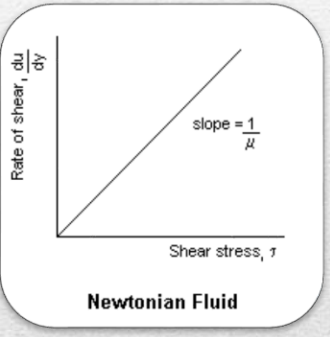
Mixing

Part 2

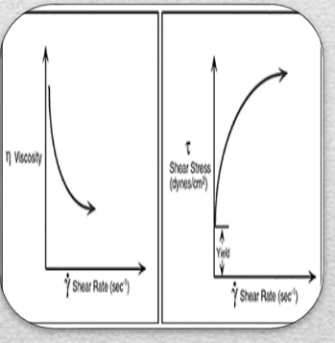
Lab -8-

FLUID MIXING AND THEIR MECHANISMS.

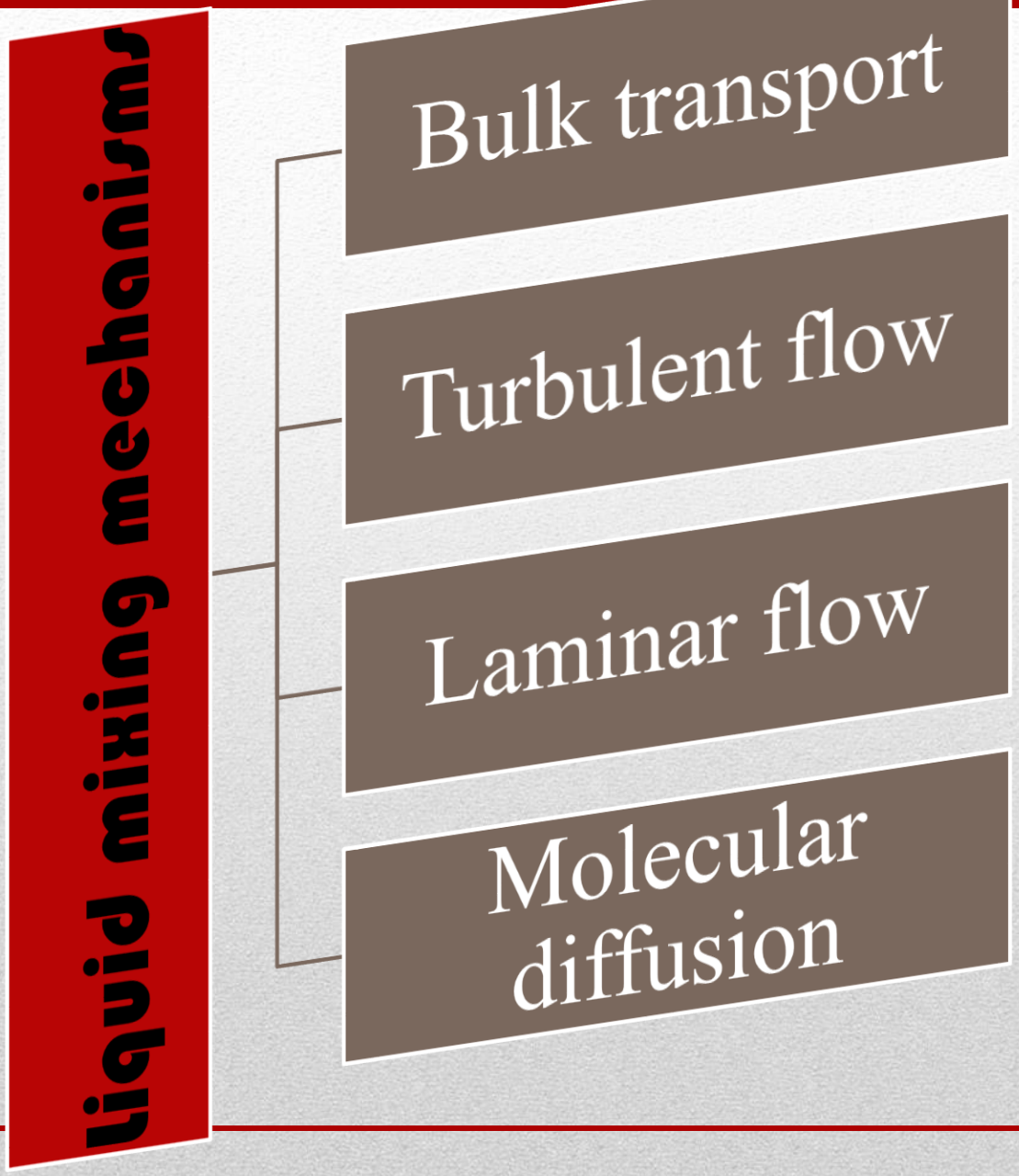
Depending upon relationship between shear rate and the applied shear stress, the fluids may be divided into



