

Study of Hammer mill and Ball mill

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Basic parts of mill

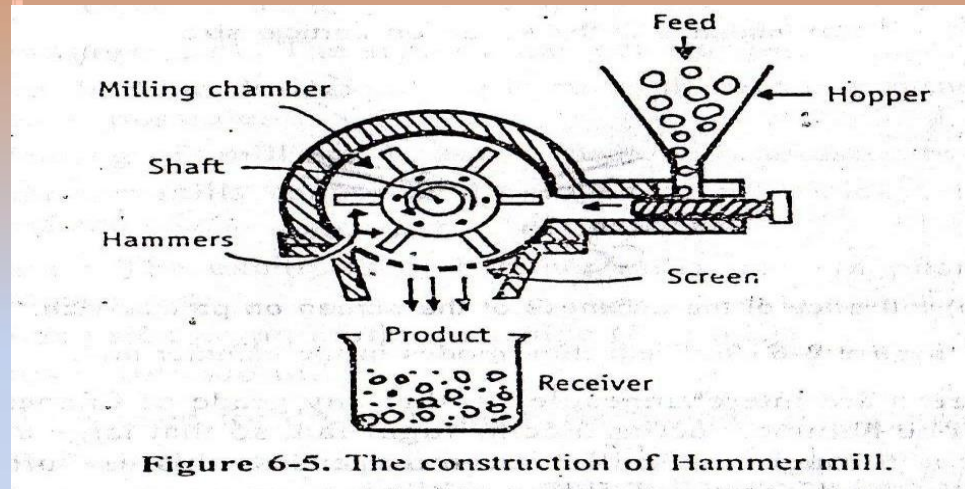
- Feed chute/hopper, which delivers the material.
- Grinding mechanism usually consisting of a rotor and stator.
- The discharging chute /sieves.

Hammer mills:

Principle:- Impact

Construction-

- In a hammer mill, swinging hammerheads are attached to a rotor that rotates at high speed inside a hardened casing.



- The hammer mill consists of a steel casing in which a central shaft is enclosed to which a number of swinging hammers are attached. When the shaft is rotated the hammers swing out to a radial position.
- On the lower part of the casing a screen of desired size is fitted which can be easily replaced according to the particle size required.
- The material is crushed and pulverized between the hammers and the casing and remains in the mill until it is fine enough to pass through a screen and collected in a suitable receiver.

Working:

- A hammer mill is essentially a steel drum containing a vertical or horizontal rotating shaft or drum on which hammers are mounted.
- The hammers swing on the ends of the cross freely or fixed to the central rotor.
- The rotor is rotated at a high speed (8000-15000rpm) inside the drum while material is fed into a feed hopper.
- The material is impacted by the hammer bars and expelled through screens in the drum of a selected size.

Use

Both brittle and fibrous materials can be handled in hammer mills, though with fibrous material, projecting sections on the casing may be used to give a cutting action. The hammer mills are available in various designs and shapes. In pharmaceutical industry they are used for grinding dry materials, wet filter cakes, ointments and slurries.

Advantages:

1. It is rapid in action, and is capable of grinding many different types of materials.
2. They are easy to install and operate, the operation is continuous.
3. There is little contamination of the product with metal abraded from the mill as no surface move against each other.
4. The particle size of the material to be reduced can be easily controlled by changing the speed of the rotor, hammer type, shape and size of the screen

Disadvantages:

1. The high speed of operation causes generation of heat that may affect thermo labile materials or drugs containing gum, fat or resin. The mill may be water-cooled to reduce this heat damage.
2. The rate of feed must be controlled carefully as the mill may be choked, resulting in decreased efficiency or even damage.
3. Because of the high speed of operation, the hammer mill is susceptible to damage by foreign objects such as stones or metal in the feed. Magnets may be used to remove iron, but the feed must be checked visually for any other contamination.

