MECHANICAL OPERATION IN CHEMICAL ENGINEERING

STUDY ABOUT MECHANICAL EQUIPMENT

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INTRODUCTION

- Mechanical operations are those **unit operations** that involve **physically changing a material**.
- Generally refers to change in size **reduction or enlargement** or shape, it is not limited to that.
- Mechanical operations also include **separation of material** on the basis **of physical/mechanical** properties like density, size, wet ability, etc.
- Mechanical operations may either be **individual operations** or **may be a part of an entire process.**
- Chemical engineers should have knowledge of mechanical operations as very often we do not have the raw material **FEED** in a **desirable form.**

MECHANICAL OPERATIONS EQUIPMENTS

- **Sieve shaker.**
- **Test sieves.**
- **Fluidization apparatus.**
- **Plate filter press.**
- **High temperature high pressure filter press.**
- **Solids handling study bench.**
- **Sigma mixer.**
- **Roll crusher.**
- **Basket centrifuge.**
- **Froth flotation unit.**
- **Ball mill.**
- **Belt conveyor.**
- **Bucket conveyer. Etc.**

EQUIPMENT USED IN CHEMICAL INDUSTRY

- **SIEVE SHAKER-**

In which we separate the different-different size of particles with the help of sieves.

sieves- 

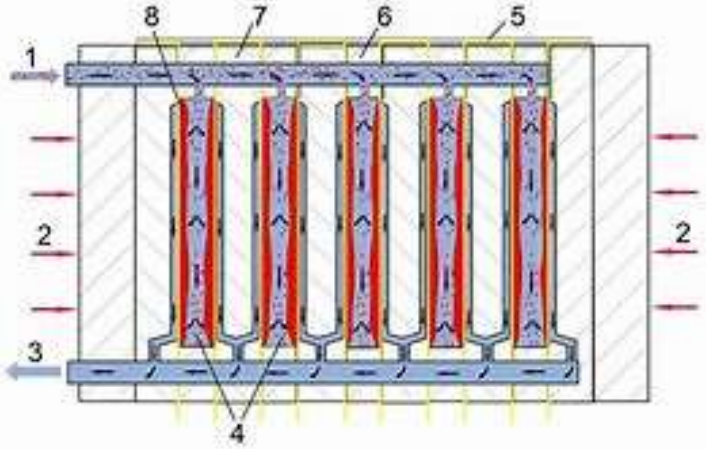
equipment- 

PLATE FILTER PRESS

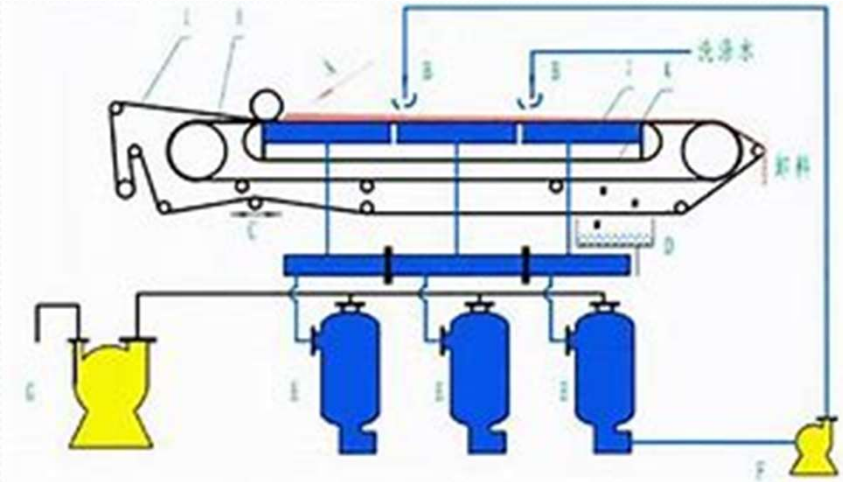
- The slurry that will be separated is injected into the center of the press and each chamber of the press is filled.
- Optimal filling time will ensure the last chamber of the press is loaded before the mud in the first chamber begins to cake.

Types of filter press

- Plate and frame filter press.



- Automatic filter press.



