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Tetra Pak PSE Liquid Food Solutions, Business Stream Dairy

Pasteurization of Milk

Tetra Pak®
PROTECTS WHAT'S GOOD

Agenda

The milk pasteurizer

- Purpose
- Incoming milk quality
- Running time
- Cleaning

Separation processes

- Hot or cold milk fat separation
- Spore removal in Bactofuge unit

Summary

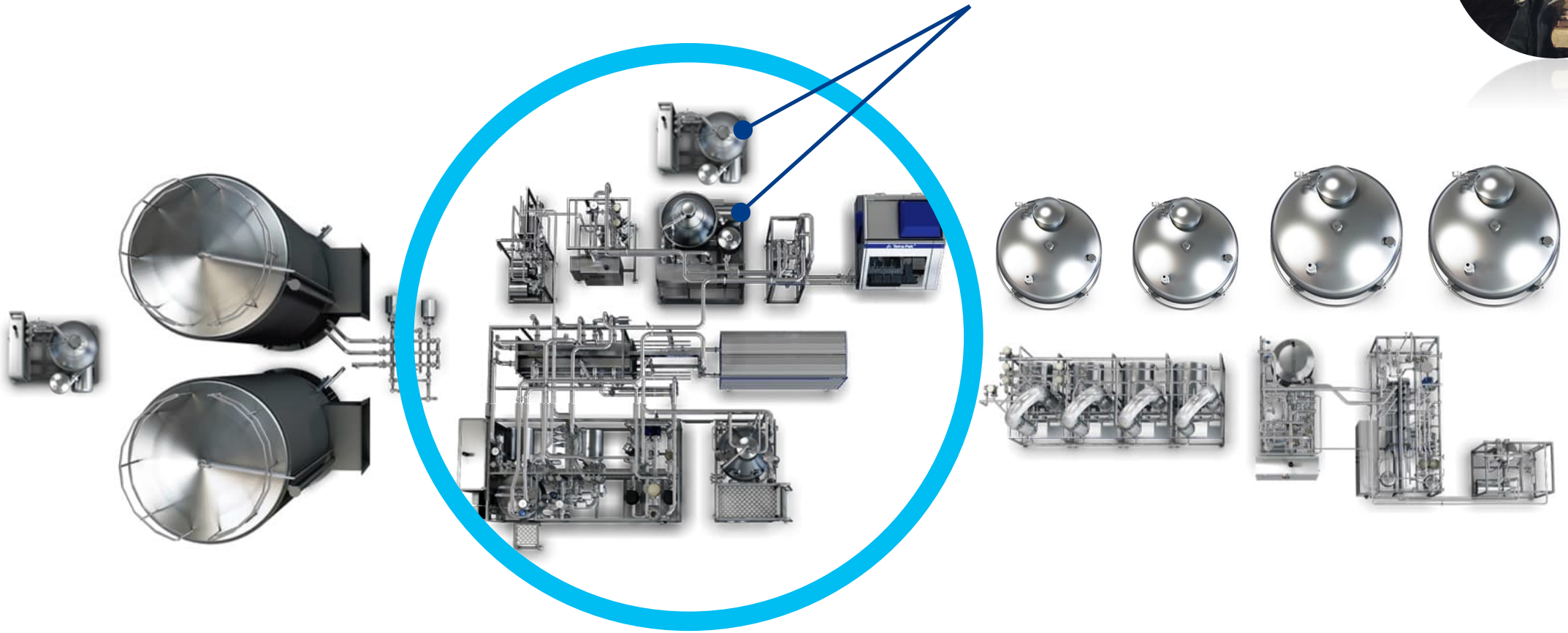
THE MILK PASTEURIZER

- Purpose

- functions and features
- running time
- cleaning

Processing line for pasteurized milk

Louis Pasteur
1822-1885



Legal / Standard definitions of pasteurization

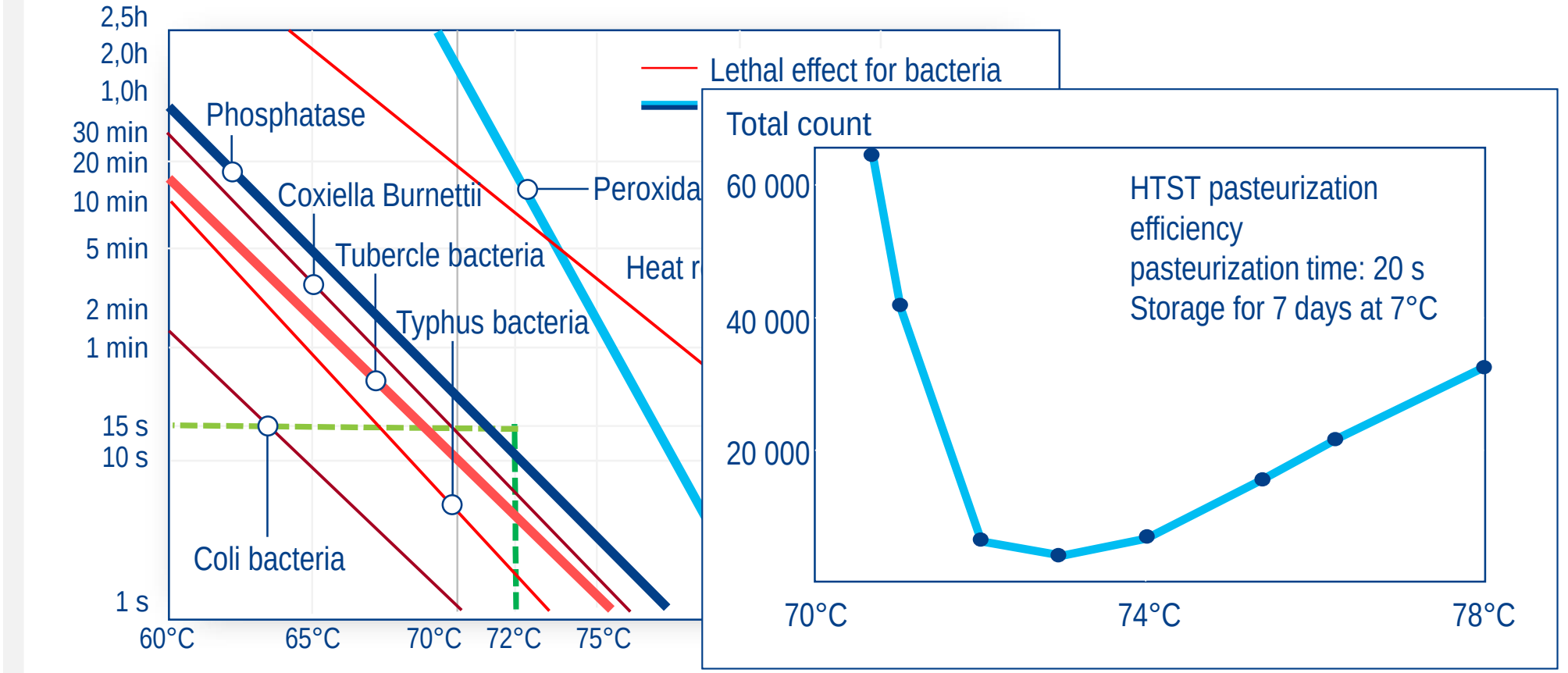
- **Codex Allimentarius:** *C. burnettii* is the most heat – resistant non-sporulating pathogen likely to be present in milk, pasteurization is designed to achieve at least a 5 log reduction of *C. burnettii* in whole milk (4% fat)
- **PMO**

OO. **PASTEURIZATION:** The terms "pasteurization", "pasteurized" and similar terms shall mean the process of heating every particle of milk or milk product, in properly designed and operated equipment, to one (1) of the temperatures given in the following chart and held continuously at or above that temperature for at least the corresponding specified time:

Batch (Vat) Pasteurization	
Temperature	**Time**
63°C (145°F)*	30 minutes
Continuous Flow (HTST and HHST) Pasteurization	
Temperature	**Time**
72°C (161°F)*	15 seconds
89°C (191°F)	1.0 second
90°C (194°F)	0.5 seconds
94°C (201°F)	0.1 seconds
96°C (204°F)	0.05 seconds
100°C (212°F)	0.01 seconds

*If the fat content of the milk product is ten percent (10%) or greater, or a total solids of 18% or greater, or if it contains added sweeteners, the specified temperature shall be increased by 3°C (5°F).

A little higher a little better?



