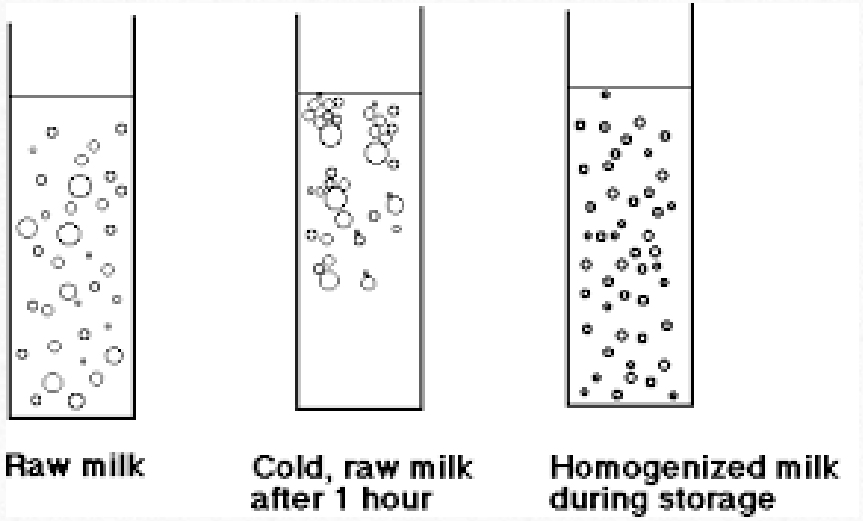
HOMOGENIZATION OF MILK

DEFINITION

Homogenization is the process of breaking up the fat globules in cream to such a small size that they remain Suspended evenly in milk rather than separating out and floating to the surface.



- It is any of several process used to make a chemical mixture the same throughout.

- It is intensive mixing of mutually insoluble phase (sometimes with the addition of surfactants) to obtain a suspension/emulsion.

- The process of homogenization was invented and patented by **Auguste Gaulin** in 1899

- Homogenization primarily cause disruption of fat globules into smaller ones.

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Objective/Purpose of Homogenization

- To reduce the size of fat globules and achieve a uniform diameter of 0.5-1μm or 2μm.
- Creating a desirable rheological properties i.e. formation of homogenization clusters, can generally affect the viscosity of a product such as cream.
- For ease of production of Recombined Milk.

HOMOGENIZATION = **Mechanical Energy** → **Heat**

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Theories of Homogenization

- **Turbulence:** Energy dissipated in the liquid going through the homogenization valve generating intense turbulent eddies of the same size as the average globule diameter. Globules are thus torn apart by these eddies currents reducing the average size.
- **Cavitation:** Considerable pressure drop with change of velocity of fluid. Liquid cavities because its vapor pressure is attained. Cavitation generates further eddies that would produce disruption of the fat globules. The high velocity gives liquid a high kinetic energy which is disrupted in a very short period of time. Increased pressure increases velocity. Dissipation of this energy leads to a high energy density (energy per volume and time). Resulting diameter is a function of energy density.

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Homogenization Process

- Homogenization effect is achieved by pushing liquid (milk) under a very high pressure through a very narrow orifice, whose diameter is just slightly larger than the diameter of fat globules.
- When the liquid passes through the narrow gap the flow velocity increases.
- The speed will increase until the static pressure is so low that liquid starts to boil.
- The maximum speed depends on the inlet pressure. When liquid leaves the gap the speed decreases and the pressure increases again.
- The liquid stops boiling and steam bubbles implode (collapse)

Homogenization can be done in two ways:

1. Single Stage 2. Two Stage

In single stage & two stage homogenization the total homogenization pressure is measured before the first stage P1 & the homogenization pressure in 2nd stage is measured before the 2nd stage P2.

The 2 stage method is usually chosen to achieve optimum homogenization/efficiency.

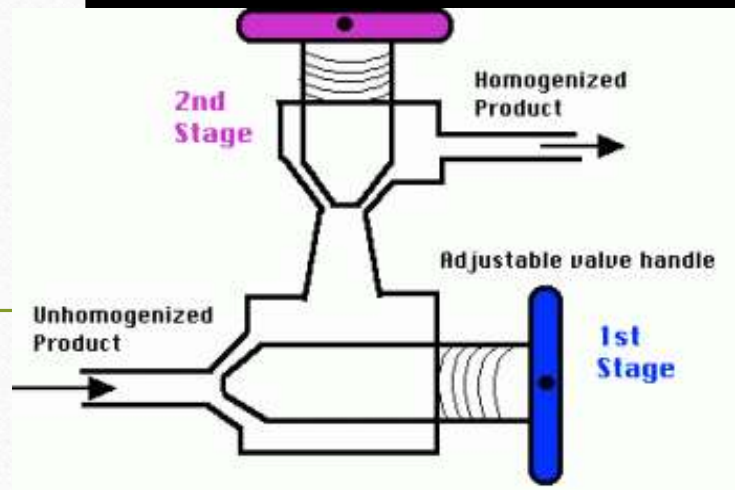
Best results are obtained when P2/P1=0.2