Newtonian Fluids



Non-Newtonian Fluids


Liquid mixing mechanisms
Bulk transport
Turbulent flow
Laminar flow
Molecular diffusion

1. Bulk transport

- The movement of relatively large portion of material being mixed from one location in the system to another.

- **Bulk transport accomplished by means of paddles, revolving blades, or other devices within the mixer arranged so as to move adjacent volumes of fluid in different direction (3D shuffling).**

It is a direct result of turbulent fluid flow which is characterized by a random fluctuation of the fluid velocity at any given point within the system.

In turbulent flow, the fluid has a different instantaneous velocities at different location at same instant in time.

Turbulent flow visualized as (eddies) with various sizes [portion of fluid moving as a unit in a direction contrary to that of general flow]. Larger eddies breakup forming smaller and smaller size eddies until are no longer distinguished.

2. Turbulent mixing

Streamline or laminar flow is frequently encountered when highly viscous fluid are being processed.

occur with gentle stirring and adjacent to stationary surfaces in vessels where turbulent flow is predominant.

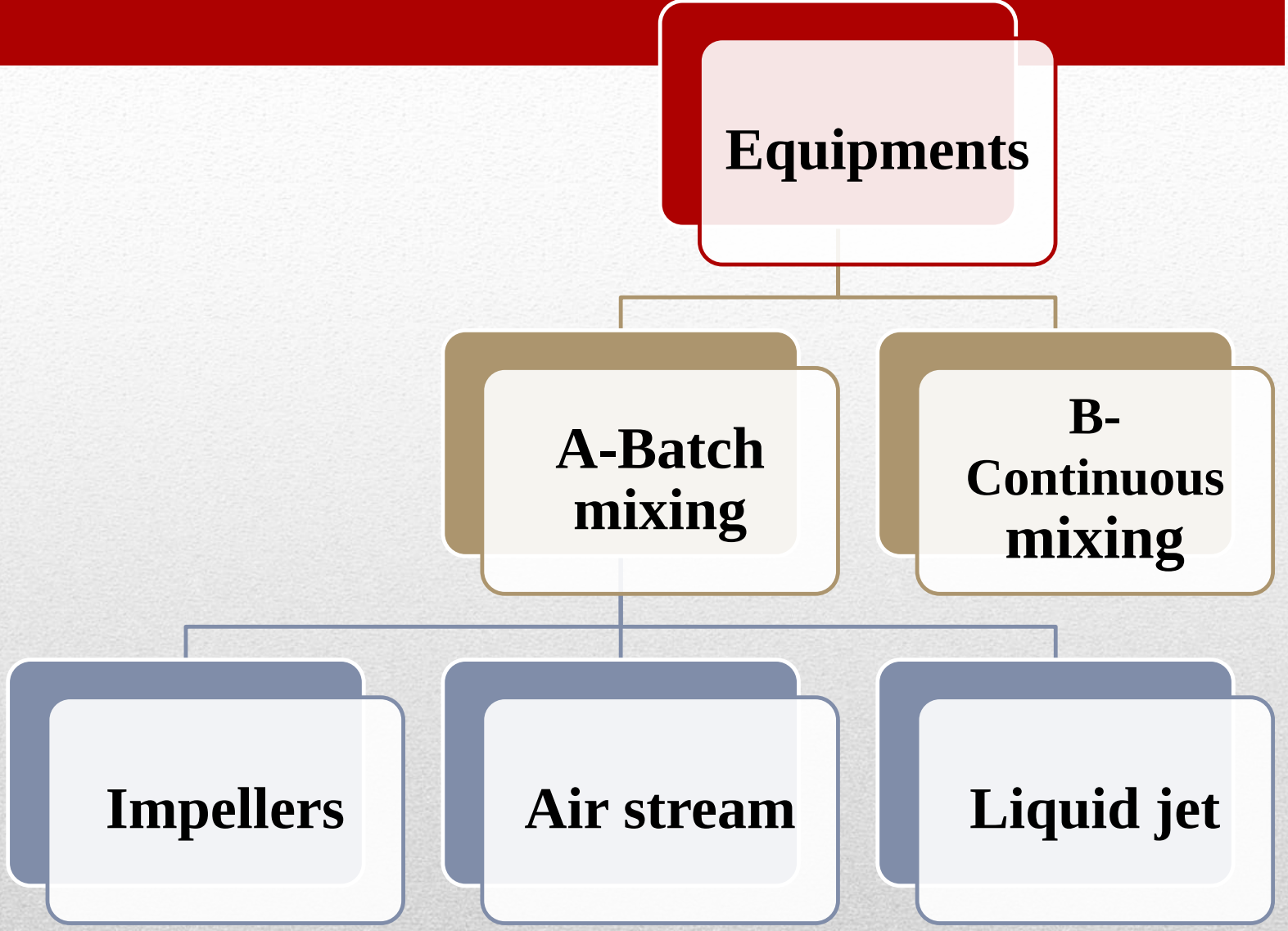
when two dissimilar liquids are mixed through laminar flow, the shear generated stretches the interface between them.

