

## VERMICULITE

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Shivers went through the vermiculite industry last year, following the findings of the Mine Safety and Health Administration (MSHA) in the US at Virginia Vermiculite's operations in Louisiana. After a visit in August, when MSHA found what it believed to be asbestos in samples, Virginia Vermiculite was charged with three counts of violating federal health and safety regulations. The decision to charge Virginia Vermiculite followed the discovery of asbestos associated with the Libbey Vermiculite Mine in Montana, earlier in the year, which received national coverage in the US. In a mixed dust environment such as a vermiculite mine, fairly sophisticated techniques are required to differentiate between particles with a 3:1 aspect ratio, which Virginia Vermiculite claims were not applied in this case. The Louisiana mine had also been pronounced clear on two separate occasions earlier in the year.

Virginia Vermiculite is appealing the decision. However, asbestos-related minerals are a hot topic in certain circles in the US and can be enough to see manufacturers withdraw the products from formulations if there is any doubt. This could have repercussions on vermiculite demand, especially in consumer end-uses such as soil additives, insulation and building products, but today the jury is still out as to the overall effect, if any, it has had on the market.

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. The vermiculite industry is fairly mature, although there have been continuing developments in supply during 2000.

### **Production Update**

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 540,000 t in 2000 according to the US Geological Survey, although this figure could be as high as 570,000 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 the Northern Transvaal, South Africa.

Production levels are steady and in 2000 output was 208,400 t, just slightly lower than that in 1999 of 208,600 t. Exports are important and Palabora represents some 87% of all the vermiculite exported worldwide. In 2000, vermiculite production improved in the latter part of the year, following the negative effects of excessive rainfalls during the March and June quarters.

Elsewhere in South Africa, Natkruit Mine (formerly Natkruit Vermiculite Mine (Pty) Ltd, located at Louis Trichardt, north of Pietersburg, announced plans to increase production by 6,000 t to 24,000 t/y with the extra capacity on line by mid-2001. The company is now owned by an offshore holding

company, after a difficult ownership battle early on in the year. Nakruit was owned by Anpac, which also owns Dinidza Vermiculite in Zimbabwe. Anpac decided to concentrate its efforts on the Zimbabwean operation, which produces coarser grades than Nakruit. Exploration undertaken by Nakruit's new owners has increased reserves to provide a mine life of 20-25 years. 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, formerly known as Shawa Vermiculite Pvt. Ltd. The company is aiming to increase production to 60,000 t. Most of the company's production is sold to European markets.

In Uganda, Canmin Resources Ltd, a wholly owned subsidiary of Canadian company IBI Corp., was awarded a mining lease at 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 now close to commencing production and aims 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, which are particularly used in insulation and horticulture applications.

In the US, W. R. Grace & Co. operates several mines, in and around the Enoree area, and several exfoliation plants across the country. Virginia Vermiculite Ltd has operations in Boswells Tavern in the Green Springs area, Virginia, and near Woodruff in South Carolina. Total US production is estimated to be 180-190,000 t/y. Stansbury Holdings Corp. is mining vermiculite from Dillon in Montana, and produced 30,000 t of concentrate in 2000. Stansbury is planning to use the mill as a pilot operation, and then expand the facilities to 45,000 t/y, subject to acquiring the necessary permits and market conditions. Eventually the

company is aiming to produce a massive 200,000 t/y of vermiculite.

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 in 2000. 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, a joint venture between Tennant Ltd (75%) and Inmet Ltd (25%), from its operations in Mud Tank, near Alice Springs in the Northern Territory.

Total production in Brazil in 2000 was around 40,000 t. Domestic consumption of vermiculite is growing, particularly for horticultural applications. Demand from the construction industry, which was never very large, is declining. The two main vermiculite producers in Brazil are Eucatex SA Industria e Comercio and Mamore Mineracao e Metalurgia, a subsidiary of the Paranapenema Group.

### **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 acoustic 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/m<sup>3</sup> to just 56-192 kg/m<sup>3</sup>, 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 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. 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 2000, prices ranged from US\$180-260/t for material in Rotterdam, and there was a slight rise in prices in the June quarter. In the US, prices of crude vermiculite have also crept up gradually on the back of the increased construction activity during 2000. Prices look set to remain stable in 2001, although increased competition from new sources of supply could mean price cuts in some sectors.

<b>Average South African Vermiculite Export Prices (mid-year), crude, bulk, US\$/t</b>		
	<b>1999</b>	<b>2000</b>
fob Rotterdam	160-260	160-260
fob barge, US Gulf Coast, per short ton	170-220	170-220

Source: *Mineral PriceWatch*, © *Industrial Minerals Information Ltd*