DEPTH OF BIOLOGY

STUDY MATERIAL

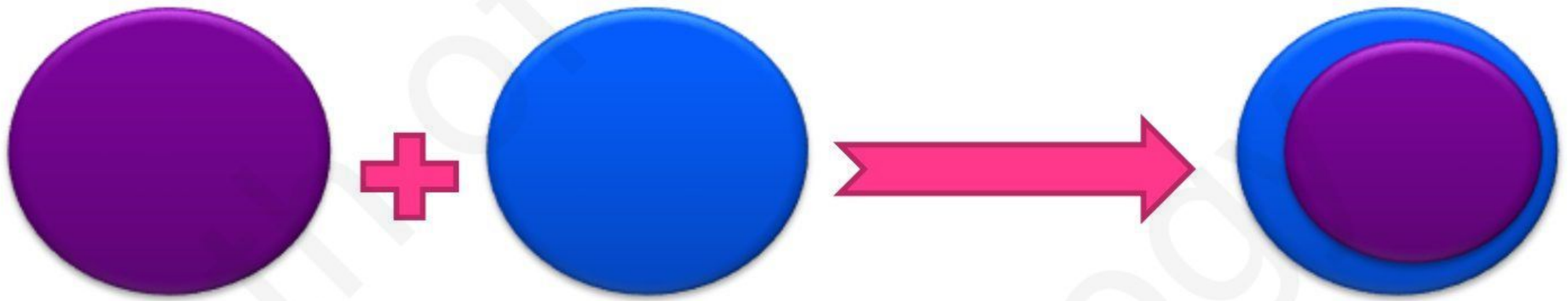
YT-DEPTH OF BIOLOGY

INSTA- DEPTH OF BIOLOGY

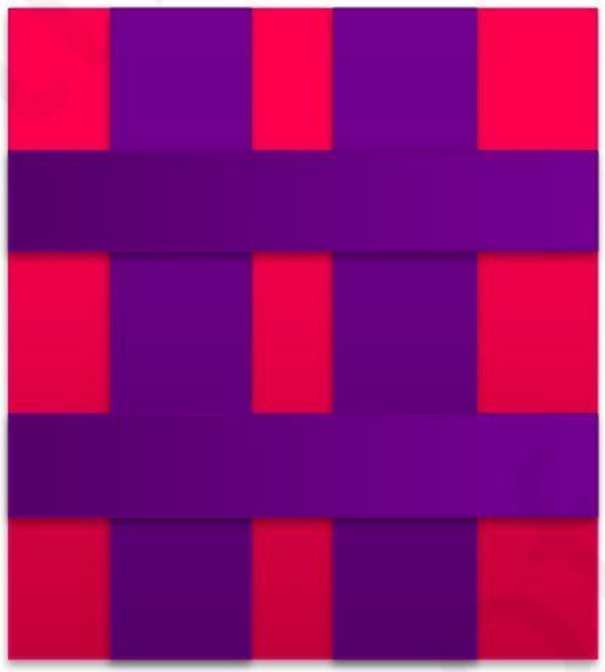
TELE- DEPTH OF BIOLOGY

MIXING

Mixing is defined As a process in Which 2 or more components mix together and combine to form one



Mixing can be defined as an operation "in which two or more ingredients in separate or roughly mixed condition are treated so that each particle of any one ingredient is as nearly as possible adjacent to a particle of each of the other ingredients [DEPTH OF BIOLOGY]



[DEPTH OF BIOLOGY]

OBJECTIVES

For;-

- UNIFORM MIXTURE- simple physical mixing
- EMULSION- mixing of 2 immiscible liquids
- SUSPENSION/PASTE- mixing of solid & liquid
- Enhance physiochemical properties of mixing

APPLICATION

- Mixing is an intermediate step in production of tablet or capsule. Mixing of powders in different proportion prior to granulation or tableting.
- Dry mixing of materials for direct compression in to tablets.
- Dry mixing of powder or composites powders in capsule and insufflations respectively. [DEPTH OF BIOLOGY]
- Blending of powders are also important in preparation of cosmetic products such as facial powder or dental powder.
- In case of potent drugs where dose is low, mixing is critical factor. Otherwise it will affect content uniformity of tablet

FACTORS

- **1. Nature of product:** For effective mixing particle surface should be smooth.
- **2. Particle size:** It is easier to mix powder of same particle size. Increasing the difference in particle size will lead to segregation.
- **3. Particle shape:** Particle should be spherical in shape to get a uniform mixture. [DEPTH OF BIOLOGY]
- **4. Particle charge**: some particle due to electrostatic charge exerts attractive force which leads to separation
- **5.Relative density:** If the components have a different density, the denser material will sink through lighter material.

SOLID VS. LIQUID MIXING

Solid Mixing	Liquids Mixing
In solid mixing two or more substances are intermingled by continuous movement of particles.	This is achieved by mixing elements of suitable shape to act as impeller to produce appropriate flow pattern in mixing vessel.
This is used for mixing of dry powders.	This is used in preparation of emulsion, suspension and mixtures.
Large sample size is required.	Small sample size is sufficient.
High power required for mixing.	Less power required for mixing.

MIXING

HOMOGENOUS MIXING

1.SOLID-SOLID
2.LIQUID-LIQUID
3.GAS-GAS

HETEROGENOUS MIXING

[DEPTH OF BIOLOGY]

1.SOLID-LIQUID
2. SOLID-GAS
3. LIQUID-GAS

MECHANISM OF SOLID MIXING

PRINCIPAL MECHANISM

- Convective Mixing
- Shear Mixing
- Diffusive Mixing

- **Convective Mixing**
- It is achieved by the inversion of the powder bed using blades or paddles or screw elements. A large mass of material moves from one part to another. Convective live mixing is referred to as macromixing.

- **Diffusive Mixing**
- It involves the random motion of particles within the powder bed, thereby particles change their positions relative to one another.
- Diffusive mixing occurs at the interfaces of dissimilar regions. Diffusion is sometimes referred to as micro-mixing.

- **Shear Mixing**
- In this type, the forces of attraction are broken down so that each particle moves on its own between regions of different compositions and parallel to their surfaces. [DEPTH OF BIOLOGY]
- In a particulate mass, the forces of attraction are predominating, which makes the layers slip over one another. Such types of attraction forces are predominant among the same type of particles. Shear forces. reduce these attractions and reduce the scale of segregation.

