

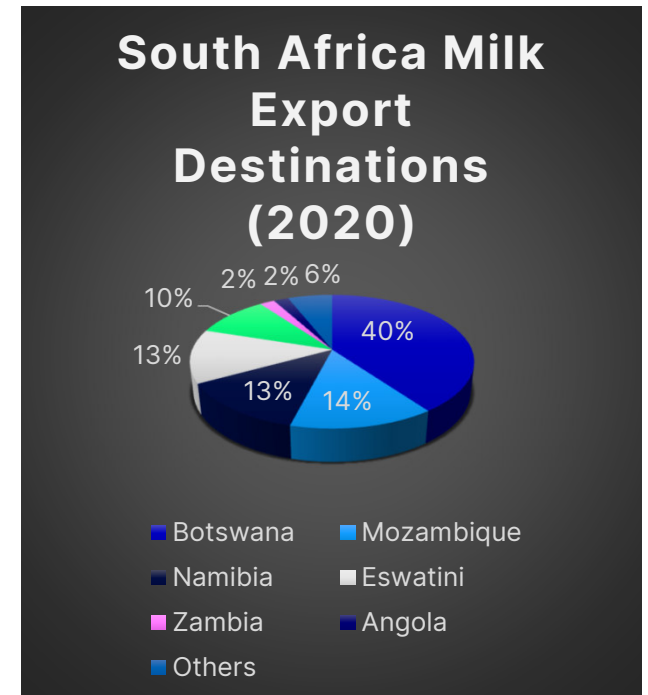
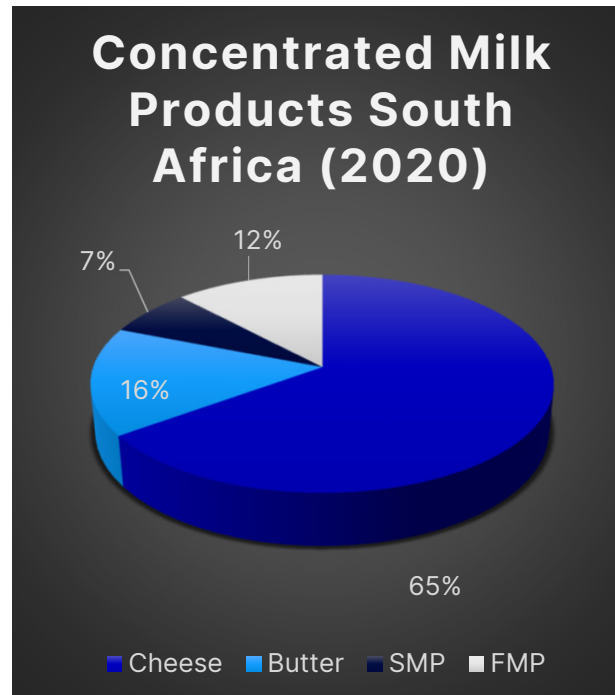
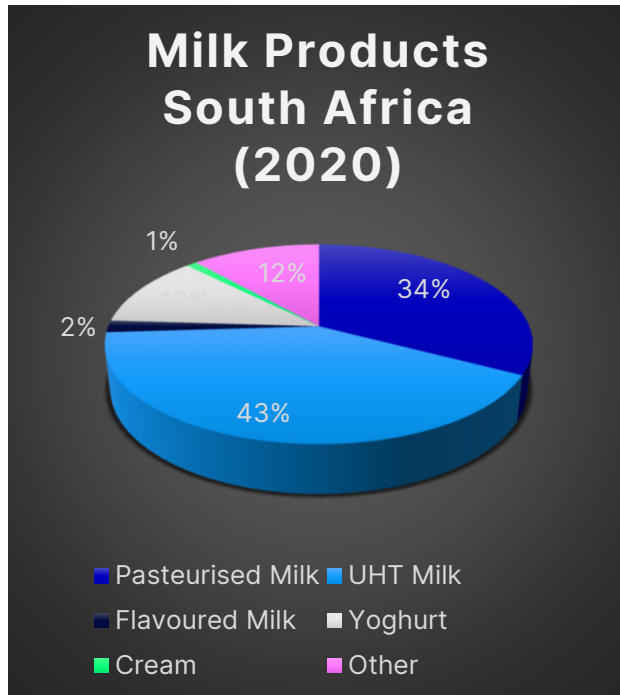
MILK PASTEURISATION

Increasing the shelf-life

Jan Bunk and Riaan Botha

Market report South Africa

1. Market Overview: Dairy Categories South Africa



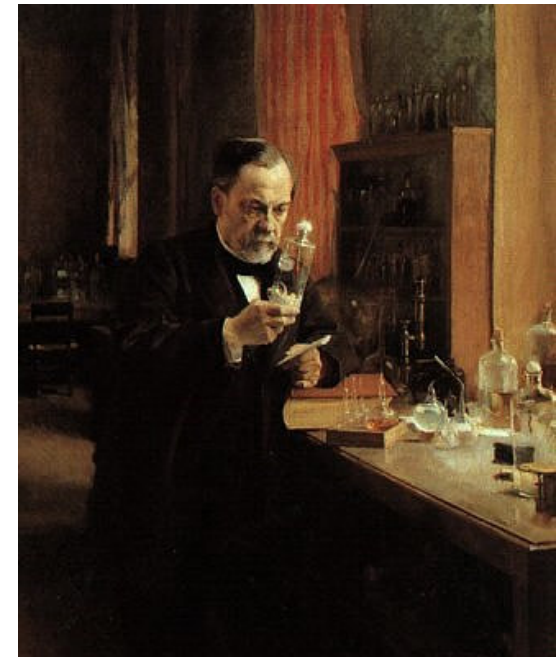
Gross Value of Milk Production 16 Billion ZAR (2019)

Gross Value of Export 3 Billion ZAR (2019)

Total milk produced 3.43 million tons (2019)

Pasteurisation History

- Pasteurize means to heat food to a temperature that will kill harmful microorganisms but not alter the quality of the food, or the taste.
 - Louis Pasteur
1822 – 1895
French physicist and chemist
 - research on the difference between fermentation and putrefaction
 - discovery of microorganisms
 - identification of pathogenic microorganisms
 - discovery of heat sensitivity of microorganisms
 - definition of a heating process of 69°C – 75°C for wine in closed bottles to prevent decomposition



