

Propellers, Turbines, Paddles & Silverson Emulsifier

MIXING: Theory and
Equipment

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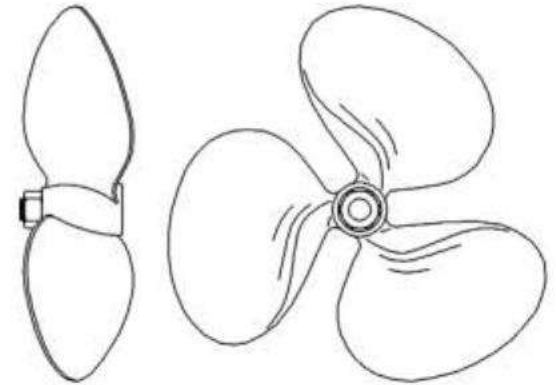


Mixing Device

- Based on **shape** and **pitch** , the are classified into 3 types,
 - » Propellers
 - » Turbines
 - » Paddles

Propellers

- It consists of number of blades, generally 3 bladed design is most common for liquids. Blades may be right or left handed depending upon the slant of their blades.
- Two or more propellers are used for deep tank.
- Size of propeller is small and may be increased up to 0.5 metres depending upon the size of the tank.
- Small size propellers can rotate up to 8000rpm and produce longitudinal movement.

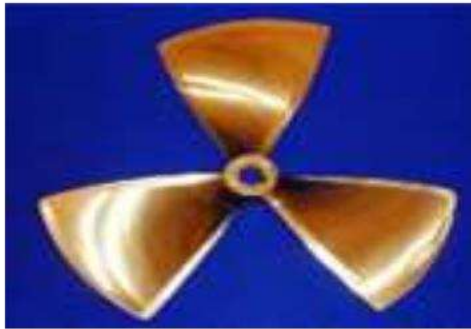


Advantages of propellers:

Used when high mixing capacity is required.

Effective for liquids which have maximum viscosity of 2.0 pascals.sec or slurry up to 10% solids of fine mesh size.

Effective gas-liquid dispersion is possible at laboratory scale.

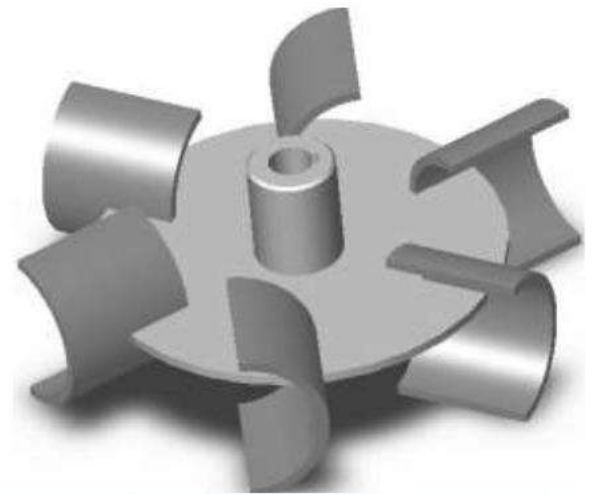


Disadvantages of propellers:

Propellers are not normally effective with liquids of viscosity greater than 5 pascal.second, such as glycerin castor oil, etc.,

Turbines

- A turbine consists of a circular disc to which a number of short blades are attached. Blades may be straight or curved.
- The diameter of the turbine ranges from 30-50% of the diameter of the vessel.
- Turbines rotate at a lower speed than the propellers (50-200rpm).
- Flat blade turbines produce radial and tangential flow but as the speed increases radial flow dominates. Pitched blade turbine produces axial flow.



Near the impeller zone of rapid currents, high turbulence and intense shear is observed. Shear produced by turbines can be further enhanced using a diffuser ring (stationary perforated ring which surrounds the turbine).

Diffuser ring increase the shear forces and liquid passes through the perforations reducing rotational swirling and vortexing.

Advantages of Turbines:

- Turbines give greater shearing forces than propellers through the pumping rate is less. Therefore suitable for emulsification.
- Effective for high viscous solutions with a wide range of viscosities up to 7.0 Pascal. Second.
- In low viscous materials of large volumes turbine create a strong currents which spread throughout the tank destroying stagnant pockets.
- They can handle slurries with 60% solids.
- Turbines are suitable for liquids of large volume and high viscosity, if the tank is baffled.



Paddles

- A paddle consists of a central hub with long flat blades attached to it vertically.
- Two blades or four blades are common. sometimes the blades are pitched and may be dished or hemispherical in shape and have a large surface area in relation to the tank in which they are used.
- Paddles rotate at a low speed of 100rpm.
- They push the liquid radially and tangentially with almost no axial action unless blades are pitched.
- In deep tanks several paddles are attached one above the other on the same shaft.
- At very low speeds it gives mild agitation in unbaffled tank but as for high speeds baffles are necessary.