LIQUID MIXING

- Simpler as compared to other
- Form homogenous mixture
- 2 types of liquid- [DEPTH OF BIOLOGY]

Miscible; easily mix

Immiscible; mixed by using agents

MECHANISM OF LIQUID MIXING

- Mechanisms of liquid mixing can be studied under four classes. They are:

1. Bulk transport [DEPTH OF BIOLOGY]
2. Turbulent mixing
3. Laminar mixing
4. Molecular diffusion

- **Bulk Transport**
- Bulk transport is defined as the movement of a large portion of a material from one location to another location in a given system. For this purpose, mixing devices such as rotating blades and paddles are used, which move the material in different directions.
- **Turbulent Mixing** [DEPTH OF BIOLOGY]
- Turbulent mixing is defined as mixing due to turbulent flow, which results in random fluctuation of the fluid velocity at any given point within the system.
- Turbulent flow is a highly effective mechanism for mixing. Turbo lent flow can be seen as a composite of eddies of various sizes. An eddy is defined as a portion of fluid moving as a unit in a direction. Large eddies tend to break up forming eddies of smaller size until they are no longer distinguishable. An additional characteristic of turbulent flow is its intensity, which is related to the velocities with which eddies move.

- **Laminar Mixing**
- Laminar mixing is the mixing of two dissimilar liquids through laminar flow, i.e., the applied shear stretches the interface between them.
- **Molecular Diffusion** [DEPTH OF BIOLOGY]
- Molecular diffusion is the mixing at the molecular level in which molecules diffuse due to thermal motion.

SEMI-SOLID MIXING

- Includes gels ,ointments ,cream ,paste etc.
- For mixing such dosage forms we use agitator; it must move the material through the mixer.
- Include combination of low speed shear ,smearing ,folding, wiping & compressing.

EQUIPMENTS

- Twin Shell Blender
- Double cone blender
- Ribbon blender
- Sigma blade blender
- Plantery mixer
- Propeller
- Turbine
- Paddle
- Silverson emulsifier

Twin Shell Blender

- ***V Cone Blender:*** The mixing occurs due to tumbling motion.

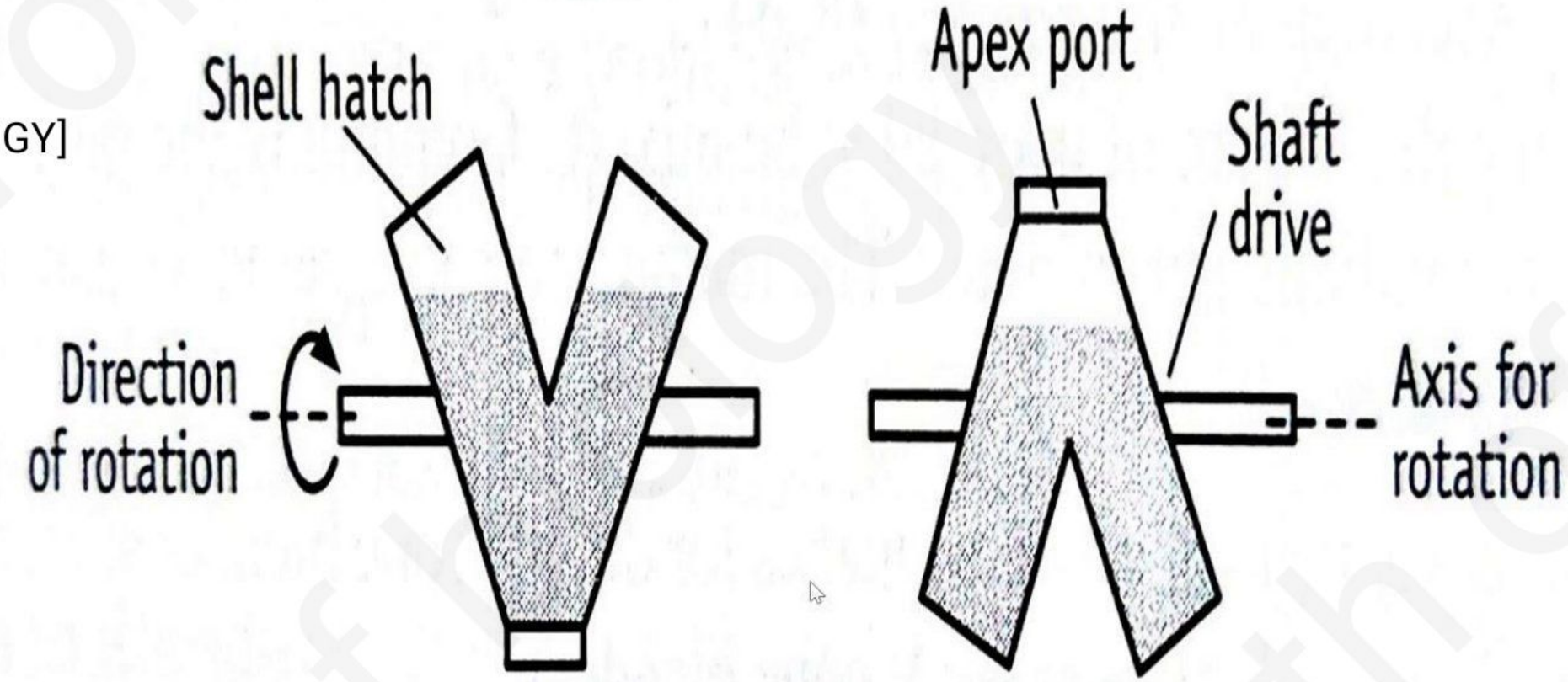


Figure 9-7. V cone blender. Rotating shell hatch without baffles.

CONSTRUCTION

- It consists of an enclosed V-shaped vessel that prevents any foreign particle to enter into chamber.
- It is made of either stainless steel or transparent plastic. It consists of a horizontal shaft rotated about an axis causing the particles within the mixer to tumble over each other onto the mixture surface.
- The charging of material into the V-Blender is through either of the two ends.
- Batches from 20 kg to 1 tonne can be loaded for mixing depending upon the size of the equipment.

WORKING

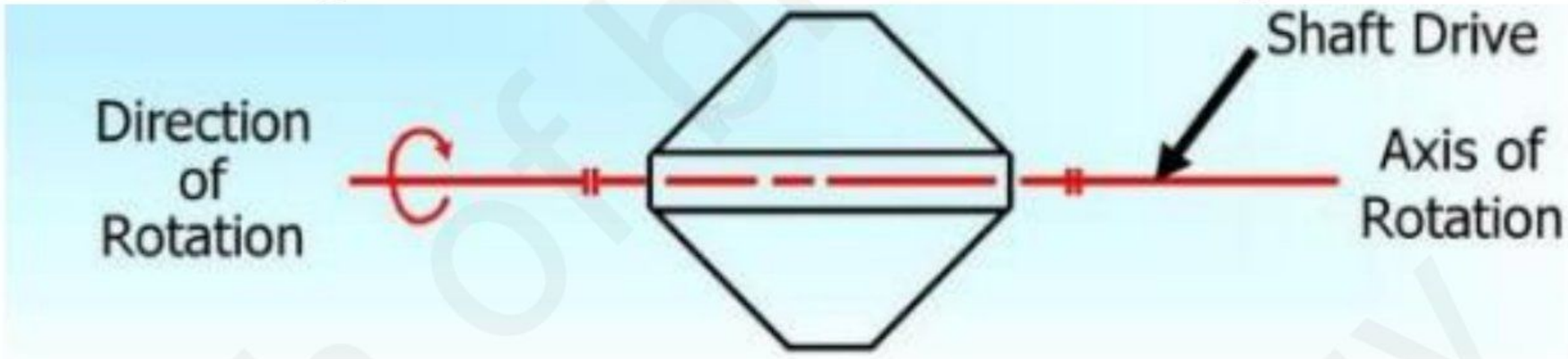
- The recommended fill-up volume for the V-Blender is 50 to 60% of the total blender volume.
- On rotation, a tumbling motion occurs.
- When the V-Blender tumbles, the material divides and recombines continuously. [DEPTH OF BIOLOGY]
- The repetitive converging and diverging movement between the material and the blender results in homogenous blending.
- The product is collected from the bottom of V.
- To prevent shear speed needs to be maintained

