VERMICULITE

By Alison M.B. Russell
Industrial Minerals Consultant

The vermiculite industry is a relatively stable and mature industry, dominated by a few suppliers worldwide. Competition is fiercer among the vermiculite exfoliators, which are the main consumers of the mineral. Markets dipped worldwide during 2001, particularly in the US owing to the poor global economic conditions. Vermiculite is the mineral name of a group of hydrated sheet silicates containing varying amounts of iron, magnesia, alumina, and potassium. Mineralogically, the most important aspect of vermiculite are the layers of water molecules within its internal structure. When vermiculite is heated rapidly above 870(C it exfoliates as the water turns to steam, forcing the layers apart in an 'accordion-like' expansion which gives rise to a corresponding decrease in density. Today, nearly all vermiculite is exfoliated for use commercially.

Production

The two main vermiculite production centres in the world are South Africa and the US, accounting for 75% of the world's crude vermiculite output. Total world production was an estimated 470,000 t in 2001 according to the US Geological Survey (USGS), although this figure could be as high as 520,000 t depending on actual production levels in China and Russia, for which official statistics are unavailable. Other principal producing countries are Brazil, Zimbabwe and Australia. Small production of vermiculite has also been recorded in Argentina, Egypt, Japan, Kenya and Mexico, nearly all of which is destined for domestic markets.

The largest supplier and exporter of vermiculite in the world is Palabora Mining Co. Ltd, a subsidiary of Rio Tinto plc, from its operations in Northern Transvaal, South Africa. In 2001, output was down 23% to 160,300 t, from the 2000 total of 208,400 t. Production of vermiculite was hampered throughout the year by wet in-pit conditions and by the low availability of plant and heavy equipment. Exports are important and Palabora represents some 87% of all the vermiculite exported worldwide.

Elsewhere in South Africa, Natkruit Mine (formerly Natkruit Vermiculite Mine Ltd), located at Louis Trichardt, north of Pietersburg, produced 6,000 t. Nakruit is mainly exporting vermiculite to the refractory, horticultural and fire protection industries in Europe, with small amounts shipped to the US and Japan.

The main producer in Zimbabwe is Samrec Vermiculite (Zimbabwe) Pvt Ltd, which operates the Shawa vermiculite mine. In 2001, the company completed a significant expansion at the facility, which took production capacity to 40,000 t/y up from 18,000 t/y. The development also included additional baggage and storage facilities at the site. The new plant was commissioned at the end of August, and was in full production a month later. The modifications to the production processes have increased the mine life to 30 years. Samrec produces the larger flake sizes of vermiculite, for which there is currently an increasing demand. Over two thirds of the Shawa production is destined for Europe, with the remainder going to Asia and the Middle East. The other smaller producer in Zimbabwe is Dinidza Vermiculite Mining (Pty) Ltd, owned by Anpac. The company is reported to have reduced production in 2001 because of increasing costs and lower yields. Dinidza also produces a range of coarse grades.

In Uganda, Canmin Resources Ltd, a wholly-owned subsidiary of Canadian company IBI Corp., began commercial mining and production in July from its Namekara mine, also known as the Bukusu project. The deposit is located in the Mbale district of

southeast Uganda near the border with Kenya. The company is aiming to have an annual output of 40,000 t/y mainly aimed at European and Middle Eastern markets. The Namekara vermiculite has a high proportion of large thin flakes, used particularly in insulation and horticulture applications.

The second largest producer worldwide is the US, where production was in the order of 140,000 t-150,000 t in 2001. The largest producer is W. R. Grace & Co. which operates several mines, in and around the Enoree area, and several exfoliation plants across the country. The other major US producer is Virginia Vermiculite Ltd, with operations in Boswells Tavern in the Green Springs area, Virginia, and near Woodruff in South Carolina. Last year, MSHA rescinded the asbestos-related citations given to Virginia Vermiculite in October 2000. The citations were rescinded after MSHA came back to retest in December 2000, and found no exposure issues. Virginia Vermiculite had voluntarily adopted the more stringent OSHA exposure standards earlier in the year, and at no time had any tests shown exposure above OSHA limits. The company also agreed to follow the OSHA guidelines for protective practices should any sampling indicate exposures above OSHA limits.

Stansbury Holdings Corp. suffered setbacks at its mining operation in Dillon, Montana, including forest fires, heavy snow and technical problems, and did not reach its targeted production levels. During the year, the company acquired a facility in Turlock, California, 12 km from Los Banos. Turlock houses vermiculite expansion facilities, which have been upgraded to produce 20,000 t/y. In early 2002, Stansbury Holding signed an agreement with IBI Corp. The agreement covers a 50/50 joint venture, which will be called Vermiculite World-wide Ltd and covers the imports of vermiculite from Uganda, which will be exfoliated at Stansbury's Los Banos plant.

China is an important up and coming source of vermiculite, and exports have increased in recent years. Official statistics of Chinese production are not available but it is estimated that current output is 100,000 t/y. There are two main producing regions in China, namely Yuli in Xinjiang in northwest China, and Lingshou in Hebei in north China, which account for 90% of production. In Xinjiang, there are four main producers, with a total output estimated at 50,000 t/y, of which 80% is destined for export markets. Production from this area is forecast to reach 150,000 t/y within the next five years. In Hebei, total production is around 50,000 t/y from ten different operations.

The only producer in Australia is Australian Vermiculite Industries (AVI) from its operations at Mud Tank, near Alice Springs in the Northern Territory. The company was acquired in early 2002 by Imerys Minerals Australia Pty Ltd, a subsidiary of the French industrial minerals group, for US$2.51 million. AVI produces some 12,000 t/y of vermiculite for fire protection, building products, and horticultural markets, supplying 80% of the domestic market. The company also has an 80% interest in the Hillview vermiculite deposit, 400 km west of Sydney.