Why Pasteurisation

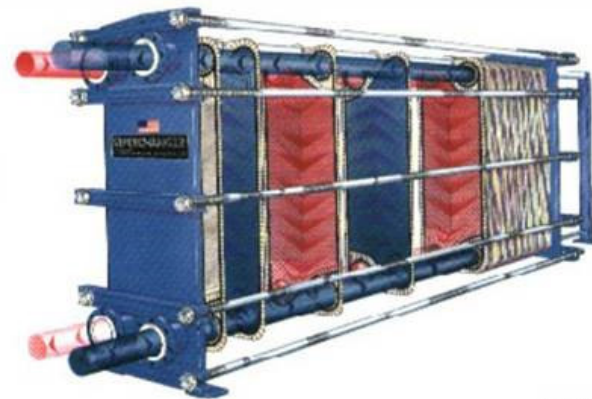
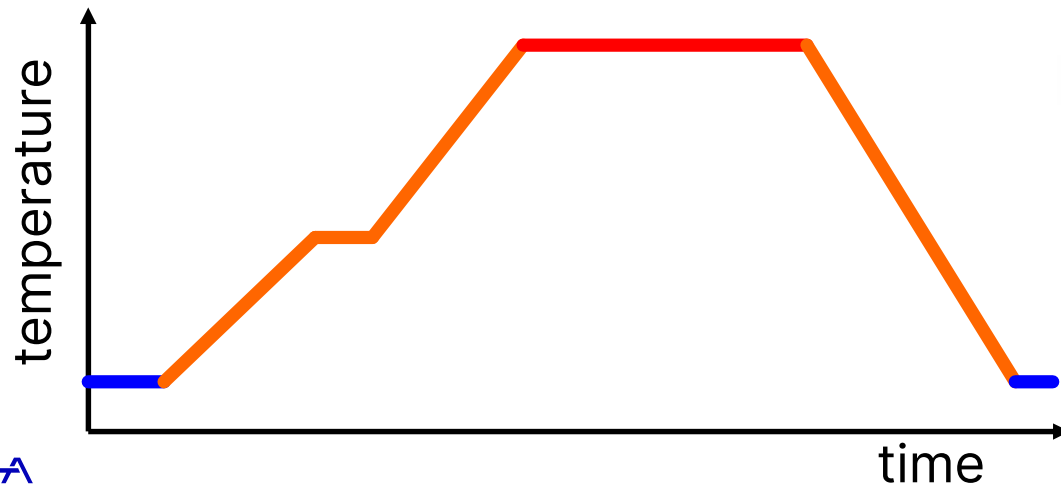
- Pasteurisation kills harmful organisms responsible for such diseases as **listeriosis, typhoid fever, tuberculosis, diphtheria, Q fever, and brucellosis.**
- Raw milk can carry dangerous germs, such as **Brucella, Campylobacter, Cryptosporidium, E. coli, Listeria, and Salmonella**, which can pose serious health risks to you and your family.
- **Pasteurisation DOES NOT reduce milk's nutritional value.**
- Forty studies assessing the effects of Pasteurisation on vitamin levels were found. Qualitatively, **vitamins B12 and E** decreased following Pasteurisation, and vitamin A increased

Milk Heating Processes

- Today **Pasteurisation** is the name for various heating processes in the dairy and beverage industry for partial destruction of microorganisms.

This can be continuous (heat exchanger) or batch wise (filled package)

- For continuous Pasteurisation processes mostly **plate heat exchangers** are used.



mass
balance

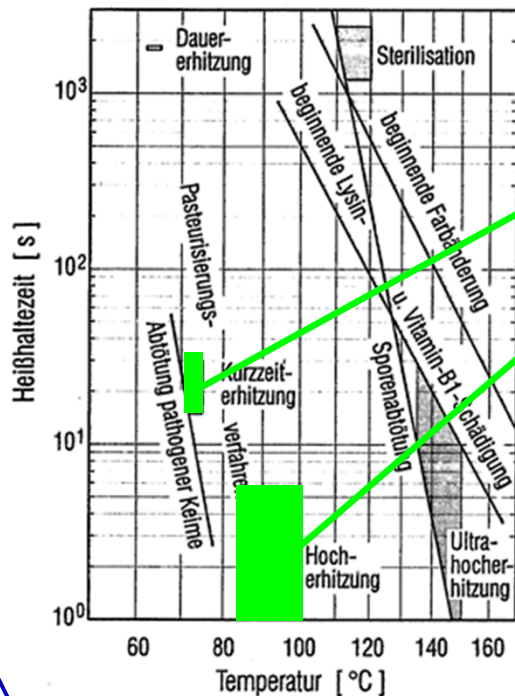
Milk Heating Processes

Effects of a Pasteurisation process are:

- killing of all pathogen microorganisms
 - destruction of unfavourable microorganism
 - inactivation of enzymes
 - denaturing of proteins
 - caramelising
 - cooking flavour
 - degradation of vitamins
- disease prevention
 - extension of shelf life
 - extension of shelf life
 - required for some milk products
 - browning at higher temperatures
 - flavour changes
 - undesired changes

Milk Heating Processes

- **Legal regulations** define heating temperatures and holding times with the main focus of disease prevention.
- In Germany the following processes are approved for the Pasteurisation of liquid milk:



- **long term** heating 62°C - 65°C, 30 min no more in use
- **short term** heating 72°C - 75°C, 15 s – 30 s ~ 1 week shelf life
- **high temperature** >85°C (cooking flavour) heating
- **UHT** 135°C – 150°C, 2 s – 4 s 3 months shelf life carton package
- **sterilisation** > 121°C, > 3 min heating in closed packages

milk for further processing (i.e. yoghurt, cheese) can be treated at **different conditions**

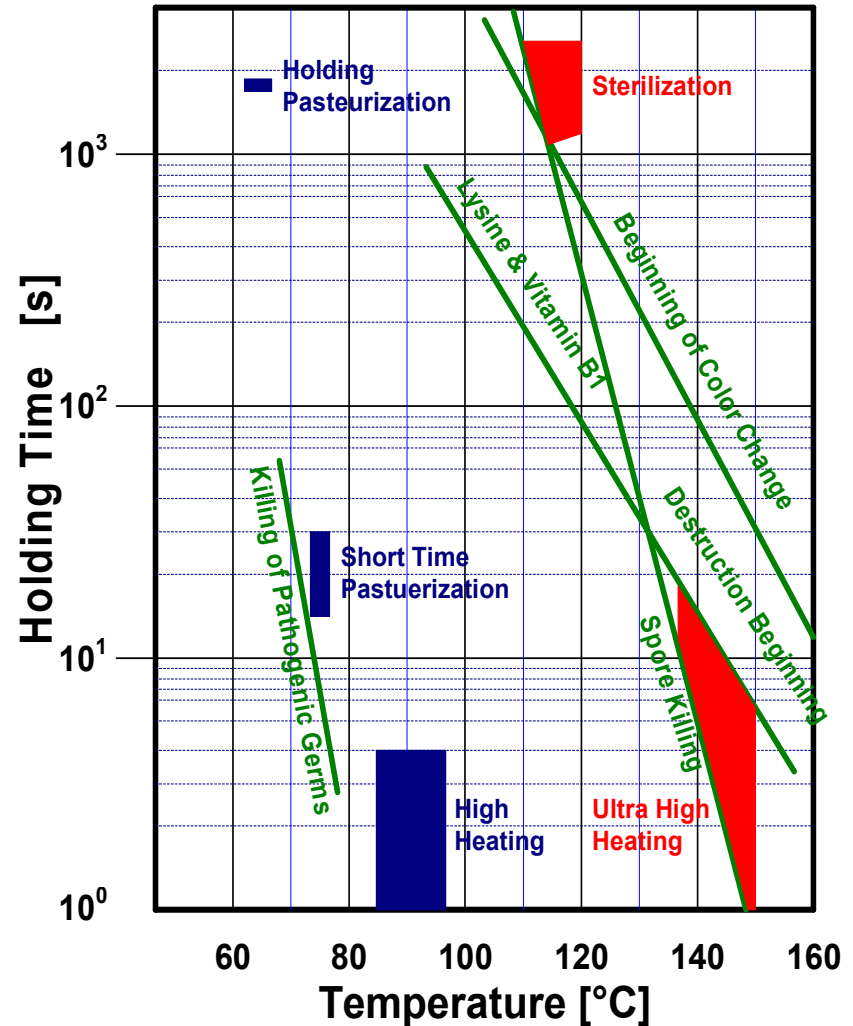
General UHT basics

Bacteriological and chemical effects

Logarithmic shown equivalent treatment time at specific treatment temperature.

