SIZE REDUCTION

It is the process of reducing drugs size in smaller particles, or fine powder is called *Size Reduction***.**

Important of size reduction

- To improve the stability of certain pharmaceutical dosage forms such as suspension the rate of sedimentation decrease to a large extent by reducing the particle size of the drug.
- To help in the process of separation of the solid from liquids by filtration by the rate of filtration depend upon the particle size.
- To increase the rate of absorption of a drugs the smaller particle size the greater is the rate of
- To increase the rate of solution is case of chemical substance become reduction of the particle size increases the surface area for the action of solvent.

Factor affecting size reduction

1. ***Hardness:-*** The hardness of the material affect the process of production it is easier brakes soft material to a small size then hard material.
2. ***Toughness:-*** The crude drugs of fibrous natura or these saving higher moisture contained are generally tough in nature.
3. ***Material structure:-*** material which show some special structure may cause problem during size reduction.
4. ***Moisture content:-*** The presence of moisture in the material influence a number of its properties such as hardness stickiness which in its turn effect the particle size reduction.
   - The material having 5% moisture in case of drying grinding and 50% moisture in wet grinding does not create the problem.
5. ***Stickiness:-*** stickiness cause a lot of difficulty in size reduction this is due to the fact the material adhere to the grinding surface or sieve surface of the mill.
6. ***Softening temperature :-*** waxy substance (Stearic Acid, or drugs containing oil or fat) because softened during the size reduction process if a heat generated this can be avoided by calling the mill.
7. ***Purity required:-*** various mill are used for size reduction often cause the grinding surface to wear of and thus impurities come in the power if a high degree purity is required such mill must be avoided.
8. ***Physiological effect:-*** Some drugs are very patent during their particle size reduction in a mill dust is produced which may have an effect on their operater in such cases the inclosed mill may be used avoid dust.
9. ***Bulk density:-*** The output of the size reduction of material in a machine depends upon the bulk density of the substance.

10. ***Ratio of feed size to product size :-*** To get a fine powder in a mill. It is required to fairly small feed size should be used hence it is necessary to carry out the size reduction process is several stage using defferent equipment.

- **Example:- Preliminary crushing following by coarse powder and then fine grinding.**

Methods Of Size Reduction

1. **Cutting**
2. **Compression**
3. **Impact**
4. **Attrition**
5. **Combined impact and attrition**

1. Cutting:-

The material is cut on a small scale by means of a sharp blade knife, root cutter or other any sharp instruments on a large scale a cutter mill is used cutting of the drug is usually done to hasten the drying of drugs.

Cutter mill

Principal of Cutter mill:-

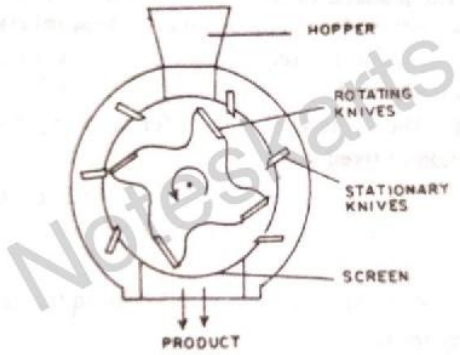
- The size of reduction is done by cutting with the help of shape knives.

Construction:-

- There are two types of knives which are fitted in this mill these are stationary knives and rotating knives.
- The stationary knives are fixed in the casing where as the rotating knives are attached to the rotor.
- The upper part of the casing also contains a hopper inlet where as the lower part has a screen of desired aperture size.

How cutter mill are Work:-

- The material to be cut is put into the hopper of the mill the rotor rotates at a high speed due to the rotation of the rotor.
- The material comes very close between stationary knives and rotating knives it cuts down the material into small pieces.



- Screen retail the material in the mill until the desired collected which come out the sieve.

Use of Cutter mill:-

The mill is used to obtain a coarse degree of size reduction of soft material such as – Roots, Peels or wood before extraction.

2. Compression:-

In this method the material is crushed by the application of pressure on a small scale using mortar and pestle whereas on a large scale roller mill is used.

Roller mill

Principal of Roller mill :-

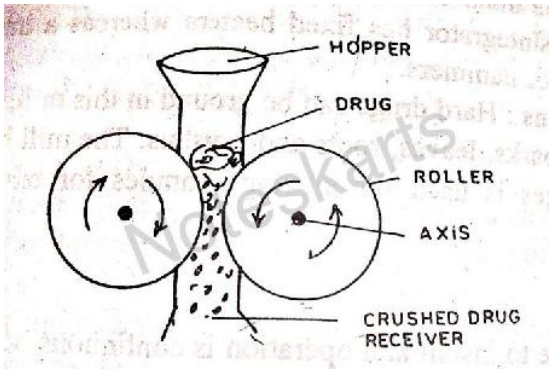
The mill work on the principle of compression of materials by applying a pressure on it.

