

VERMICULITE

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Vermiculite is a hydrated magnesium-aluminum-iron silicate. 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 to gold or bronze. This expansion process is also 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 surveys—one for mine/mill operations and the other for exfoliation plants. Of three mine/mill operations, data were obtained from one. Output for the two nonrespondents was estimated based on previous years' production levels and estimates

Because there have only been three U.S. mining operations (two companies) of vermiculite concentrate in recent years, vermiculite data collected by the USGS are proprietary and must be withheld. However, according to Moeller (2001, p. 65), estimated U.S. output in 2000 was about 150,000 metric tons (t) (table 1). The two U.S. producers of vermiculite concentrate were W.R. Grace & Co., from its operation at Enoree, SC; and Virginia Vermiculite Ltd., with operations near Woodruff, SC, and in Louisa County, VA.

Vermiculite concentrate was shipped to exfoliating plants for conversion into lightweight material. Output of exfoliated vermiculite sold or used in 2000, using partly estimated data, was about 165,000 t (table 1). Domestic production of

exfoliated vermiculite sold or used was by 13 companies operating 19 plants in 10 States (table 2). Of the 19 known exfoliation plants, 9, or 47%, responded. The nine operations produced 42% of the sold or used vermiculite listed in tables 1 and 3. Data for the remaining operations were estimated from previous years' production levels. States that produced exfoliated vermiculite, in descending order of output sold and used, were South Carolina, Ohio, Arizona, Pennsylvania, New Jersey, Arkansas, Florida, Illinois, Texas, and New Mexico.

Stansbury Holdings Corp. faced some unanticipated circumstances at its vermiculite operation at Dillon, MT. These included forest fires, the onset of a harsh winter, and mechanical breakdowns at its vermiculite mill. Also, the company's Los Banos, CA, exfoliating plant was facing new, more restrictive State air emissions standards. Consideration was being given to locating the Los Banos plant to another California location or to Nevada or Montana (Stansbury Holdings Corp., May 15, 2001, Letter to shareholders, accessed June 27, 2001, at URL http://www.stansburyholdings.com/shareholder_letters/may2000.html).

Consumption

Horticultural and other related applications, such as soil conditioning and free-flowing fertilizer carrier medium, continued to be major end uses of vermiculite. In soil conditioning, vermiculite particles retain moisture and nutrients, releasing them gradually to plant roots. The air spaces improve aeration of soil and create passageways for drainage (GTG Hydroponics, [undated], Soils and soil amendments, accessed August 21, 2001, at URL <http://www.gtghydroponics.com/soil.htm>). One supplier was offering, for example, a number of horticultural mixes that varied in composition but fell within the composition range of 10% to 55% Canadian sphagnum peat moss, 10% to 65% vermiculite, 5% to 20% perlite, 0% to 25% oak bark, and 0% to 60% pine bark. Uses for these products included seed starting, cutting propagation, and provision for

Vermiculite in the 20th Century

Vermiculite in the United States was first produced in small quantities in the mid-1920s. By 1936, the first year that vermiculite output was recorded by the U.S. Bureau of Mines, production of vermiculite concentrate had reached about 15,400 metric tons. The major use for exfoliated (expanded) vermiculite was for heat, cold, or sound insulation. It was used loose as a filler in the walls of houses and in water heaters, fire safes, stoves, furnaces, and refrigerators. It also served as a lightweight aggregate in insulating plaster, concrete, and other materials, where insulating and sound-deadening properties and low specific gravity were of value.

Output of vermiculite concentrate in the United States reached a high of about 331,000 tons in 1973.

In 2000, U.S. output of vermiculite concentrate was an estimated 150,000 tons. Insulation and agricultural uses (such as horticulture and soil conditioning) accounted for about 80% of the usage of the exfoliated vermiculite product. U.S. imports of vermiculite were about 59,000 tons; South Africa supplied about 74%, and China, about 23%. South Africa had the world's largest output of vermiculite during the 1990s, and in 2000, it produced about 209,000 tons.

aeration, percolation, and nutrient retention characteristics in horticulture and some landscape applications (The Scotts Company, Summer 2001, Product guide—Soil mixes & amendments, accessed July 31, 2001, at URL <http://www.scotts.com/professionalhorticulture/SoilMixesAmendments.cfm>).

Another application of vermiculite was use beneath above-ground swimming pools as a pool cushion. It provides a soft, level surface that protects the vinyl liner from sharp objects. Vermiculite also can be mixed with portland cement to form an insulating monolithic porous concrete base for use beneath vinyl inground swimming pools. The base protects pools from being damaged by changes in the water table and hydrostatic pressure (The Schundler Co., [1994]).

Prices

Published prices for vermiculite serve as a general guide only because of variations in source, quantity, application, and other factors. Prices for raw (unexpanded) U.S. vermiculite concentrate, bulk, ex-plant were about \$143 to \$220 per metric ton, depending on particle size. For imported South African crude vermiculite, bulk, f.o.b. barge, U.S. Gulf Coast, prices ranged from \$187 to \$243 per ton (Industrial Minerals, 2000b).

The average value of U.S. exfoliated vermiculite sold or used by producers, using partly estimated data, was \$322 per metric ton (table 1) and was a composite value including both U.S. and imported material.

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 tariff code 2530.10.0000. According to Moeller (2001), U.S. exports of vermiculite concentrate in 2000 were about 5,000 t (table 1) and were believed to be shipped primarily to Canada. Total U.S. imports of vermiculite in 2000 were about 59,000 t (Port Import/Export Reporting Service, data printout, 2001). South Africa supplied about 74% of the tonnage, and China, 23%.