SIGMA MIXER

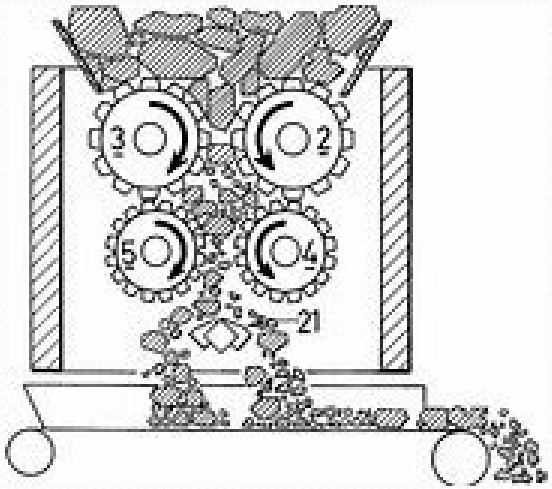
- **The** sigma blade mixer is a commonly used mixer for high viscosity materials.
- **The** sigma mixer is one of the most popular used for mixing and kneading high viscosity materials. It belongs to the family of double arm kneader mixers.

Sigma blade-

Sigma mixer-

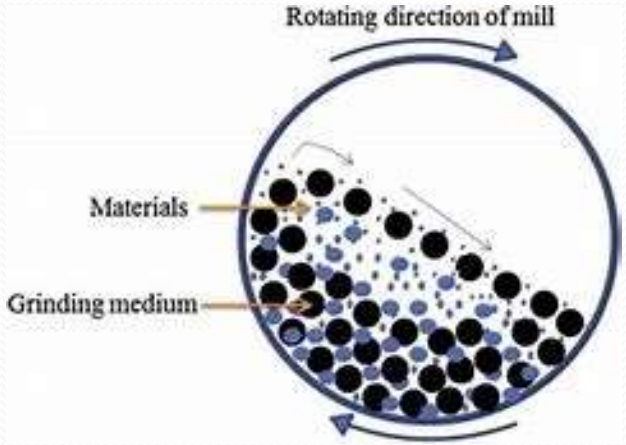
ROLL CRUSHER

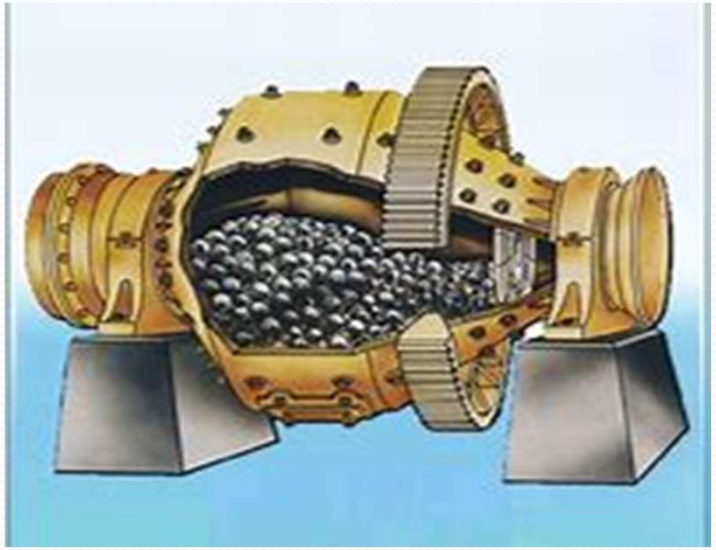
- **A** roll crusher is a machine designed to reduce large rocks into smaller rocks, gravel, or rock dust.
- **I**t may be used to reduce the size, or change the form, of waste materials so they can be more easily disposed of or recycled, or to reduce the size of a solid mix of raw materials.