3. Laminar mixing

Mixing at the molecular level by diffusion *resulting* from thermal motion of molecules.

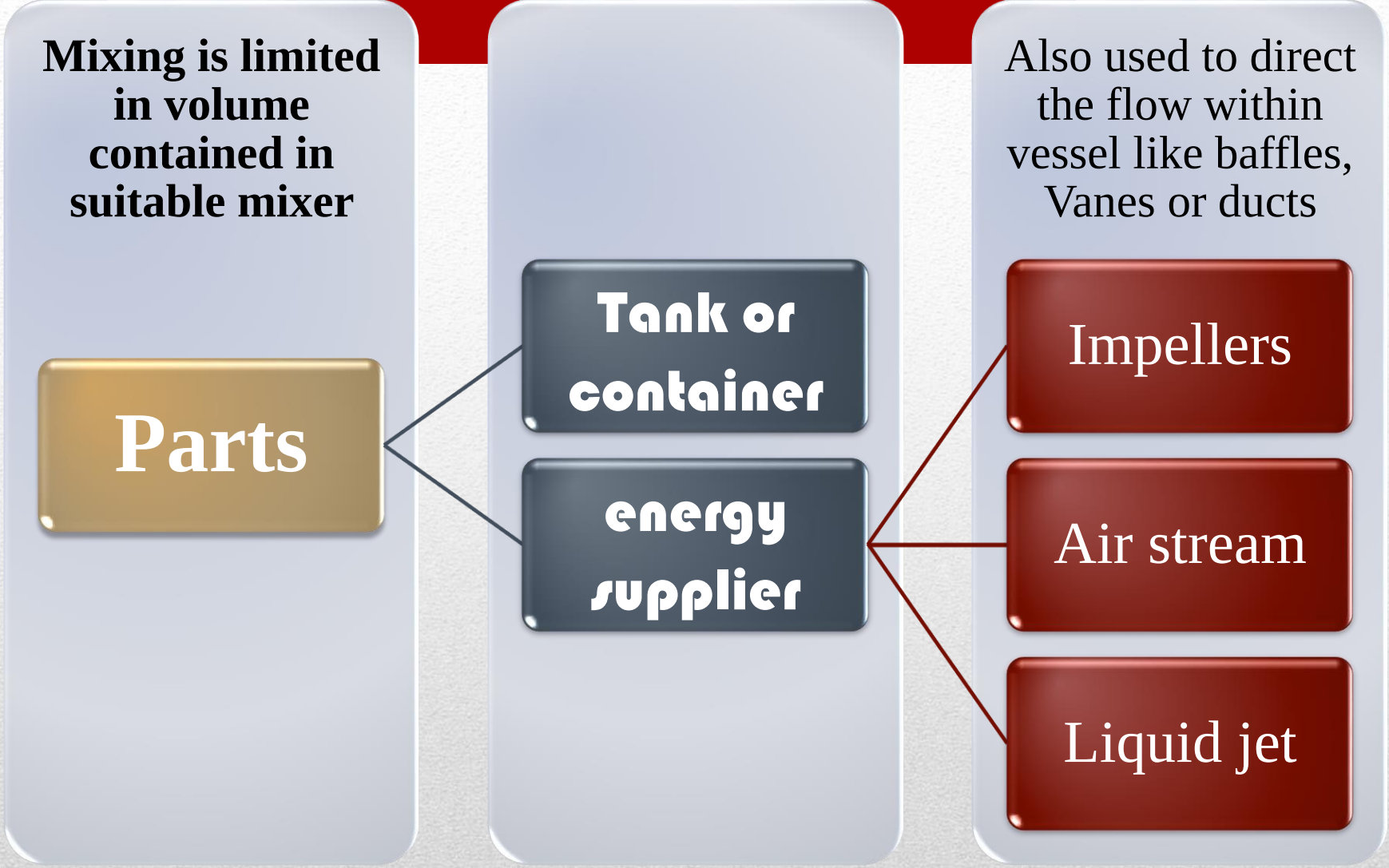
Occurs in conjugation with laminar flow that *tends* to reduce sharp discontinuities at the *interface* between the fluid layers which leads *to complete* mixing after sufficient time.

