

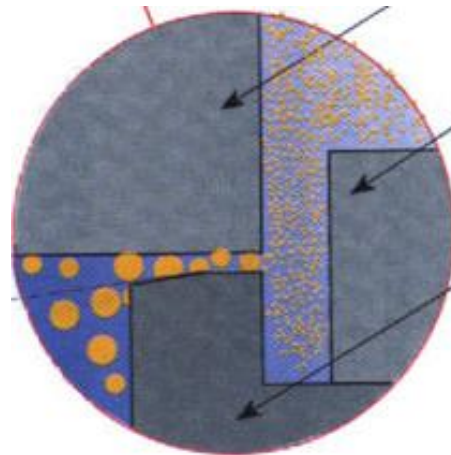
HOMOGENIZATION

Summing up- What?

The process of breaking up the fat globules to very small sizes in order to prevent cream formation is known as homogenization.

The fat globules present in normal milk varies from 0.1 to 3 or 4 microns depending upon the breed of cows and various other factors.

By homogenization, we break up the fat globules to below 2 micron sizes.



Summing up- What?

Homogenized milk is that which has been treated in such a manner as to ensure break up of the fat globules to such an extent that after 48 hours of storage,

no visible cream separation occurs on the milk in a quart bottle,

OR

proportionate volumes in containers of other sizes does not differ by more than 10% from the fat percentage of the remaining milk as determined after through mixing.

Advantages

- Prevents cream formation.
- Increases milk viscosity → richer appearance when used in tea or coffee.
- Fat globules do not rise readily and there is no necessity for agitating the milk before serving.
- Prevents churning of fat during rough handling or excessive agitation.
- Reduces curd tension, i.e. forms a soft curd when homogenized milk is coagulated → milk is more palatable due to brighter appearance, heavier body and richer flavor.
- Milk becomes more digestible partly because of the smaller fat globules and partly because of the lower curd tension. Recommended for infants.

Summing up- Why?

- Reduces the chances of separation of fat during the manufacture of evaporated milk and ice-cream → smoother texture of the product.
- Homogenizer can be used to prepare reconstituted milk by mixing butter oil or butter with skim milk.
- Less susceptible to oxidized flavor development.

Summing up- Why?

BUT:

**Fat recovery from
homogenized milk is
difficult.**

How??

Four different forms of fat globules in milk

- **Single globules unattached.**
- **Clusters, consisting of two or more globules loosely attached.**
- **Clumps, consisting of two or more globules tightly clumped together so that the individual appearance of the globules is almost lost.**
- **Churned or butter particles in which the individual globules have lost their identity.**

How?