BALL MILL

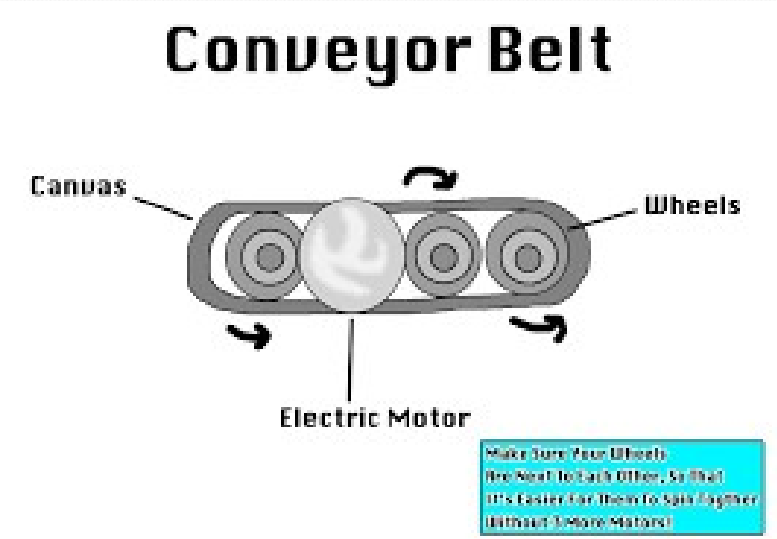
- A ball mill is a type of grinder used to grind and blend materials for use in mineral dressing processes, paints, pyrotechnics, ceramics and selective laser sintering.
- Works on the principle of impact and attrition: size reduction is done by impact as the balls drop from near the top of the shell.





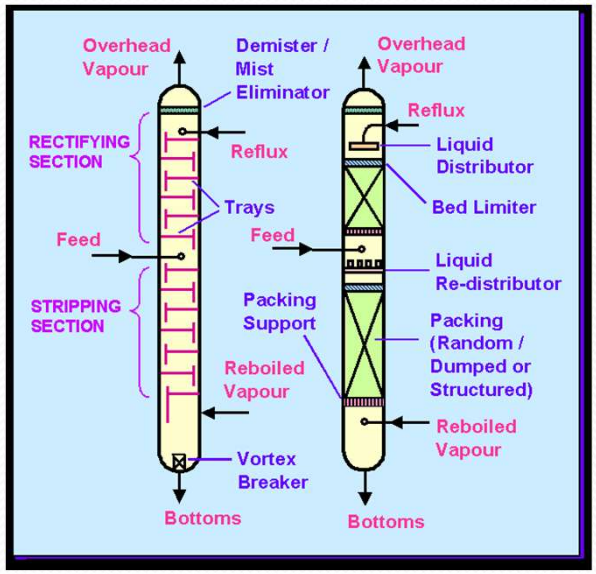
CONVEYOR BELT

- **A** conveyor belt is the carrying medium of a belt conveyor system.
- **A** belt conveyor system consists of two or more pulleys.
- **O**ne or both of the pulleys are powered, moving the belt and the material on the belt forward.