World Review

In Western Europe, the United Kingdom was the major consumer of vermiculite. The largest end use in Western Europe was for building boards, which were essentially of two types. One type was produced using a wet slurry manufacturing process; the other type was made using a binder such as metal silicate or equivalent (Ellicott, 2000).

A number of companies in Western Europe produced exfoliated vermiculite for the horticultural market. The insulation market included loose-fill insulation and insulation shapes for uses that included secondary insulation in such industrial installations as aluminum smelters (Ellicott, 2000).

Canada.—Normiska Corp., Mississauga, Ontario, signed an agreement to acquire VIL Vermiculite, Inc., for about \$1.8 million. VIL's assets included manufacturing facilities for horticultural grades of vermiculite and perlite in Lachine, Quebec. Normiska's product lines included sphagnum peat moss, pine bark mulches, and composts (Industrial Specialties News, 2000).

South Africa.—Palabora Mining Co. Ltd. is the world's largest supplier and exporter of vermiculite from its operation in the northern Transvaal. Material is exported worldwide (Russell, 2000). The company formerly named Natkruid Vermiculite Mine (Pty.) Ltd., which is located north of Pietersburg, was purchased by an offshore holding company and became known as Natkruid Mine. Plans called for an increase in output to 24,000 metric tons per year (t/yr) by 2001 from 18,000 t/yr. Natkruid was exporting vermiculite largely to the refractory, horticultural, and fire protection industries of Europe (Industrial Minerals, 2000a).

Outlook

Although horticultural and related applications have been the largest end uses of vermiculite in the United States in recent years, other uses appear to be growing, including as an intumescent (swelling) material for use, for example, in gaskets. Another use is in coatings and binders (chemically delaminated vermiculites that form high-tensile-strength films). As finely ground material, vermiculite serves as a functional filler in coatings, construction materials, and friction brake applications (Moeller, 2001). Materials that compete with vermiculite in general include mineral wool, perlite, and polystyrene (Ellicott, 2000).

Although South Africa is the largest supplier of vermiculite, Australia, Brazil, China, and Zimbabwe have significant output. Production of the mineral in China was said to be increasing, and that country may become a major supplier in the future (Moeller, 2001).

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TABLE 1
SALIENT VERMICULITE STATISTICS 1/

(Thousand metric tons and thousand dollars)

| | 1996 | 1997 | 1998 | 1999 | 2000 |
|-----------------------------|----------|-------------|-------------|-------------|-------------|
| United States: | | | | | |
| Sold and used by producers: | | | | | |
| Concentrate | W | W | W | 175 e/ | 150 e/ |
| Exfoliated | 135 | 155 e/ | 170 e/ | 175 e/ | 165 e/ |
| Value | \$45,300 | \$49,400 e/ | \$53,300 e/ | \$55,300 e/ | \$53,200 e/ |
| Average value 2/ | \$334 | \$318 e/ | \$313 e/ | \$315 e/ | \$322 e/ |
| Exports e/ | 8 | 9 | 11 | 13 | 5 |
| Imports for consumption | 48 | 67 | 68 | 71 | 59 |
| World, production 3/ | 280 4/ | 301 4/ | 328 r/ 4/ | 541 r/ | 512 e/ |

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.

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

2/ Based on unrounded data.

3/ Excludes production by countries for which data were not available.

4/ Excludes U.S. data.

TABLE 2
ACTIVE VERMICULITE EXFOLIATION PLANTS IN THE UNITED STATES IN 2000

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

TABLE 3
ESTIMATED EXFOLIATED VERMICULITE
SOLD AND USED IN THE UNITED STATES, BY END USE 1/

(Metric tons, unless otherwise specified)

| | 1999 | 2000 |
|--------------------|---------|---------|
| Aggregates 2/ | 28,300 | 25,000 |
| Insulation 3/ | W | W |
| Agricultural: | | |
| Horticultural | 27,200 | 33,800 |
| Soil conditioning | 39,600 | 31,300 |
| Fertilizer carrier | W | W |
| Total | W | W |
| Other 4/ | 6,290 | W |
| Grand total | 175,000 | 165,000 |

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

1/ Data rounded to no more than three significant digits; may not add to totals shown.

2/ Includes acoustic insulation, fireproofing, and texturizing uses.

3/ Includes high-temperature and packing insulation and sealants.

4/ Includes various industrial and other uses not specified.

TABLE 4
VERMICULITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

| Country | 1996 | 1997 | 1998 | 1999 | 2000 e/ |
|--|---------|---------|------------|------------|------------|
| Argentina e/ | 40 | 822 3/ | 1,000 r/ | 2,800 r/ | 2,800 |
| Australia e/ | 2,500 | 5,000 | 10,000 | 12,000 | 12,000 |
| Brazil | 21,999 | 23,000 | 24,300 | 23,400 r/ | 23,000 |
| China | NA | NA | NA | 40,000 e/ | 40,000 |
| Egypt | 447 | 447 | 12,376 | 12,000 e/ | 12,000 |
| India | 2,405 | 4,405 | 4,080 | 4,000 e/ | 4,200 |
| Japan e/ | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Kenya | 734 | 1,418 | 353 | 164 r/ | 165 |
| Mexico | 350 | 295 | -- | 100 e/ | 100 |
| Russia e/ | 30,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| South Africa | 196,000 | 211,001 | 221,300 | 217,800 r/ | 208,835 3/ |
| United States, sold and used by producers 4/ | W | W | W | 175,000 e/ | 150,000 |
| Zimbabwe | 10,249 | 14,841 | 14,804 | 13,898 r/ | 18,935 3/ |
| Total | 280,000 | 301,000 | 328,000 r/ | 541,000 r/ | 512,000 |

e/ Estimated. r/ Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

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

2/ Excludes 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 20, 2001.

3/ Reported figure.

4/ Concentrate.