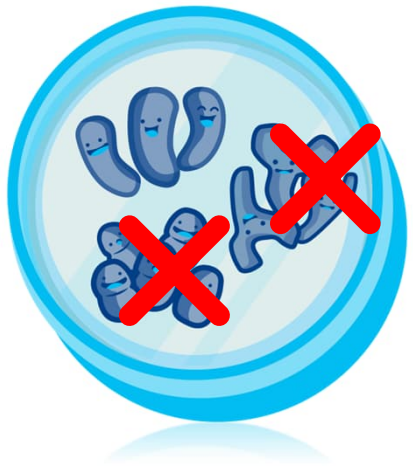
Heat treatment of milk

Pre-treatment		
Thermization	63–65°C/15 sec	Preliminary heating
Chilled distributed products		
LTLT Pasteurization	63°C/30 min	Pasteur‘s method
HTST Pasteurization	72–75°C/15 sec	Milk
HTST Pasteurization	82– 85°C/15 sec	Cream
HTST Pasteurization	90-95°C/5 min	Milk for fermented products
HTT Pasteurization	120–150°C/0,1–4 sec	Cold storage ESL products
Ambient distributed products		
UHT	135–150°C/4–15 sec	
Conventional sterilization	approx. 116°C/20 min	

LTLT = low temperature / long time, HTST = high temperature / short time, UHT = ultra high temperature; HTT = High Temperature Treatment

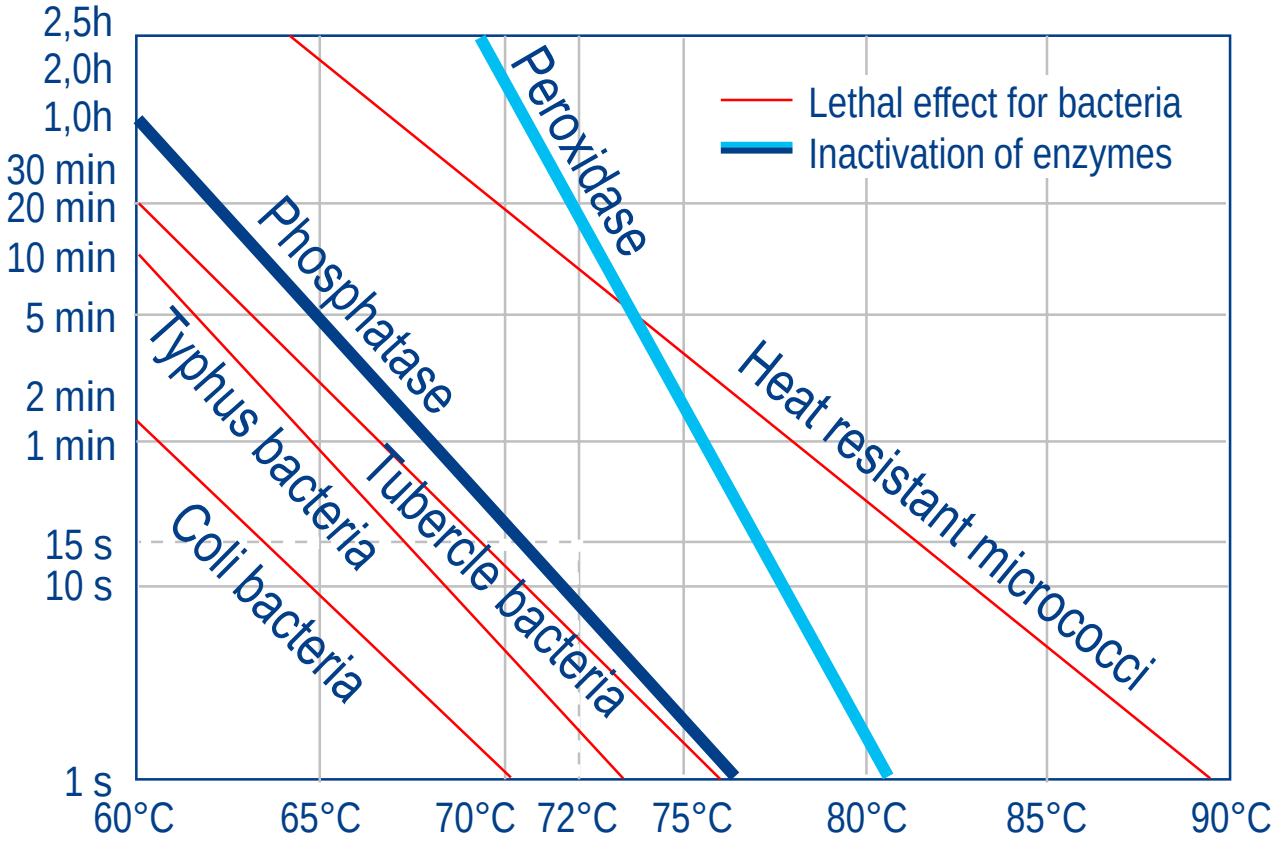
Increased impact on Product qualites

Limited microbiological shelf life



HTST pasteurization for Cream

- **Standards for cream >10% fat**
  - +3°C from milk 4%, i.e., 75°C
- **Recommendation for cream >10% fat**
  - 82 °C for 15sec
  - phosphatase and peroxidase are inactivated
  - Increased temperature for improved
  - deactivation of enzymes



The key is to control growth through the process

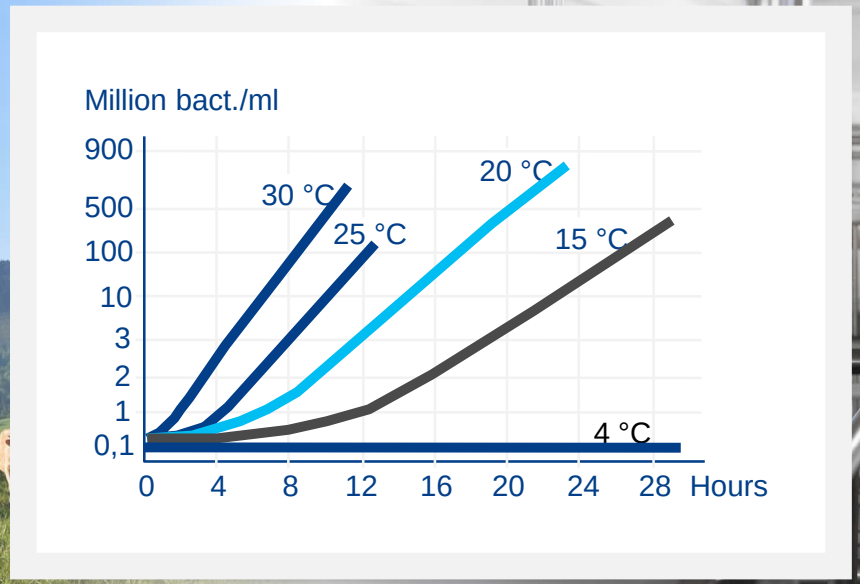
MINIMISE

Incoming flora	Process Survivors	Re-infection	Growth
			
Raw material quality Transportation	Processing parameters	Hygienic design & operation	Chilled operation

