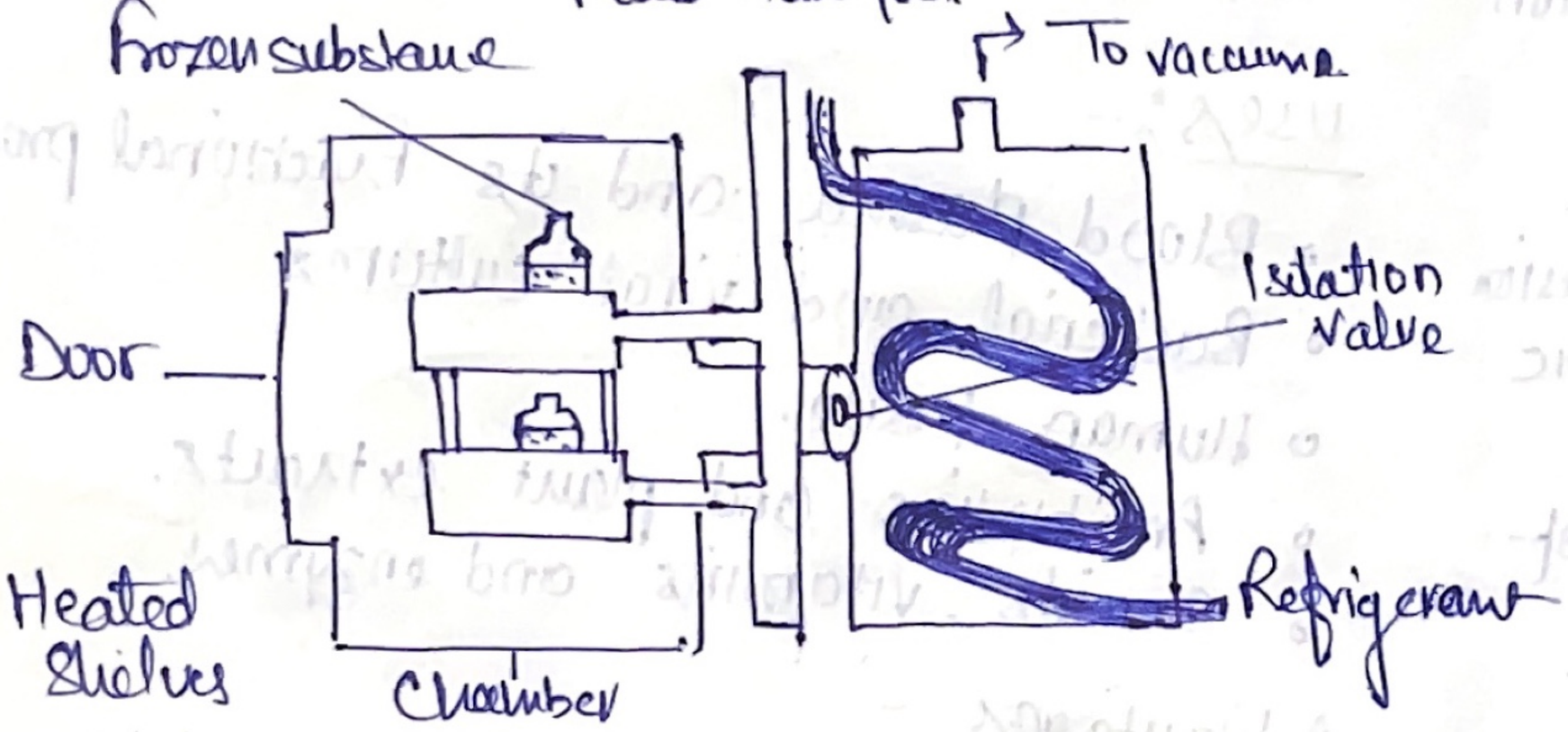
FREEZE DRYER

Freeze drying is also known as lyophi-lization.

Principle - In freeze drying, water is removed from the frozen solid into vapour without conversion to a liquid phase.