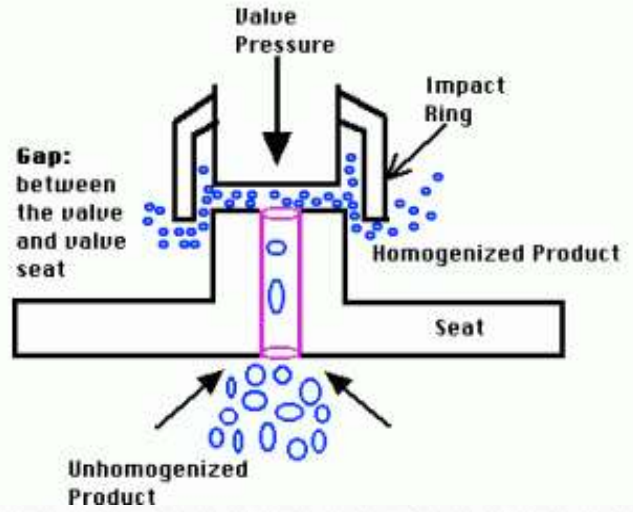
In first stage pressure is around 2000-2500psi & 2nd stage 500-1000psi.

Temperature is 120°F

In 1st stage fat globules join together to form clumps and is known as **Post clumping.**

Single stage homogenization may be used for production of high viscosity product.(Cream)





Process Requirements

- The physical state and concentration of the fat phase at the time of homogenization contribute materially to the size and dispersion of the ensuing fat globules.
- Cream with higher fat content than 12% cannot be homogenized because it causes clumping & shortage of membrane material (Casein). Therefore, a good homogenization effect requires 0.2g casein per g of fat.
- Temperature during homogenization range from 55 – 80ºC & homogenization pressure is between 10-25Mpa (100 – 250 bar) depending on the product.

Factors affecting Homogenization

- **Temperature of Milk**: Milk should have above 33C temperature at the time of homogenization for fat phase in liquid for proper subdivision.
- **Pressure of homogenization**: 10-25Mpa (100 – 250 bar)

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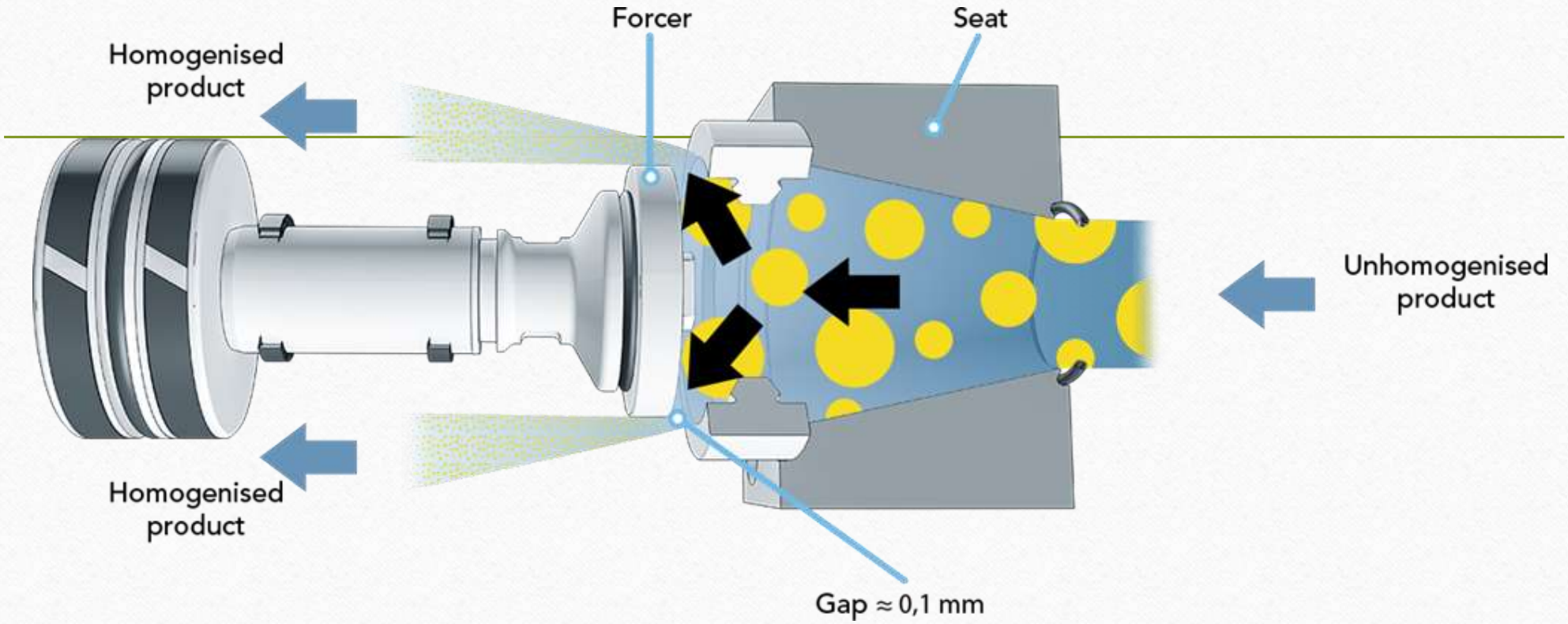