Total production in Brazil in 2001 was around 25,000 t. Domestic consumption of vermiculite is growing, particularly for horticultural applications. Demand from the construction industry, which was never very large, is declining. The main vermiculite producer in Brazil is Mamore Mineracao e Metalurgia, a subsidiary of the Paranapenema Group. Mamore is currently trying to increase the size of its mine in Goias State in central Brazil, to lower its cost base. The company is targeting the domestic agricultural industry, where vermiculite is used for producing seedlings. Mamore is also building an export market currently running at some 200 t/mth for vermiculite as an asbestos substitute. Mamore's production of expanded vermiculite is 36,000 t/y.

In Russia, Novokaolinovyy GOK, based in Novokaolinovyy, Chelyabinsk oblast has won the mining rights to the Subutakskiy vermiculite, also in Chelybinsk oblast. The

company is planning to produce 50,000 t/y of vermiculite and has been granted a 20-year mining lease. Elsewhere in the CIS, Navoi Mining-Metallurgical Combine in Uzbekistan is investigating the potential of the Tebinbuliak vermiculite deposit, located 75 km east of Nukus City in Karakalpakstan Republic. Demand for exfoliated vermiculite is estimated at 50,000 t/y in Uzbekistan, and is currently met by Russian imports.

Consumption

Heating vermiculite to cause exfoliation or expansion is the key to the mineral's usage in a variety of applications, primarily in the construction industry as a lightweight aggregate and in insulation. It is also used in horticulture and for its heat resistant properties. Vermiculite is also rot proof, odourless and non-irritating, and has good accoustic insulation, all desirable properties for certain building products. Commercially, vermiculite is almost always used in an expanded form. In theory, the mineral can expand up to 40 times its original volume, but in practice commercial vermiculite ores expand between 8 and 12 times. There is a corresponding decrease in bulk density from 640-960 kg/m3 to just 56-192kg/m3, as the exfoliated product consists of 90% trapped air.

Exfoliation plants are usually located close to the market place, because the low density of the finished product can quickly make transport costs prohibitively expensive. Exfoliation can be carried out in several different types of furnaces including rotary, vertical, cascading, vibrating tray and injection tray. Most vermiculite processing and exfoliation companies are based in North America and Europe, which are also the main consuming areas accounting for some 80% of global production. Other exfoliation operations around the world include facilities in Brazil, Australia, India and Japan.

The US market has been impacted by the asbestos issue over the past year, with the area hardest hit being the horticultural sector where consumer purchases of potting soils are well down. One estimate put the fall in the market at 70% during 2001. Overall, consumption of vermiculite was down by 17% last year in the US, some of which is attributable to the general economic conditions. However, US vermiculite producers believe that the worst is over, that public confidence in the mineral will return and that the asbestos issue is laid to rest.

The construction industry is the major end market for exfoliated vermiculite as an ultra-lightweight aggregate for numerous concrete, plaster, fire-resistant and formed products, and loose-fill insulation. Many of these markets in North America and Western Europe are now mature and growth prospects are in line with overall building activity in the developed world. However, higher levels of growth are predicted in fireproofing and fire-resistant applications.

Vermiculite is being used more as a component in a product, as there is now more awareness of its beneficial properties. This has led to a requirement for a substantially more uniform material and an increased demand for more easily incorporated smaller particles.

Vermiculite is also widely used in agriculture and horticulture, because it is free flowing and absorbs moisture. In agriculture, it is used in animal feed, as a bulking agent and anti-caking material, and in fertiliser and pesticide manufacture, for seed encapsulant and soil conditioning. In horticulture, vermiculite is used in blocking mixes, hydroponics and micro-propagation, sowing composts and potting mixes.

Substitution

Vermiculite continually faces substitution by other materials in specific applications, particularly where price is a major factor. Perlite, with a much lower basic price structure, continues to threaten vermiculite, as it can be expanded in a similar manner and shares many of the same properties. Markets in which both products compete include animal feed supplements, fire-proofing

materials, insulation, and certain foundry applications. Recently, the use of perlite has been tempered slightly by concern over potential free-silica exposure, which is another current health and safety issue. To counter the threat of substitution, vermiculite exfoliators are producing pre-blends of vermiculite with binders, dispersants and other additives.

In fire-retardant applications, other minerals used include alumina trihydrate, antimony oxide, borates, bromine, asbestos, magnesite, magnesia, perlite and phosphates. Synthetic polymers have, to some extent, replaced vermiculite in sprayed passive fire protection to structures. In the US, polystyrene has replaced vermiculite in cementitious compounds.

Prices

Prices are led by the major producers, therefore the South African export prices and the US domestic prices are the benchmarks for the industry. In 2001, prices for South African material were static, ranging from US$160-260/t for material in Rotterdam and US$170-220/st for the US Gulf Coast (fob barge). Prices look set to remain stable in 2002. Increased competition from new sources of supply, such as the expansion at Samrec Vermiculite in Zimbabwe, could result in falling prices in some sectors, unless markets pick up or Palabora, once again, has lower production levels in 2002. The increased demand for larger vermiculite flakes could mean that prices for these niche products will gradually rise.

Average South African Vermiculite Export Prices (mid-year), Crude, Bulk, (US$/t)

	2000	2001
fob Rotterdam	160-260	160-260
fob barge, US Gulf Coast, per short ton	170-220	170-220

Source: Mineral PriceWatch, (c) Industrial Minerals Information Ltd