Construction -



- Drying chamber in which trays are loaded
- Heat supply in the form of radiation source, heating coils
- Vapour condensing or adsorption system.
- Vacuum pump or steam ejector or both

The chamber for vaccum is generally designed for batch operation.

It consist of shelves for keeping the material.

The condensor consists of a relatively large surface cooled by solid carbon dioxide slurred with acetone or ethanol.

The temprature of the condenser must be much lower than the evaporated surface of frozen substance.

Working -

Preparation and pretreatment

The soln is pre concentrated under normal vaccum tray drying. This reduce actual drying by 0 to 10 times.

↓

Prefreezing to solidify water

Vials, ampoules or bottles in which the Aqueous soln is packed are frozen in cold shelves (about -50°C).

During this stage, cabinet is maintained at low temprature and atmospheric pressure.

⇓

Primary Drying (sublimation)

In this step the material to be dried is spread as much large surface as possible for sublimation.

when a soln of solid is dried, the depression of freezing point of water occurs.

"The preisure and temprature at which the frozen solid vapourises without conversion to a liquid is reffered to as the eutectic point"

~~Heat is~~ Vacuum is applied to the tune of about 3 mmHg (0.4 kPa) on the frozen sample.

Heat is supplied which transfer as latent heat and ice sublimes directly in to vapour state.

During this stage, about 90 to 99 % water is removed. Still traces of moisture is present in the sample.

⇓

Secondary drying

During this stage, traces of moisture is removed.

⇓

Packaging

After vacuum is replaced by inert gas, The bottles and vials are closed.

Uses :-

- Blood plasma and its fractional products
- Bacterial and viral cultures
- Human tissue
- Antibiotics and plant extracts.
- Steroids, vitamins and enzymes.

Advantages -

- Thermolabile materials can be dried.
- Denaturation does not occur.
- Loss of volatile material is easy
- Moisture level can be
- Material can be dried in its final container.

Disadvantages

- Equipment and running costs are high
- The period of drying is high. Time cannot be shortened.

MIXING

Mixing may be defined as an operation in which each particles of any one ingridients lies as close as possible to the adjecent particle of other ingridient.

The process in which we mix two or more substance to each other is called mixing

objective -

- A blend of solid particles.
- A suspension of an insoluble solids in a liquid
- A mixture of two immiscible liquids
- A dispersion of particles in a semisolid as in the preparation of ointments or paste.

Applications

- Uniformity of mixing ensures uniformity in composition and dose accuracy.
- Uniform distribution of suspending or emulsifying agents improve physical stability of biphasic liquids.

- The uniform mixing of the lubricant
- mixing enhances the rate of chemicals reaction, rate of dissolution and growth of micro organism.

Factors influencing Mixing

- Nature of the surface
- Density of the particles
- Particle size
- Particle shape
- Particle charge
- Proportion of Materials

- Nature of the surface-
Rough surface of one of the components does not induces satisfactory mixing.

Same Nature surface of Particles (substance) $\propto$ $\uparrow$es rate of mixing

- Particle size-
It is easy to mix two powders having approx -imetly the same particle size.
The variation of particle size can lead to separation.

Particle size $\propto \frac{1}{\text{mixing}}$

- Particle shape- The ideal particle is spherical in shape for the purpose of uniform mixing

same particle shape $\propto$ $\uparrow$es in rate of mixing.

- Particle charge- some particle attractive forces due to electrostatic charges on them

Neutral charge particle $\propto$ $\uparrow$es in rate of mixing.

- Proportion of Material - The best result can be obtained if two powders are mixed in equal proportion by weight and by volume.