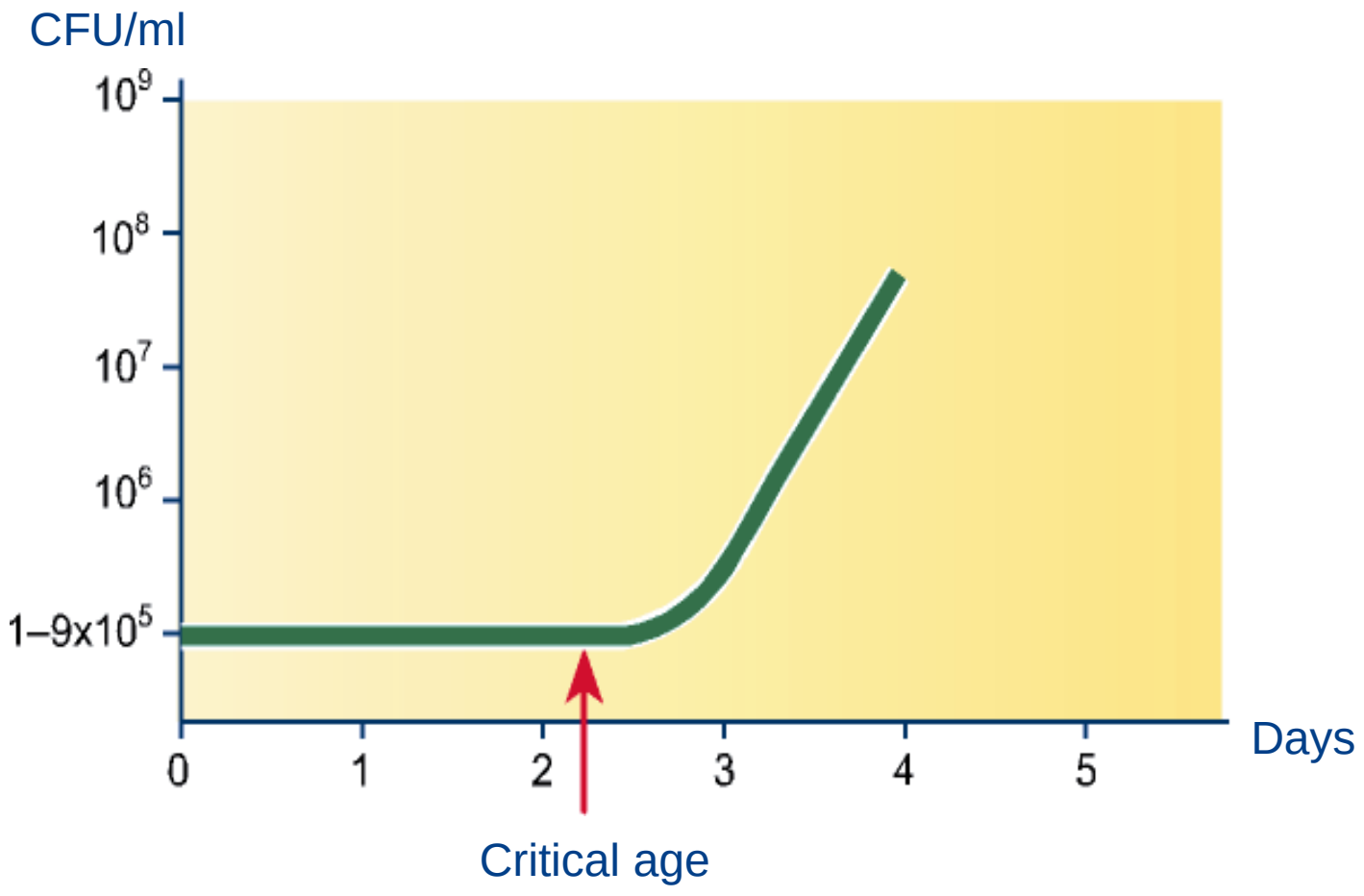
PARAMETERS TO CONSIDER

Raw milk to the dairy

From farm to dairy



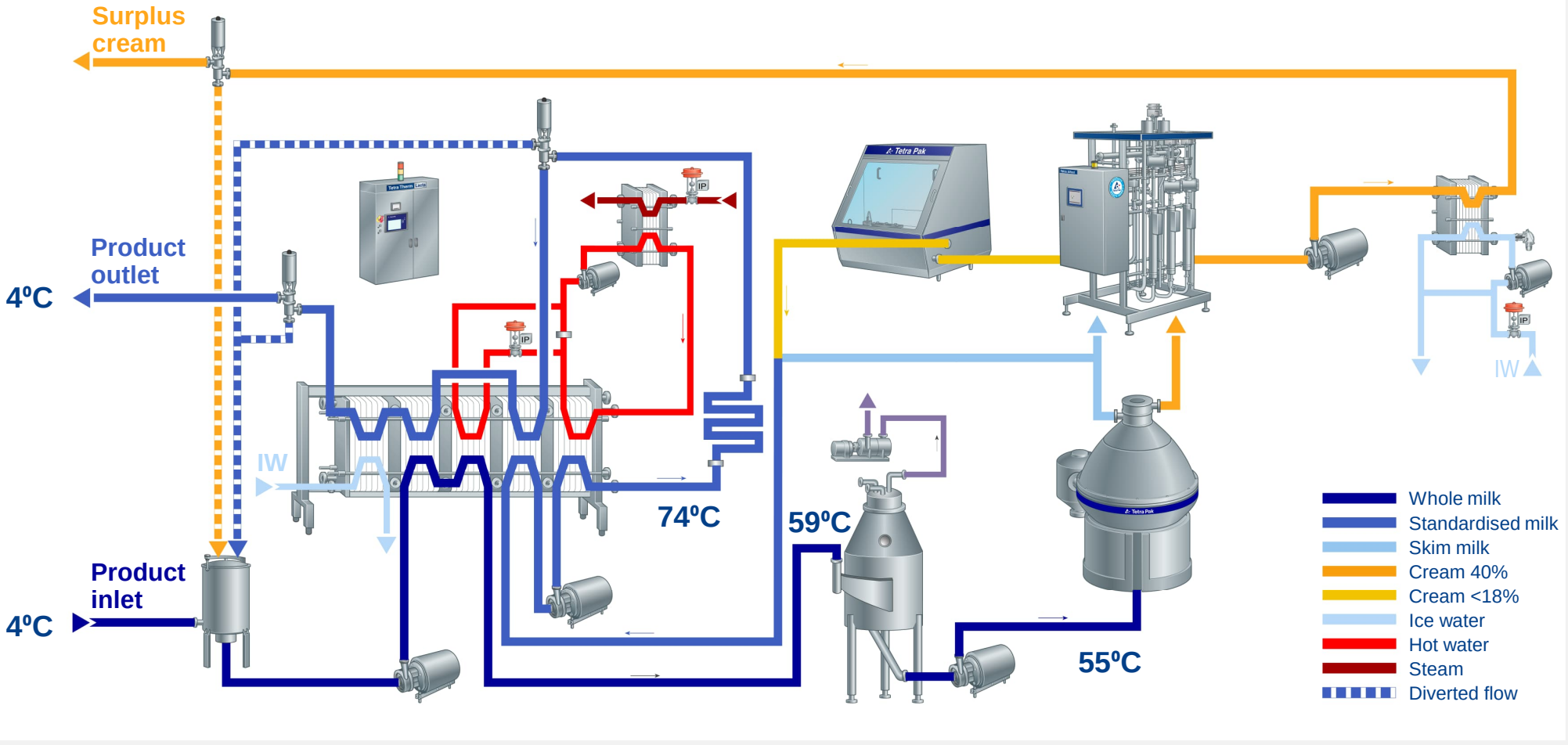
Bacterial development in raw milk at +4°C



THE MILK PASTEURIZER

- purpose
- **Functions and features**
- running time
- cleaning

Milk Pasteurizer



Secure food safety

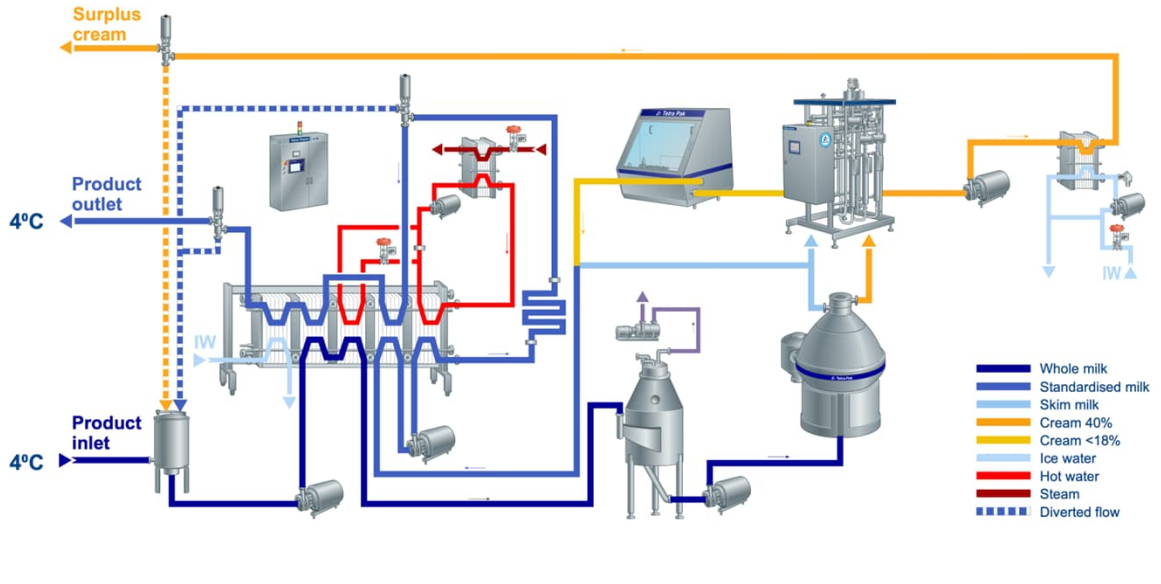
Pasteurizer requirements and features

- **Clarification prior to heat treatment**:
  The milk must be free of particles. In a filter or, more effectively, in a centrifugal clarifier or centrifugal separator

- **Automatic control of pasteurization temperature**

  Two temperature switches, one before and one after the holding tube for increased safety at pasteurization temperature and interlocked with the flow diversion valve.

- **Product flow re-circulation in case of**
  - pasteurization temperature failure
  - low level in balance tank.
  - too high flow
  - too high outlet temperature.

