Steatite (HF-82)

- **Mill Lining Blocks**
- **Grinding Media**

What is Steatite ?

Jyoti Steatite grade HF-82 ceramic composite corresponds to German steatite ceramic grade KER 221.

It is a low loss alkali free fused magnesium silicate material, tough, hard and dense ceramic.

Jyoti's Steatite ceramic mill lining blocks and grinding media are ideal performance partners.

Manufacturing Process

Steatite is a magnesium meta silicate composite formulated from selected quality of soapstone, china clay, barium carbonate and other chemicals in its residual. The raw mix composite is wet milled to micro fine particle size. The composite slurry is spray dried in micro processor controlled spray dryer to form homogeneous free flowing spherical granules. Such granules are pressed in T.C. moulding tools in automatic uniaxial dry powder compacting presses, under high compaction pressure.

The pressed mill lining bricks and grinding media are sintered at around 1350°C in gas fired high temperature shuttle - tunnel kilns in natural oxidising atmosphere to form an impervious, vitrified, tough, non porous, dense hard material. Due to its mechanical strength and other relative features steatite ceramic is found most suitable ceramic composite for production of ball mill linings and grinding media.

The true value of mill lining and grinding media is measured by length of trouble free service in relation to mill production output.

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Steatite (HF-82)

Typical Properties

Material Properties	Units	Steatite
Colour	-	Off White
Specific Gravity	-	2.7
Water absorption	%	0.0
Flexural strength	Kg/cm^2	1,300
Compressive strength	Kg/cm^2	8,500
Hardness	HV_{10}	520
Coefficient of linear thermal expansion (20°C-1000°C)	$X10^{-6}$/°C	8.5
Safe operating temperature (No Load)	°C	1,050
Dielectric strength (20°C)^5 mm thick	KV/mm	6
Dielectric constant (20°C: 1MHZ)	-	6
Dissipation factor 20°C: 1MHZ	-	0.0004
Volume resistivity (20°C)	Ohm-cm	10^{13}

Hardness Comparison

Material	Moh Hardness
Diamond	10
Sapphire	9
Duralox	9
Topaz	8
Steatite	7.5
Quartz	7
Tool steel	6.5
Silica	6
Glass	5.5
Carbon Steel	5.5
Limestone	3.4
Copper	3
Gypsum	2
Talc	1

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Steatite (HF-82)

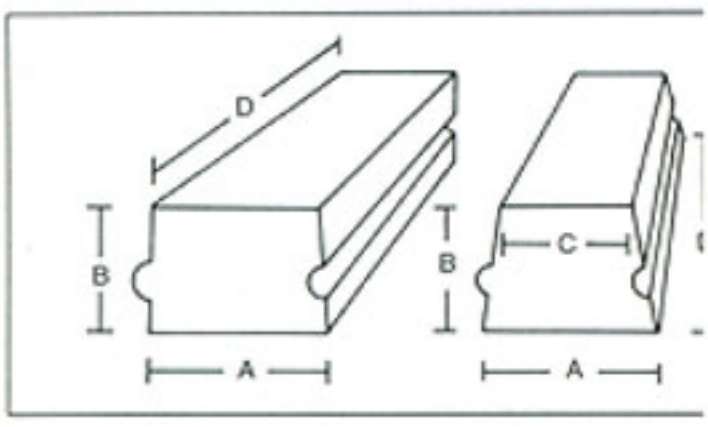
Chemical Properties

SiO_2	61.50%
MgO	27.40%
BaO	3.20%
AL_2O_3	6.80%
Fe_2O_3	0.50%
Na_2O	0.10%
CaO	0.50%

STEATITE (HF-82) - Mill Lining Blocks

- **Mill Lining Brick Sizes And Installation**
- **Advantages**

Mill Lining Brick Sizes and Installation



Steatite ceramic mill lining bricks are with tongue and groove design to form an interlocking pattern in installation, ensuring firm fixation of bricks in a mill shell and in ' end flanges with minimum quantity of fixing adhesive/cement. Interlock fixing of bricks prevents bricks to give way from installation, chipping off and spalling off edges. Steatite mill lining bricks are available in a wide range of sizes and thickness to suit small and large size ball mills.