Pasteurisation corresponds to the killing of **pathogenic germs**, so that subsequent storage of the product within the **cold chain** is ensured (in compliance with the legally prescribed shelf life).

UHT means the killing of **germs and spores**, so that a subsequent storage **outside the cold chain** is ensured (in compliance with the legally prescribed shelf life).



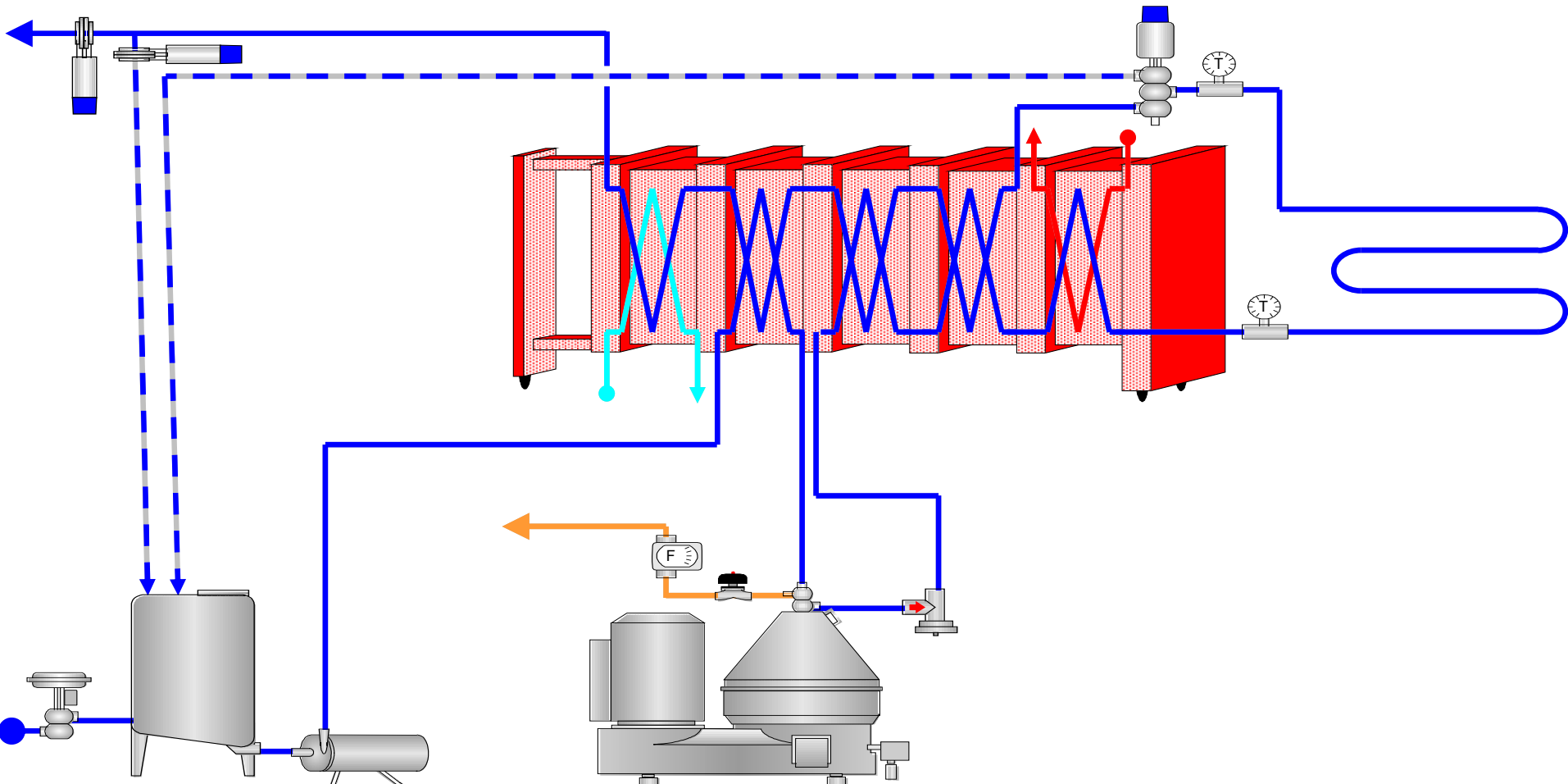
Process steps for producing Fresh/ESL and UHT - milk

	1	2	3	4	5	6
Past.fresh milk	Heating 55°C	Skimming	Standardi- sation	Homogeni- sation	Pasteuri- Sation 74°C / 25-30 sec.	Cooling 4°C
ESL milk	Heating 55°C	Skimming	Standardi- sation	Homogeni- sation	UH Heating 127°C 3 sec.	Cooling 4°C
UHT milk				Homogeni- sation	UH Heating 145°C 2-3 sec.	Cooling 4°C

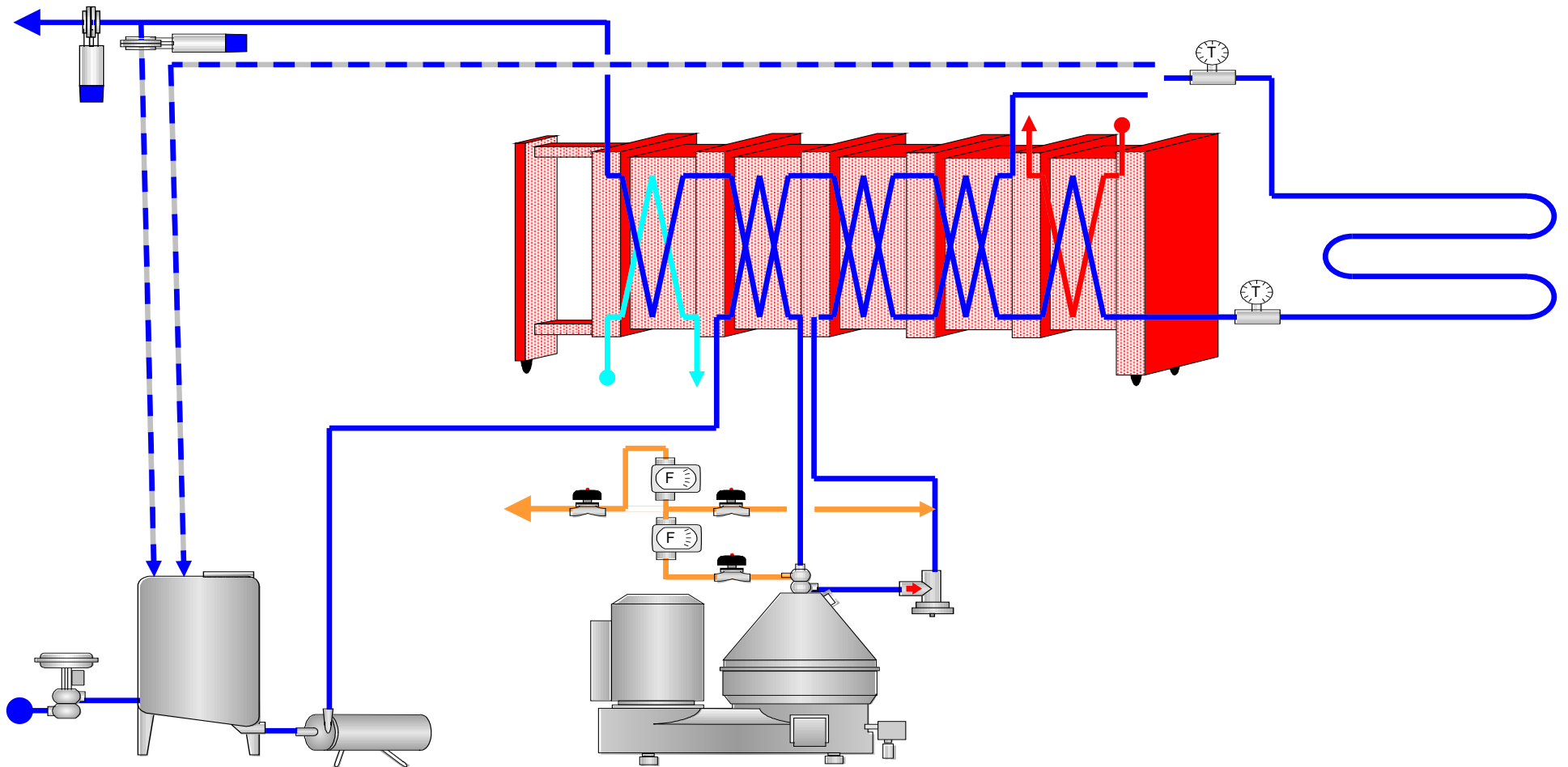
**Elimination of undesirable constituents
like dirt, blood, somatic cells, bacteria and spores!**