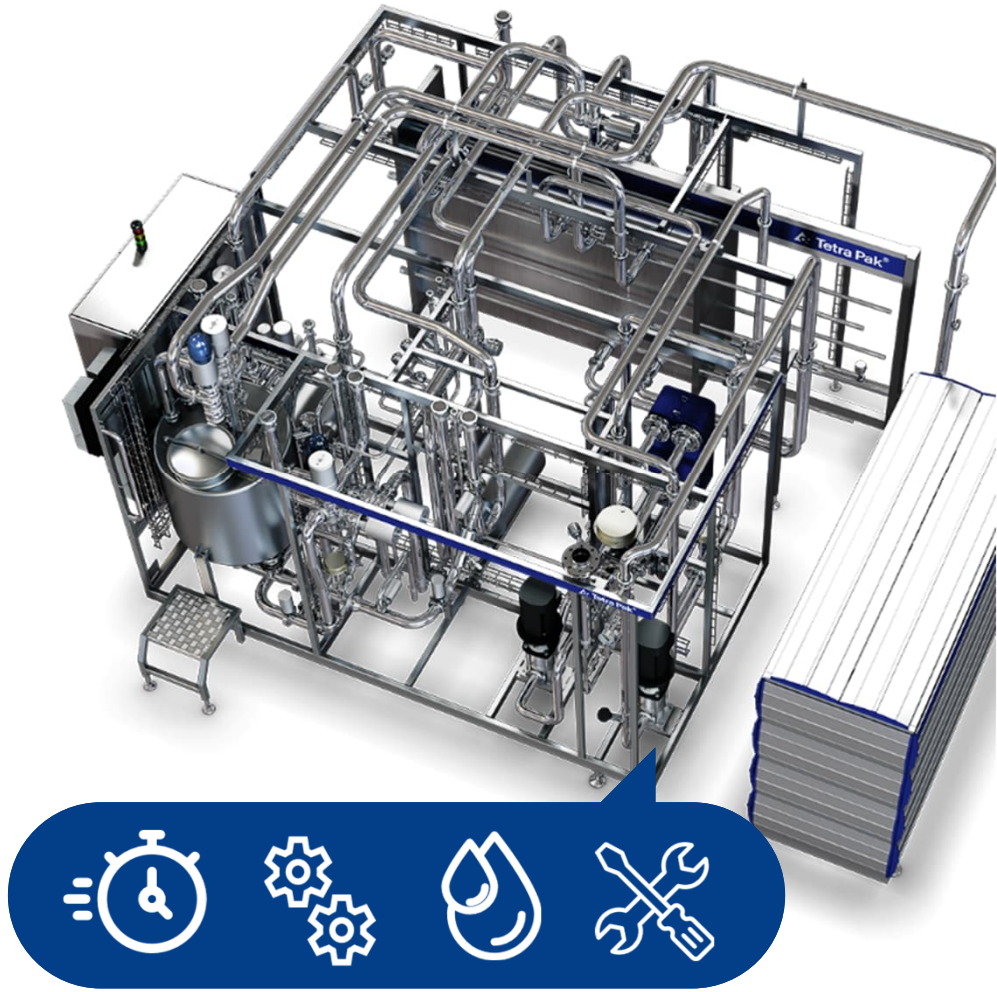


THE MILK PASTEURIZER

- purpose
- functions and features
- **Running time**
- cleaning

Running time defined

- **“Running time” or “production time” is defined as continuous operation time from start to stop of production**
- **STOP will be due to design parameters getting out of specification**
  - Flow, Pressure, differential pressure (dP), temperature or delta temperature (dT)
- **Or STOP will be due to quality parameters getting out of specification**
  - Microbiological growth



Microbiological load of pasteurized milk

Raw milk

Total Plate Count

- Thermoduric Count
- Non-thermoduric

After pasteurization

Total Plate Count

- Thermoduric Count (survive)
- Non-thermoduric (0 cfu/ml)

Cold storage

Total Plate Count

- Psychrotrophic Count (can grow)
- Mesophilic and thermophilic (will not grow)

Keep in mind - criteria for shelf life limit:

Total plate count or **sensory analysis?**

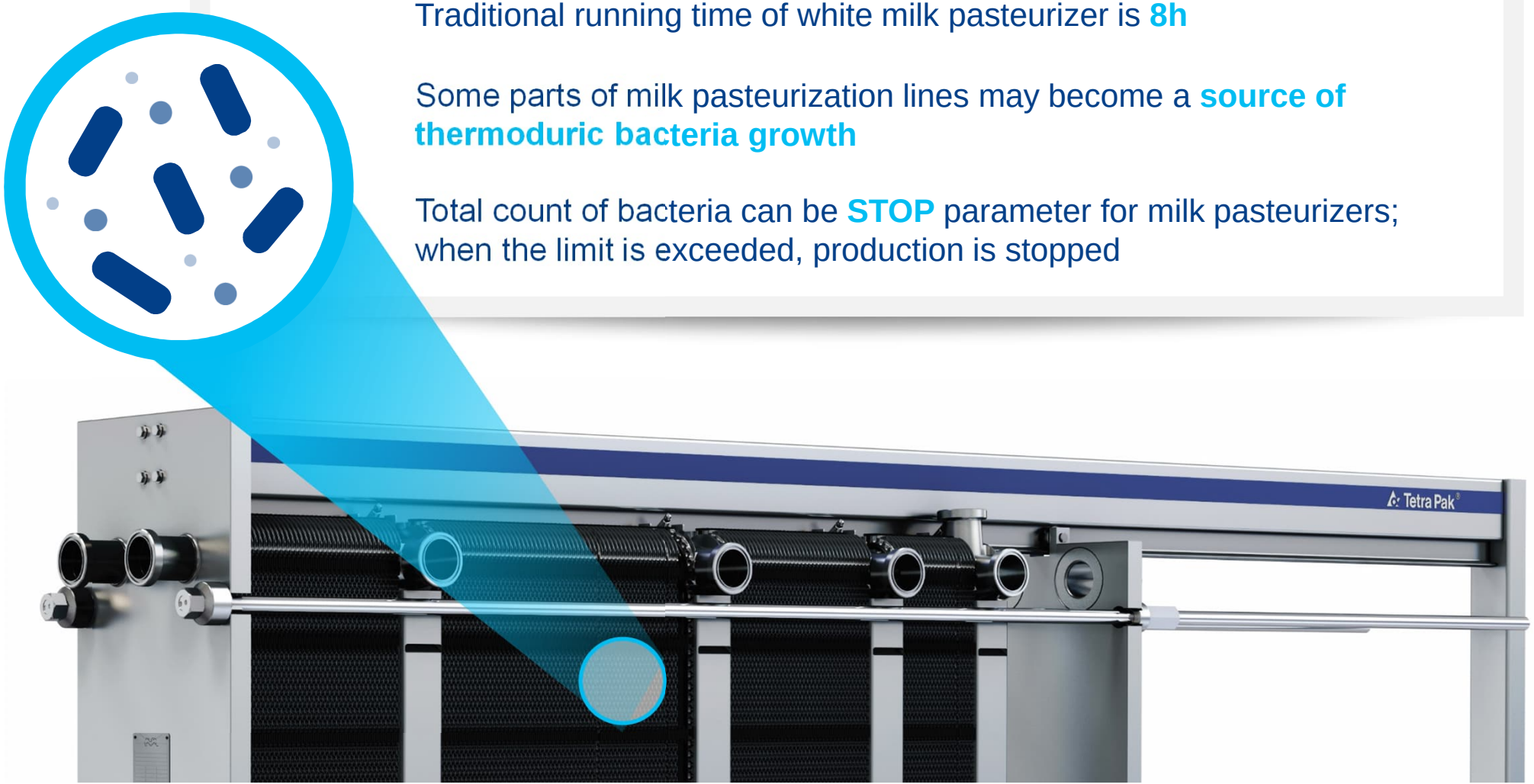
What about microorganism activity?

Limitation for running time of pasteurizers?

Traditional running time of white milk pasteurizer is **8h**

Some parts of milk pasteurization lines may become a **source of thermoduric bacteria growth**

Total count of bacteria can be **STOP** parameter for milk pasteurizers; when the limit is exceeded, production is stopped



Pasteurization is not a one-size-fits-all solution

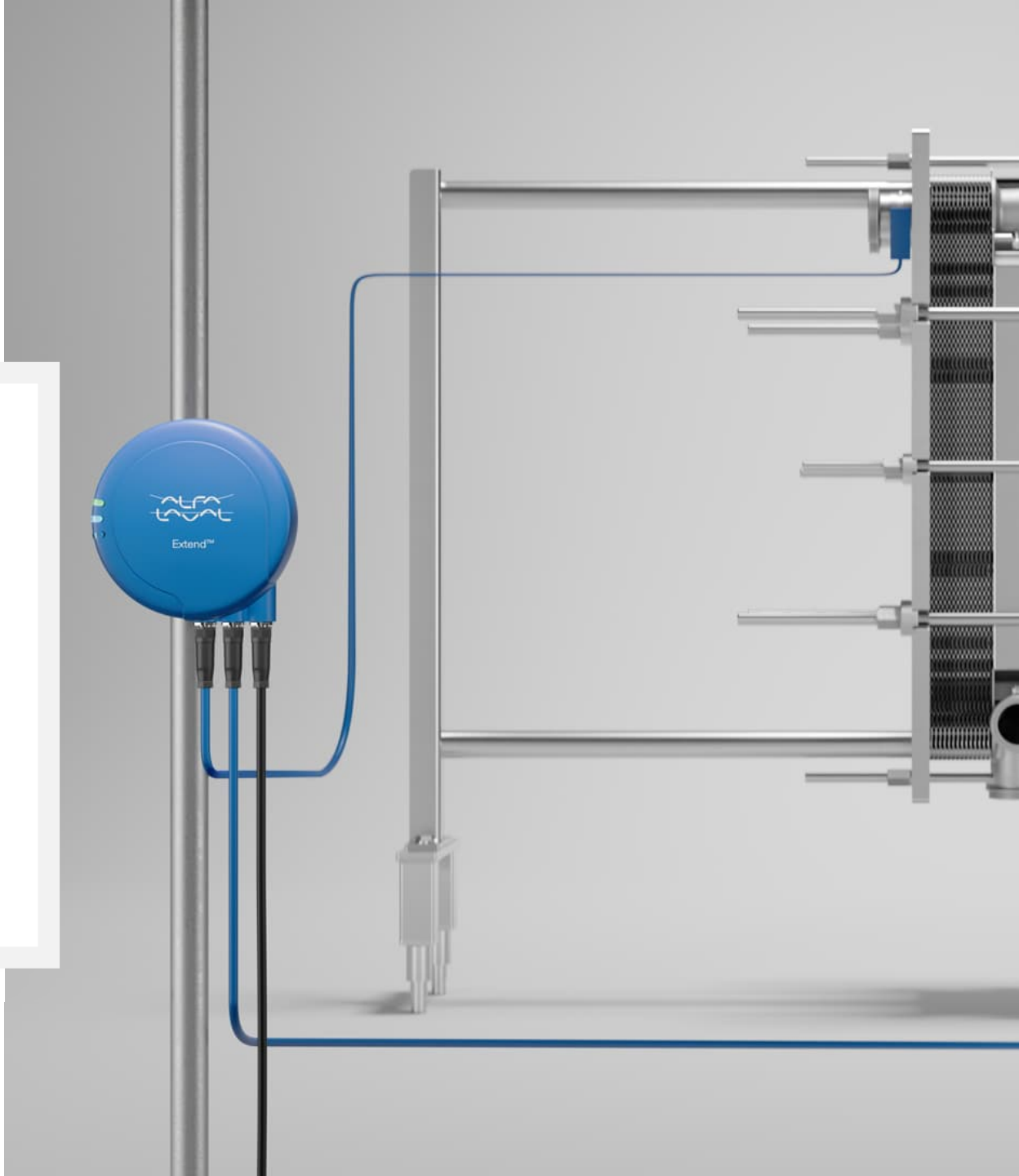
APPLICATION	HEAT TREATMENT	MAX. RUN TIME (H)	LIMITING FACTOR	STOP PARAMETER
Pasteurized consumption white milk	72 - 74°C / 15 -30 s	20 h ± 2	Customer production time schedule (PTS)	
Milk for cheese or powder	72 C / 15 s	8 h ± 2	Growth on PHE-surface of thermoduric thermophilic bacteria	Number of thermoduric thermophilic bacteria in the outgoing milk
Pasteurized Consumption cream (any fat content)	82°C / 15 s	12 h ± 2 (may be longer for fat content below 25%)	PTS and/or heat induced fouling	If applicable - dT or pressure in PHE