Difference b/w solid Mixing & liquid mixing -

Truly Liquid Mixing	Solid Mixing
◦ Truly Homogeneous Liquid phase can be observed	◦ Product often consist of two or more easily identifiable phases.
◦ Small sample size is sufficient to study degree of mixing	Large sample size is required.
◦ Mixing requires low power	Mixing requires high power

MECHANISM OF MIXING IN SOLIDS

- Convective Mixing
- Shear Mixing
- Diffusive Mixing
- Convective mixing - Convective mixing is achived by their inversion of the powder bed using blades or paddles or screw element.
- A large mass of Material moves from one part to another.
- Shear mixing - In this type, the forces of attraction are broken down by shear on it.
- Diffusive mixing - It involves the random motion of particles within the powder bed, thereby particles change their positions relative to one another. This occurs on account of free flowing particles in an expanded bed.

MIXING PROCESS STEPS -

- Expansion of the bed of solids
- Application of three dimentional Shear forces to the powder bed.
- Mix long enough to permit true randomization of particles.
- Maintain Randomization.

CLASSIFICATION OF EQUIPMENTS FOR SOLID MIXING.

- Based on the flow properties of the powders appropriate mixer should be selected.

Free flowing solids → V cone blender, Double cone blender

Cohesive solids → Planetary mixer, Sigma blender.

- Based on the scale of mixing.

→ Batch type (small scale)

eg- Mortar & pestle (Trituration)
Double cone blender } Tumbling, diffusion
V cone blender }
Ribbon blender } convecting, shearing
Sigma blender }

→ Continous Type (large scale)

Barrel type
Zigzag type.