Construction of Roller mill.

- It consists of two cylindrical roller made of stone. which are mounted horizontally.
- These roller are capable of rotation on their longitudinally axis these roller maybe form a few cm up to a meter in diameter.
- Generally one of the roller is driven directly while the second one runs freely.

Work of Roller mill.

The material to be crushed is fed from the hopper into the gop between the two roller due to the rotation of these roller the material is crushed the gaps between the roller can be adjusted to control the degree of size reduction.



Uses of Roller Mill :-

- It is used for producing intermediate grade of powder.
- It can be operated continuously.
- It is efficient in function and can grind different type of material.

3. Impact:-

- Impact occurs when the material more or Less stationery and is hit by an object moving at height speed or when the moving particles strikes a stationary surface either case the material break into small pieces there is no apparatus which can be used on a small scale to effect side reduction by impact but on a large scale hammer mill and disintegrator are used when side disintegrators are used when side reduction of material is done by impact.

Hammer mill

***Principal of Hammer mill* :-**

It work on the principle of impact.

Construction:-

It consists of metal causing inclosing a control soft to which four or more swinging hammer are attached the lower part of the cosing consists of a screen through which material can pass in a suitable receiver when the descried of size reduction is reached.

Working:-

- The material is put into the hopper. Which is connected with the derma
  the material is powered to the desire size due to fast rotation of hammer and is called under the screen this mill has the advantage of continuous operation because the chance of jamming is less as the hammer are not fixed
  the material can product coursed to moderately fine powder.

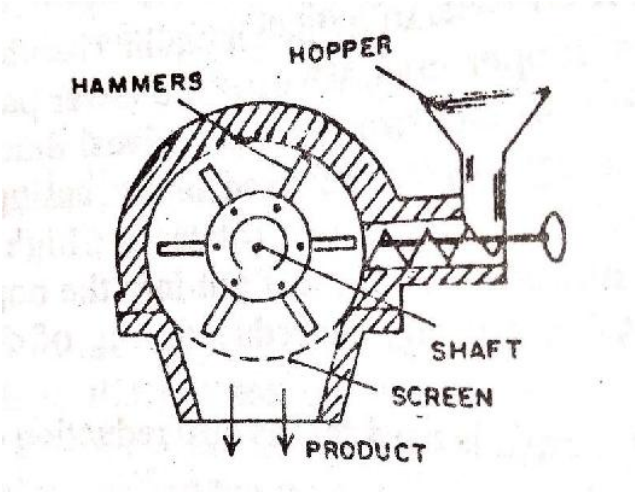


Fig:- Hammer Mill diagram

- Due to the high speed of operation heat is generated which may affect themselves drugs are material more ever high speed of operation.
- It foreign objects such as stone or metal is person in the field.

Advantage of Hammer mill:-

- It is used for production of intermediate grade of powder.
- It can be operated continuously.
- It is effecting in function and can grind deferent type of material.

Disadvantage of Hammer mill:-

- Due to high speed heat is generated.
- It is not suitable for heat sensitive material.

Disintegrator

Principal of Disintegrator:-

The size reduction in disintegrator is done by impact.

Constriction of Disintegrator:-

- It consists of a Steel drum having a soft in the center the shaft consist shaft dies or rich fine fused the soft rotate which a speed of five thousand to seven thousand/minutes.

- The side and upper ineer surface of the drum is rough and undedulating the lower part of the drum has a detachable screen or sieve the sieve has a definite pore size.

Working of Disintegrator:-

The beater are mainly pence pull for grinding what are help why the can dilution of the inner surface and roughness of drum the material is feed to beaters through hopper which is feted to the drum the material is broken into small practical by impact of the beaters the air Vastly inside the chamber is increased the air is allowed to pass through and outlet on which dust bag is tied which retain the fine partial of powder.