- **Approximately 8 hours running time** is still an appropriate limit for cheese and milk powder products, because of the need to limit the number of thermoduric thermophilic microorganisms in final products
- Consumption milk can be run for **20±2 hours** with no risk to food safety and quality

The Solution

Alfa Laval Extend™

- Special engineered electrical pod
- Weak, safe electrical current through the plate pack
- Connect to inlet and outlet pipe of HE
- Bacteria do not attach to the surface



Want to learn more?

Recommend: White Paper @ TetraPak.com

WHITE PAPER

Sign up for white paper

Sign up to download the white paper "Consumption milk pasteurizers can be run much longer than 8 hours"

Download paper to learn more ›

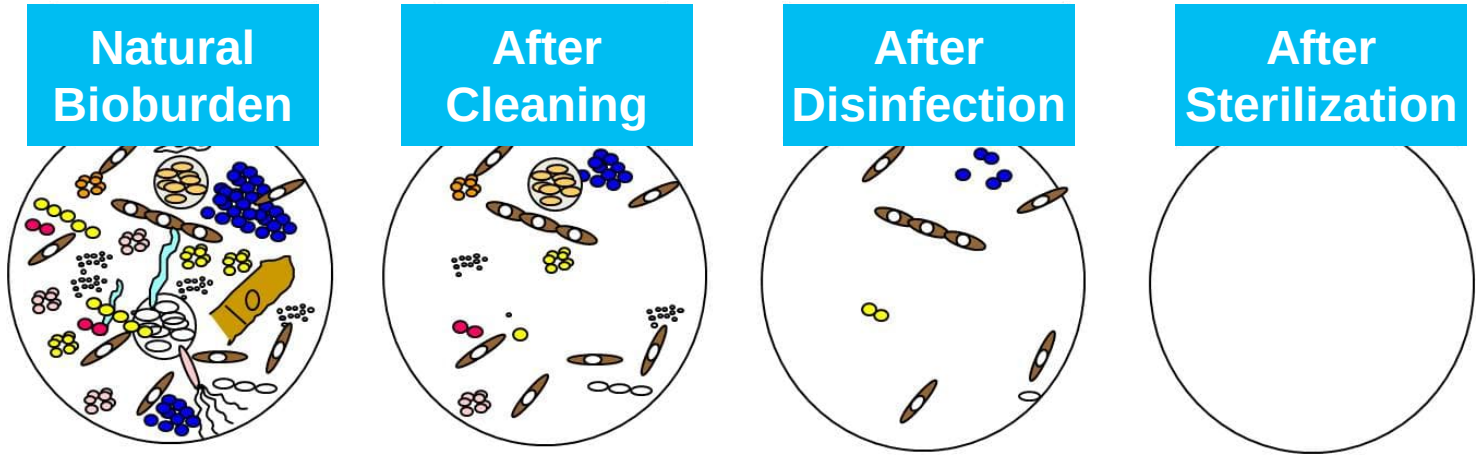
THE MILK PASTEURIZER

- purpose
- functions and features
- running time
- **Cleaning**

Making the line ready for production

- Pre-sterilization is performed in aseptic lines and sometimes for extended shelf life (ESL) products.
- **Disinfection** is used in non-aseptic production lines. Commonly only on “pasteurized side”
- Require a successful cleaning prior to pre-sterilization/disinfection

Mibi status on the stainless steel surfaces



Centrifugal separators in the pasteurizer

Centrifugal separation in dairy process lines

Clarification

Removal of non-milk solids and somatic cells

Separation

Separation of cream and skim milk

Bactofugation

Reduction of the microbiological load

Centrifugal separation in dairy process lines

Clarification

Removal of non-milk solids and somatic cells

Separation

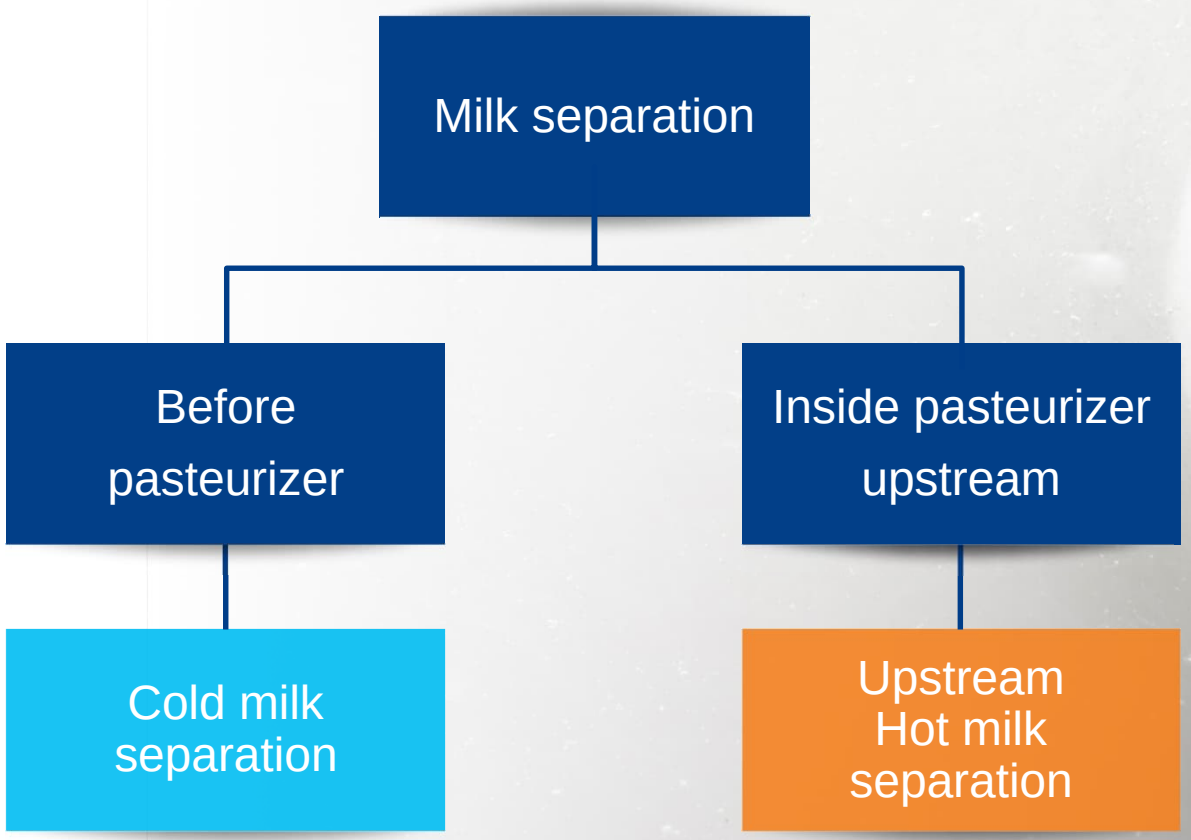
Separation of cream and skim milk

Bactofugation

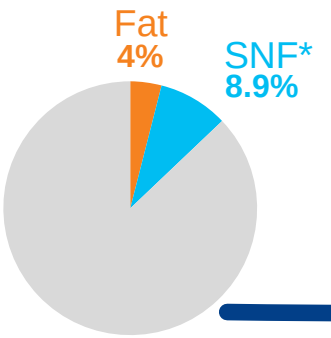
Reduction of the microbiological load

Where to place the milk separator?