Effects/Advantages of Homogenization

- Smaller fat globules leading to no cream-line formation.
- Whiter and more appetizing color.
- Reduced sensitivity to fat oxidation.
- More full-boiled flavor & better mouthfeel
- Better stability of cultured milk products (Soft curd).

Disadvantages

- Homogenized milk cannot be efficiently separated.
- Milk will not be suitable for production of semi hard/hard cheese because the coagulum will be too soft.
- Reduced heat stability in case of single stage homogenizer, high fat content & forms clumping of fat globules.
- More susceptible to ‘sunshine flavour’

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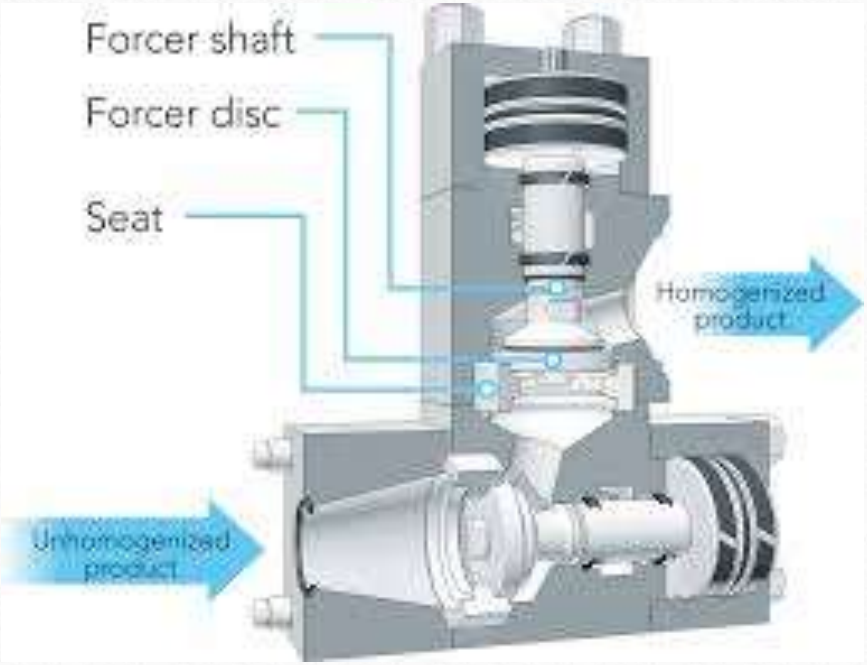
Application of homogenization

1. Fresh milk – Creaming of fat is avoided & taste improvement is achieved.
2. Coffee cream, Evaporated Milk – Avoids creaming improves whitening power in coffee.
3. Cheese milk – Reduce the fat content of whey, provides a more uniform fat distribution in the cheese mass, inhibits 'fat sweating' of cheese & enhance the biochemical fat degradation.
4. Acidified dairy products – Improvement in consistency, taste, more stable acid gel & reduced whey synergizes in yoghurt & in other coagulated products.
5. Milk mix beverage – Good distribution of additive & fat.
6. Ice-cream mix – Reduced buttering of fat during freezing.

- Homogenization can be:

1. Complete Homogenization – E.g. Milk
2. Partial Homogenization – E.g. Cream

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