

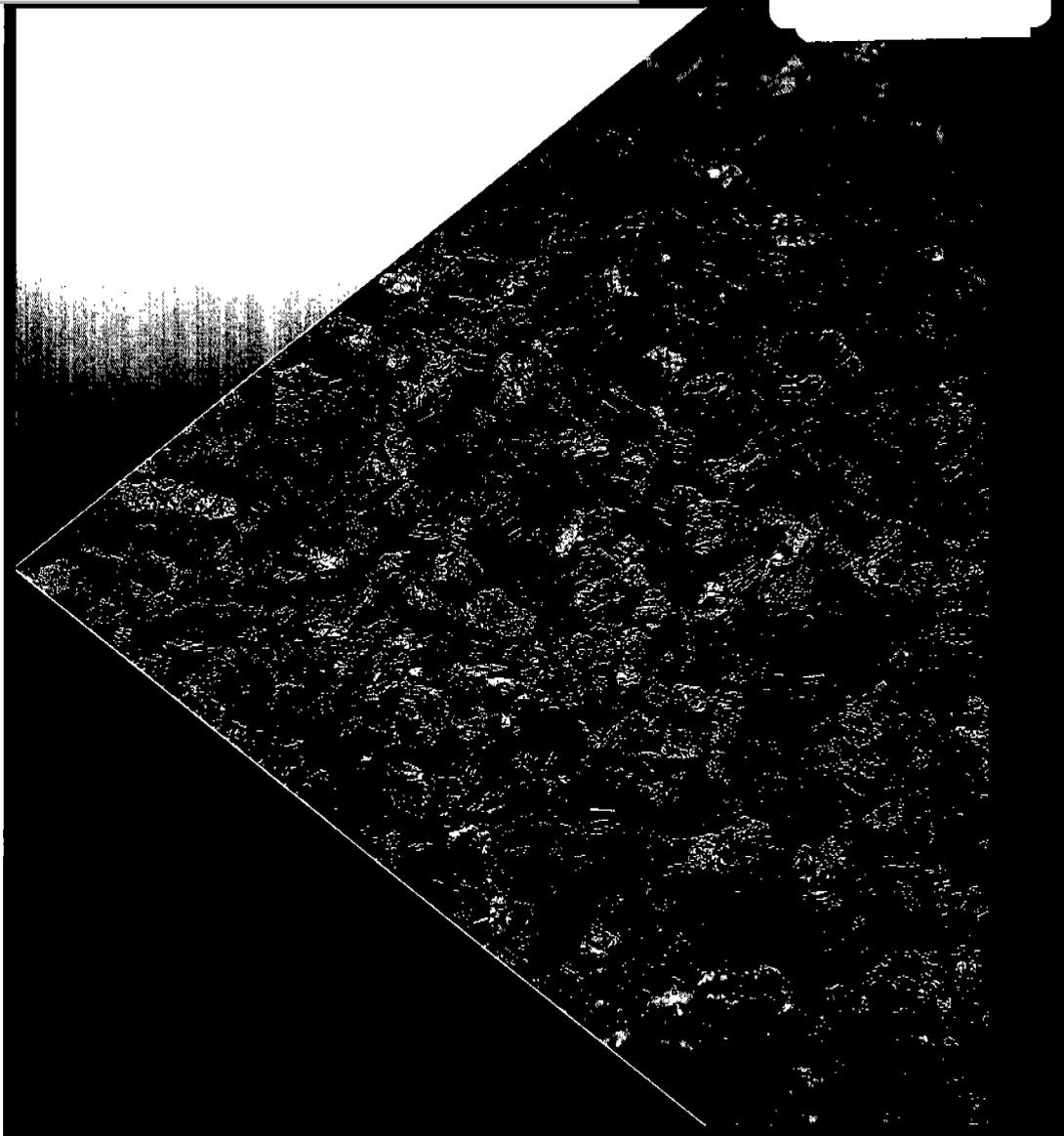
Note: This is a reference cited in AP 42, *Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources*. AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP-42 Section	<u>11.28</u>
Reference	<u>3</u>
Report Sect.	<u>AR</u>
Reference	<u>4</u>



The
Vermiculite
Association
Inc.