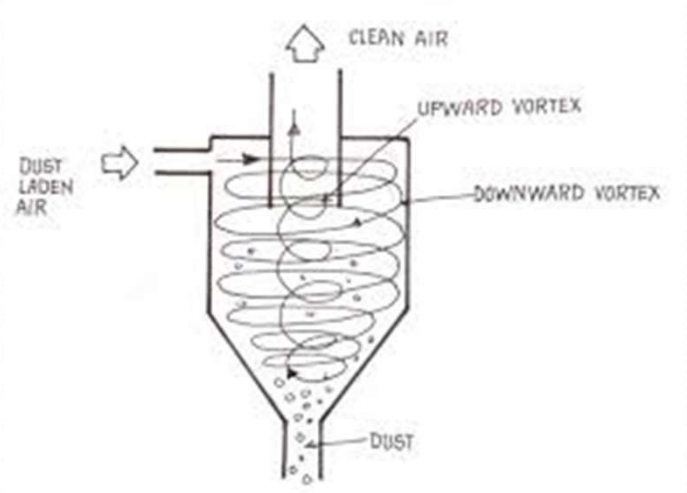
PACKED COLUMN TOWER

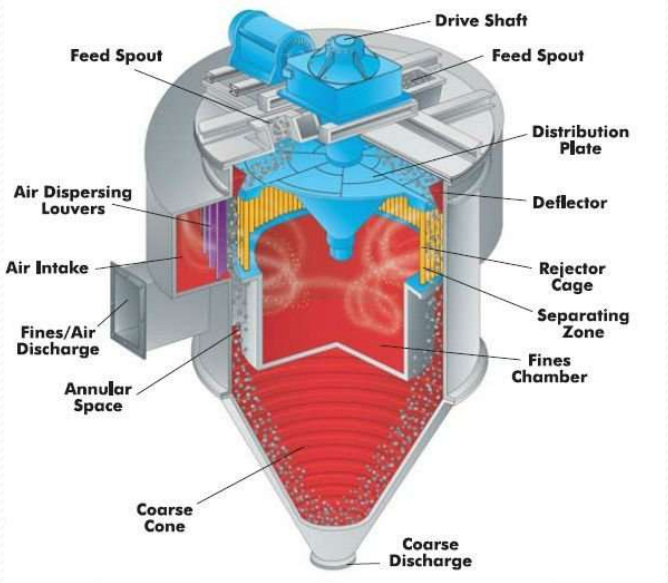
- Packed column are most frequently used for gas absorption.
- It consists of cylindrical medium.
- First gas is enter trough downward region.



CYCLONE SEPARATOR

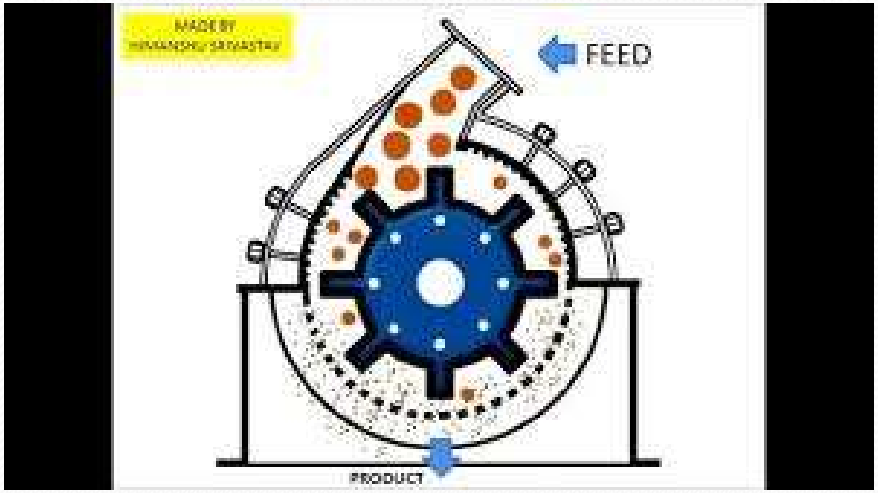
- **Cyclone** separator is a device used for removing the dust particles from the air.
- **A** cyclonic separation is a method of removing particulates from an air, gas or liquid stream, without the use of filters.





HAMMER MILL

- It is a machine in which we crush, pulverize, shred, grind and reduce material to suitable sizes.
- Its principle is based on the crushing operation and grinding operation.



CRUSHING LAWS

- **RITTINGER'S LAW-**

  The work required for crushing operation is directly proportional to the new surface.

$$P/M \propto (1/Dsb) - (1/Dsa)$$

Where

P = power.

M = feed rate of machine.

Dsb AND Dsa = initial and final diameter.

BOND'S LAW

- It states that power required for crushing and grinding operation. It also states that intermediates stages are required to form a product stage.

or

- It states that work required for crushing and grinding operation is inversly proportional to the square root of particle size (dp).

$$P/M \propto 1/(\sqrt{dp})$$

KICK'S LAW

- It states that the power required for crushing and grinding operation is directly proportional to the logarithm ratio between initial to final diameter.

$$P/M \propto \ln(D/d)$$

- **WHERE**
- **P** = power.
- **M** = feed rate of machine.
- **D and d** = initial and final diameter.

SCREENING EQUIPMENT

- **Gyrating screen-**

  The feed is inserted from the top and gyratory motion triggers the penetration of particles into the next deck through *screen* openings. Casings are inclined at relatively low angles (< 15°) to the horizontal plane.

STATIONARY SCREEN

- A large-capacity screening or sorting appliance for coal or ore. It consists of a series of heavy metal bars arranged side by side and spaced at a definite distance apart. The bars are set at an angle so that material delivered at the upper end will just slide, and chutes are arranged to receive oversize at the lower end and undersize passing between the bars. The stationary bar screen is still used at many small mines.

GRIZZLIES SCREEN

- Vibrating screen that is placed between a vibrating feeder and a primary crusher. Most often used for pre-screening, the typical feed materials that require grizzly screens versus the typical vibrating screen are very coarse aggregates.


Thank
you