By location of separator and temperature of separation



Inputs and outputs in milk separation



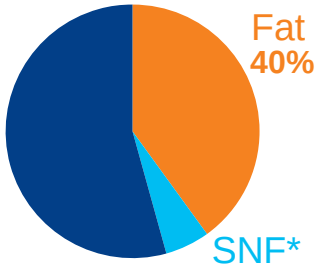
WHOLE MILK

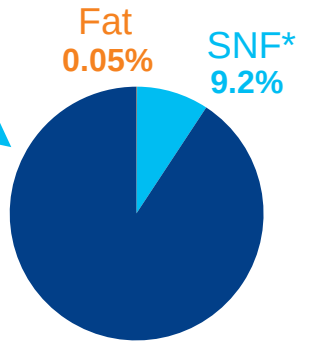
100%

10%

90%

CREAM





SKIMMED MILK

*SNF: solids non-fat

Whey separation at a glance

Principles of whey separation

WHEY
Fat 0.3%
SNF* 6.5%

100%

1%

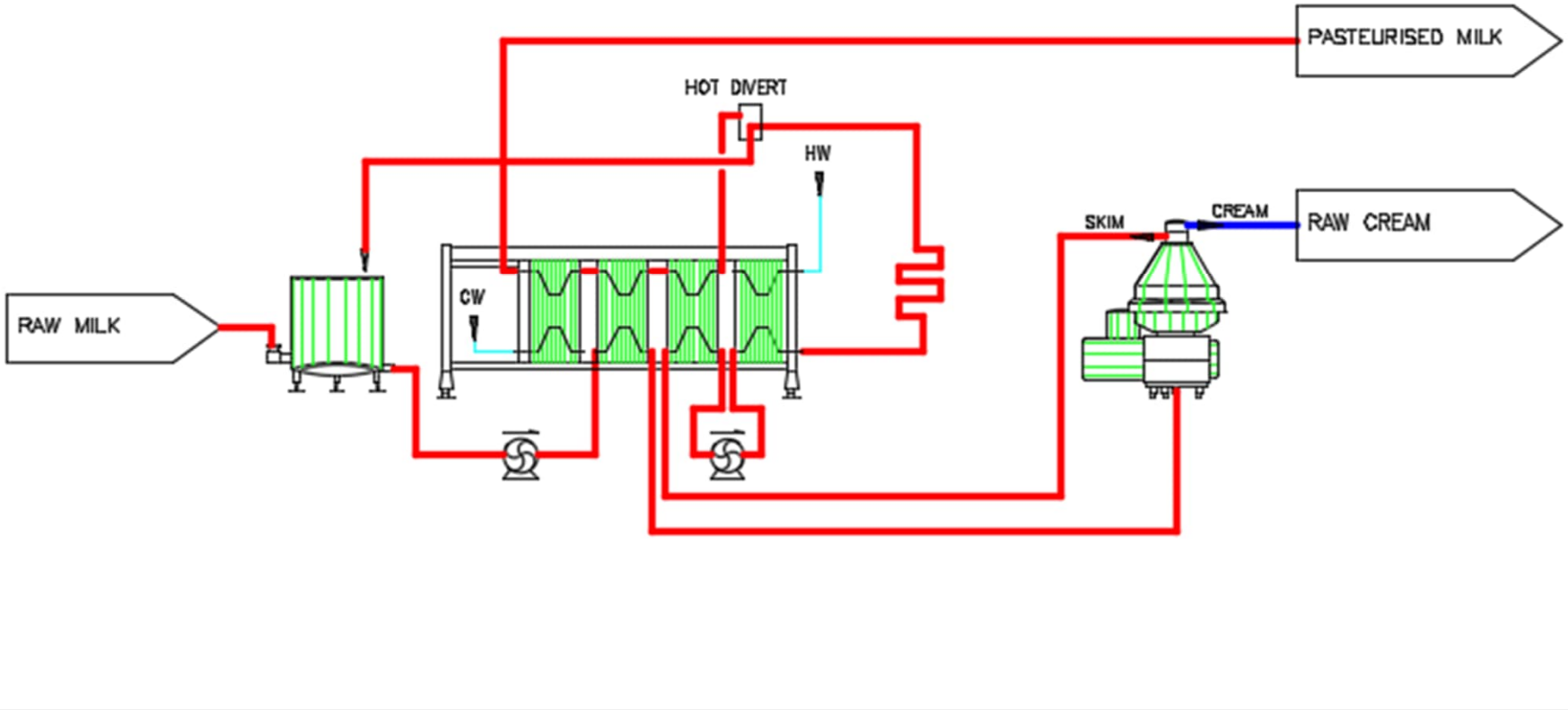
99%

WHEY CREAM
Fat 35-40%
SNF* 3.9%

SKIMMED WJEY
Fat 0.05%
SNF* 6.5%

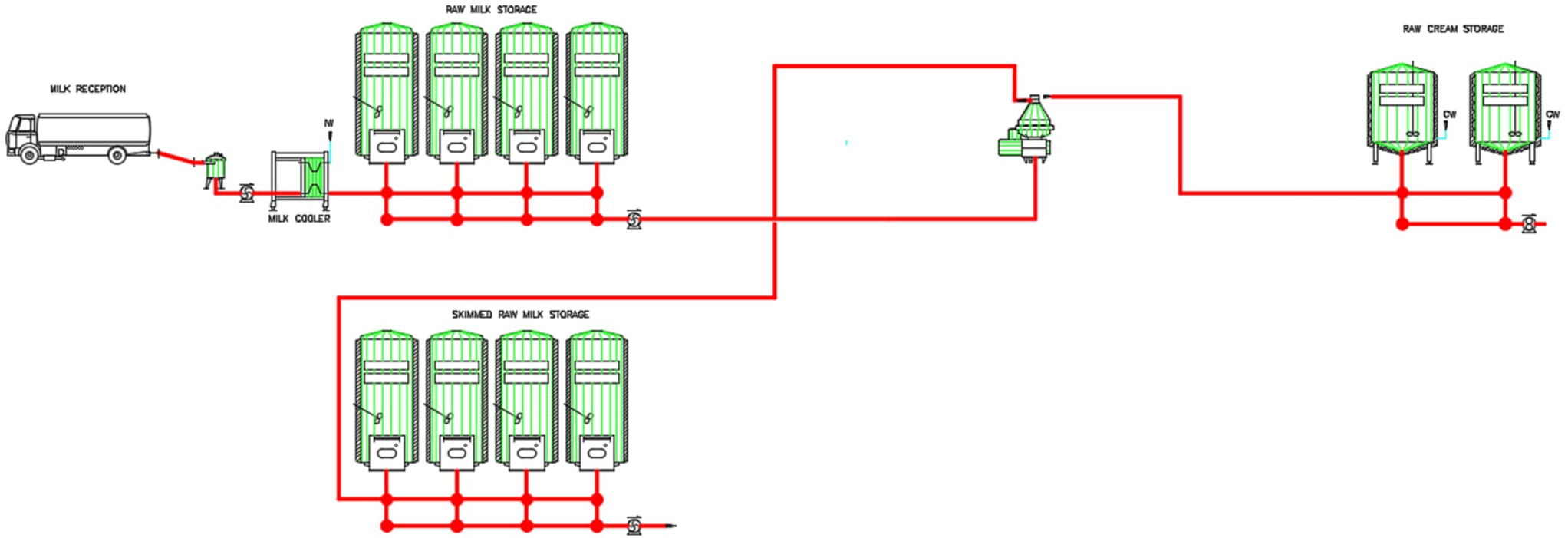
*SNF: solids non-fat

Hot milk separation



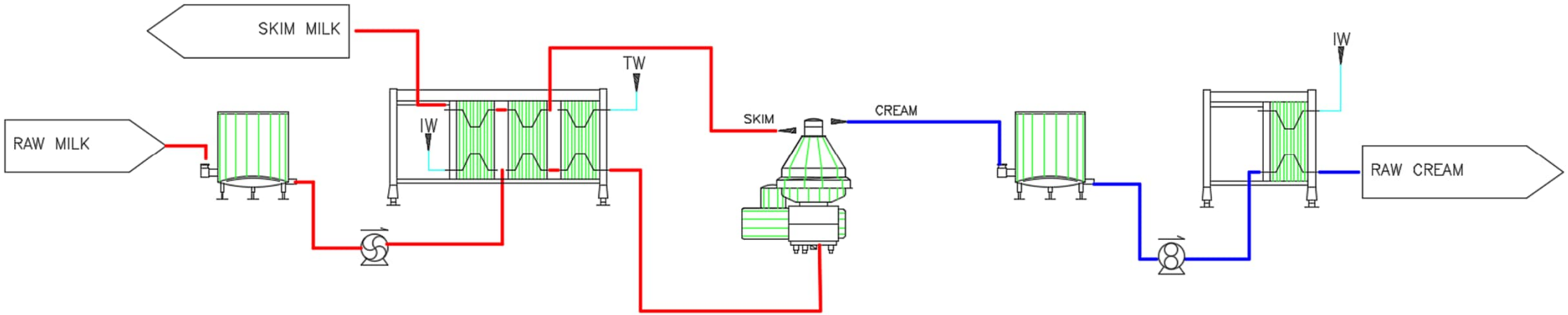
Cold milk separation

Directly from raw milk silo



Cold milk separation

Regenerative pre-heating



	Upstream hot milk separation	Cold milk separation
Skimming efficiency	Down to 0.05%	≤0.1%-0.3%
Cream	20%-60% fat	≤40%±2 fat
Products	All dairy products	UHT milk, Milk powder
Highlighted benefits	- Highest skimming efficiency - Highest capacity - Smaller machine (compared to cold milk)	- Reduces Thermophilic growth - Longer production time - Less CIP - Less equipment

Centrifugal separation in dairy process lines

Clarification

Removal of non-milk solids and somatic cells

Separation

Separation of cream and skim milk

Bactofugation

Reduction of the microbiological load

When is spore removal needed?