VERMICULITE

**Its Properties
And Uses**

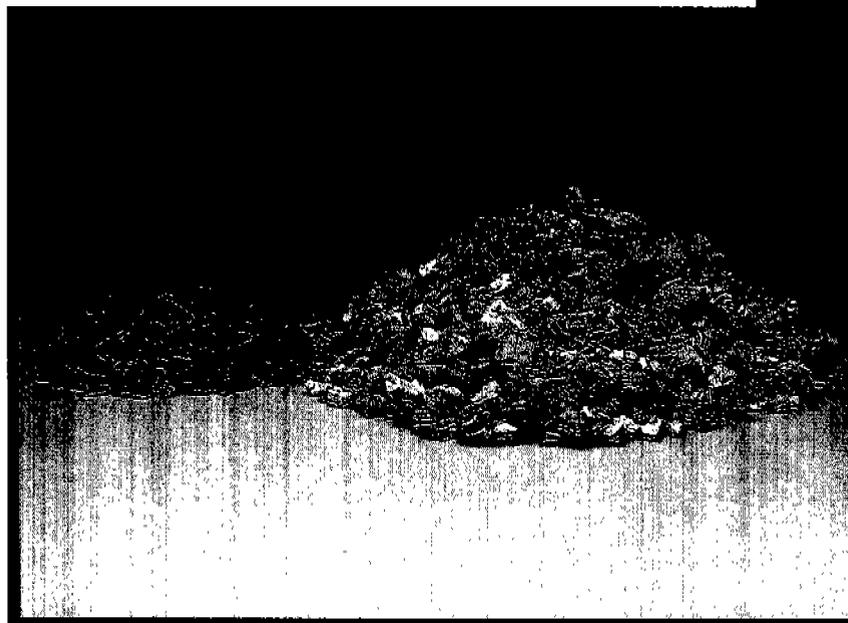
VERMICULITE: ITS PROPERTIES & USES



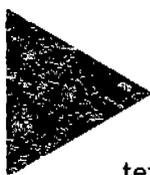
Vermiculite is the mineralogical name given to hydrated laminar magnesium-aluminum-iron-silicate which resembles mica in appearance. When subjected to heat, it has the unusual property of exfoliating or expanding, due to the generation of interlaminar steam.

Vermiculite is found in various parts of the world. Locations of the predominant commercial mines are in North America, South America, and Africa. Other deposits in countries such as India, Japan, Kenya, Zimbabwe, China, the Soviet Union and Australia are being developed.

Vermiculite mines are surface operations where ore is separated from other minerals, and then screened or classified into several basic particle sizes. The bulk density of crude vermiculite or vermiculite concentrate is in the range of 640-1120 kg/cu m or 40-70 lb/cu ft.

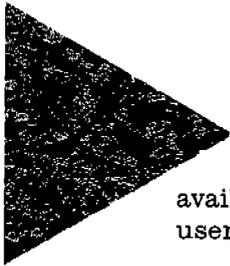


EXFOLIATION OR EXPANSION



When heated quickly to an elevated temperature, particles of vermiculite exfoliate by expanding at right angles to the cleavage, into worm-like pieces (the name vermiculite is derived from the Latin 'vermiculare', to breed worms). This characteristic of exfoliation, the basis for commercial use of the mineral, is the result of the mechanical separation of the layers by the rapid conversion of contained water to steam. The increase in bulk volume of commercial grades is 8 to 12 times, but individual flakes may exfoliate as many as 30 times. There is a color change during expansion that is dependent upon the composition of the vermiculite and furnace temperature.

SAFETY, STORAGE & HANDLING



Information on safe handling, storage, personal protection, health, and environmental considerations has been gathered on this product and is available from the material suppliers upon request. It is recommended that all users and specifiers acquaint themselves with this information.

For more information, please contact:

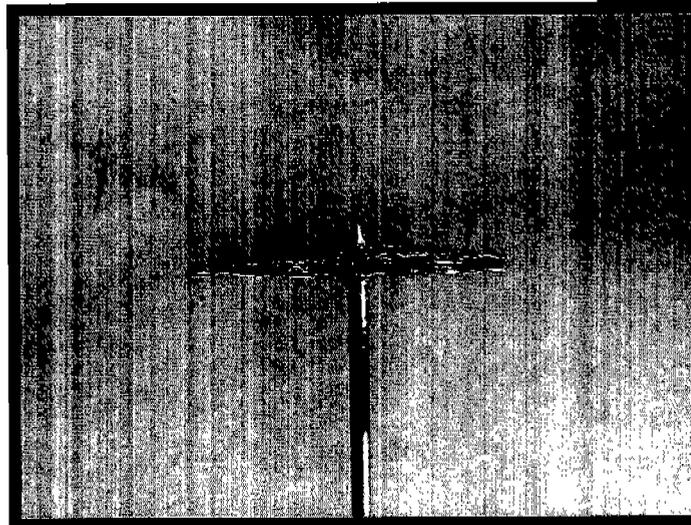
The Vermiculite Association

**11 S. LaSalle St., Suite 1400
Chicago, IL 60603
312/201-0101
FAX: 312/201-0214**

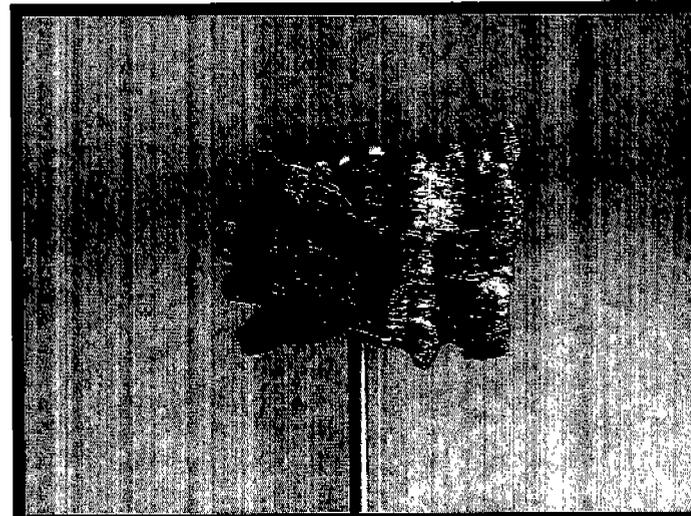
We hope the information given here will be helpful. It is based on data and knowledge considered to be true and accurate and is offered for the user's consideration, investigation and verification but we do not warrant the results to be obtained. No statement, recommendation or suggestion is intended for any use which would infringe any patent or copyright.

TYPICAL PHYSICAL PROPERTIES OF EXFOLIATED VERMICULITE

Color:	Light to dark brown
Shape:	Accordion-shaped granule
Bulk density(a):	64-160 kg/cu m 4-10 lb/cu ft
Moisture loss @110°C (230°F):	4-10%
pH (in water):	6-9
Combustibility:	Non-combustible
Sintering temperature:	1150-1250°C 2100-2280°F
Fusion point:	1200-1320°C 2200-2400°F
Cation exchange capacity (b):	50-150 me/100g
Specific heat:	0.84-1.08 kJ/kgK 0.20-0.26 kcal/kgK 0.20-0.26 Btu/lb°F
Waterholding capacity (a):	200-325% by wt 20-50% by vol



**Ore Concentrate Before
Exfoliation**



Concentrate After Exfoliation

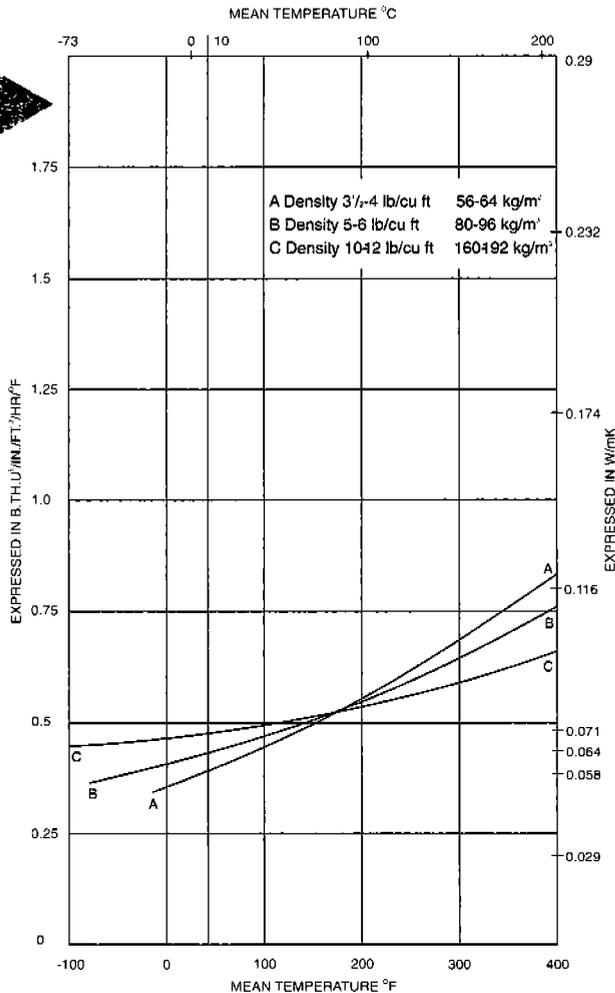
Thermal conductivity at different bulk densities