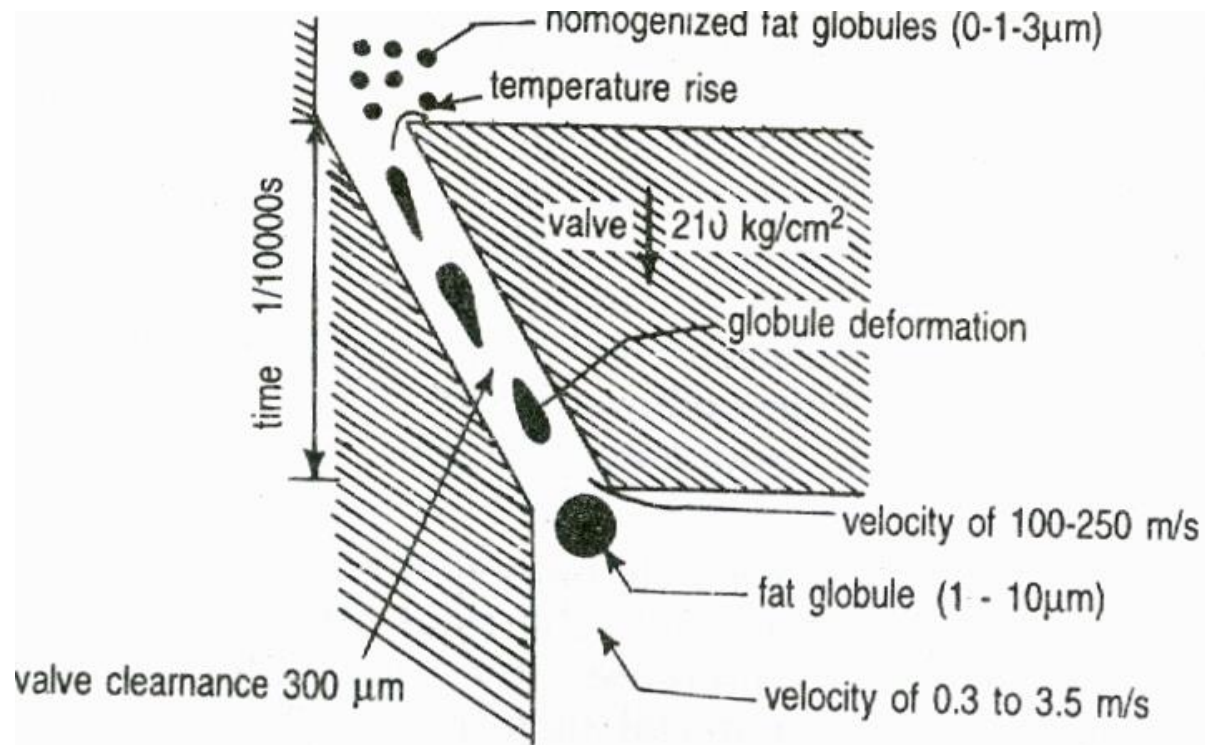
By reducing size

In an equipment known as homogenizer.

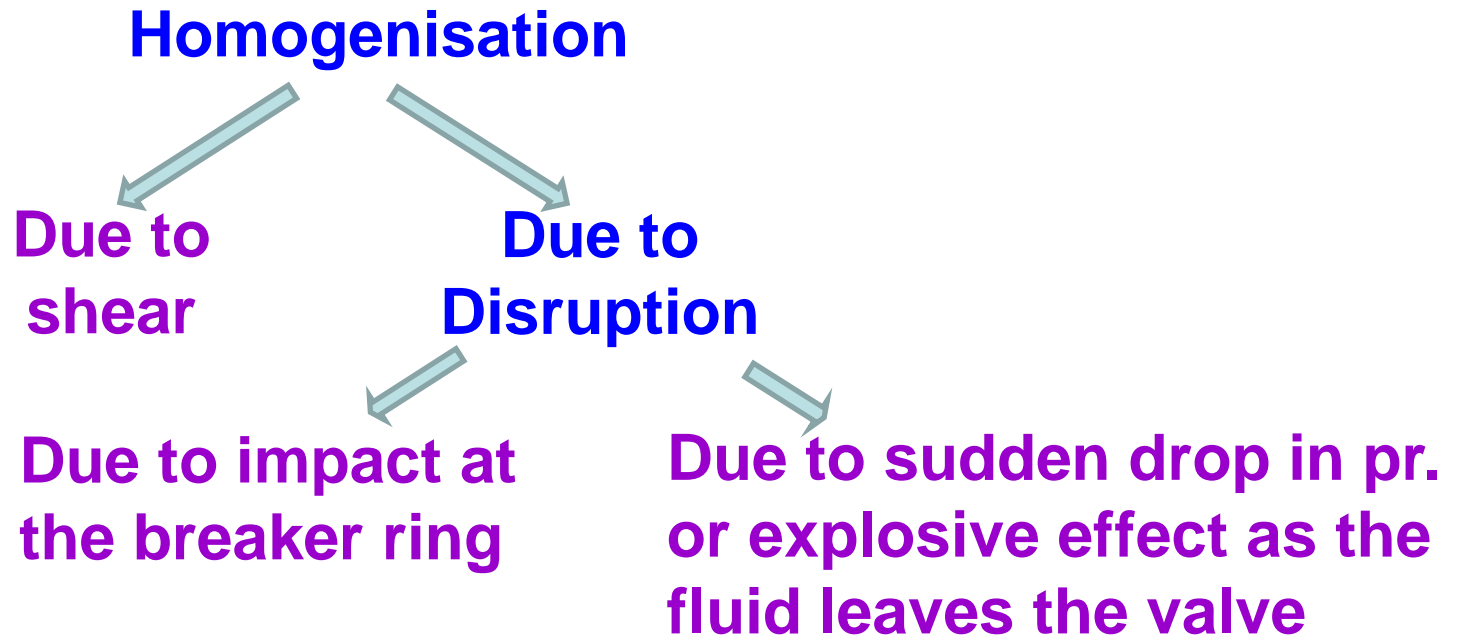
A homogenizer should break up all the clusters, clumps and butter particles present in un-homogenized milk.