Variants:-

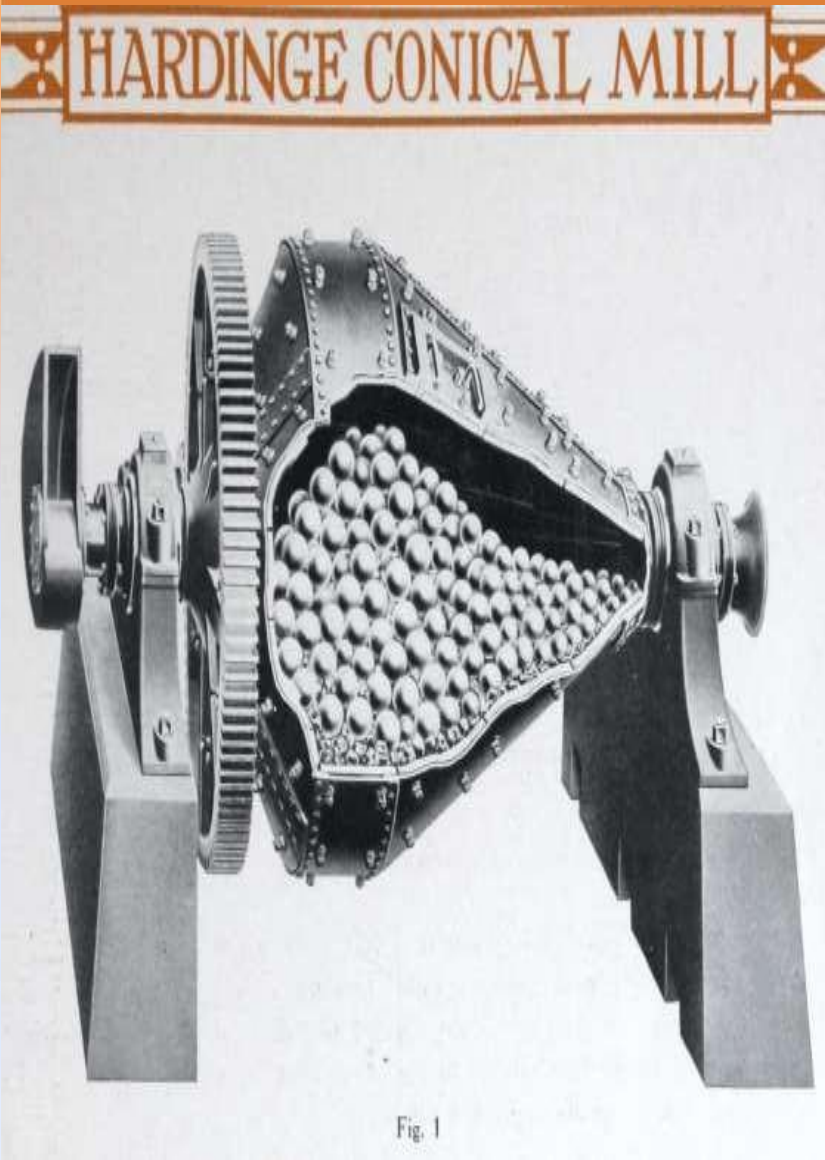
Stocks tornado mill, Fitz mill, Micropulveriser, Hammer crusher



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BALL MILL/TUMBLING MILL



Principle: impact b/w rapidly moving balls and powder material. At low speed balls roll over each other attrition takes place.

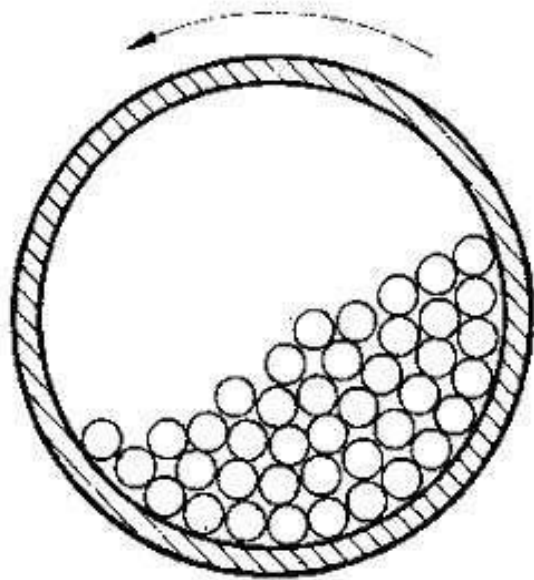
Construction:

- A ball mill consists of a hollow cylindrical shell rotating about its axis.
- The axis of the shell may be either horizontal or at a small angle to the horizontal. It is partially filled with balls.
- The grinding media is the balls, which may be made of steel (chrome steel), stainless steel, ceramic, or rubber.
- The inner surface of the cylindrical shell is usually lined with an abrasion-resistant material such as manganese steel or rubber. Less wear takes place in rubber lined mills. The length of the mill is approximately equal to its diameter. The cylinder is made of a metal and usually lined with chrome.