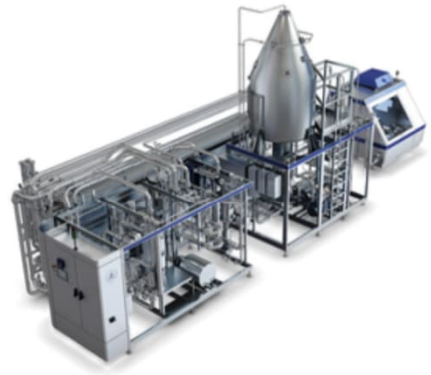
- Spore removal is a **complement to pasteurization**
- **Targets “thermoduric” spores and bacteria** that survive heat treatment
- Performed by a **spore-removal Bactofuge** unit
- Key variables to consider
  - Initial bacterial loads of different products vary widely
  - Target removal organisms differ between production line and end-products
  - Reduction rates differ with microbiological complexity of milk, cheese and whey

Spore reduction

Different processing solutions

Spores can be inactivated by **High Heat Treatment**

(>7 logs reduction)



Spores can be removed with **Filtration units** in combination with pasteurization

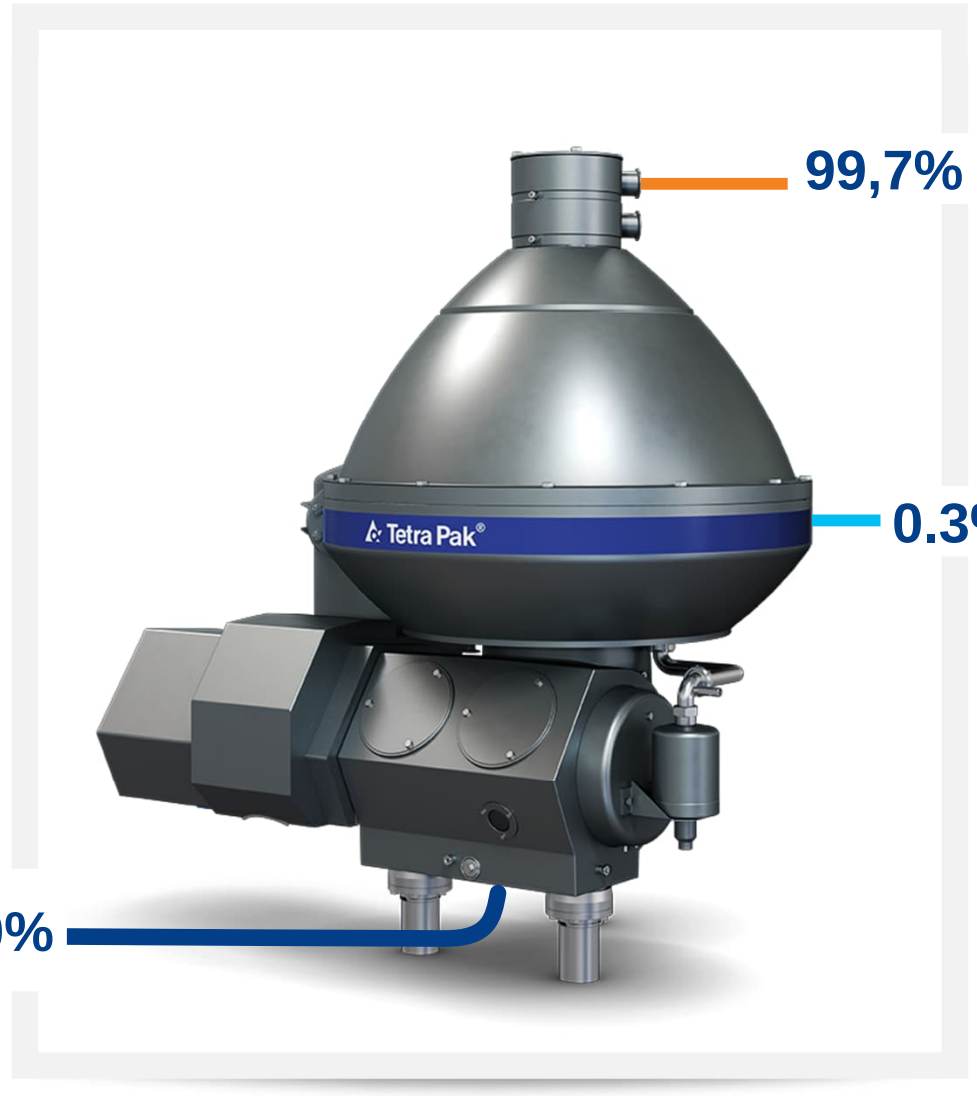
(up to 6-7 logs reduction, removal based on size difference)

Spores can be removed by **Bactofuge units**, and it is a complement to pasteurization

(up to 1-2 logs reduction, removal based on density difference)

Spore and bacteria removal

Tetra Pak BB unit



CLEANED MILK

Fat 4%
SNF* 8.6%

99,7%

0.3%

Fat 0.1%
SNF* 15-20%

Discharged (Impurities including spores and bacteria)

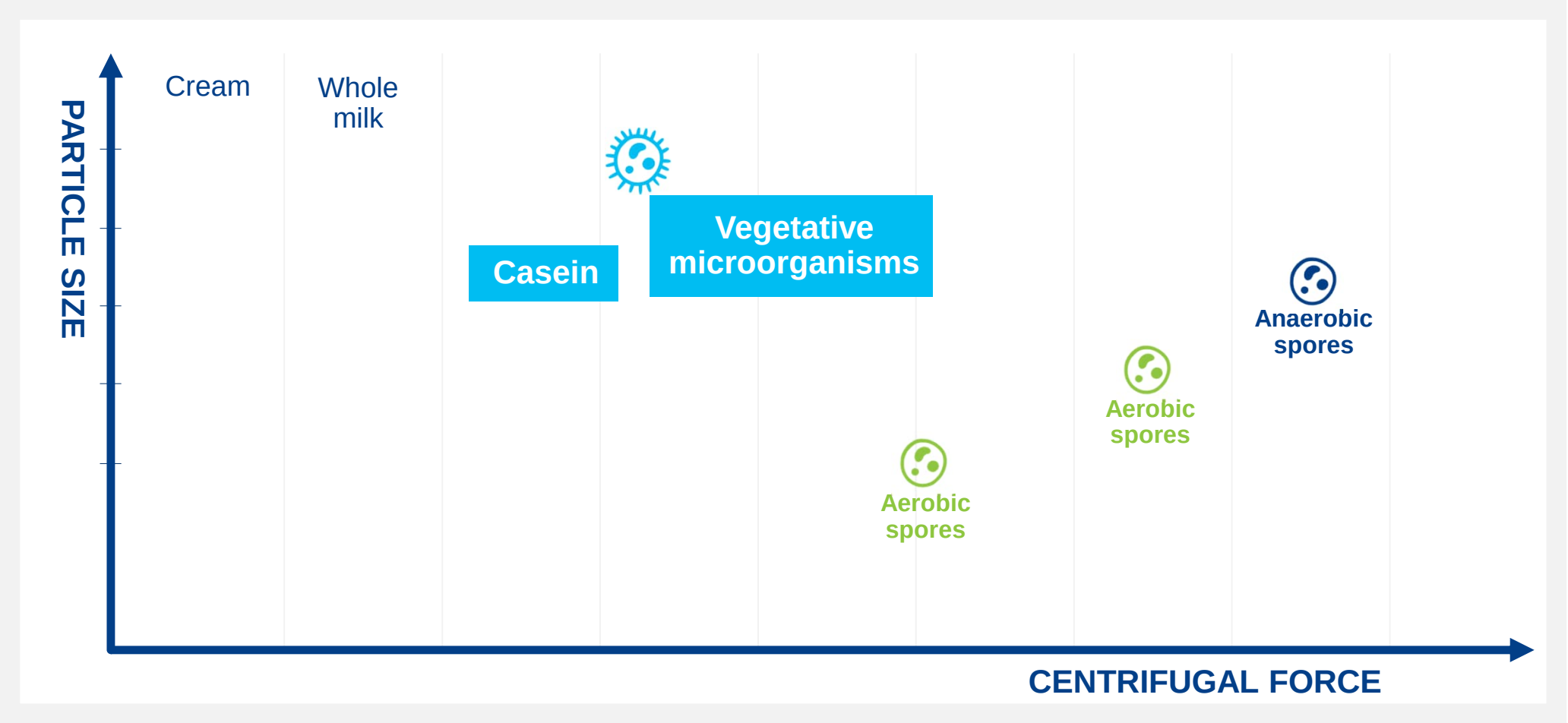
Fat 4%
SNF* 8.9%

100%

WHOLE MILK

SNF = solids non-fat (lactose, protein, some minerals)

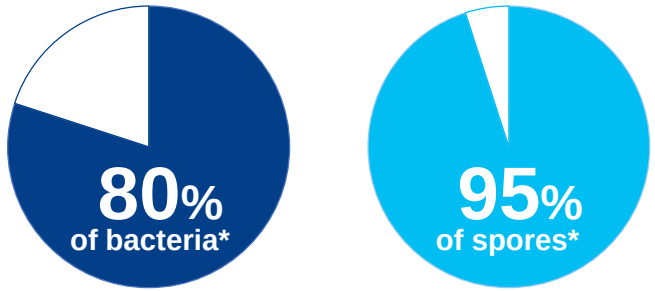
Heaviest and densest spores separate first