How?: The Homogenizer

It consists of a high pressure pump fitted with a minute orifice having an adjustable opening through which fluids are forced at high pressure.

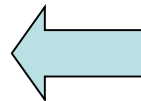


How??



In actual practice most valves employ a combination of three principles.

Size and shape of orifices



Volume to be handled in a given time and also by the viscosity of the product.

How??

Effect of homogenization pressure on fat globules break up

Pressure (psi)	Range of size of fat globules micron	Average size of fat globules in micron
500	1 to 14	2.39
1,000	1 to 7	1.68
1,500	1 to 4	1.40
2,000	1 to 3	1.08
2,500	1 to 2.5	0.99
3,000	0.5 to 2	0.76

So pressure should be between 2000 to 3000 psi.

How??

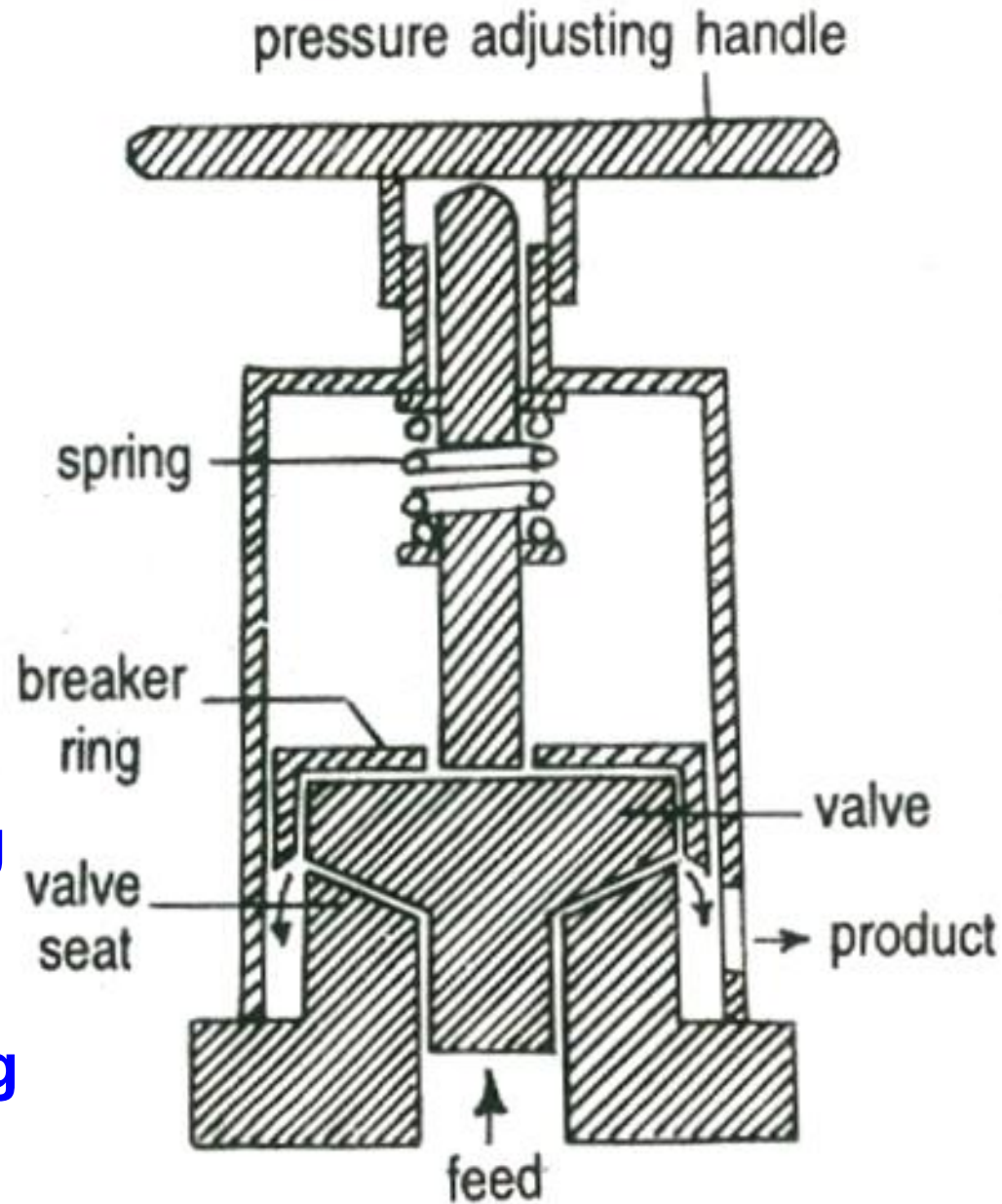
Proper dispersion is equally important.