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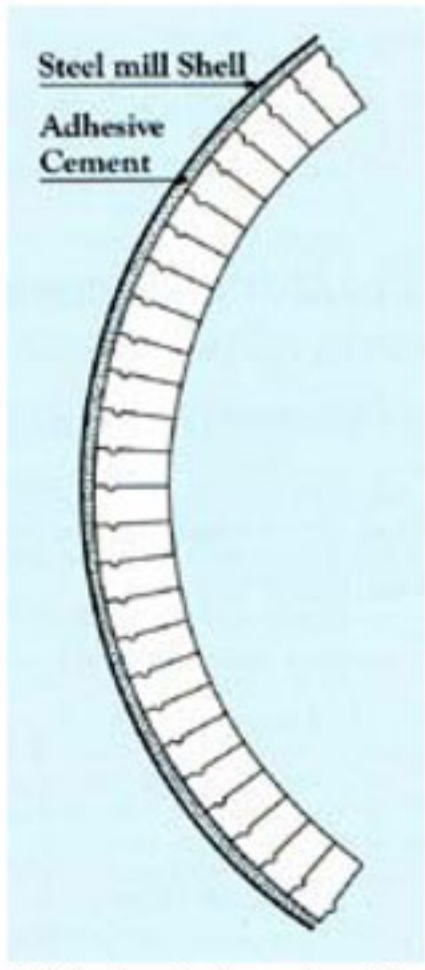
Mill Lining Blocks

Block Number	Dimensions in Millimeters				Appropriate Weight Kgs.	Suitable For Ball Mill Size
	A	B	C	D		
TAPER C-32	40.0	47.0	32.0	100	0.455	457 MM Ø To 762 MM Ø (18" . 30" Ø)
C-51	59.5	65.0	51.5	150	1.425	900 MM Ø (3' Ø)
C-53	59.5	65.0	53.5	150	1.450	1220 MM Ø (4' Ø)
C-54	59.5	65.0	54.5	150	1.470	1524 MM Ø (5' Ø)
C-55	59.5	65.0	55.5	150	1.490	1830 MM Ø (6' Ø)
C-59 W/O Tongue & Groove	59.5	65.0	55.5	150	1.470	--
Straight B-30	50.0	30.0	--	100	0.370	For Mill End Lining 457 MM Ø To 762 MM Ø (18" Ø To 30" Ø)
B-32	32.0	47.0	--	100	0.390	--
B-42	65.0	42.0	--	150	1.080	For Mill End Lining 900 MM Ø To 2133 MM Ø (3" Ø To 7" Ø)
B-53	53.3	65.0	--	150	1.360	--

A strong thin steatite ceramic lining brick can put more working volume in a mill than a thick natural stone lining blocks.

In 1800 mm Dia x 1800 mm L Ball Mill a 65 mm thick steatite brick lining will provide about 25% more mill working volume than the 125 mm thick natural stone lining blocks.

Recommended staggered lining pattern



Mill shell lined with all tapered bricks

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Mill Lining Blocks

Advantages

Following features and benefits are worth considering to use Jyoti steatite ball mill linings for milling substances of hardness below 7 on Moh's scale.

1. **Lower in cost as compared to alumina ceramic**
2. **Light in weight as compared to alumina**
3. **Longer service life as compared to traditional ceramic lining materials**
4. **Easy to machine, chip or grind**
5. **Substantial increase in mill volume due to lower thickness as compared to traditional stone lining**

Steatite ceramic mill lining bricks are tough and hard to resist high impact, high abrasion and corrosion wear, high temperature resistant than steel, rubber, polyurethane, natural stone and other conventional mill lining materials. Under normal working conditions Steatite ceramic mill lining lasts many times longer than steel, rubber, stone and other conventional porcelain lining materials. Hardness of Steatite ceramic is 7.5 on Moh's scale and 500 at 10 kgs load on Vickers scale against the tool steel which is having hardness of 5.5 on Moh's scale, and 400 at 10 kgs load Vickers scale. Steatite ceramic is resistant to acids and alkalis except hydrofluoric acid.

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Grinding Media

Steatite HF-82 - Grinding Media

- Steatite Grinding Media
- Grinding Media Sizes
- Calculation of Media Charge
- Advantages and Applications

Steatite Grinding Media

Jyoti Steatite Ceramic Grinding Media are manufactured from our Grade HF-82 and are harder than steel in wear resistance. Steatite is a fused magnesium silicate material manufactured from selected pure finely milled raw materials. It is off white in color and does not contaminate the materials to be milled.

As steatite HF-82 has homogeneous internal microstructure, wear rate of our steatite grinding media is so insignificant that it does not affect color and composition of the milled product.

Steatite grinding media are used preferably for milling low viscosity materials, not requiring high grinding force. It has a specific density $\geq$ 2.7 gm/cc.

Therefore these grinding media posses high milling efficiency and are used particularly where heat generation during the milling operation is detrimental and prohibitive.

Steatite grinding media comes in ball shape and cylinders with radius end corners.