4. Molecular diffusion


Equipments
A-Batch mixing
B- Continuous mixing
Impellers
Air stream
Liquid jet

Equipments

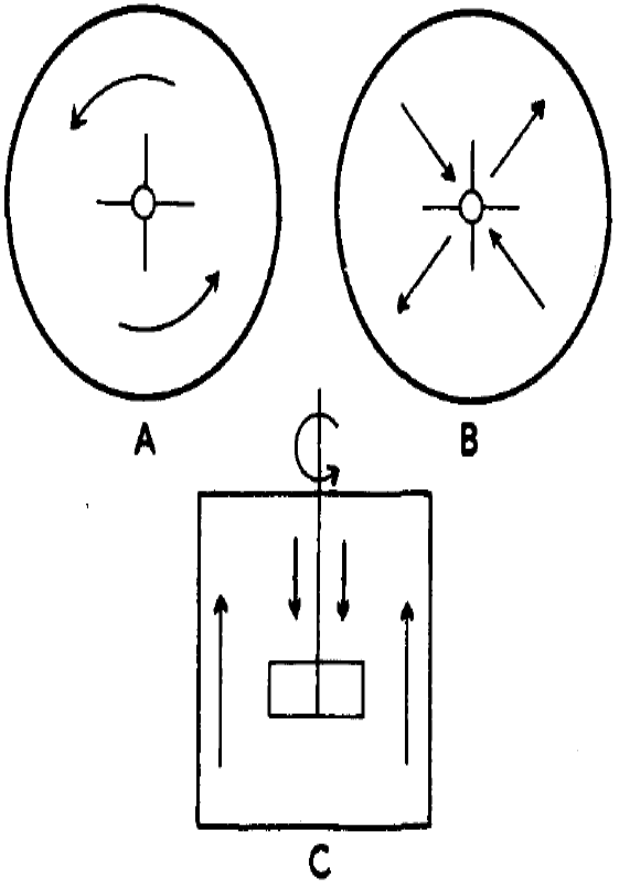
A. Batch Mixing



Types of impeller depend on

1- Type of flow (radial, axial, tangential)