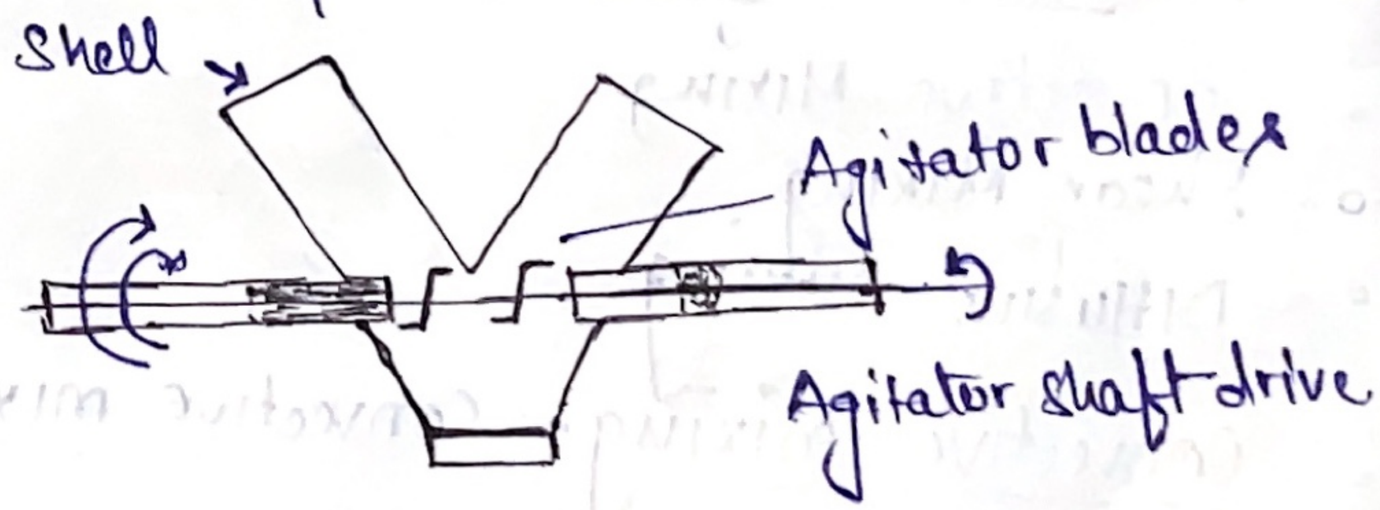
EQUIPMENTS

TWIN SHELL BLENDER OT V CONE BLENDER

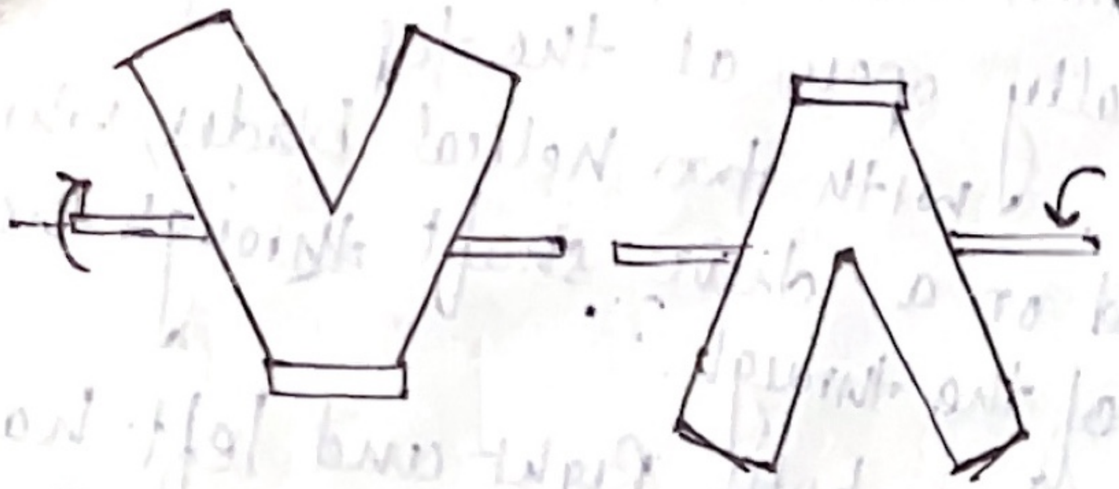
Principle - Tumbling

construction

- It is made up of either stainless steel or transparent plastic
- smaller models take a charge of 20 kg and Rotate at 35 revolution per minute, while Larger ones takes a charge of about 1 tonne and rotate 15 revolution per minute.
- The material is loaded through either of the shell hatches.
- Emptying of the blend is normally done through an apex port.



V- cone blender



Working - The material (to be blended) is loaded approximately 50-60% of its total volume.

- As the ~~material~~ blender Rotates, the material undergoes tumbling motion.
- when 'V' is inverted, the material splits into two portions.
- This process of dividing and recombining continously yields ordered mixing by mechanical means.
- After the mixing is done the material is collected in the bottom of the V.

Advantage

- If Fragile granules are to be blended, Twin shell blender is suitable because of minimum attrition.
- They handle large capacities
- Easy to clean, load and unload
- This equipment Requires minimum maintenance.

Disadvantages

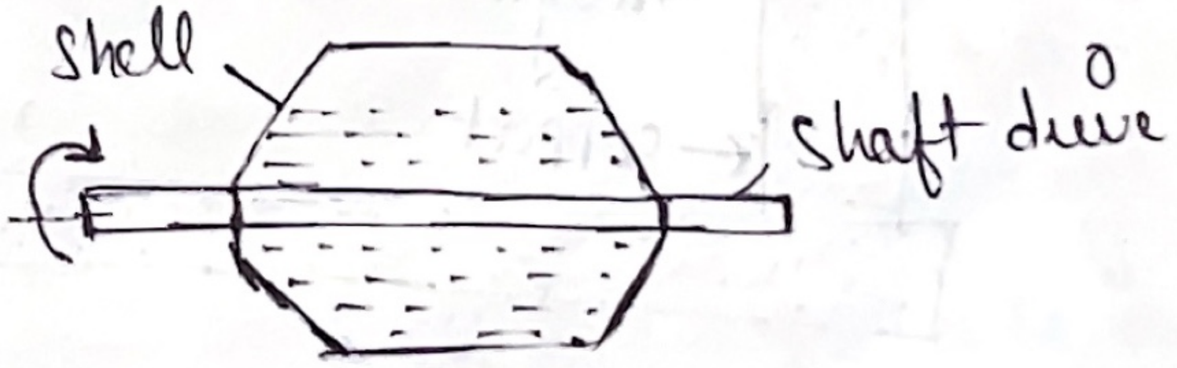
- Twin shell blender needs high headspace for installation
- it is not suitable for fine particulate system.

