Indian Minerals Yearbook 2018

(Part- III : Mineral Reviews)

57th Edition

VERMICULITE

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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June, 2019

27 Vermiculite

Vermiculite is a term applied commercially to micaceous minerals (essentially hydrated silicates of Al, Mg and Fe), usually alteration products of biotite or phlogopite micas, formed by the removal of much alkalies and addition of water. Vermiculite differs from mica in its characteristic property, i.e., exfoliation. Crude vermiculite is always exfoliated before use.

RESERVES/RESOURCES

The total reserves/resources of vermiculite as on 1.4.2015 as per NMI data, based on UNFC system have been placed at 2.35 million tonnes of which about 69% are placed under Reserves category and balance 31% are placed under Remaining Resources category. Reserves/ resources are located in Tamil Nadu (79%), Andhra Pradesh (12%), Karnataka (6%), Rajasthan (2%) and Jharkhand (1%). Nominal resources are located in Gujarat, Madhya Pradesh and West Bengal (Table-1).

PRODUCTION & STOCKS

Production of vermiculite at 6,055 tonnes in 2017-18 decreased by 33% as compared to 9,042 tonnes in the previous year.

There were 5 reporting mines in 2017-18 and 6 reporting mines in the previous year.

Andhra Pradesh was the leading producer of vermiculite in 2017-18 which accounted for 79% of the total production and remaining 21% was from Tamil Nadu state (Tables - 2 to 4).

Mine-head closing stocks of vermiculite at the end of the year 2017-18 were 26,915 tonnes as against 27,570 tonnes for the previous year (Table - 5).

The average daily employment of labour during the year was 68 as against 78 in the previous year.

Table – 2 : Principal Producers of Vermiculite, 2017-18

Name & address of producer	Location of mine	
	State	District
T.Meenatchi Sundaram, Plot No. 2, Industrial Estate, Gudur P.O., (Mandal), SP SR Nellore - 524 101, Andhra Pradesh.	Andhra Pradesh	Nellore
Tamil Nadu Minerals Ltd, 31, Kamarajar Salaitwad House, Chepauk, Chennai-600 005, Tamil Nadu.	Tamil Nadu	Vellore
Dugar Insulation India Pvt. Ltd, 7th Floor 34 (123), Dugar Towers, Marshalls Road, Egmore, Chennai City - 600 008, Tamil Nadu.	Andhra Pradesh	Nellore
B. Koteswara Rao, 558.53-4A, Swarna Bharathi Nagar, Malavya Nagar, Gudur, Nellore-524 101, Andhra Pradesh.	Andhra Pradesh	Nellore

Table-1: Reserves/Resources of Vermiculite as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India: Total	**1582906**	**19413**	**30566**	**1632885**	**36411**	**26196**	**39794**	**58396**	**20179**	**538607**	**-**	**719582**	**2352467**
By Grades													
Refractory	28089	-	14238	42327	-	-	-	-	-	807	-	807	43134
Unclassified	1554817	19413	16328	1590558	36411	26196	39794	58396	20179	537800	-	718775	2309333
By States													
Andhra Pradesh	60892	19413	30566	110871	2040	917	5850	58396	5127	88865	-	161195	272066
Gujarat	-	-	-	-	-	-	-	-	-	1960	-	1960	1960
Jharkhand	-	-	-	-	-	-	-	-	-	30048	-	30048	30048
Karnataka	-	-	-	-	13550	22520	29450	-	1562	66658	-	133740	133740
Madhya Pradesh	-	-	-	-	197	-	66	-	-	66	-	329	329
Rajasthan	-	-	-	-	20623	2759	4428	-	13000	2883	-	43693	43693
Tamil Nadu	1522014	-	-	1522014	-	-	-	-	-	343051	-	343051	1865065
West Bengal	-	-	-	-	-	-	-	-	490	5076	-	5566	5566