USES

- V-Blenders are generally used for Food products, Milk powder, Dry flavors. Pesticides and Herbicides, Animal feed, Spice blends, Baby foods, and Cosmetics

DOUBLE CONE BLENDER

- The mixing occurs due to tumbling motion.



CONSTRUCTION [DEPTH OF BIOLOGY]

All parts of the equipment including the mixing tank and blades are made of stainless steel.

The equipment consists of two cones joined as a cylindrical section which is rotated about an axis on the shaft

- The conical shape at both ends allows uniform mixing and easy discharge [DEPTH OF BIOLOGY]

WORKING

- The powder is filled up to two-thirds of the volume of the blender to ensure proper mixing.
- The rate of rotation should be 30-100 revolutions per minute. [DEPTH OF BIOLOGY]
- On rotation, mixing occurs due to tumbling motion.
- The product can be discharged from the bottom of the equipment.
- The mixing tank can be slanted freely at the angle of 0° to 360° degrees for discharging and cleaning purposes.

USES

- Double Cone Blender is efficient and versatile equipment for the homogeneous mixing of dry powders and granules. Dry powder mixing for tablets and capsule formulations.
- It can be used for pharmaceutical, food, chemical, and cosmetic products, etc.

ADVANTAGES

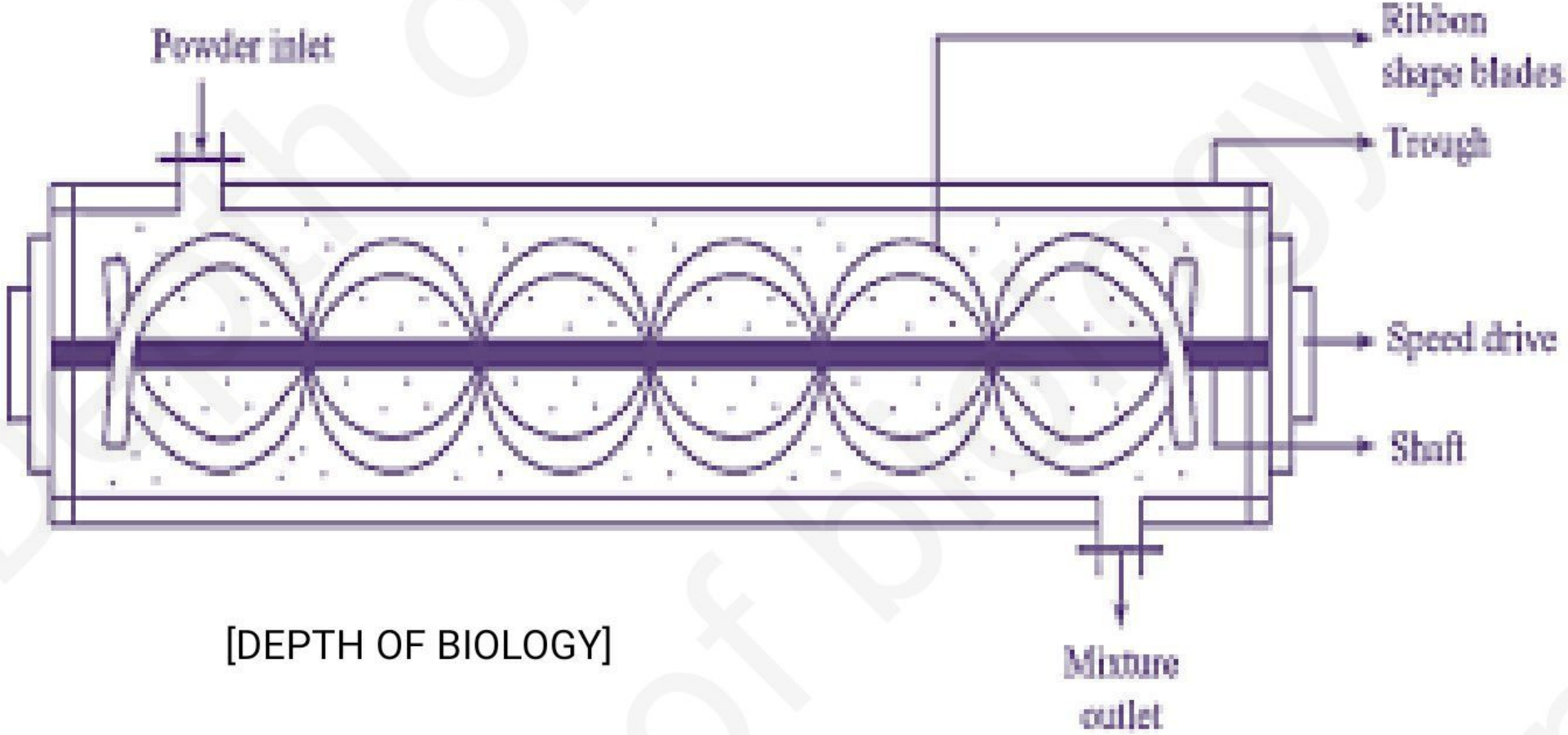
- Easy to maintain and clean
- There are no chances of clogging of material into comers [DEPTH OF BIOLOGY]
- A large amount can be handled easily
- It is efficient for mixing powders of different densities
- Wear on equipment is little

DISADVANTAGES

- Not suitable for fine particles
- Not suitable for particles with greater particle size difference due to less shear

RIBBON BLENDER

- The mechanism of mixing is shear which is transferred by moving blades.



CONSTRUCTION

- Comprises of usually a non movable horizontal cylinder open from the top
- Fitted with 2 helliical blades mounted on same shaft [DEPTH OF BIOLOGY]
- Both left & right hand twist present in blades
- Connected to fix speed drive
- Loaded from top & discharged at bottom

WORKING

- The materials to be blended are loaded into the blender, typically filling it between 40 and 70 percent of the total volume of the container.
- Ribbons are allowed to rotate with the help of the drive system. During the blending operation, one blade slowly moves the solids in one direction and the other moves them rapidly in the opposite direction.
- As a result, homogeneous blending is achieved in a short time. The mixing is generally carried out in 15 to 20 minutes. [DEPTH OF BIOLOGY]
- After blending, the material is discharged from a discharge spout located at the bottom of the trough.