Double cone Blender

Principle - Tumbling.

construction -

- it is made up of stainless steel.
- it is usually charged and discharged through the same port.
- it is an efficient design for mixing powders of different densities.
- The rate of Rotation should be optimum depending on the size and shape of the tumbler.



working - same as V-cone blender

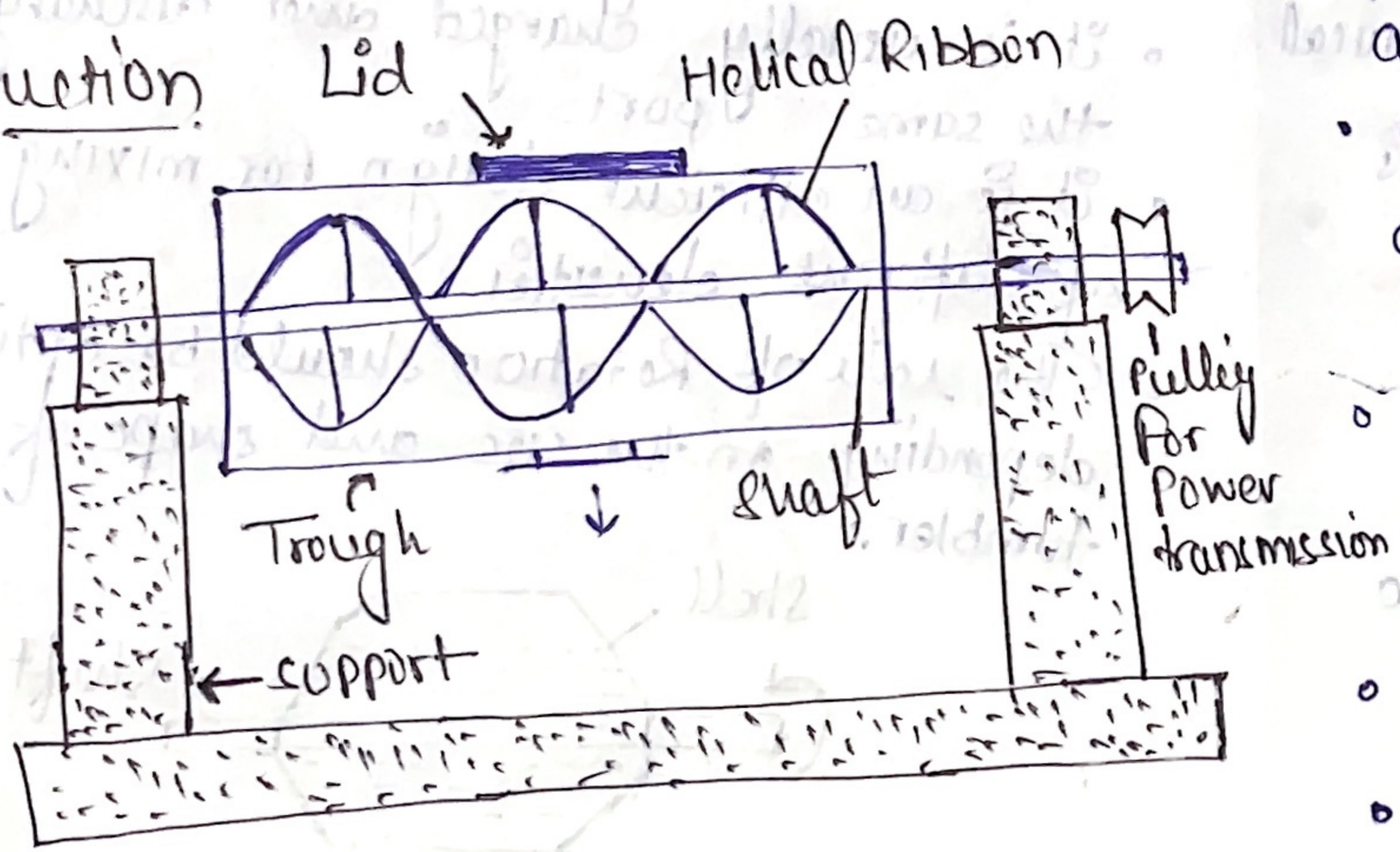
Advantages
Disadvantages } same as Twin shell blender (V-cone)