**Norm in SA 20.000 -100.000 bacterial spores / ml
Norm in EA 1.000.000-12.000.000 bacterial spores / ml**

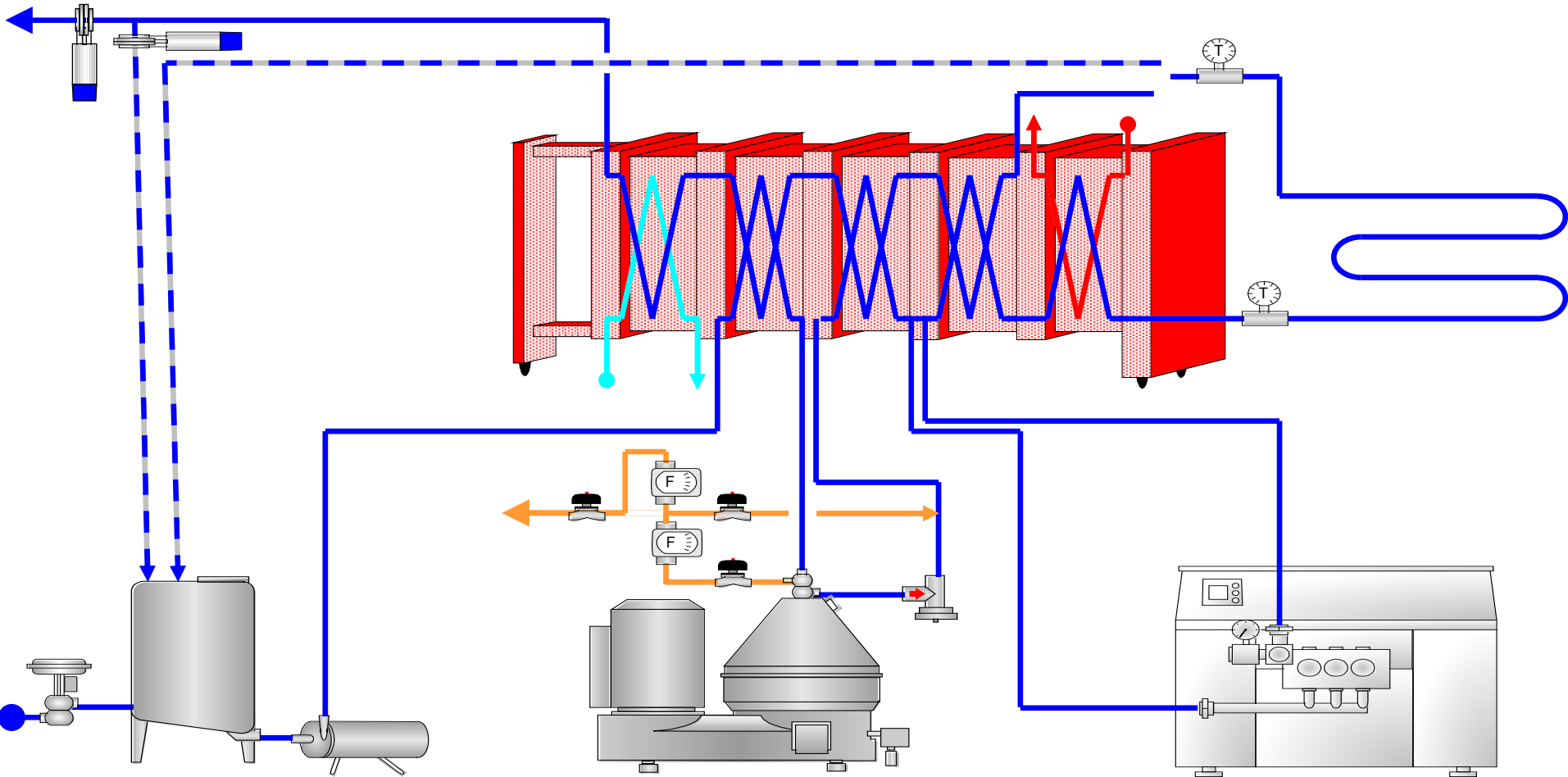
Pasteuriser Process



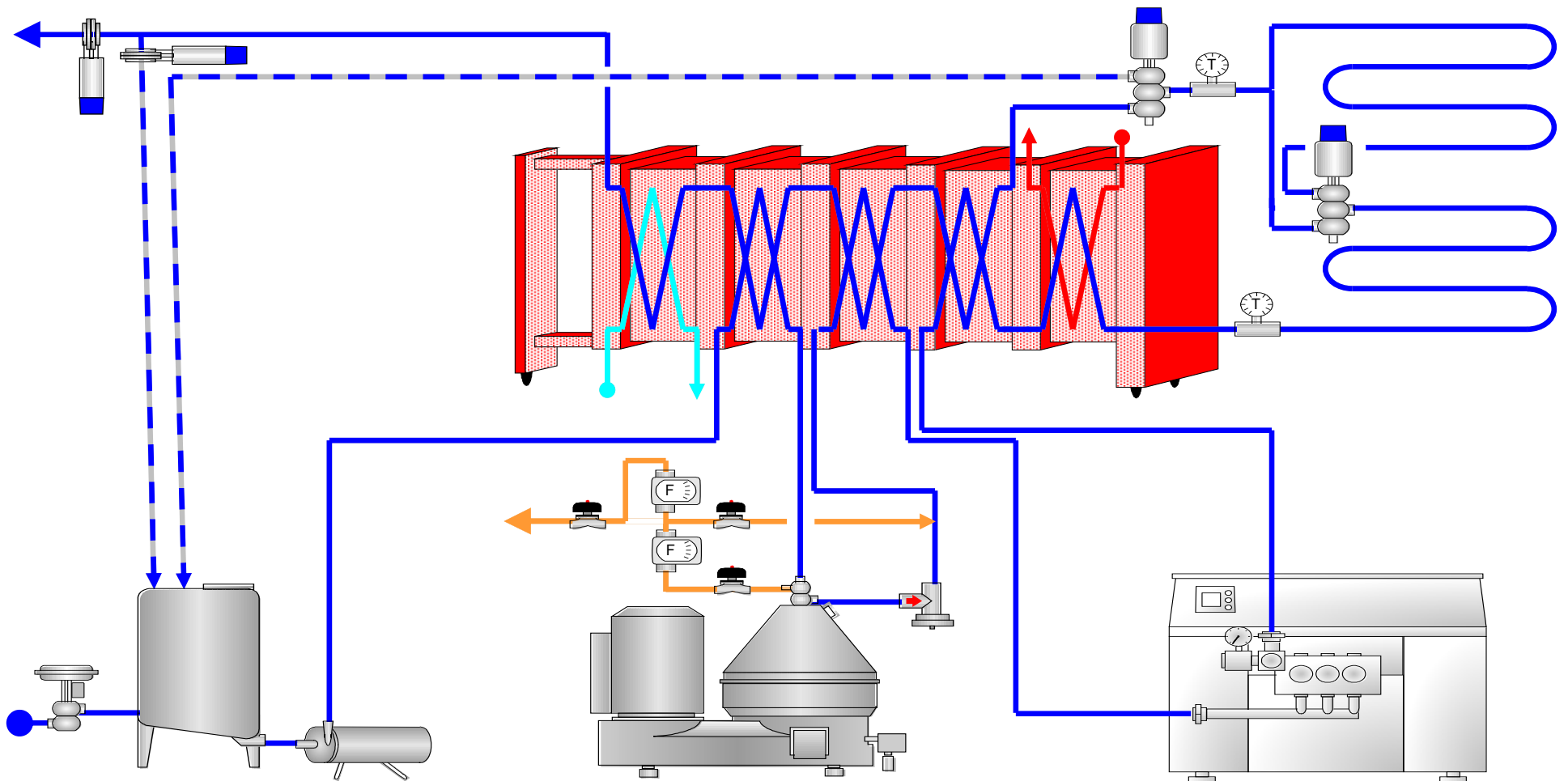
Option: Manual Standardising



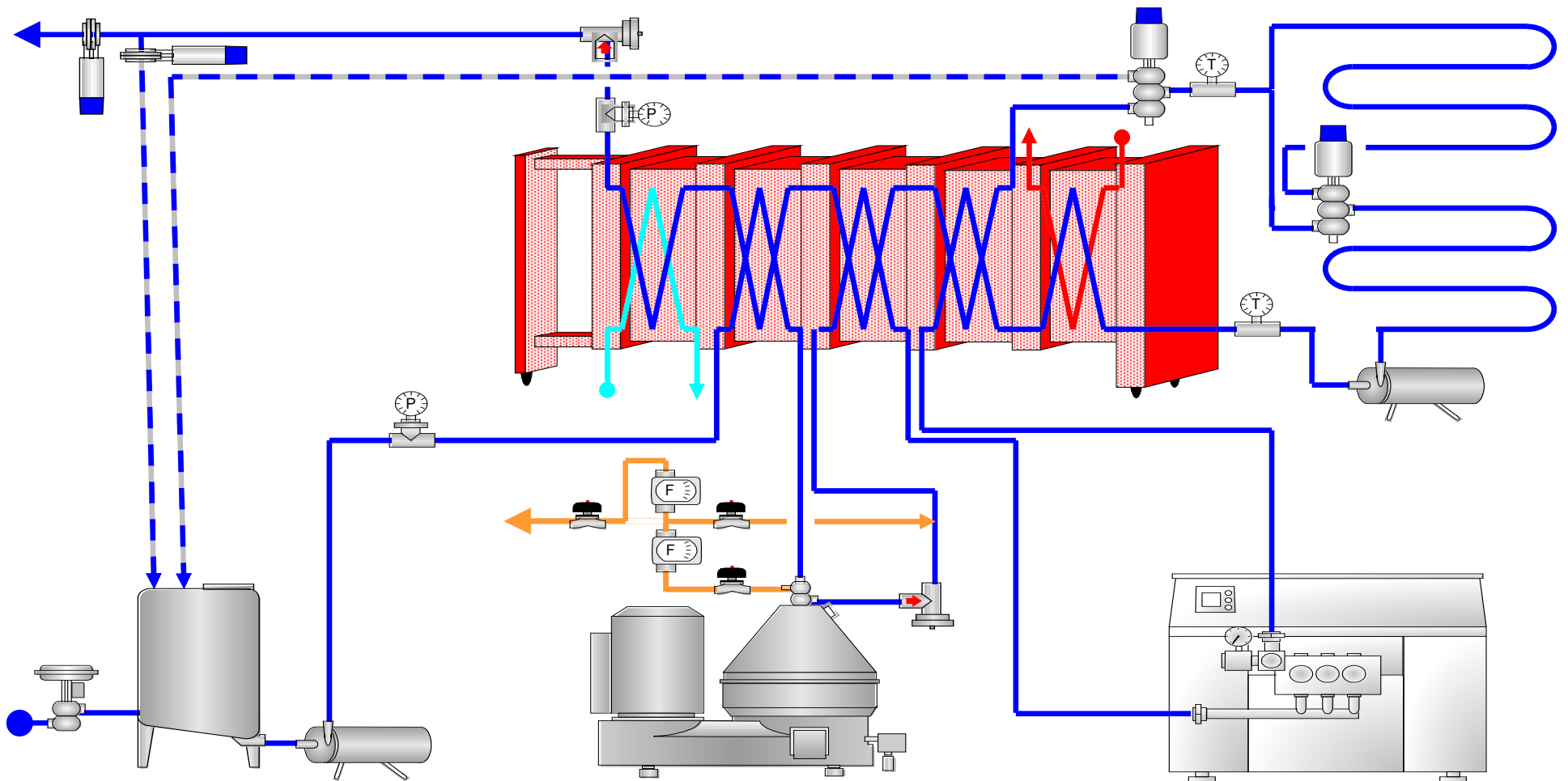
Option: Homogenizer



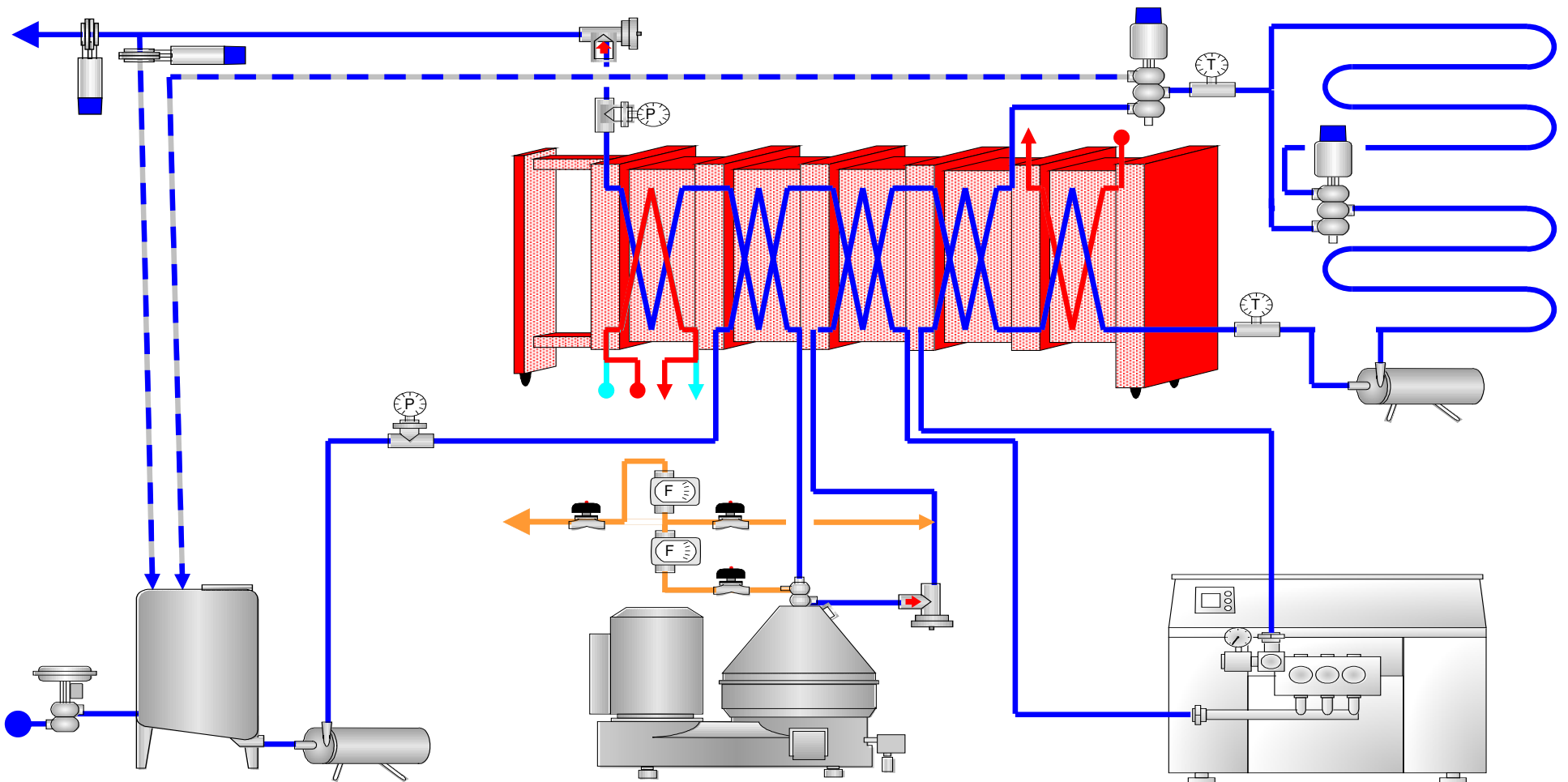
Option: Extended Holding Time



Option: Differential Pressure Control

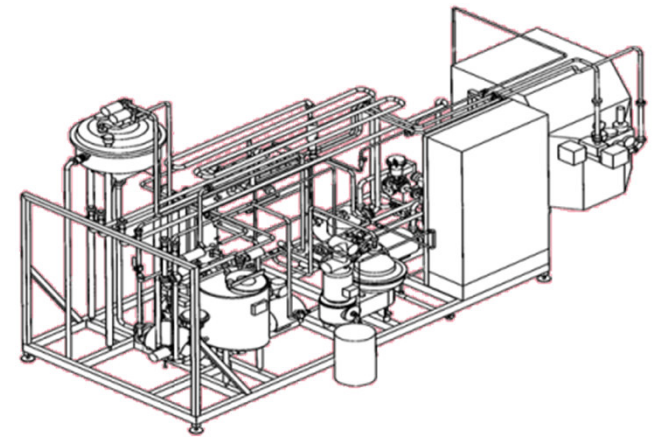


Option: Post Heating



Standard

- **skid** mounted units with internal piping and internal wiring, easy installation and commissioning
