a functional filler in coatings, construction materials, and friction brake applications (Moeller, 2004).

Vermiculite production in China is said to be increasing at a significant rate. Although data have not been received by

the USGS, a nongovernmental source indicates that the largest producer, located in Xinjiang Province, has an output of 70,000 metric tons per year (t/yr). Mines in Hebei Province supply an additional 18,000 t/yr. China appears to be gaining worldwide market share (Moeller, 2004). Asia is a significant market for vermiculite, with Japan and other countries traditionally being supplied from South Africa and, more recently, Australia and China. Vermiculite use in construction and horticulture applications may show some growth in the future (Dickson, 2003).

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GENERAL SOURCES OF INFORMATION

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Other

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TABLE 1
SALIENT VERMICULITE STATISTICS¹

(Thousand metric tons and thousand dollars unless otherwise specified)

| | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|------------------|------------------|--------------------|--------------------|--------------------|
| United States: | | | | | |
| Production: ² | | | | | |
| Concentrate | 175 ^e | 150 ^e | NA | NA | NA |
| Exfoliated: ^e | | | | | |
| Quantity | 175 | 165 | 140 | 115 | 95 |
| Value ^e | 55,300 | 53,200 | 48,000 | 44,900 | 34,800 |
| Average value ^{e,3} dollars per metric ton | 315 | 322 | 340 | 390 | 370 |
| Exports ^e | 13 | 5 | 7 | 10 | 15 |
| Imports for consumption | 71 | 59 | 65 | 56 | 37 |
| World, production ⁴ | 541 | 513 | 299 ^{r,5} | 377 ^{r,5} | 347 ^{e,5} |

^eEstimated. ^rRevised. NA Not available.

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

²Sold or used by producers.

³Based on unrounded data.

⁴Excludes production by countries for which data were not available.

⁵Excludes U.S. data.

TABLE 2
ACTIVE VERMICULITE EXFOLIATION PLANTS IN THE UNITED STATES IN 2003

| Company | County | State |
|--|--------------|-----------------|
| Isolatek International | Sussex | New Jersey. |
| J.P. Austin Associates, Inc. | Beaver | Pennsylvania. |
| Palmetto Vermiculite Co., Inc. | Spartanburg | South Carolina. |
| P.V.P. Industries | Trumbull | Ohio. |
| Scotts Company, The | Greenville | South Carolina. |
| Southwest Vermiculite Co., Inc. | Bernalillo | New Mexico. |
| Sun Gro Horticulture, Inc. | Jefferson | Arkansas. |
| Do. | La Salle | Illinois. |
| Schundler Co., The | Middlesex | New Jersey. |
| Thermal Ceramics Inc. | Macoupin | South Carolina. |
| Thermo-O-Rock East, Inc. | Washington | Pennsylvania. |
| Thermo-O-Rock West, Inc. | Maricopa | Arizona. |
| Verlite Co. | Hillsborough | Florida. |
| Vermiculite Industrial Corp. | Allegheny | Pennsylvania. |
| Vermiculite Products, Inc. | Harris | Texas. |
| Whittemore Co., The | Essex | Massachusetts. |
| W.R. Grace & Co., Construction Products Division | Maricopa | Arizona. |
| Do. | Broward | Florida. |
| Do. | Greenville | South Carolina. |

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

(Metric tons)

| | 2002 | 2003 |
|-------------------------|---------|--------|
| Aggregates ² | 30,900 | 24,800 |
| Insulation ³ | W | W |
| Agricultural: | | |
| Horticultural | 17,400 | 15,000 |
| Soil conditioning | 28,500 | 30,600 |
| Fertilizer carrier | W | W |
| Total | W | W |
| Other ⁴ | W | 15,300 |
| Grand total | 115,000 | 95,000 |

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.

TABLE 4
VERMICULITE: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

| Country | 1999 | 2000 | 2001 | 2002 | 2003 ^e |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|
| Argentina | 2,800 ^e | 2,800 ^e | 1,110 ^r | 1,105 ^r | 1,124 ^p |
| Australia ^c | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 |
| Brazil, concentrate | 23,400 ^e | 24,074 | 21,464 | 22,577 ^r | 22,600 ^p |
| China ^c | 40,000 | 40,000 | 40,000 | 50,000 | 50,000 |
| Egypt ^c | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 |
| India ^c | 4,000 | 4,200 | 4,300 | 4,300 | 4,400 |
| Japan ^c | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Kenya | 164 ³ | 124 ³ | -- ^e | -- ^e | -- |
| Malawi | -- | -- | 1 | 1 ^{r,e} | 1 |
| Russia ^c | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| South Africa | 217,800 | 208,835 | 156,632 | 210,297 | 182,802 ⁴ |
| Uganda | -- | -- | 220 ^r | 664 ^r | 1,724 ⁴ |
| United States, concentrate, sold and used by producers | 175,000 ^e | 150,000 ^e | NA | NA | NA |
| Zimbabwe | 13,898 | 18,935 | 11,632 | 23,803 | 20,016 ⁴ |
| Total | 541,000 | 513,000 | 299,000 ^r | 377,000 ^r | 347,000 |

^cEstimated. ^pPreliminary. ^rRevised. NA Not available. -- Zero.

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

²Excludes production by countries for which data are not available and for which general information is inadequate for formulation of reliable estimates. Table includes data available through July 22, 2004.

³Reported exports.

⁴Reported figure.