- **Some homogenizers may give excellent break up, but the dispersion is very poor, resulting in excessive clustering and clumping and even churning.**
- **This cause the development of excessive viscosity, which sometimes makes the product very difficult to pump or cool.**

Homogenising pump

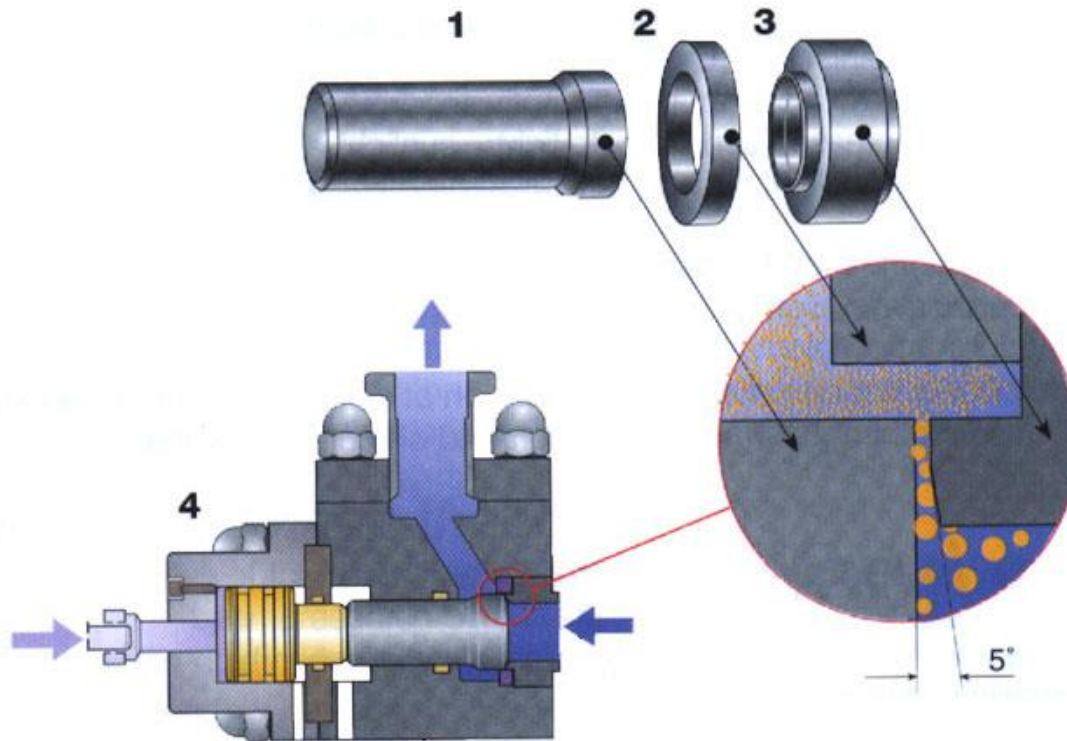
New modern valves use low pressure, even 1/3rd less than that of conventional valves and furthermore they maintain efficiency without frequent valve grinding, since the wearing out (the wire valve) is replaced every day.