- **graphic control panel**
- **full automatic** design
- **balance tank** with level control
- **plate heat exchanger** with 92% heat regeneration
- **skimming separator**
- **standomat MC**
- short term heating **74°C**
- holding tube **15 s**
- paperless temperature **recorder**
- ice water **cooling**



Options

- increased **heating temperature** (variable)
- extended **holding time**
(variable by change over valve)
- **variable** capacity
- manual **standardising** unit or Standomat
- single or double **bacteria removal**
- partial or full flow **homogeniser**
- **deaerator**
- **cream cooler**
- **post heating**
- **cream pasteurisation**
- **differential pressure** control
- **CE** conformity, **EAC** certificate



Standard and Options

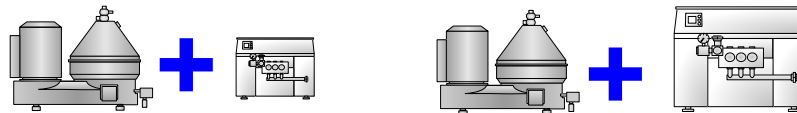
- The **pressure at the mixing point** for the standardisation has to be low enough (approx. 2 bar) to enable flow from the cream as well as from the skim side. This applies for automatic as well as for manual standardising.

On the other hand the homogeniser needs a sufficient **supply pressure** of approx. 2,5 - 4 bar.