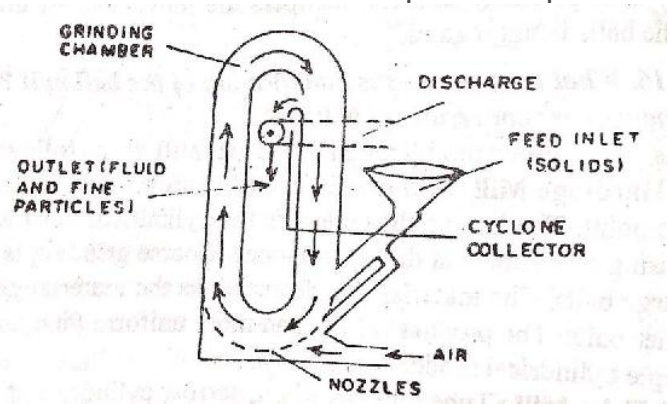


Fig:- Fluid energy mill diagram

Advantages of Disintegrator:-

- Used full for grinding vegetable drugs.
- Used full for poudring of hard material.
- Used full for mixting of deference powder ingredient.

Disadvantage of Disintegrator:-

- Possible for jamming of beater if large piece of material enten in it.

Ball Mill

Principal of Ball Mill:-

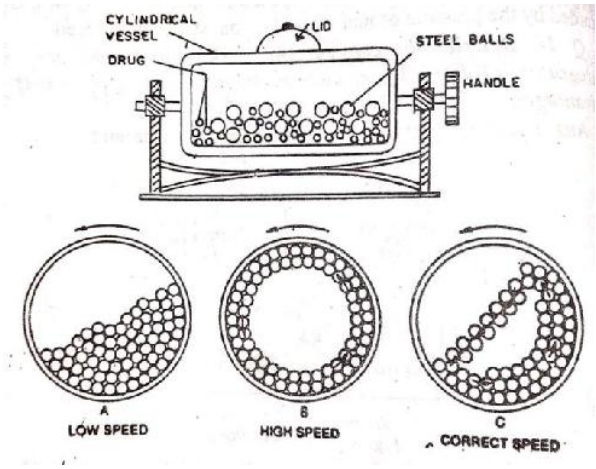
It works on the principle impact and attrition.

Construction of Ball Mill:-

It consists of a hollow cylinder which is mounted on a metabolic frame. In such a way that it can be rotated on it clockwise (Longitudinal axis) the cylinder contains balls that occupancy 30 to 50% of the mill. Volume the weight of cabal consists the ball size depends on the size of the feed and the diameter of mill the cylinder and balls are made up of mental and are usually Lind with chrome in pharmaceutical industry some time the cylinder of the ball mill is linde with rubber or porcelain.

Working of Ball Mill:-

The drug to be round to put into the cylinder of the mill and is rotates the speed of rotation is very important at a low the mass of ball will slide or rollover each other and only a negligible amount of size reduction at a high speed the ball mill will be thrown out to the walls by sentri fugal force and grinding but at about to 2/3rd of the speed the centrifugal force just occur with the results that the balls are carried or most to be the top of the mill and then fallen by this way the mix size reduction is effect by attrition after a suitable time the material is taken out and pass through a sieve to get powder of the required size.



Ball mill diagram

Advantages of Ball Mill:-

- It can product very fine powder.

- It can be used for continues operation.
- If sieve are classified classifier to attach to the balls.
- The sutable for both weight or drug grinding process.

Disadvantage of Ball Mill :-

- The ball mill is a very noises.
- Wear occurs from the ball as well as from the cassing which may result contamination.

Fluid energy mill:-

Principal of Fluid energy mill:-

- It work on the principle of impact and attrition.

Construction of Fluid energy mill:-

it consists of a loop of pipe which has a diameter of 20 to 200 mm depending upon the overall High of the loop which may be of two about 2m. This are an inlet for the feed and a series of nozzles for the inlet of air or an inert gas. It also has an outlet with a classifier which allow the air to escape but prevent the particular to pass until they become sufficient fine.

Working of Fluid energy mill:-

The air are inlet gas is introduce with a very high pressure through the nazzles solid are introduce into air steam through in let due to high degree of turbulence impact and attrition force occurs between the particle the find particles are classified through a classifine fluid energy mill reduced the particle 1 to 20 micron to get a very fine powder even upto 5 micron the material is pretreated to reduce the particular size to of 100 mesh and then pass through flued energy mill.

Use of Fluid energy mill:-

- The mill is used to grind sensitive material to found powder.
- The mill is used to grind those material in which high degree of purity required.

Advantages of Fluid energy mill:-

- No wear and tear of mill.
- Sutable for heat sensitive material.
- It used for obtain particular in µ size.

Disadvantages of Fluid energy mill:-

- Pre milling of material is required.
- Controled supply of feed is required.