USES

- ribbon blender is used for blending large volumes of dry solids, wet solid mass, bulk drugs, chemicals, and cosmetic powders.

ADVANTAGES

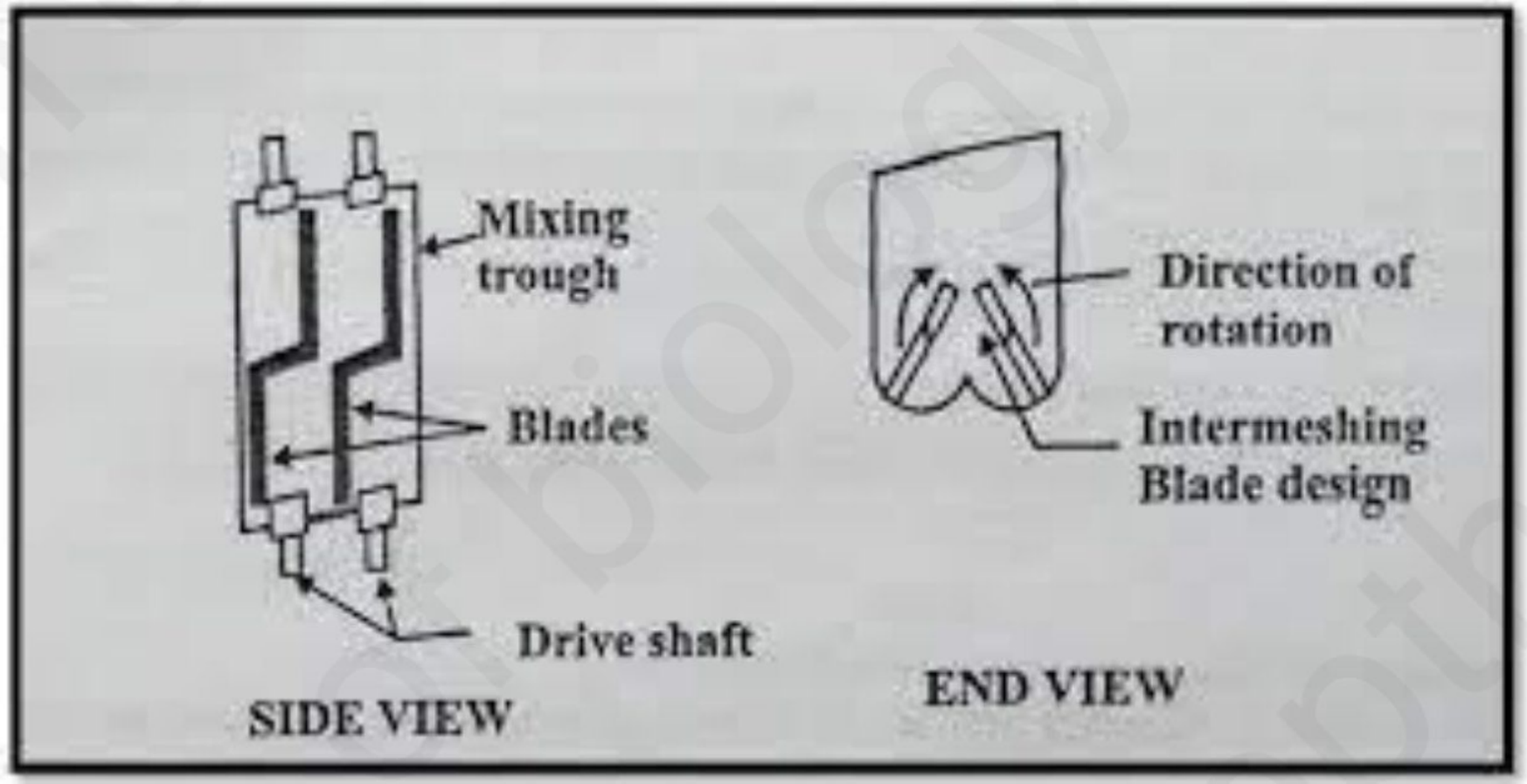
- Ribbon blenders can be operated in both batch and continuous modes.
- High shear by baffles cause break down of aggregates
- Less headspace requirement

DISADVANTAGES

- It is practically difficult to obtain 100% discharge in the ribbon blender.
- Higher clearance between the external periphery of the outer ribbon and the container may result in unmixed or dead spots. [DEPTH OF BIOLOGY]
- The movement of ribbons near the vessel walls due to high shear and compression can damage fragile materials and cause attrition.

SIGMA BLADE MIXER

- The mechanism of action is shearing which is produced by intermeshing sigma-shaped blades. Sigma Blade Mixer belongs to the family of double arm kneader mixers.



CONSTRUCTION

- Double trough shaped stationary bowl
- 2 sigma shaped blades are fitted horizontally in each trough of the bowl
- Connected to fix speed drive
- Loaded from top & unloaded by tilting entire bowl [DEPTH OF BIOLOGY]

WORKING

- The powders (40 to 65 percent of the mixers total volumetric capacity) are introduced from the top of the trough.
- The entire process is carried out in a closed enclosure because the dust can be released. [DEPTH OF BIOLOGY]
- The blades move at a different speeds using the drive system. which includes a motor, gear reducer, couplings, gears, bearings, and seals.
- The material moves up and down and shear occurs between the blades and the wall of the trough. The equipment is also attached to the perforated blades to break lumps and aggregates.
- The discharge of the material is either by tilting the mixing vessel, through the bottom discharge valve, or a discharge screw. The homogeneous mixture is obtained in 10 to 30 minutes. Mixing homogeneity up to 99%.

USES

- The sigma blade mixer is a commonly used mixer for high viscosity materials. [DEPTH OF BIOLOGY]
- Sigma blade mixers are used for the wet granulation process in the manufacture of tablets, pill masses, and ointments.
- It is primarily used for solid-liquid mixing and also for solid-solid mixing.