2- Shape and pitch of blades



A and B, *Diagrammatic representation of cylindric tanks in which tangential and radial flow occur, respectively. C, Side view of a similar tank in which axial flow occurs.*

Impeller types

Impeller types

Propellers

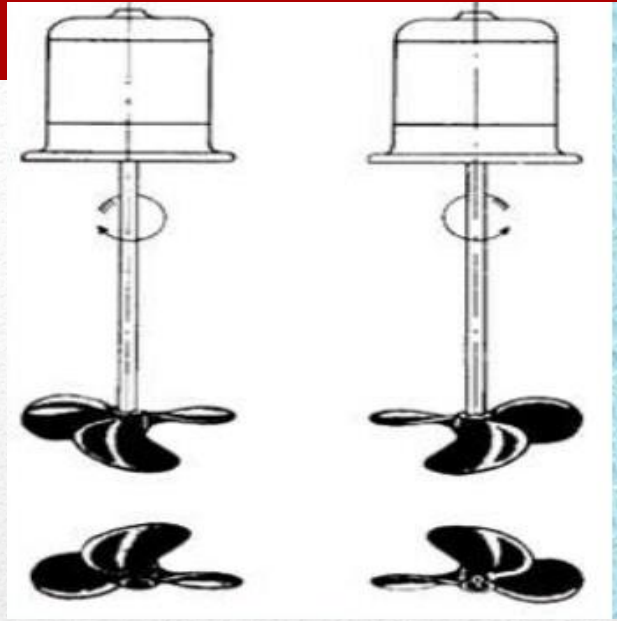
- Produce flow parallel to their axis.
- High efficient with low viscosity liquids

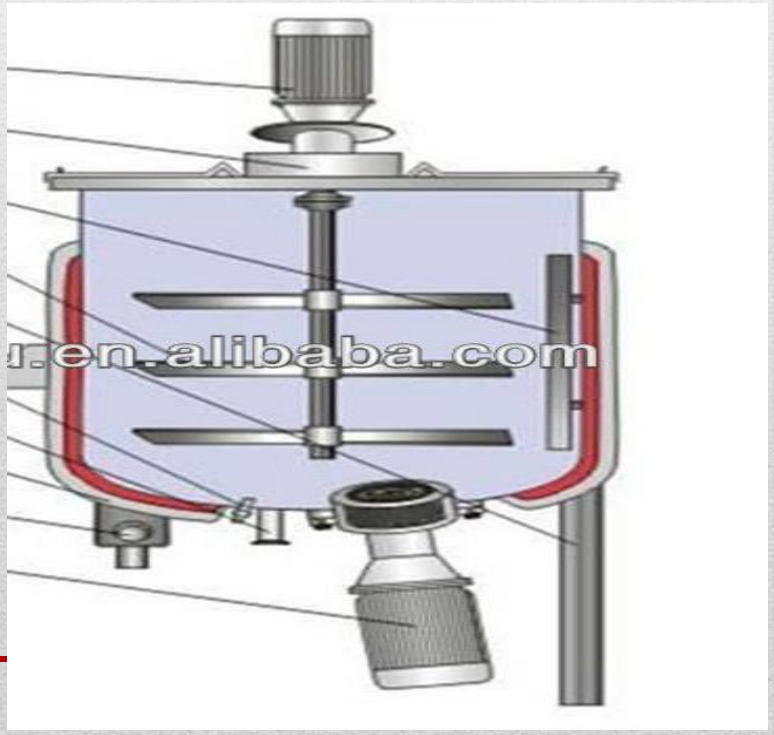
Turbine

- Produce axial or tangential flow or combination
- Blades have constant pitch throughout their length and used for very viscous liquids.

Paddles

- Circulation is primarily tangential.
- Operate at a very low speed and used to mix low viscosity liquids and semisolids.

