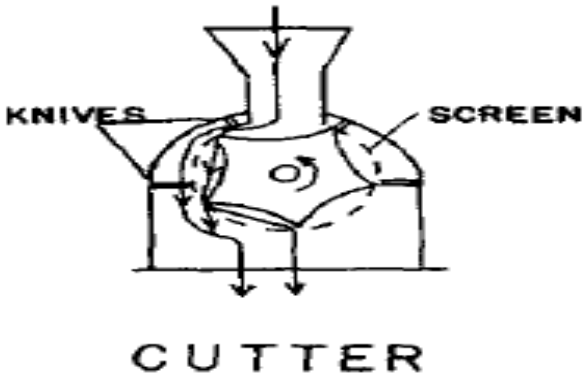
Cutting mill

Cutting mill is used for tough materials , fibrous materials & provide a successive cutting or shearing action rather than attrition or impact.

The rotary knife cutter has a horizontal rotor with 2 to 12 knives spaced uniformly on its periphery & a cylindric casing having several stationary knives.

the bottom of the case holds a screen.

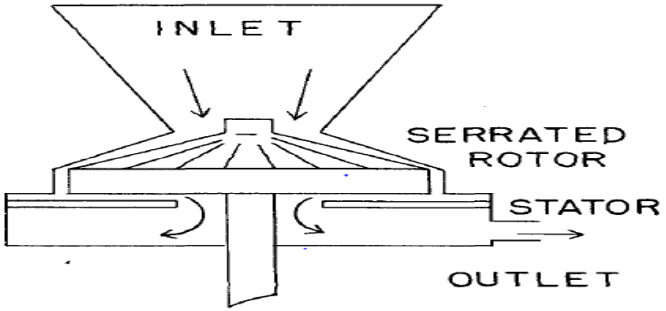


A disc mill consists of two vertical discs; each may rotate in opposite directions (double-runner disc mill), or only one may rotate (single-runner disc mill), with an adjustable clearance. The disc may be provided with cutting faces, teeth, or convolutions. The material is premilled to approximately 40-mesh size and is usually suspended in a stream of air or liquid when fed to the mill.

Roller mill

- Roller mills consist of 2 to 5 smooth rollers operating at different rate.

Colloid mill



Consists of a high speed rotor & stator with conical milling surfaces between which in is an adjustable clearance .

The material to be ground should be premilled as finally as possible to prevent damage to the colloid mill.

This mill is used to process suspension & emulsions, it is not use to process dry materials.

The premilled solids are mixed with the liquid vehicle before being introduced into the colloid mill.

In pharmacy, the colloid mill is used to process suspensions and emulsions; it is not used to process dry materials. The premilled solids are mixed with the liquid vehicle before being introduced into the colloid mill. Interfacial tension causes part of the material to adhere to, and to rotate with, the rotor. Centrifugal force throws part of the material across the rotor onto the stator. At a point between the rotor and stator, the motion imparted by the rotor ceases, and hydraulic shearing force exceeds the particle-particle attractive forces holding the individual particles in an aggregate. The particle size of milled particles may be smaller than the clearance, because the high shear is the dispersing force. In emulsification, a clearance of 75 microns may produce a dispersion with an average particle size of 3 microns. The milled liquid is discharged through an outlet in the periphery of the housing and may be recycled.

Rotor & stator may be smooth surfaced or rough surfaced

Smooth surfaced there is a thin uniform film of material between them & is subjected to the maximum amount of shear.

Rough *surfaced* mills add intense eddy currents turbulence & impaction of the particles to the shearing action & useful with fibrous material because fibers tend to interlock & clog smooth- faced mills.

A colloid mill tends to incorporate air into a suspension . Aeration may be minimized by use of a vertical rotor , which seals the point at which the rotor shaft enters the housing, & keep the rotor & stator in contact with the liquid.

The wasted energy of milling which appears as heat, may raise the temperature of a liquid by as much as 40^{0}C. The passage of cooling water through the mill jacket may reduce the temperature by as much as 20^{0}C . Sanitary design mills, which may be sterilized.

Techniques of milling
1-special atmosphere

Hygroscopic material can be milled in a close system supplied with dehumidified air.

Thermoliable , easily oxidizable. & combustable materials should be milled in a closed system with an inert atmosphere of carbon dioxide or nitrogen.

2- temperature control

As only a small % of the energy of milling is used to form new surface. The bulk of energy is converted to heat. This heat may raise the temp. of the material many degrees & unless the heat is removed, the solid will melt , decompose or explode. To avoid these things the milling chamber should be cooled by means of a cooling jacket or a heat exchanger.

Waxy & low melting materials are 1- chilled before milling or 2-fed to the mill simultaneously with dry ice.

Pretreatment. For a mill to operate satisfactorily, the feed should be of the proper size and enter at a fairly uniform rate. If granules or intermediate-sized particles are desired with a minimum of fines, presizing is vital. Pretreatment of fibrous materials with high-pressure rolls or cutters facilitates comminution.

Subsequent Treatment. If extreme control of size is required, it may be necessary to recycle the larger particles, either by simply screening the discharge and returning the oversize particles for a second milling, or by using air-separation equipment in a closed circuit to return the oversized particles automatically to the milling chamber. With materials to be reduced to micron size, an integrated air-separation, conveyor, and collection element usually are required.

Dual Process. The milling process may serve simultaneously as a mixing process if the feed materials are heterogeneous. If hot gas is circulated through a mill, the mill can be used to comminute and dry moist solids simultaneously. The fluid-energy mill has been suggested as a means of simultaneous size reduction and dispersion. It has been suggested that the particles in a fluid-energy mill can be coated with almost a monomolecular film by premixing with as little as 0.25% of the coating agent.

3- wet & dry milling

If the product undergoes physical & chemical change in water , dry milling is recommended .

In the dry milling the limit of fineness is reached in the region of 100 microns when the material cakes on the milling chamber.

The addition of a small amount of grinding aid may facilitate size reduction.

These dispersing agents are useful in the revolving mill if coating of the balls occurs.

The addition of less than 0.1% of surface active agent may increase the production rate from 20 to 40%.

Wet grinding

1-eliminates dust hazards & is usually 2- done in low speed mills,3- which consume less power .