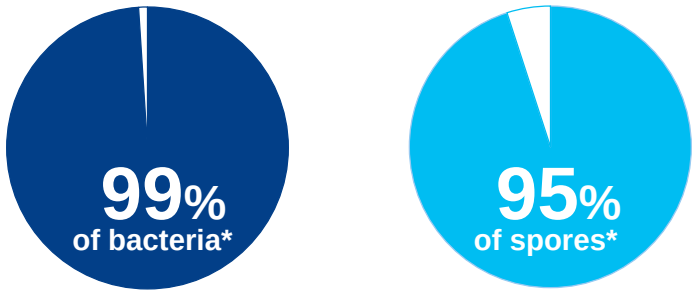
Spore removal - optimal solution with lowest heating impact

- Mild heat treatment **can inactivate some bacteria but not spores** (depending on temperature & time)
- Pasteurization **does not kill all bacteria or spores**
- The higher the heat applied, the **more thermal effects and impact on product quality**
- A Spore Removal unit is an **optimal solution for removing spores** with lowest heating impact

SPORE REMOVAL UNIT REMOVES APPROXIMATELY



SPORE REMOVAL UNIT + PASTEURIZER REMOVE APPROXIMATELY

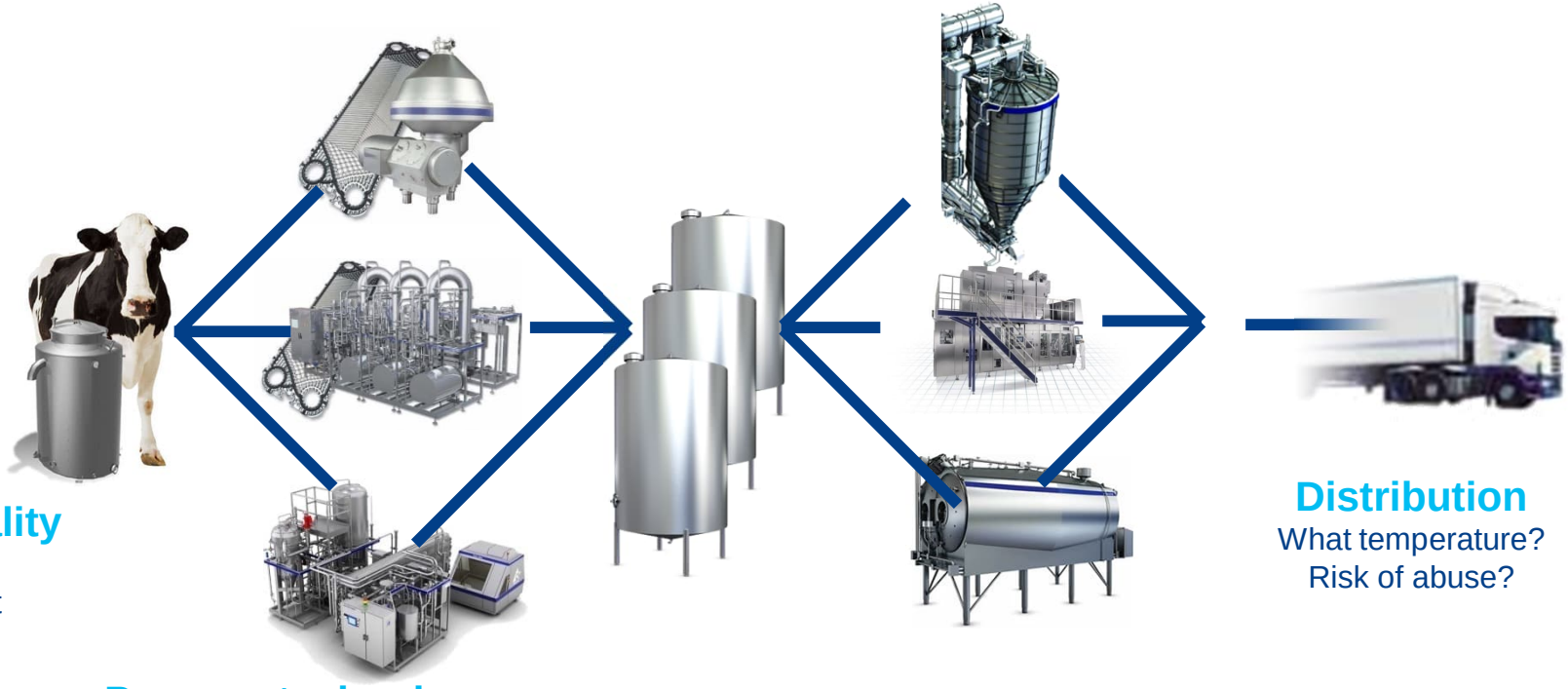


* Bacteria removal substantially depends on bacteria type

Summary

Microbiological load of pasteurized milk

Control of the value chain – Holistic approach



Raw milk quality
Total Plate Count
Thermoduric Count
Spore count

Process technology
Pasteurization
Bactofugation+pasteurization
Microfiltration+pasteurization
High Heat treatment

Transfer & Storage
Transfer
Storage
CIP&Sterilisation
Temperature

Next step
Extended hygiene
Filling temperature

Distribution
What temperature?
Risk of abuse?

Further questions

Evert Faber

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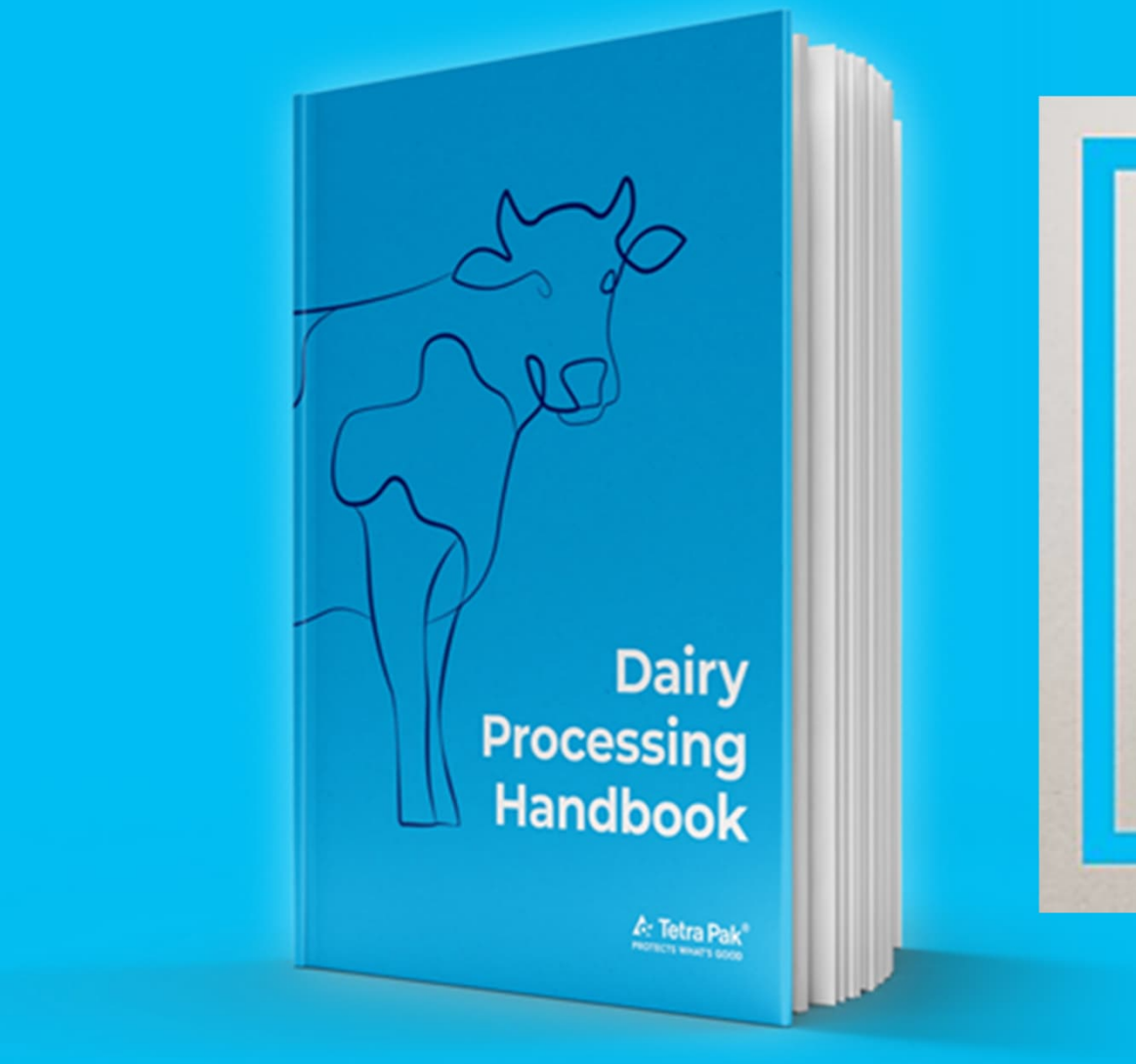

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