RIBBON BLENDER

Principle - The mechanism of mixing is shear. High shear rates are effective in breaking lumps and aggregates.

- convective mixing also occurs as the powder bed is lifted and allowed to cascade to the bottom of the container

construction



- it consist of non-movable horizontal cylindrical through usually open at the top.
- it is fitted with two helical blades, which are mounted on a drive shaft through the long axis of the through.
- the blades have both Right and left hand twists.
- Ribbon blender is top loading with a bottom discharge spout.

working -

Through the fixed speed drive, ribbons are allowed to rotate.

- one blade moves the solid slowly in one direction and other moves them quickly in opposite direction
- The agitator blades rotates, lifts and distributes the material in an irregular manner.
- Convective and shear mixing occurs.
- The blend is discharged through discharge spout.

Use - it is used for liquid-solid and solid-solid mixing.

Advantages -

- it can be also be used as continous blender by feeding material at one end and discharging at the other end.
- High shear can be applied using perforated baffels, which bring about Rubbing and breaking of Aggregates.

Disadvantages -

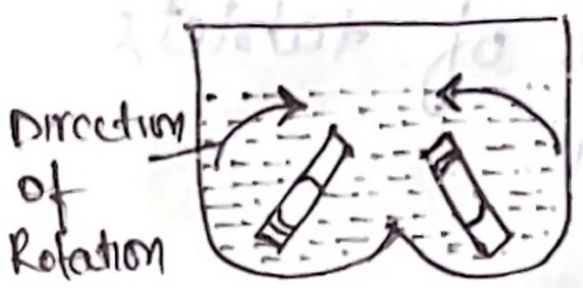
- it is poor mixer, because of movement of particles is two dimensional.
- Dead spots are observed.
- It is having fixed speed drive.

SIGMA BLADE MIXER

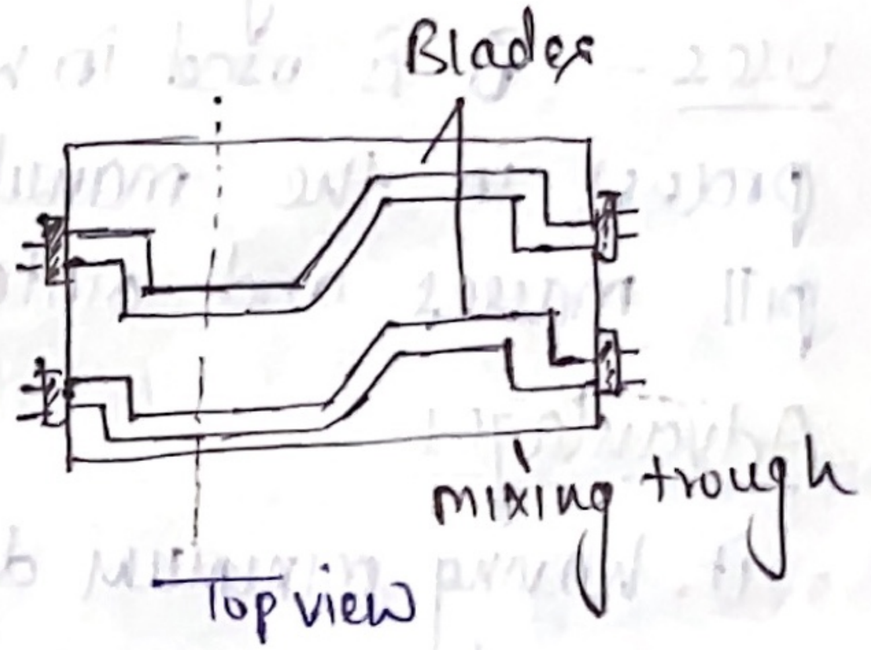
Principle - The mechanism of mixing is shearing.