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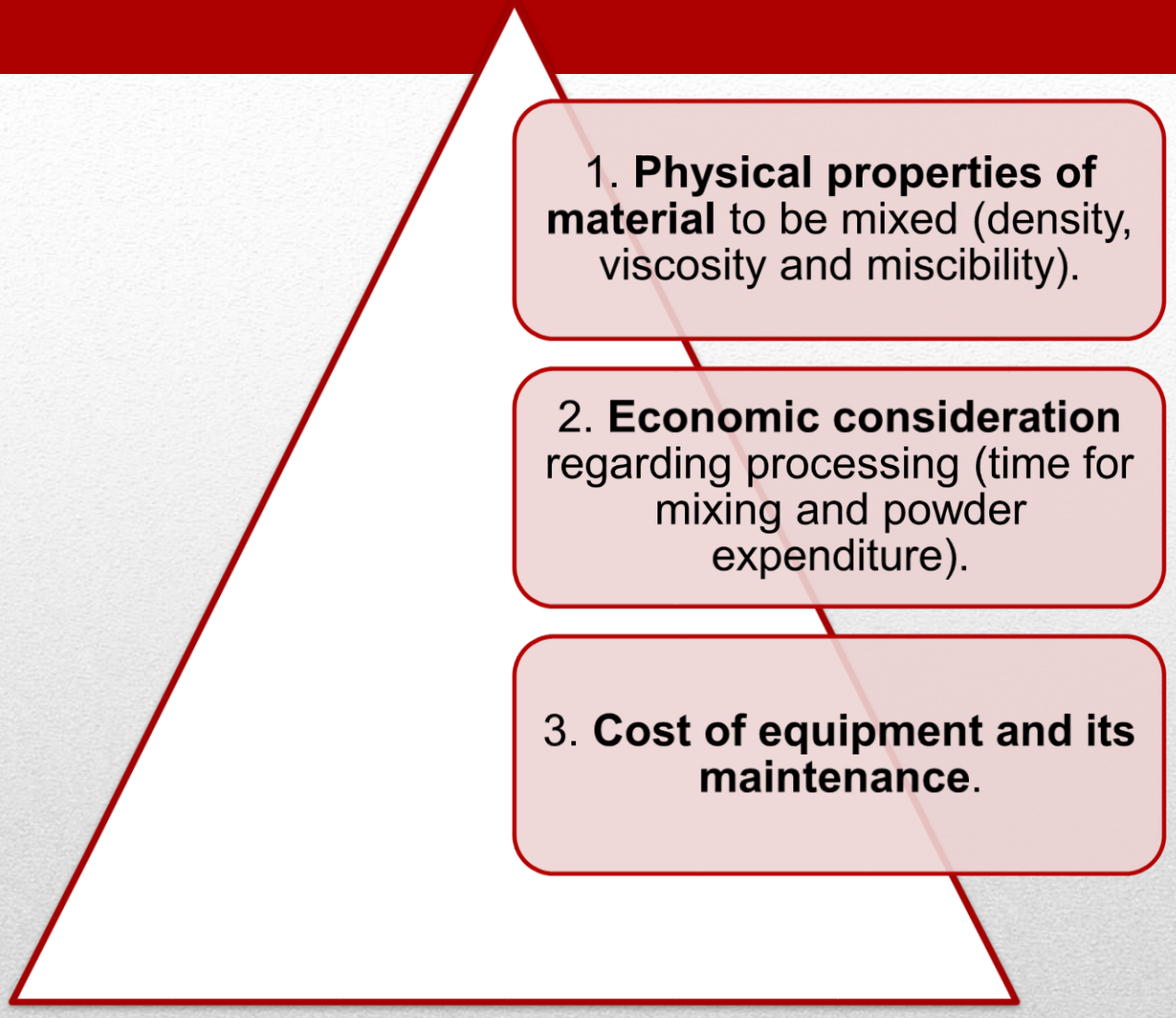

Factors affecting mixer selection

Mixers in polyphase systems

Liquid –liquid mixing

- Mixing of two immiscible liquids requires subdivision of one of the phases into globules which then distributed throughout bulk of fluid forming a stable emulsion.

Solid-liquid mixing

- Mixing of Finely divided solid with liquid of low viscosity in the production of suspension depends on separation of aggregates into primary particles and the distribution of these particles throughout the fluid.


Thank You