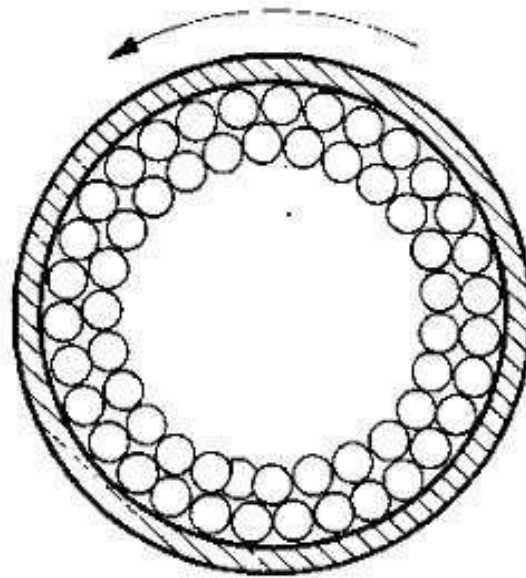
- The cylinder contains balls that occupy 30 to 50% of the mill volume.
- The ball size depends on the size of the feed and the diameter of the mill.
- Balls are made up of steel, iron or stoneware and act as grinding medium.

Working

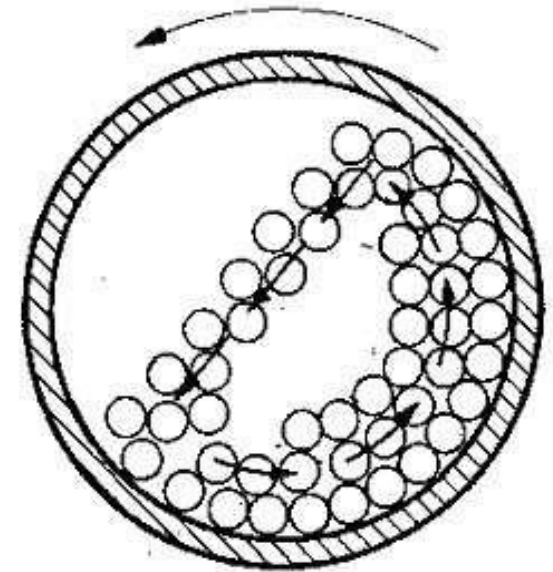
- The drug to be ground is put into the cylinder of the mill in such a quantity that it is filled to about 60% of the volume.
- A fixed number of balls are introduced and the cylinder is closed. The mill is allowed to rotate on its longitudinal axis.
- The speed of rotation is very important. At low speed, the balls roll over each other and attrition will be a predominant mode of stress. This mode of attrition is used for wet grinding (use small or glass pebbles).
- At correct speed, the centrifugal force just occurs, as a result the balls are picked up by the mill wall and carried nearly at the top, where they break contact with the wall and fall to the bottom to be picked up.
- In this manner impact stress will also be induced and size reduction is made effective.
- At still high speed, the balls are thrown out to the wall by centrifugal force. Hence, grinding will not occur.



(a) Low speed with sliding



(b) High speed with centrifuging



(c) Correct speed with cascading

Fig. Ball mill operation

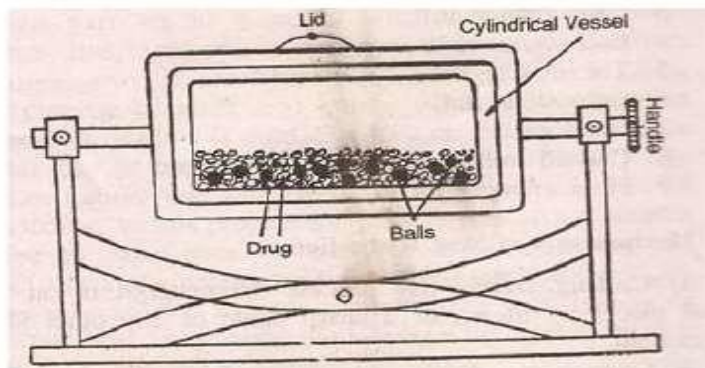


Figure 5-a Ball mill



Figure 5-b An example of Grinding media for ball mill (Lead antimony-grinding media with aluminum powder)

Uses:

- For fine grinding with a particle size of 100 to 5 mm or less.
- For production of ophthalmic and parenteral products.
- For milling dyes, pigments and insecticides at low speed.

ADVANTAGES:

- It can produce very fine powder.
- Ball mill is used for both wet and dry grinding processes.
- Toxic substances can be ground, as the cylinder is closed system.
- Rod or bars can also be used as grinding media instead of balls for sticky materials.
- Installation, operation and labor costs are low.
- Since the mill is closed system used for sterile products and oxygen sensitive products.

DISADVANTAGES:

- The ball mill is a very noisy machine.
- Ball mill is a slow process.
- Soft, tacky (gummy) and fibrous material cannot be milled by ball mill.
- Wear occurs from the balls as well as from the casing which may result in the contamination of the product.