Bulk densities		Thermal conductivity values	
Kg/cu m	lb/cu ft	Lambda (λ)W/mK	Btu in/sq ft h°F
56-64	3.5-4.0	0.058	0.40
80-96	5.0-6.0	0.064	0.44
160-192	10-12	0.071	0.49

Notes:

- (a) Bulk density and water holding capacity vary with particle size.
- (b) Exchangeable ions are Mg^{+2} and Ca^{+2} , sodium acetate saturation/ammonium acetate substitution method.

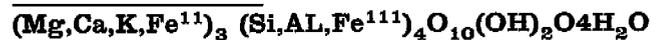
THERMAL CONDUCTIVITY OF EXFOLIATED VERMICULITE



TYPICAL CHEMICAL ANALYSIS

Element	Percent by Weight
SiO ₂	38-46%
Al ₂ O ₃	10-16
MgO	16-35
CaO	1-5
K ₂ O	1-6
Fe ₂ O ₃	6-13
TiO ₂	1-3
H ₂ O	8-16
Other	0.2-1.2%

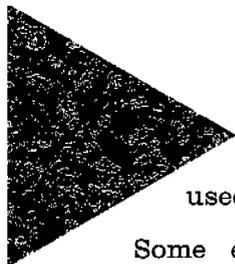
Chemical Formula



EXFOLIATED VERMICULITE PARTICLE SIZES

Size		Densities		Equivalent Names/Designations	
		Kg/Cu M	Lb./Cu. Ft.	System A	System B
16mm (5/8")	down	56-72	3.5-4.5	NA	Premium (6)
8mm (5/16")	down	64-85	4.0-5.0	1	Large (4)
4mm (5/32")	down	72-90	4.5-5.5	2	Medium (3)
2mm (0.08")	down	75-112	4.7-7.0	3	Fine (2)
1mm (0.04")	down	80-144	5.0-9.0	4	Superfine (1)
0.5mm (0.02")	down	90-160	5.6-10.0	5	Micron (0)

HOW VERMICULITE CAN BE USED



Vermiculite has been used in various industries for over 70 years. It is used in the construction, horticultural, agricultural, and industrial markets.

Some examples of vermiculite uses include:

CONSTRUCTION

Gypsum plaster
Air setting binder
Board
Loft insulation
Fire protection
(internal & external)
Acoustic finishes
Floor and roof
screeds
(lightweight
insulating
concrete)
Sound deadening
compounds

AGRICULTURAL

Animal feed
Pesticide
Fertilizer
Bulking agent
Seed encapsulant
Anti-caking
material
Soil conditioner

HORTICULTURAL

Seed germination
Sowing composts
Seedling
wedgemix
Blocking mixes
Rooting cuttings
Micro-propagation
Twin scaling bulbs
Potting mixes
Hydroponics

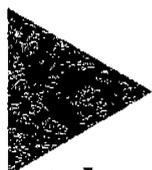
INDUSTRIAL

Paints
Moulded products
Brake pads &
brake shoes
Fireproof safes
Filtration
Insulation - high
& low
temperature
Insulation blocks
& shapes
Furnaces
Sealants
Fixation of
hazardous
materials
Castables
Drilling muds
Nuclear waste
disposal
Absorbent packing
Perfume absorbent
Molten metal
insulation
Dispersions



Below are some examples of typical binders and other materials which are often used in combination with vermiculite:

- ▶ Portland cement
- ▶ High alumina cement
- ▶ Clay
- ▶ Plaster (gypsum)
- ▶ Fertilizers
- ▶ Resins
- ▶ Sodium silicate
- ▶ Potassium silicate
- ▶ Peat
- ▶ Bark



Consider vermiculite if you are looking for:

- ▶ Loosefills
- ▶ Carriers
- ▶ Asbestos substitutes
- ▶ Absorbents
- ▶ Soil conditioners
- ▶ Lightweight aggregates
- ▶ Density modifiers
- ▶ Fire protection
- ▶ Industrial heat insulation