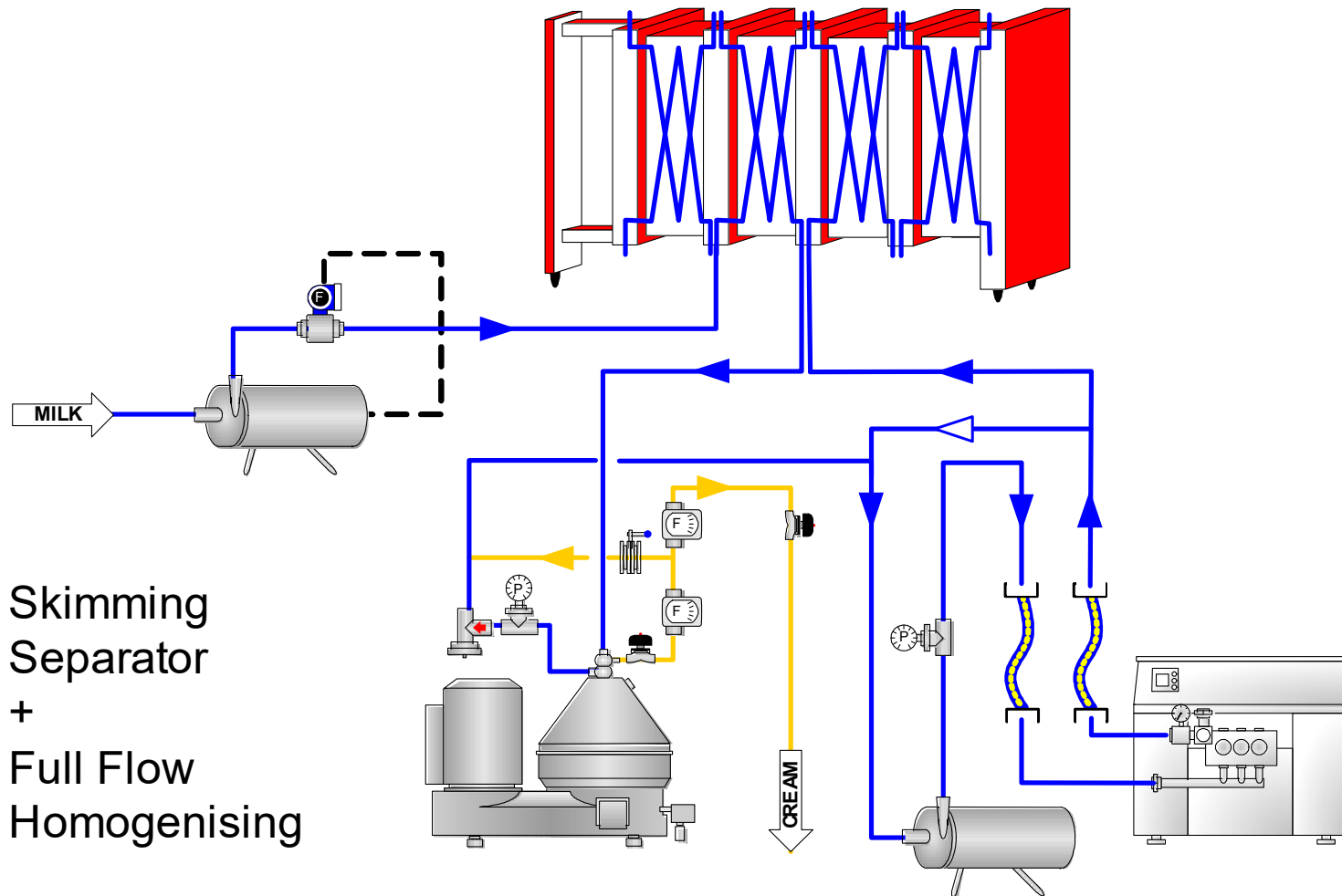
Thus a **booster pump** between standardising and homogenising is necessary.



- A **recirculation possibility** enables full homogeniser flow even when the separator flow is low during discharge.
- For **partial homogenising** the homogeniser capacity should be approx. **1/3** of the system capacity.
- For **full flow homogenising** the homogeniser capacity must be slightly higher than the system feed capacity to avoid unhomogenized product to pass through.
- The connection of the homogeniser should comprise some **damping elements** to keep the vibrations from the rest of the system.



Separator + Homogeniser



Skimming
Separator
+
Full Flow
Homogenising

Homogenizer



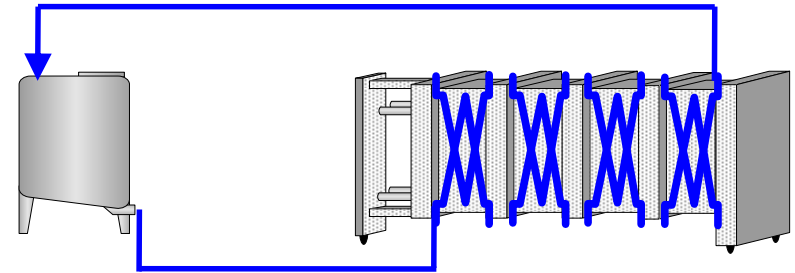
homogenizing conditions recommended by Niro Soavi

milk	65°C	2 stages or 1 stage	140 bar / 20 bar 160 bar
cream 10%	75°C	2 stages	180 bar / 40 bar
cream 20%	75°C	2 stages	130 bar / 25 bar
cream 30%	75°C	2 stages	80 bar / 15 bar
cream 40%	75°C	1 stage	45 bar
cream 45%	75°C	1 stage	30 bar

Production Organisation

Product recirculation should always be avoided for a couple of reasons:

- Multiple heating is increasing the **temperature impact** on the product, **taste** and **colour** are changing.
- Returning standardised milk to the balance tank changes the “raw” milk fat content. As a result the cream fat will be decreasing and the **standardizing** will **be out of control** for a while.
- Returning **homogenized** milk into the balance tank makes a **separation** almost **impossible**. The cream fat will decrease while the skim milk fat is increasing.



Production Organisation

- A long continuous production at steady conditions is reducing mixing phases between different products. Avoid very short production runs and frequent changes of parameters.
- Changing setpoints you should avoid unnecessary and big jumps. Please have in mind that there are mixing phases due to the necessary re-stabilising of the control loops and due to product push out.
- The order of a product sequence should be consistent regarding cream and milk fat content (i.e. 2% - 2,5% - 3%), heating temperature (i.e. 92°C – 84°C – 76°C) and so on.



Production Organisation

A high **raw milk quality** is essential for the production of high quality products. The minimum raw milk standards for our pasteurisers are:

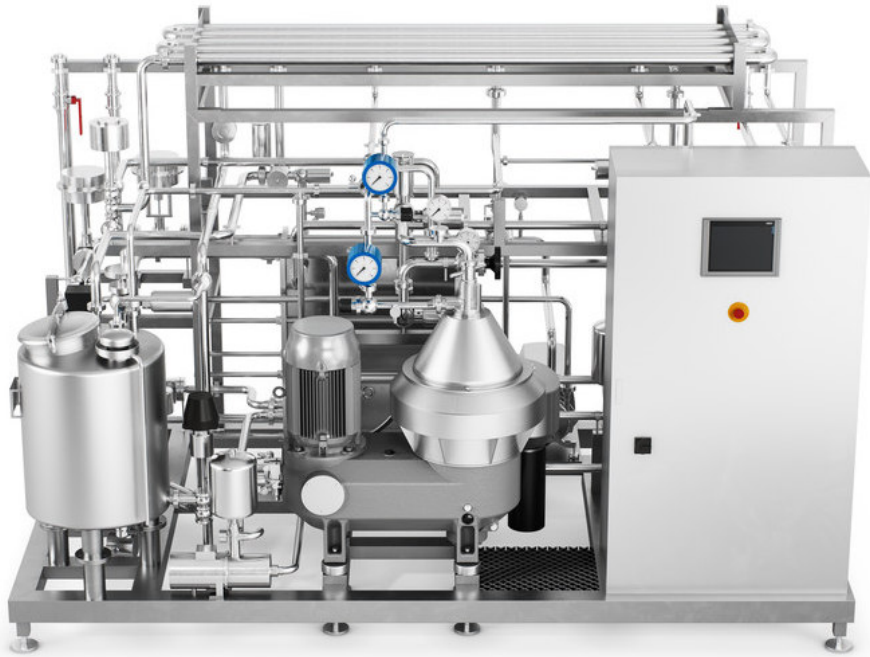
- **pH** value
- storage **temperature**
- **age**
- total **bacteria count**



6,6 – 6,8
 $\leq 8^{\circ}\text{C}$
 $\leq 48 \text{ h}$
 $\leq 1.000.000 \text{ cfu/ml}$

- The **production time** of a pasteuriser is limited by the fouling of the heating section in the plate heat exchanger. This fouling is very dependent on the raw milk quality.
- If product is burning on on the heat transfer surface the **temperature difference** between hot water and product is increasing. Monitoring this temperature difference enables you to run the plant according to the actual conditions until an **alarm** message tells you to shut down the production.