ADVANTAGES

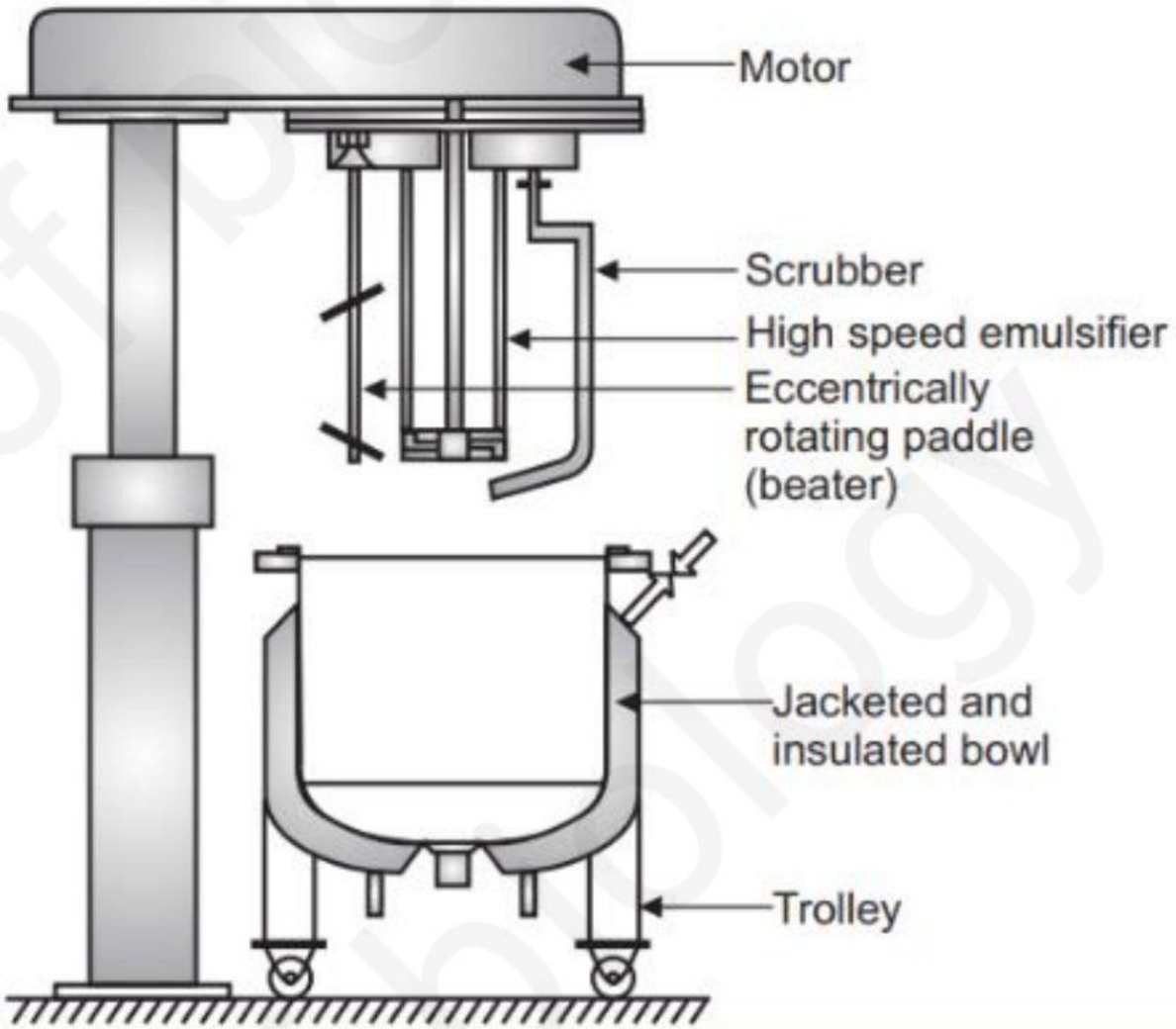
- During mixing, minimum dead space is created.
- lumps and aggregates broken by perforated blades
- Loss of volatile solvent during mixing can be prevented by closing the chamber.

DISADVANTAGES

- The power consumption in double arm kneader mixers is very high compared to other types of mixers and can range from 45 to 75 kW/m of mix material. [DEPTH OF BIOLOGY]
- Both blades rotate at the same speed.

PLANTERY MIXER

- Planetary Mixers work on the principle of shear that develops between the stationary wall and the rotating blade. The blade is also used to reduce the size. The planetary blades rotate on their axis while they travel around the center of the mixing bowl which ensures complete and effective mixing. [DEPTH OF BIOLOGY]


Motor
Scrubber
High speed emulsifier
Eccentrically
rotating paddle
(beater)
Jacketed and
insulated bowl
Trolley

CONSTRUCTION

- It consists of a vertical cylindrical shell or bowl that can be removed. The shell or bowl is covered and may be provided with nozzles, a liquid spray arrangement viewing ports.
- The material can be loaded into the mixer either through the nozzles on the top cover, or directly loaded into the mixer bowl. [DEPTH OF BIOLOGY]
- The mixer has two blades that rotate on their axes when they orbit the mixing container on a common axis. The mixing Blade is mounted at the top of the shell.
- The drive system consists of a motor and a gearbox that drives the planetary head. Each planetary blade is generally driven by gears that rotate due to the movement of the planetary head.

WORKING

- The material to be mixed is loaded into a mixing bowl or shell.
- The blades rotate on their axis when they orbit the mixing bowl on a common axis. [DEPTH OF BIOLOGY]
- Therefore there is no dead spot in the mixing and high shear is applied for mixing.
- After mixing, the material is discharged through a bottom valve, or by manual scooping of the material from the bowl.

Advantages

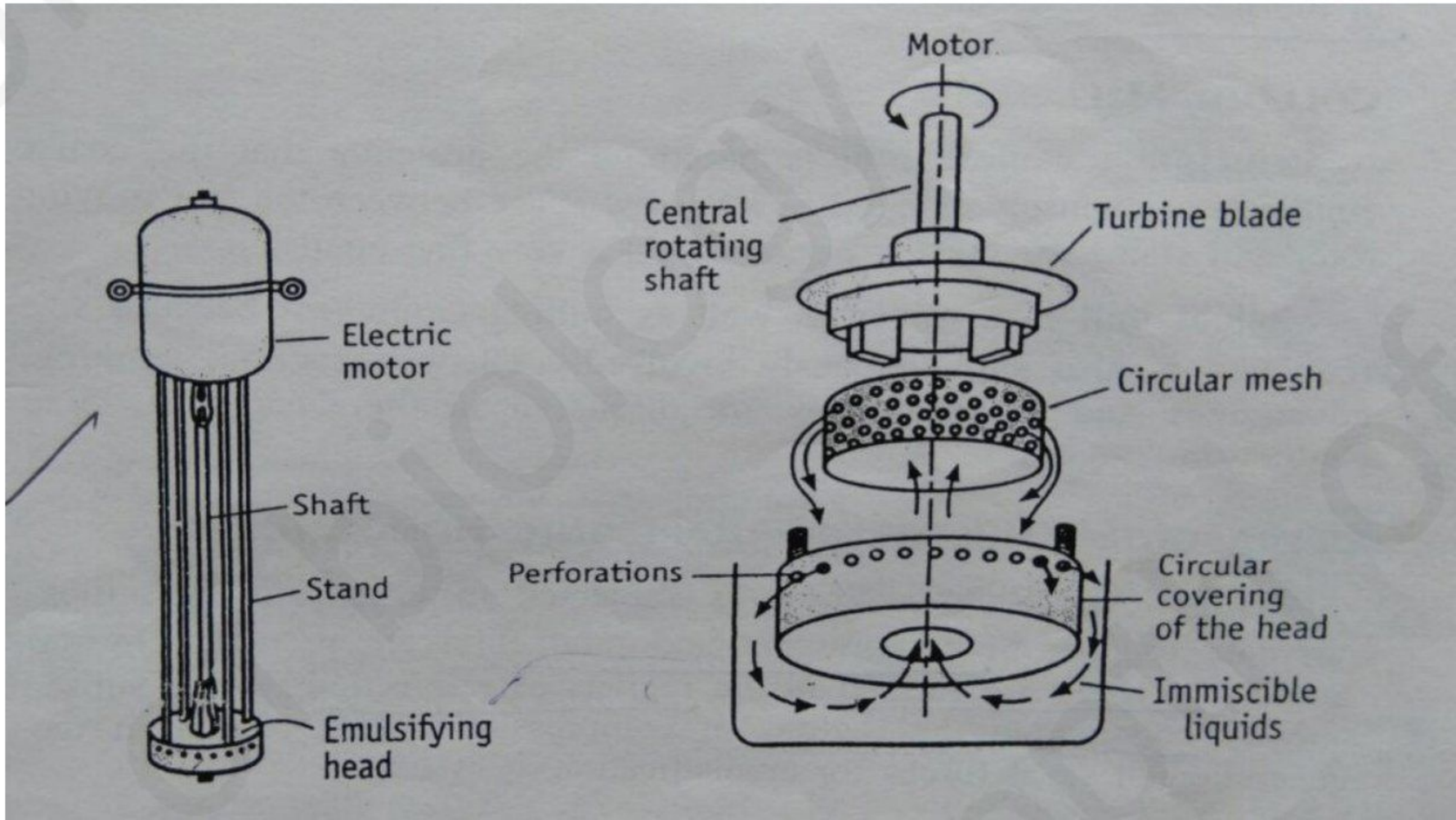
- Simple construction, operation, and relatively lower cost
- No dead spot in the mixing
- The rotation speed of blades can be varied
- Used for the wet granulation process
- High mixing efficiency