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Grinding Media

Grinding Media Sizes

Steatite Ceramic Satellite Type Spheres

Size - (Dia) (mm)	Weight (Approx) (gms)	No. of Balls per kg. (No. / kg)
4.5	0.14	7143
6.0	0.33	3030
8.0	0.77	1300
10.0	1.50	667
12.5	2.88	347
15.0	5.00	200
20.0	11.75	85
25.0	22.70	44
30.0	39.00	26
40.0	97.00	10.3
50.0	186.00	5.4
60.0	330.00	3.0

Steatite Ceramic Cylinders With Chamfered End Corners

Size Dia X Length (mm)	Weight (Approx) (gms)	No. of Balls per kg. (No. / kg)
6 x 6	0.50	2000
8 x 8	1.16	862
10 x 10	2.20	455
12.5 x 12.5	4.30	233
15 x 15	7.50	133
20 x 20	17.40	57
25 x 25	34.00	29
30 x 30	63.00	16

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Grinding Media

Calculations of mill motor power, mill speed and media charge

Considering the weight of mill lining and grinding media, work out the motor power required, in consultation with the mill manufacturer.

• To calculate media charge for cylindrical mill

Formulae are given below:

1. For batch type ball mill :

$$M = 0.000691 \times D^2 \times L$$

where : M = Weight of grinding media charge in kgs
D = Mill Internal Dia in cms. after lining
L = Internal length of the mill in cms. after lining.

2. For continuous type ball mill :

$$M = 0.000503 \times D^2 \times L$$

Example - To calculate grinding media charge for a steatite brick lined batch type mill size : Dia 6' x 6' Long (Dia 180 cm x 180 cm L) (mill openings are not considered).

Thickness of tapered bricks = 6.5 cms
Thickness of straight bricks = 4.2 cms
Therefore D = 180 - 13 = 167 cms
L = 180 - 8.4 = 171.6 cms
M = 0.000691 x 167 x 167 x 171.6
Grinding media quantity = 3307 kgs

• To calculate the motor power required for a cylindrical type ball mill, the following formula can be applied :

$$W = 0.04116 \times D^3 \times L \times n \times (0.6d + 0.4d1)$$

where : W = Required motor power in HP
D = Internal dia of the mill in mtr
L = Internal length of the mill in mtr
d = Specific gravity of grinding media
d1 = Specific gravity of substance
n = Speed of ball mill in rpm.

Example - 1: Let the internal dia of the mill be 1.8 mtr and internal length be 1.8 mtr. If Alumina grinding media is used density d = 3.6. If milling substance is alumina in slurrry form with around 70% solids then d1 = 2.0

Therefore

$$W = 0.04116 \times (1.8)^4 \times 19 \ (3.6 \times 0.6 + 2 \times 0.4) = 24.3 \text{ HP}$$

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Example - 2: If Steatite grinding media are used to mill the glass frit
d = 2.65 and d1 = 1.6 then,
$W = 0.04116 \times (1.8)^4 \times 19 \times (2.65 \times 0.6 + 1.6 \times 0.4) = 18.3$ HP

- To calculate the speed of the mill, use the following formula :

$$Nc = \frac{76.6}{D^{1/2}}$$

Where : Nc = Critical speed
D = Internal dia in ft.

Actual speed of the mill should be approximately 62% of Nc for wet milling and 75% of Nc for dry milling.

Advantages and Applications

Advantages

Easy To Use

Steatite grinding media are fully vitrified, non-porous, and satin smooth in surface finish, allowing easy and thorough cleaning while changing charge from one color shade to another.

Uniform Quality

Steatite grinding media are synthetic products produced in the most modern plant under stringent quality control checks at various manufacturing levels to ensure quality consistency.

Longer Life

The best quality raw materials, most modern production equipment and rigid quality control checks at all processing levels elevate the grinding media to the highest quality level. After sintering grinding media are duly tumbled to reduce its initial wear loss by removing its fired skin and to obtain satin smooth surface finish. All these above processes ensure considerably longer life than traditional grinding media.

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Grinding Media

Applications

A) **Paint and Varnish manufacturing industries.**
Practically for all types and combinations of paints, primers, rust protection paints, pigments, film producing products of all kinds printing inks, carbon dyes on wax-and synthetic bases for carbon paper and typewriter ribbons, ribbon inks.

B) Pencil-colors, Ceramic stains, textile dyes, leather dressing colors etc.

C) Chemical, Pharmaceutical and Cosmetic Industries.

D) Lubricants, photographic emulsions, recording tape materials, adhesive, binding agents for sealing substances, electroceramic matters, ferrities etc.

E) **Food manufacturing industries**
Cocoa and chocolate substances, coffee extracts, flat glazings and coating substances.

F) **Plastic Industry**
Plastic dispersions, solutions for softening pigments, latex, fillers, vulcanising pastes etc.

G) Ceramic Industry-Glazes, Frits, Stains, Steatite Porcelain bodies.

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