Mixing and Agitation

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Introduction

- Agitation
- Mixing
- Agitation and mixing of liquids
- Agitation equipment
- Types of Agitators
- Methods to avoid formation of vortex
- Draft tubes
- Power consumption of mixer impeller, selection of mixing equipment in dairy industry, mixing pump.

Agitatation

It is induced motion of a material in a specified way usually in a circulatory pattern inside some sort of container e.g. agitation of milk in storage tank.

Mixing

It is random distribution, into and through one another, of two or more initially separate phases. e.g. Mixing of Ice cream ingredients before freezing.

Agitation and Mixing of Liquids

Purpose

- To distribute solid particles
- Blending miscible liquids
- Dispersing immiscible liquids to form emulsion
- Dispersing gas through the liquid
- Assisting in heat transfer

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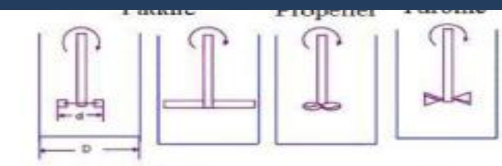
Agitation equipment

1. Vessel
2. Motor

Types of agitators

(1) Paddle
(2) Propeller
(3) Turbine



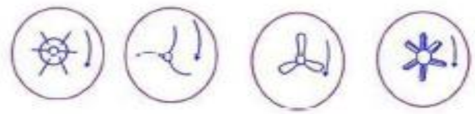


Fig. 30.1 Agitators

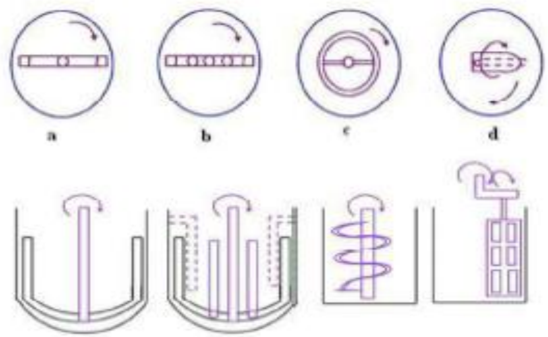


Fig.30.2 Agitator (Scraping type)

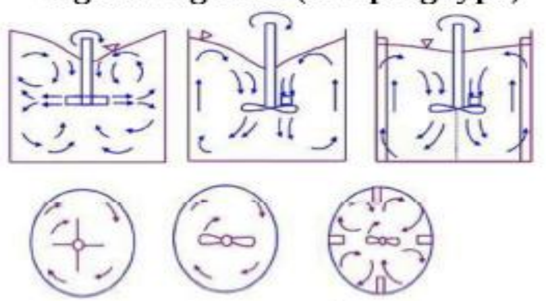


Fig.30.3 Vortex formation

Mixing and Agitation 30.1

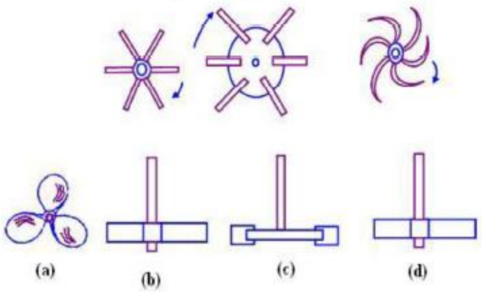


Fig.30.4 Turbine

(a). Three blade marine propeller (b). Open straight blade turbine (c). Blade disk turbine (d). Vertical curved blade turbine

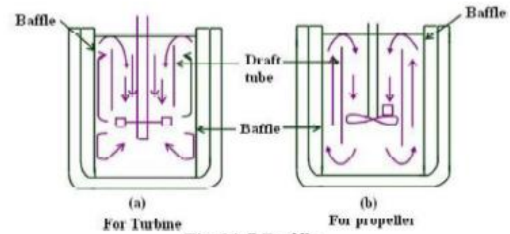


Fig.30.5 Baffle

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Methods to avoid formation of vortex

1) Tilted impeller shaft
2) Mounted on side of tank
3) Baffles

Draft Tubes

1) Draft tubes add to the fluid friction
2) For a given power input, reduce flow rate

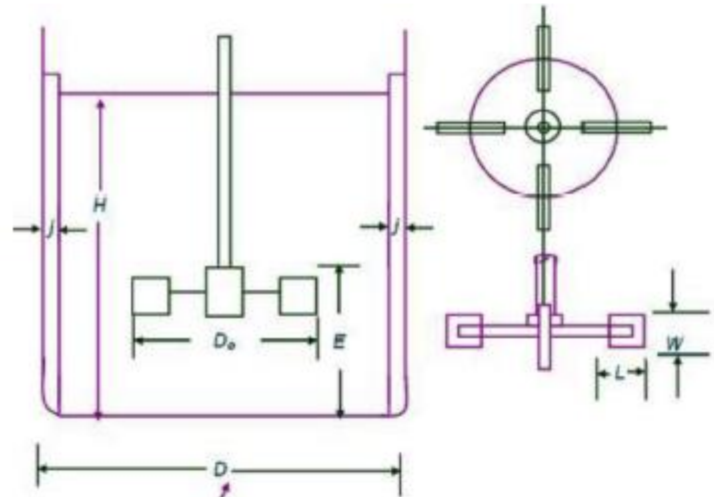

Fig.30.6 Standard turbine

Typical Proportions

$$\frac{Da}{Dt} = \frac{1}{3} \qquad \frac{H}{Dt} = 1 \qquad \frac{J}{Dt} = \frac{1}{12}$$

$$\frac{E}{Dt} = \frac{1}{3} \qquad \frac{W}{Da} = 1 \qquad \frac{J}{Da} = \frac{1}{4}$$

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Circulation, velocities and power consumption in agitated vessels

Volumetric flow rate, q is proportional to the speed and the cube diameter of impeller. Another important parameter is the Flow Number, a dimensionless number.

Flow Number, $N_{Q1} = N_{Q1} = q\ n\times (D_a)^3$

Flow number is constant for each type of impeller

For standard flat–blade turbine, in a baffled vessel, $N_Q \approx 1.3$

For Flat – blade turbines, the total flow, estimated from the average circulation time for particles is

$qT=0.92\times n\times (D_a)^3 \times (D_t / D_a)$

For a $D_t/ D_a =3$ the $q_T = 2.76\, nD_a^3$ or 2.1 times the value at the impeller (N_Q=1.3). The above equation should be used only for Dt / Da ratio between 2 and 4

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Thank you