DISADVANTAGES

- Require high power
- Heat build-up within powder mix

SILVERSON MIXER EMULSIFIER

- Silverson mixer emulsifier produces intense shearing force and turbulence by the use of high-speed rotors.



CONSTRUCTION

- The construction of a Silverson emulsifier is shown in the Figure.
- It consists of long supporting columns connected to a motor that gives support to the head.
- The central portion contains a shaft, one end of which is connected to the motor and the other end is connected to the head.

- The head carries turbine blades.
- The blades are surrounded by a mesh, which is further enclosed by a cover having openings.

WORKING

- The emulsifier head is placed in the vessel containing immiscible liquids (or coarse emulsion) in such a way that it should get completely dipped in the liquid.
- When the motor is started, the central rotating shaft rotates the head, which in turn rotates turbine blades at a very high speed. [DEPTH OF BIOLOGY]
- This creates a pressure difference. As a result, liquids are sucked into the head from the center of the base and subjected to intense mixing action.
- Centrifugal forces expel the contents of the head with great force through the mesh and onto the cover . [DEPTH OF BIOLOGY]

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- As a result, a fine emulsion emerges through the openings of the outer cover. [DEPTH OF BIOLOGY]
- The intake and expulsion of the mixture set up a pattern of circulation to ensure the rapid breakdown of the bigger globules into smaller globules [DEPTH OF BIOLOGY]

USES

- Silverson mixer is used for the preparation of emulsions and creams of fine particle size.

DISADVANTAGES

- Occasionally, there is a chance of clogging of the pores of the mesh.

Advantages

- Silverson mixer is available in different sizes to handle liquids ranging from a few milliliters to several thousand liters. [DEPTH OF BIOLOGY]
- It can be used for batch operations. It is also used for continuous operation by incorporating into a pipeline, through which the immiscible liquids flow.

IMPELLER

- Mainly used for liquid mixing
- Classified into 3 types on basis of shape & pitch of the blades that are attached to central shaft

PROPELLERS

[DEPTH OF BIOLOGY]