Figures rounded off

Table – 3 : Production of Vermiculite, 2015-16 to 2017-18

(By States)

(Qty in tonnes; Value in `'000)

State	2015-16		2016-17		2017-18 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**23279**	**10556**	**9042**	**8162**	**6055**	**7078**
Andhra Pradesh	21890	7986	7225	2441	4790	2891
Rajasthan	421	400	127	127	-	-
Tamil Nadu	968	2170	1690	5594	1265	4187

Table – 4 : Production of Vermiculite, 2016-17 & 2017-18
(By Sectors/States/Districts)

(Qty in tonnes; Value in `'000)

State/District		2016-17			2017-18 (P)	
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**6(3)**	**9042**	**8162**	**5**	**6055**	**7078**
Public sector	1	1690	5594	1	1265	4187
Private sector	5(3)	7352	2568	4	4790	2891
Andhra Pradesh	**5(1)**	**7225**	**2441**	**4**	**4790**	**2891**
Nellore	5(1)	7225	2441	4	4790	2891
Rajasthan	**(2)**	**127**	**127**	-	-	-
Ajmer	(2)	127	127	-	-	-
Tamil Nadu	**1**	**1690**	**5594**	**1**	**1265**	**4187**
Vellore	1	1690	5594	1	1265	4187

Figures in parentheses indicate no. of associated mines with apatite, felspar, mica and quartz.

Table – 5 : Mine- head Closing Stocks of Vermiculite 2016-17 & 2017-18

(By States)

(Qty in tonnes)

State	2016-17	2017-18 (P)
India	**27570**	**26915**
Andhra Pradesh	21519	20765
Karnataka	400	400
Rajasthan	159	159
Tamil Nadu	5492	5591

MINING AND INDUSTRY

In Andhra Pradesh vermiculite is available in the district of Nellore, where there are 4 working (private) mines during 2017-18. DGS Minerals, with 30 acres of mining land as approved by the State Government of Andhra Pradesh for a period of 20 years, with vermiculite mines are engaged in mining, quarrying and processing of vermiculite. The vermiculite is mined and refined using a variety of techniques and supplied commercially in a range of particle size grades of vermiculite concentrate. In Tamil Nadu good quality deposits of vermiculite are mostly found in the North Arcot district, where there are a few working mines. In Karnataka vermiculite is found in the districts of Hassan, Mandya and Mysuru. In West Bengal vermiculite occurs in the district of Bankura.

Vermiculite, when heated to a high degree of temperature exfoliates and expands 8 to 14 times in volume and yields exfoliated vermiculite by loss of water molecules. The chemical composition shows average moisture 7.89%, loss on ignition 11.05%, SiO_2 30.52%, Fe_2O_3, 16.32 % and TiO_2 2.63%. Exfoliation observed at right angles to the strong basal cleavage. This property is the basis for its commercial use. There is change in the colour during heating process depending upon the compositon of the vermiculite and furnace temperature.

USES

Vermiculite is known for its horticultural applications. It is a common component in potting soils. Unfoliated (unexpanded) vermiculite has only minor uses, such as for circulation in drilling muds and in the annealing of steel. In order to convert raw vermiculite into a product suitable for industrial use, it must be exfoliated or expanded by heating, a process termed 'exfoliation'. Vermiculite is chemically inert, fireproof, non-conductor of electricity and a good insulator against heat (both radiant and conducted), cold and sound. Unlike cork and other organic lightweight insulating material, it neither rot nor attacked by vermin and has a fair mechanical strength.

Vermiculite is added to soil for conditioning and lightening either alone or in conjunction with peat or compost. This will accelerate the growth by enabling the plant to absorb the NPK nutrients and promote anchorage for tender young root systems.

It is also used as a carrier in fertilizers, herbicides and insecticides. Cementing mixtures of exfoliated vermiculite and binding agents, such as gypsum and plaster, have been important products and are applied to structural steel members in commercial buildings.