Main components of a homogenizer



- Pump
- Homogenizing valve
- Breaker ring
- Tension spring
- Valve seat

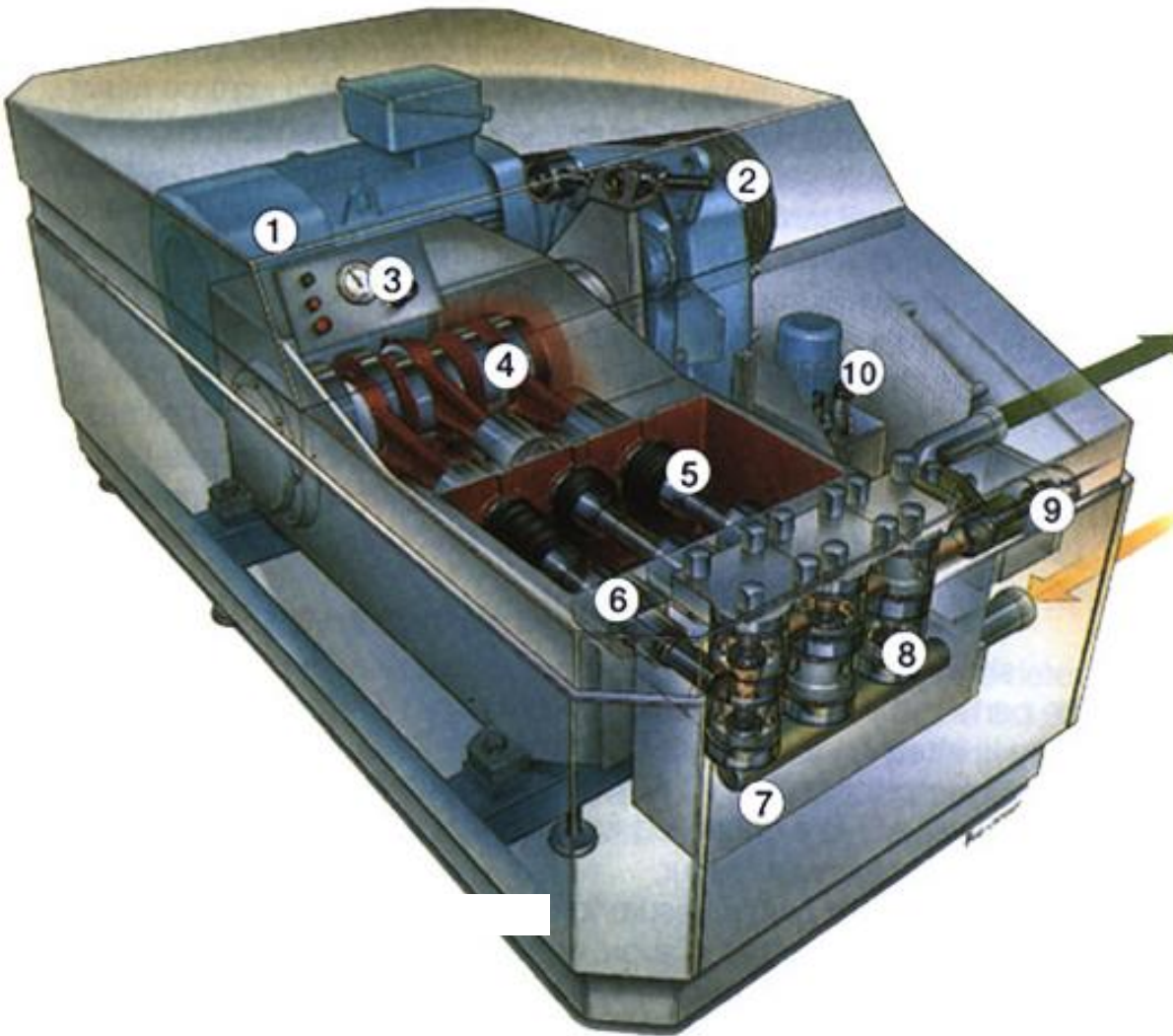
Main components of a homogenizer



Components of a single-stage homogenization device

1. Forcer
2. Impact ring
3. Seat
4. Hydraulic actuator

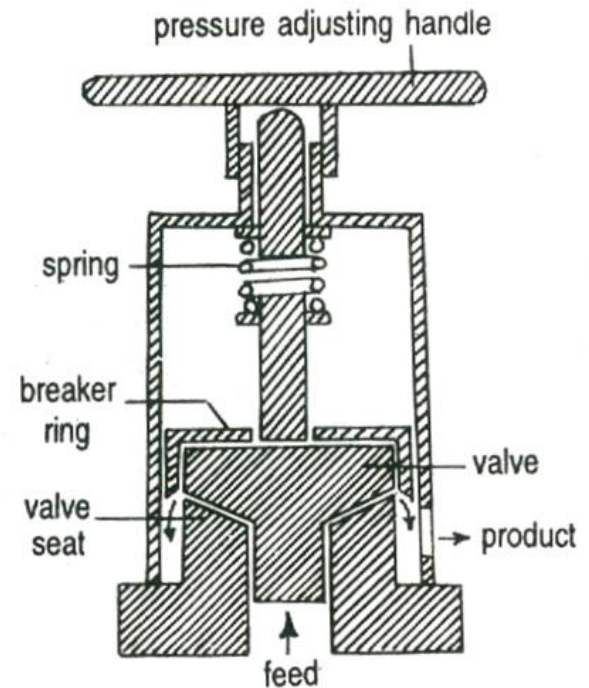
Main components of a homogenizer



1. Main drive motor
2. V-belt transmission
3. Pressure indication
4. Crank case
5. Piston
6. Piston seal cartridge
7. Solid stainless steel pump block
8. Valves
9. Homogenising device
10. Hydraulic pressure setting system