Uses of paddles:

Paddles are used in the manufacture of antacid suspensions, agar and pectin related purgatives, antidiarrheal mixtures such as bismuth-kaolin.



Advantages of paddles:

Vortex formation is not possible with paddle impellers because of low speed mixing.

Disadvantages of paddles:

Mixing of the suspension is poor therefore baffled tanks are required.

Advantages of liquid mixing

- Liquid mixing promotes heat transfer between liquid and a heating source. This step is essential in the crystallization of drug substances. Uniform heat transfer in the solution yields crystals of same size.
- Liquid mixing is essential in the manufacture of number of dosageforms.

E.g.:

- Suspensions
- Emulsions
- Solutions
- Aerosols

Silverson mixer -Emulsifier

Principle:

- It produces intense shearing forces and turbulence by use of high speed rotors.
- Circulation of material takes place through the head by the suction produced in the inlet at the bottom of the head.
- Circulation of the material ensures rapid breakdown of the dispersed liquid into smaller globules.
- It consists of long supporting columns and a central portion. Central portion consists of a shaft which is connected to motor at one end and other to the head.
- Head carries turbine blades.
- Blades are surrounded by a mesh, which is further enclosed by a cover having openings.



Uses:

- Used for the preparation of emulsions and creams of fine particle size.

Advantages:

- Silver son mixer is available in different sizes to handle the liquids ranging from a few milli liters to several thousand liters.
- Can be used for batch operations as well as for continuous operations by incorporating into a pipeline, through which the immiscible liquids flow.

- **Disadvantages:**

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

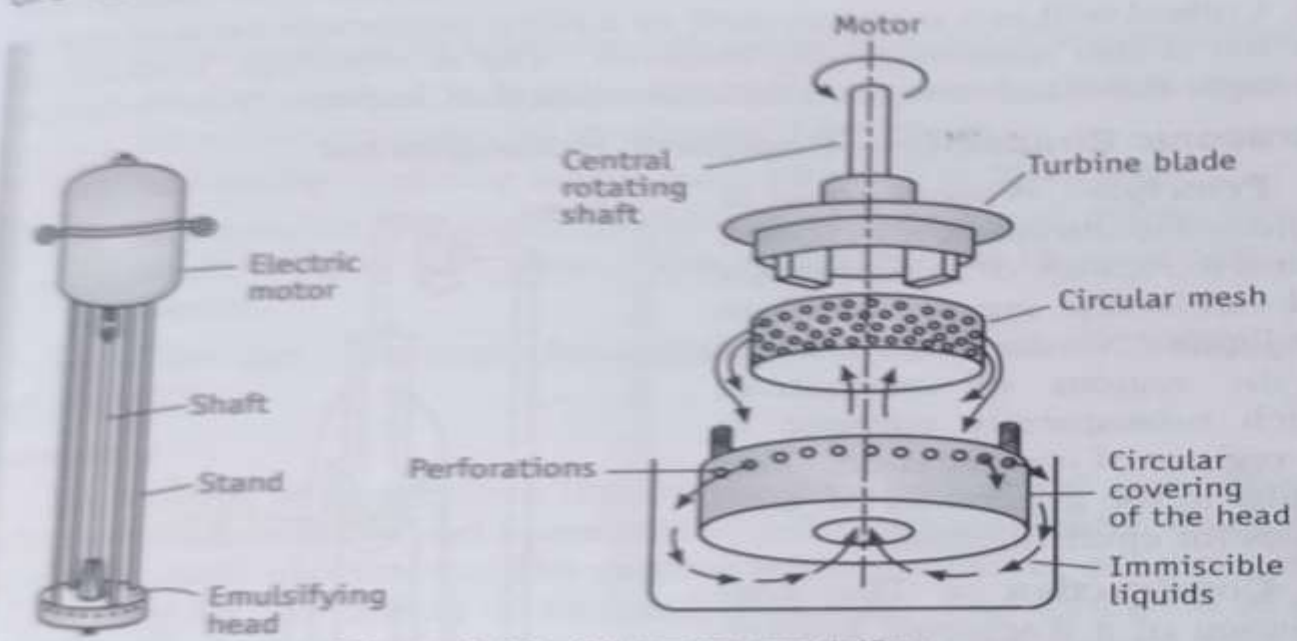


Figure 9-28. Silverson emulsifier.

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. 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 (Figure 9-28b). As a result a fine emulsion emerges through the openings of the outer cover. The intake and expulsion of the mixture set up a pattern of circulation to ensure rapid breakdown of the bigger globules into smaller globules.



Thank You