The mineral is used in various types of building boards and in pollution control applications. Fine-sized, untreated vermiculite concentrates are included in the preparation of fireproof plaster boards. The exfoliated product forms the basis of some lightweight plasterboard, whilst ground, exfoliated vermiculite is used in various refractory board products.

The principal uses of expanded vermiculite are based on its thermal insulating quality (due to presence of innumerable air cells), low-density, fireproof nature and granular form. Larger vermiculite granules are used as a loose fill for thermal insulation for homes, industrial structures, cold storage, refrigeration and high temperature and low temperature industrial equipment.

Vermiculite is also used for refractory and high temperature insulation can withstand hot face temperature of 1000 ^oC i.e. it act as a thermal insulator.

The high absorbency and chemical inertness of exfoliated vermiculite have made it suitable for a wide range of absorbent packing materials as well as for packaged units for the containment of oil and similar liquids. Like perlite, vermiculite is a mined mineral that is heated to yield a soilless ingredient of potting mixes. Unlike perlite, vermiculite absorbs and retains water and nutrients. This quality is desirable especially in container gardens because of their quicker evaporation rates compared to in-ground plantings. On heating, vermiculite swells up and exfoliates into thin sheets; the swellings may be twenty times or more. The swelled-up vermiculite is very light and thus may be used as an ingredient for the making of light cement or plaster. Vermiculite is also used in the Packing Industry and the making of insulator against heat and sound. Its colour may be yellow, brown or blue. It is very soft and slippery like soap. Pure vermiculite is also used for plaster aggregates as fireproof insulating material in steel/concrete structures. It is widely used in lightweight insulating material for roof/floor deck system, insulation fill for homes and commercial building, packaging material, bitumen coated vermiculite screens, acoustic insulation, etc.

SUBSTITUTES

Expanded perlite is a substitute for exfoliated vermiculite in lightweight concrete and plaster. Other denser but less costly substitutes in these applications are expanded clay, shale, slag and slate. Alternate materials for loose-fill fire- proofing insulation include fibreglass, perlite and slag wool. In agriculture, substitutes include bark and other plant materials, peat, perlite, sawdust and synthetic soil conditioners. Finely ground pine bark also called "pine fines" is a principal ingredient of most potting mixes. As an alternative to vermiculite, pine fines also has water retentive qualities, especially with smaller particle sizes. Cotton gin waste includes gin leavings such as stems, leaves and hulls. Cotton gin compost renders these waste products into a viable alternative to vermiculite, also because of its ability to increase water-holding qualities in mixes. Resembling sphagnum peat moss, coir is the finish product of ground coconut husks. The University of Arkansas Co-operative Extension Service Reports that coir can retain up to nine times its weight in water.

CONSUMPTION

The apparent consumption of vermiculite was 5,922 tonnes during 2017-18.

POLICY

As per foreign trade policy 2015-20, the imports and exports of vermiculite (unexpanded) (ITC (HS) Code 25301010) and vermiculite insulation bricks (ITC (HS) Code 69029030) are allowed 'free'.

WORLD REVIEW

Vermiculite occurrences in Colorado, Nevada, North Carolina, Texas, and Wyoming contain estimated resources of 2 million to 3 million tonnes. Significant deposits have been reported in Australia, China, Russia, Uganda and some other countries, but reserves and resources information come from many sources and in most cases, it is not clear whether the numbers refer to vermiculite alone or vermiculite plus other minerals and host rock and overburden. The details of world reserves of vermiculite, as per Mineral Commodity Summaries, 2019 are given in Table-6. Global vermiculite production increased by about 6.6% in 2016, mostly owing to an increase in production from the world's leading producer, Parabora Mining Co. Ltd [a subsidiary of Palabora Copper (Pty) Ltd] in South Africa. Data for vermiculite production in China, which may have produced significant quantities of vermiculite, were largely unavailable. Although mines and prospects in Brazil, Peru and South Africa had the potential to increase the production of medium to coarse grades, expected production increased in 2015 and 2016, especially of coarser grades, had yet to materialize. To give a generalised view of the development in various countries the country-wise description as sourced from the latest available publication of Minerals Yearbook 'USGS' 2016 is furnished below:

Brazil

Brasil Minerios Ltd was by far the leading vermiculite producer in Brazil. The company's largest mine was the Sao Luis De Montes Belos Mine near Goiania in the State of Goias in Central Brazil and its main processing plant was in Sao Luis. The mine had an estimated production capacity of 60,000 tonnes per year (t/yr) of vermiculite ore with estimated reserves of 1.2 million tonnes (Mt) of vermiculite ore. With expansion of its mining operations continuing, Brasil Minerios produced and sold about 52,000 tonnes of vermiculite concentrate in 2016.

Bulgaria

In 2016, Wolff & Muller Minerals Bulgaria OOD, a German-Bulgarian joint-venture company, mined vermiculite ore from its Belitza opencast mine. The company had limited production at, and continued development of , the nearby Verona vermiculite deposit in southwestern Bulgaria near the capital of Sofia. It processed the crude vermiculite ore into a concentrate in superfine and micron-sized products at a plant capable of producing 20,000 t/yr.

China

Production levels of vermiculite in China were not available, but the vermiculite Association estimated annual Chinese exports of vermiculite to be 110,000 tonnes in 2016, suggesting that annual production must be at least that much. Xinjiang Yuli Xinlong Vermiculite Co., Ltd mined vermiculite ore from its 14.8 Mt deposit at its Xinlong Mine in the No.2 sector of the Qeganbulake ring complex in the Bazhou area of Zinjiang Uyghur Autonomous Region.

South Africa

In 2016, South Africa continued to be the world's leading producer and exporter of vermiculite accounting for about 40% of estimated world production. From 2000 through 2016, on an average, nearly 90% of the vermiculite produced in South Africa was exported. In 2016, about 166,000 tonnes were produced most of which was mined by Palabora Mining Co, Ltd Under the ownership of a consortium consisting of South African and Chinese entities led by the Industrial Development Corporation of South Africa Ltd and China's Hebei Iron & Steel Group the Palabora Mining Co. Ltd increased production in 2016 by about 20% from that of 2015 from its mine in Limpopo Province. In near by areas, the company was preparing for the opencast mining of ore that was equally rich in high-purity vermiculite. The new mine will have a production capacity of 1.5 Mt/yr of ore and yield 170,000 t/yr or vermiculite concentrate, extending the company's total mine life through 2033. Because of grade constraints and lower recovery rates from portions of the vermiculite ore body, the vermiculite product has continued to shift toward fine and superfine grades.

Turkey

Organik Madencilik A.S., a 50-50 joint venture of Turkey's Yildrim Group and the Greek mining group S&B [a subsidiary of Imerys SA (Paris,France) proceeded with plans to develop the country's first vermiculite mine at the Karakoc vermiculite deposit in Sivas in central Turkey.The deposit, discovered by Turkey's Government Exploration Co. in the 1990s is thought to contain as much as 2.8 Mt of high-quality vermiculite and 2.5 Mt of lower quality vermiculite. The company anticipated production of 5,000 tonnes of vermiculite concentrate in its first year. Sales are likely to go through Imerys' established network.

Uganda

Early in the year, Australian developer Black Mountain Resources Ltd initiated its purchase of the Namekara Vermiculite Mine in the Manafwa district of eastern Uganda from the newly esablished Africa Phosphate Pty, Ltd and assumed full control of the operation. The company reported an increased estimate of nearly 62 Mt of inferred resources, with a grade of 18.2% vermiculite and containing 11 Mt of vermiculite. The vermiculite resources include significant quantities of coarse and medium grades.