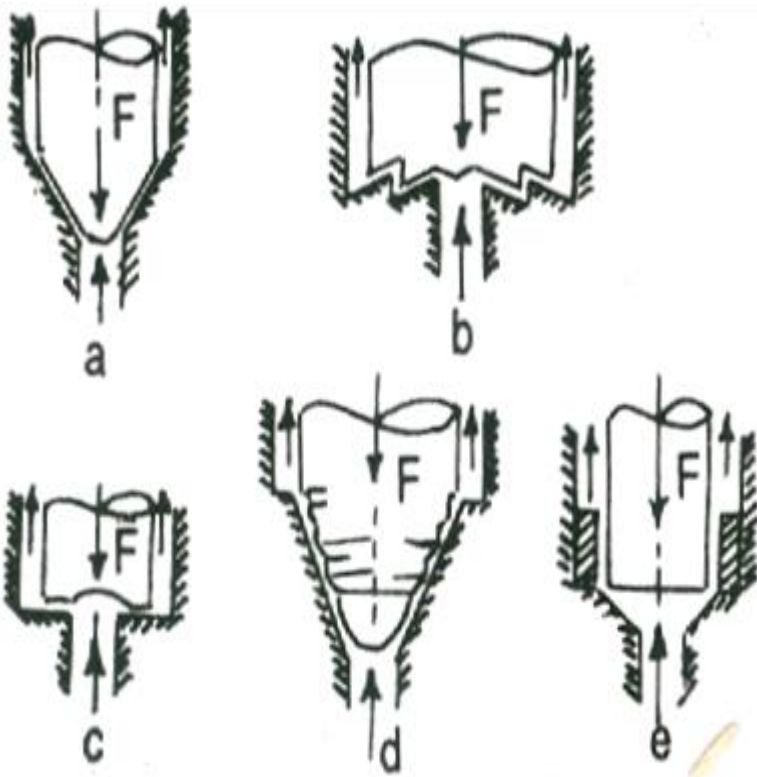
Main components of a homogenizer

- The **homogenising valve** is the heart of the homogeniser.
- This may be of different shapes and sizes.
- Most valves are of **poppet type**, which have a **breaker ring** so that the fluid strikes the inner surface of the breaker ring perpendicularly as it leaves the orifice formed by the **conical shaped valve and seat**.
- The valve is held by a **heavy spring** having adjustable tension. As the fluid pressure comes against it, the valve rises **few thousands of an inch** to form a narrow annular opening (orifice).