Construction -

- it consist of double through shaped stationary bowl.
- Two sigma shaped blades are fitted in bowl. these are connected to a fixed speed drive.
- The mixer is loaded from the top and unloaded by tilting the entire bowl.



Cross section



Working -

- Different powders are introduced from the top of the through.
- Through the fixed speed drive, the sigma blades are rotate.
- The blades move at different speeds, one usually about twice the speed of other. resulting lateral pulling of the material
- The material further moves downward over the point and the sheared between the blades and the wall of the through.
- The final stage of mix represents an

equilibrium state.
- After the mixing is done the bowl is tilted to empty the blend.

Uses - it is used in wet granulation process in the manufacture of tablets pill masses and ointments.

Advantages

- it having minimum dead space
- Shearing can break lumps and aggregates.

Disadvantage-

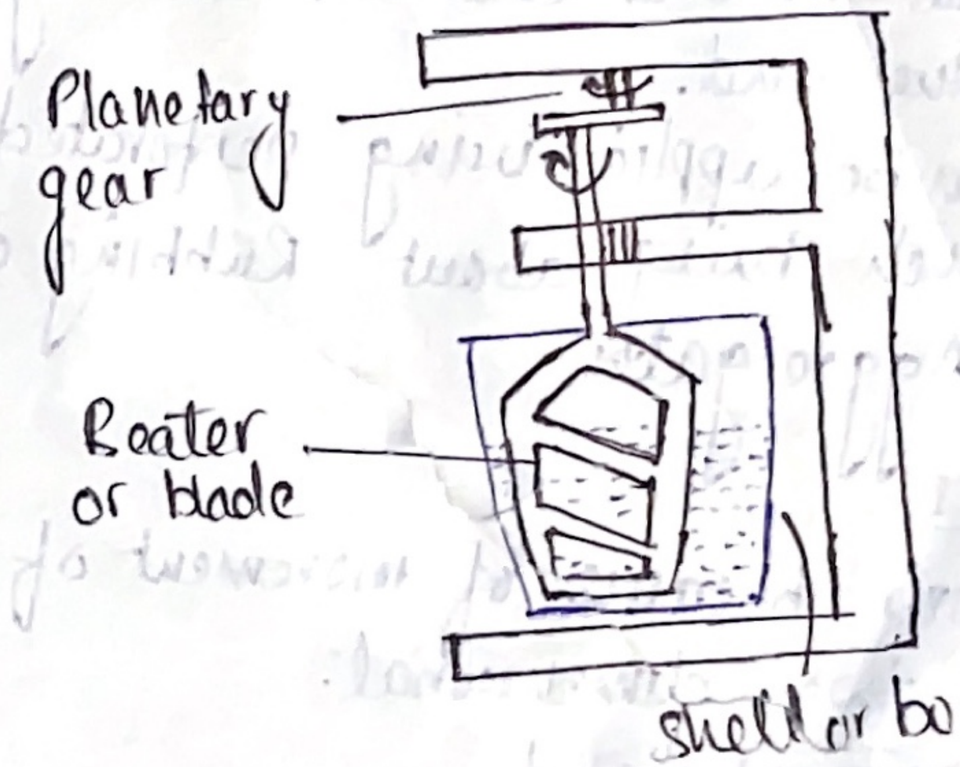
- it works at fixed speed.

Planetary mixer

Principle - Shearing and tumbling.

Construction-

- it consist of a vertical cylindrical shell.
- The mixing blade is mounted from the top of the bowl.
- The mixing shaft is driven by a planetary gear. it rotates around the ring gear which further rotates round the mixer blade.



Working-

- In planetary mixer, the agitator has a planetary