Zimbabwe

Samrec vermiculite (Pvt) Ltd, [a subsidiary of Imerys SA (Paris, France)], the leading vermiculite producer in the country conducted intermittent mining at the Shawa Mine. Samrec operated the Shawa Mine, which is about 300 kilometers southeast of the capital of Harare.The surface mining operation with ore to a depth of 40 meters had an expected mine life of more than 30 years in one the largest vermiculite deposits in the World. In the fourth quarter of 2014, the most recent period for which information is publicly available, the company operated at the rate of 40,000 t/yr. The ore, which included a significant portion of large flake vermiculite, was processed into concentrates, the majority of which was exported to Europe, the Middle

East, Japan and the United States. The Minerals Marketing Corp. of Zimbabwe, which was responsible for marketing and selling the country's industrial minerals, reported exports of nearly 30,900 tonnes of vermiculite concentrate at a value of $ 4.14 million in 2015 (most recent year available), representing a 3.7% increase from about 29,500 tonnes at a value of $ 4.05 million in 2014.

India's production of vermiculite during 2015-16, 2016-17 and 2017-18 was 23 thousand tonnes, 9 thousand tonnes and 6 thousand tonnes respectively. South Africa is the largest producer of vermiculite (166 thousand tonnes) in the world during 2017, followed by USA (100 thousand tonnes), Brazil (60 thousand tonnes) (Table-7).

Table – 6: World Reserves of Vermiculite (By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (Rounded off)	**NA**
Brazil[#]	6,200
India*[#]	1,600
South Africa	14,000
USA[e]	25,000
Other countries	NA

Source: *Mineral Commodity Summaries, 2019*

** India's total reserves/resources as per UNFC system as on 01.04.2015 were estimated at 2.35 million tonnes, # Reserves data for Brazil and India were revised based on Government information*

Table – 7: World Production of Vermiculite (By Principal Countries)

(In '000 tonnes)

Country	2015	2016	2017
Brazil[e]	60	60	60
Bulgaria[e]	10	10	10
China[e]	15	15	15
India*	23	9	6
Russia	8	12	12[e]
South Africa	138	166	166
USA[e]	100	100	100
Zimbabwe[e]	30	35	35
Other countries	10	5	6

Source: *World Mineral Production, 2013-2017*

**India's production of vermiculite during 2015-16, 2016-17 and 2017-18 was 23 thousand tonnes, 9 thousand tonnes and 6 thousand tonnes respectively.*

FOREIGN TRADE

Exports

Exports of vermiculite decreased drastically by 40% to 454 tonnes in 2017-18 as compared to 756 tonnes in 2016-17. Exports were mainly to Norway (58%), UAE (21%) and Japan (16%) (Table-8).

Imports

Imports of vermiculite also decreased drastically by 42% to 321 tonnes in 2017-18 from 551 tonnes in 2016-17. Imports were mainly from Brazil (59%), South Africa (27%), Zimbabwe and China (7% each) (Table-9).

Table – 8: Exports of Vermiculite (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**756**	**8312**	**454**	**5093**
Norway	342	2926	264	2043
UAE	250	3004	96	1594
Japan	64	774	74	902
Congo, Dem. Rep.	-	-	1	318
Qatar	-	-	10	117
Nepal	++	8	5	43
Greece	-	-	++	31
Korea, Rep. of	-	-	2	18
Maldives	-	-	1	15
Saudi Arabia	-	-	1	6
Other countries	100	1600	++	6

Table – 9: Imports of Vermiculite (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**551**	**14412**	**321**	**7415**
Brazil	336	7836	189	4473
South Africa	65	1648	86	2114
Zimbabwe	72	1188	24	445
China	-	-	22	376
Japan	++	107	++	7
USA	51	2913	-	-
Mozambique	24	437	-	-
UK	3	283	-	-

FUTURE OUTLOOK

Exploration and development of vermiculite deposits containing medium, large and premium (coarser) grades (mostly in China and South Africa) are likely to continue because of the higher 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 fine, superfine, and micron grades.