**Cross section
of a poppet type
homogenizing
valve**

Homogenising valve

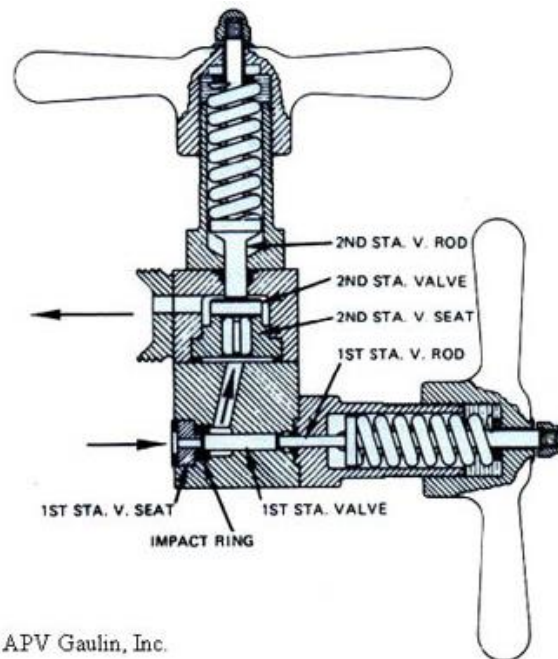


Types of
Homogenizing
valves

- The valve parts are subjected to **extreme abrasion** because of the high velocity and pressure of the fluid as it passes through the valve. So they must be constructed of extremely tough and wear resistant hard metals such as **stellite**.
- The valve size must be suited to capacity of the machine. Larger valves cause excessive clustering and too small valves may not give proper break up.

Homogenising valve

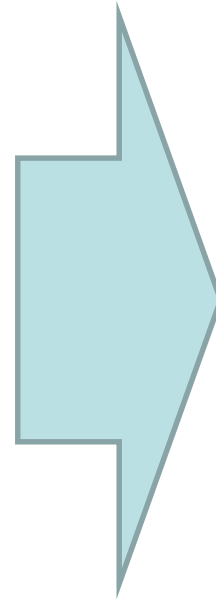
- Any slight grooving due to wear and tear may reduce the effectiveness → two valves in series or a two stage homogeniser.
- The principal advantage of two stage method is that it improves dispersion of fat globules and is useful in controlling viscosity of cream and ice cream mix.