TURBINE

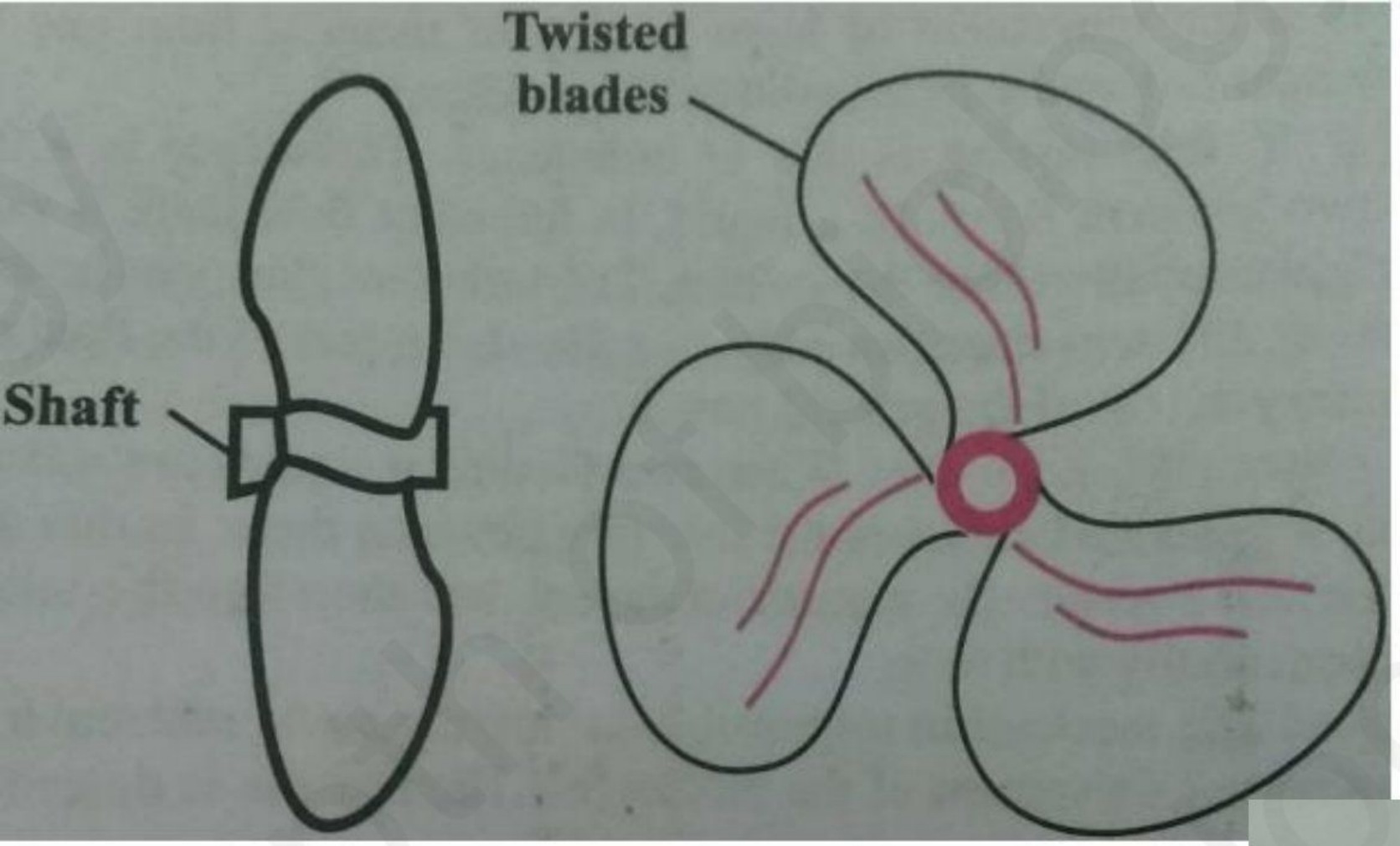
PADDLES

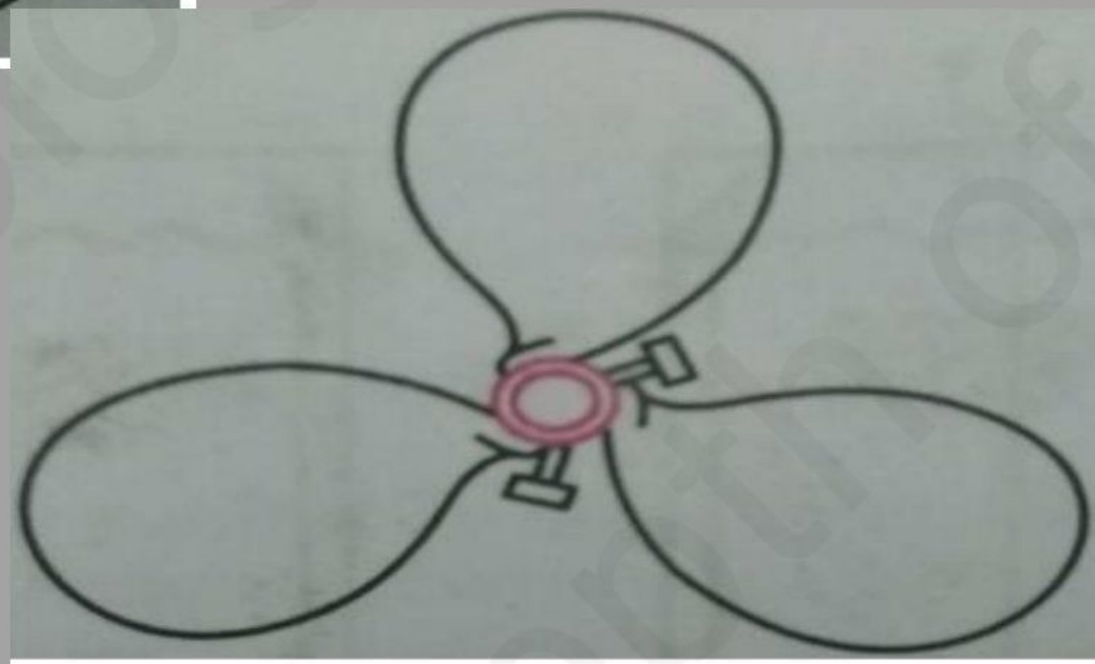
PROPELLER

- Based on mechanism of shearing

CONSTRUCTION

- Three blade design is most common
- May be right/left handed depending on direction of blades.
- Size is usually small
- Speed is 8000rpm





WORKING

- Take liquid which we have to mix
- Dip the propeller with the help of stand
- Start the motor
- Propeller produces axial movement of liquid
- After completion of mixing remove the propeller
- We get required liquid

USES

- Multivitamin elixir, disinfectant solution are manufactured by this
- Used when high mixing capacity is needed

Advantages

- Propeller is effective when high mixing capacity is required

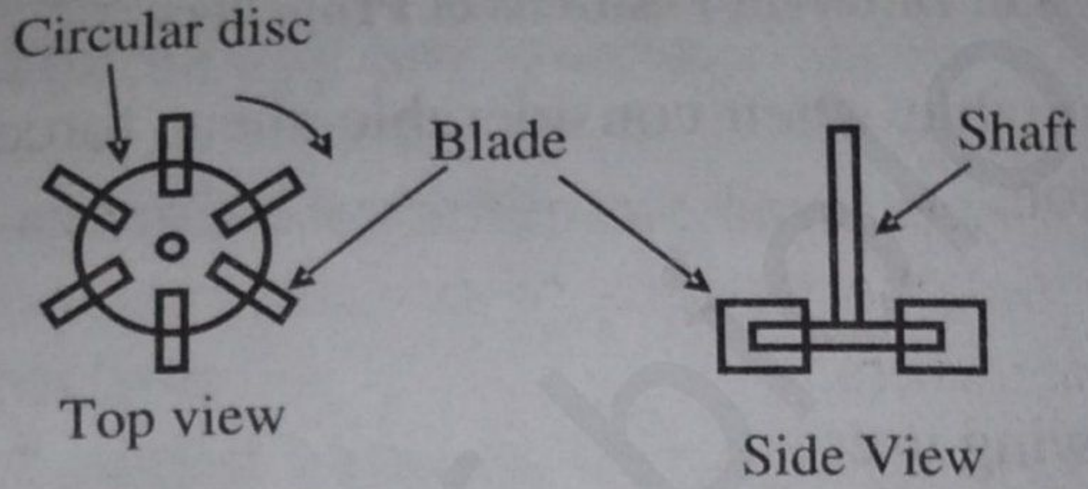
DISADVANTAGES

- Propellers are not effective for liquids having viscosity greater than 5.0 Pascal second. ?
  Equipment cost is high