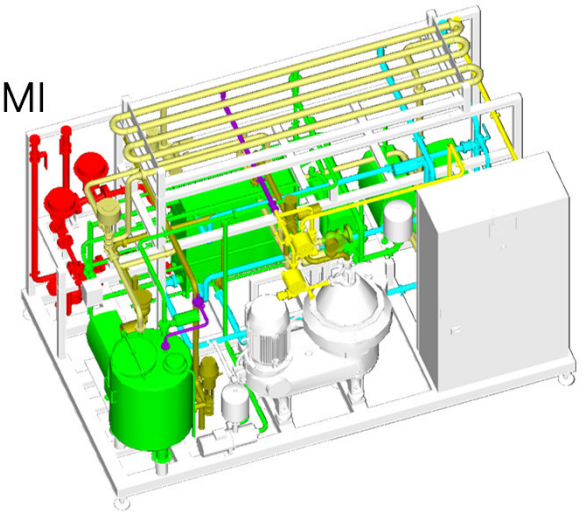
Small Scale Pasteurizers



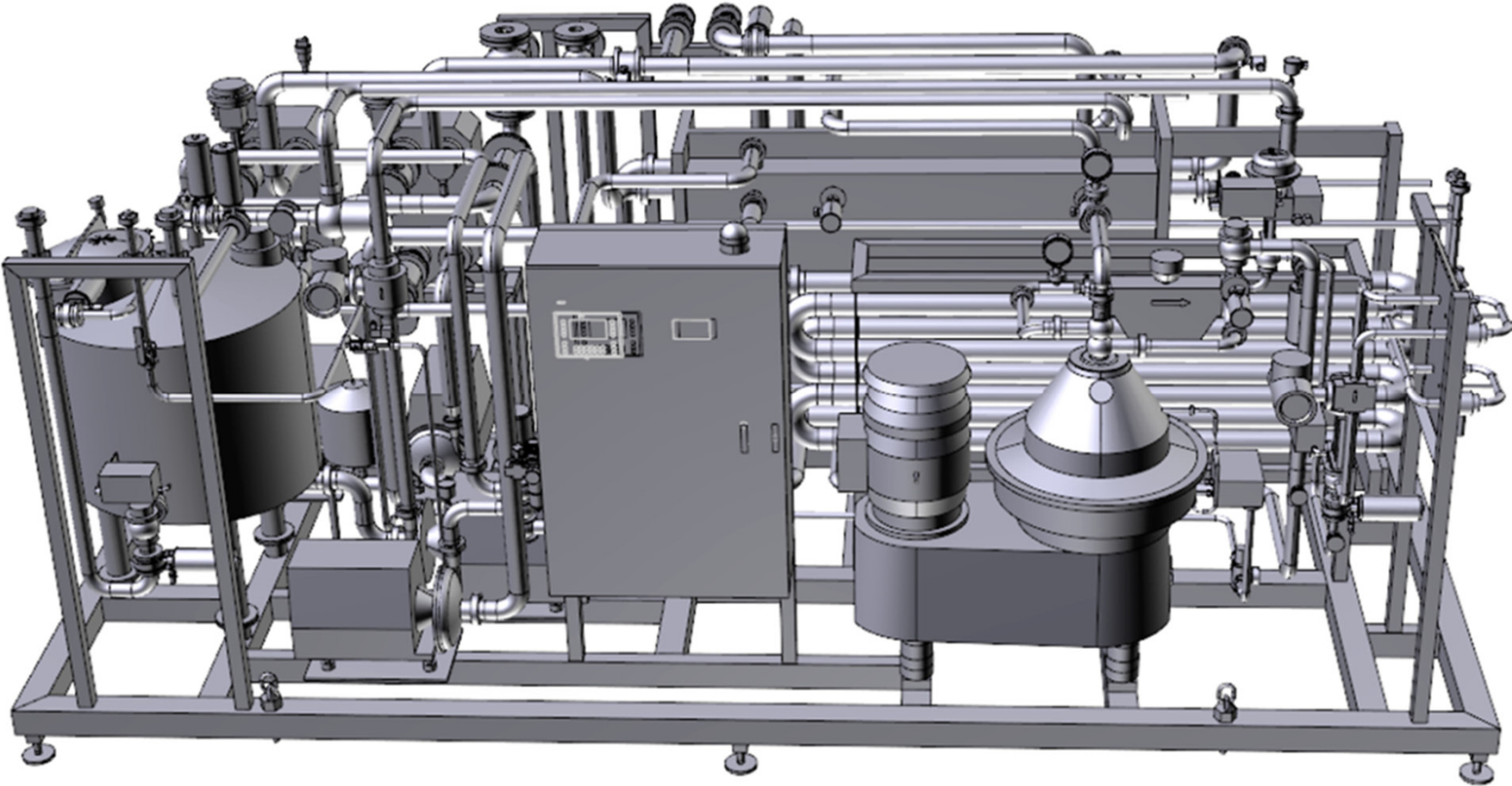
- A **modular system** of small scale pasteurizers is available now.
- **3 capacities** 3.000 l/h / 5.000 l/h / 10.000 l/h
- **Long holding** tube optional
- **Post heating** optional
- Manual **standardizing**
- **NO** other options

Concept Small Scale Pasteurizers

- 3 sizes
 - 3.000 l/h (DN 25, GEA milk skimmer pro 20)
 - 5.000 l/h (DN 40, GEA milk skimmer pro 40)
 - 10.000 l/h (DN 50, ecocream)
- 3 variants
 - milk pasteurizer 4°C – 75°C / 20 s – 4°C
 - cheese milk pasteurizer 4°C – 75°C / 20 s – 5°C or 30°C
 - yogurt milk pasteurizer 4°C – 75°C / 20 s or 300 s – 5°C or 30°C
- Standard equipment
 - PLC control for machine and process
 - paperless recorder for pasteurizing temperature and system status
 - 90% heat recovery
 - booster pump for operating water
 - manual standardizing / flow calculator on HMI
 - internal CIP
 - skid mounted including separator and MCC / PLC
- Options
 - partial flow homogenizer
 - differential pressure control / monitoring
 - cream cooler
 - mobile crane for separator service



Examples



Examples



Examples



Jan Bunk

Head of Dairy Application Sales
Sales & Service

Liquid & Powder Technologies | LPT Execution - EMEA

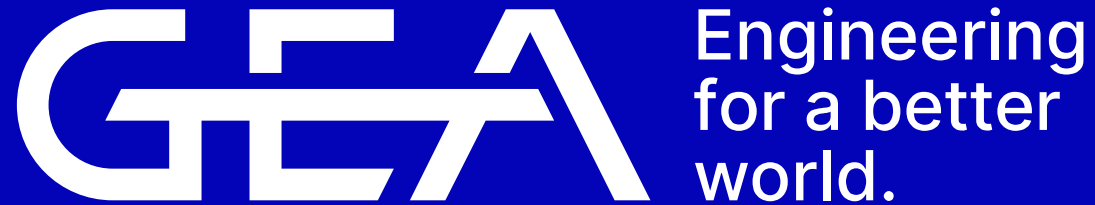
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