Homogenising pump

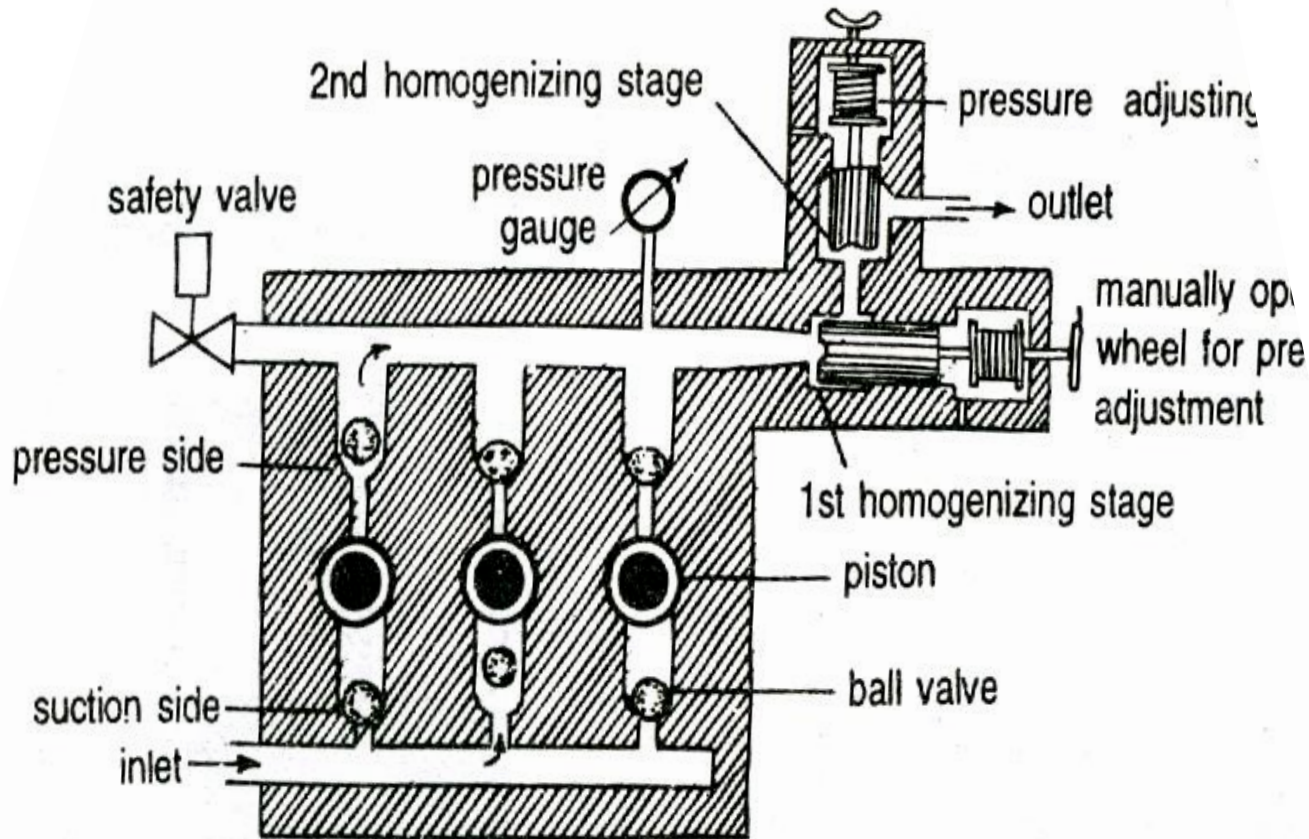
Steady pressure is important because

- The shearing effect of the valve changes with the velocity of the fluid and, for a certain valve, can be correct at only a given velocity.
- With fluctuating pressure, the velocity will fluctuate, thus causing irregular results, non-uniform products and thereby decreasing the efficiency.
- A single plunger pump will develop pulsating pressure.



3-plunger
positive
displacement
pump, or,
triplex pump.

Typical two stage Homogenising valve with 3-plunger pump



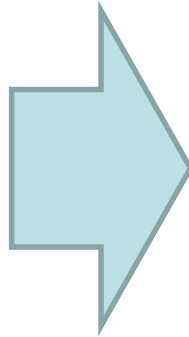
The overlapping of strokes tends to give a reasonably uniform pressure (about 20% pressure variation is there).

Temperature during homogenization

Melting point of fat: **33°C**.

Inactivation of lipase: **55°C**

Viscosity should be optimum



To inactivate the enzyme lipase and to reduce the tension between globules, the milk is heated to **65-70°C** during homogenization.

Pressure during homogenization

- Milk with up to 6% fat content, usually 2000-2500 psi in a single stage is sufficient.
- Higher pressure may increase the tendency for the milk to curdle when cooked, due to the increased destabilizing effect on the milk proteins.
- For products with >6% fat, 2-stage homogenization is needed to prevent fat clumping : 2000 to 3000 psi at the first stage and 500 psi at the second.

Points to be taken care

- **High T \Rightarrow Reduce clustering, Reduce viscosity, Better break up**
- **Low temp (50-55°C) homogenization reduces break up and offers more resistance to flow.**
- **Increase in pr. \Rightarrow Finer break up of fat globules, Increase tendency to form clusters or clumps.**
- **Irregular pulsating pr. \Rightarrow reduce efficiency**
- **High T and high pr \Rightarrow Excessive casein destabilization.**
- **High acidity \Rightarrow More viscosity, Clusters or clumps**

Thank You