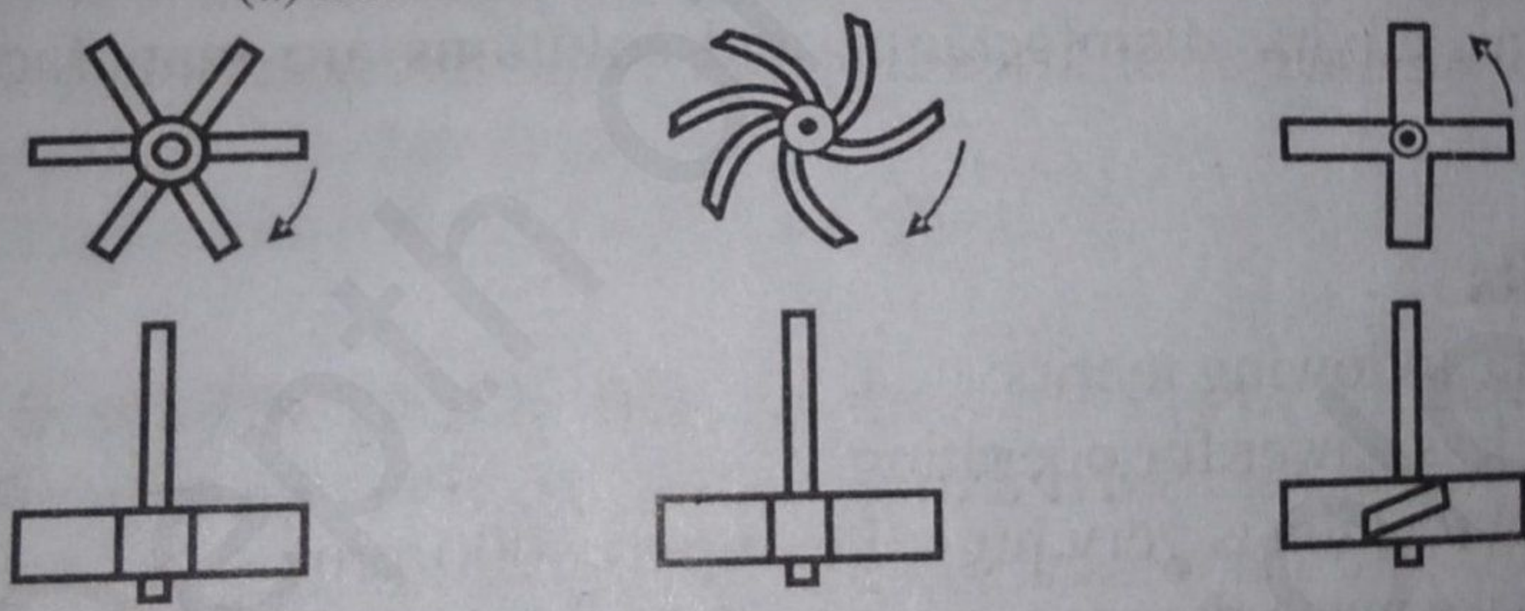
TURBINE

- A turbine mixer is a mechanical device that is used in mixing different type of liquids. The turbine mixer works mainly on the principle of shearing action.

[DEPTH OF BIOLOGY]



(a) Blade disc turbine or flat-bladed turbine.



(b) Various types of turbines.

Figure 8.7: Turbine Impeller

CONSTRUCTION

- Turbine consists of number of blades attached to the circular disk. [DEPTH OF BIOLOGY]
- The blades used in the mixture are of various types: flat blades, disk-type flat blades, inclined blades, curved blades, arrow headed blades, and so on.
- The diameter of turbine varies from 30 to 50 percentage of the diameter of vessel.
- As compared to propeller turbines rotates at lower speed.

WORKING

- Take the liquids which we want to mix
- Place turbine into vessel & start rotation
- Blades produce flow & shear in liquid

USES

- Turbines used for thin paste and emulsification.

[DEPTH OF BIOLOGY]

- Turbines can also be used to handle slurries with 60 percentage solids.
- Mainly used for semisolid materials

DISADVANTAGES

- Turbines have less pumping rate

[DEPTH OF BIOLOGY]

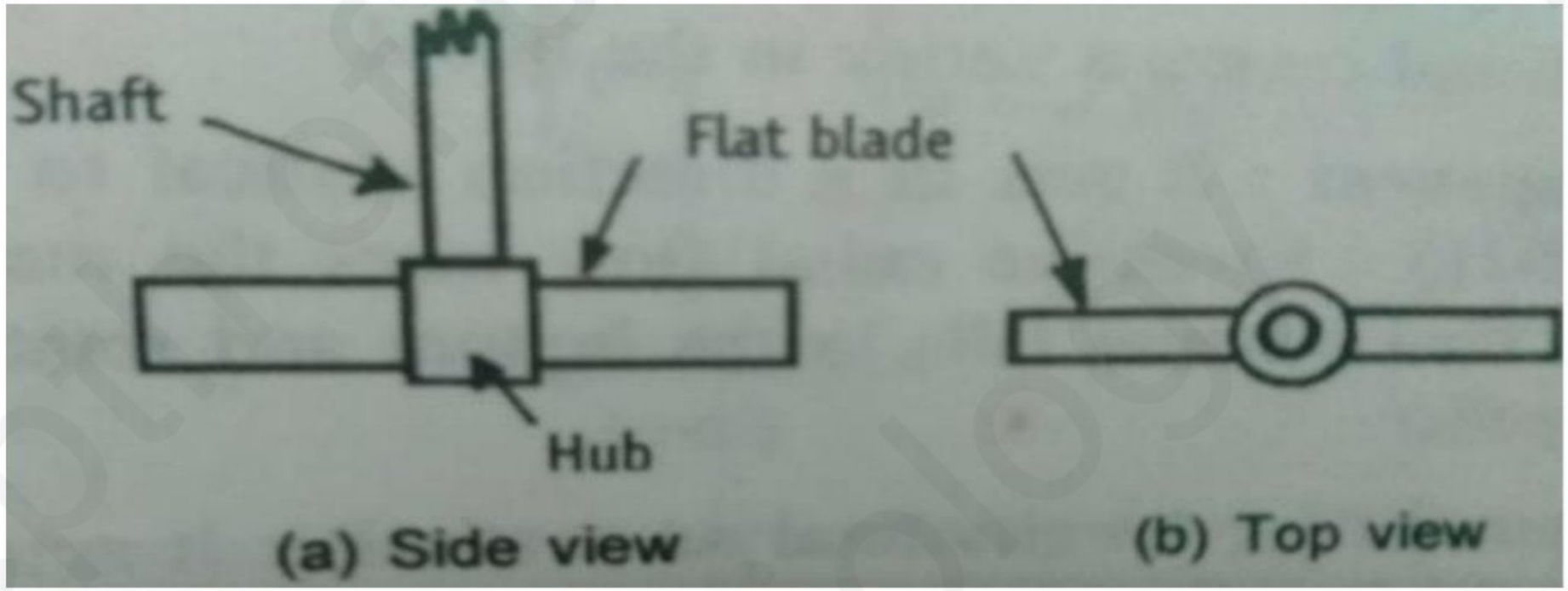
Advantages

- Turbines give greater shearing force than propeller.
- Therefore, turbines are suitable for emulsification

[DEPTH OF BIOLOGY]

PADDLES

- Works on principle of shearing



CONSTRUCTION

- Paddles consist of two long flat blades attached vertically to a shaft.
- Speed is low- 100rpm
- Paddles with 2-4 blades are common

WORKING

- Take the liquids which we want to mix
- Place paddle into tanks & start rotation
- Shaft carrying hub blades rotates at a low speed. They push liquid radially & tangentially
- After mixing paddles are removed

USES

- Paddles are used in the manufacture of antacid suspensions (aluminium hydroxide gel and magnesium hydroxide), agar and pectin related purgative, antidiarroheal mixtures such as bismuth-kaolin.

Advantages

- Vortex formation is not possible.
- It has low speed.
- Mixing efficiency is better.
- No dead spots and deposited solids

DISADVANTAGES

- Here suspension mixing is poor.
- Baffled tanks are required.