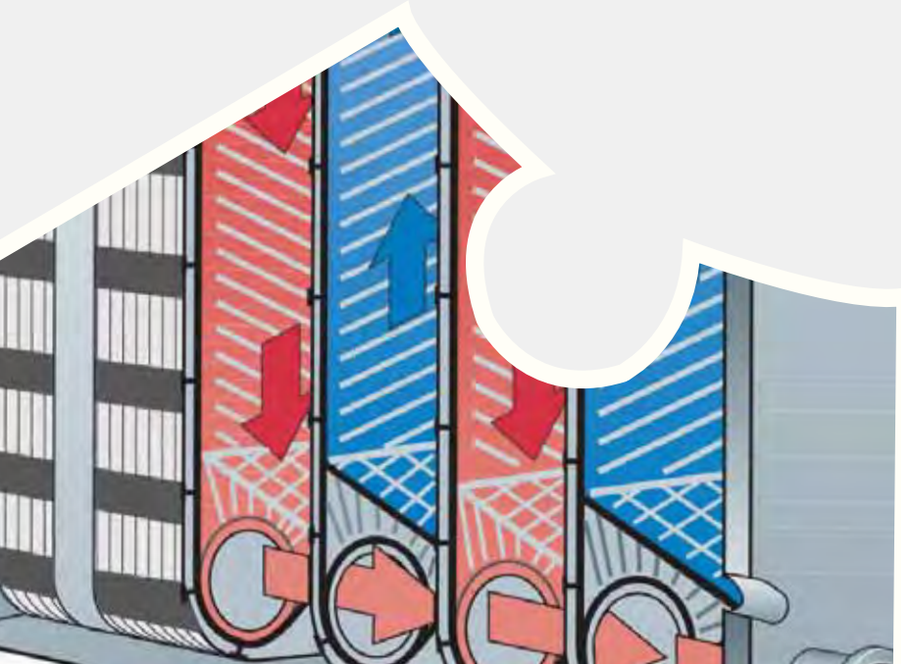
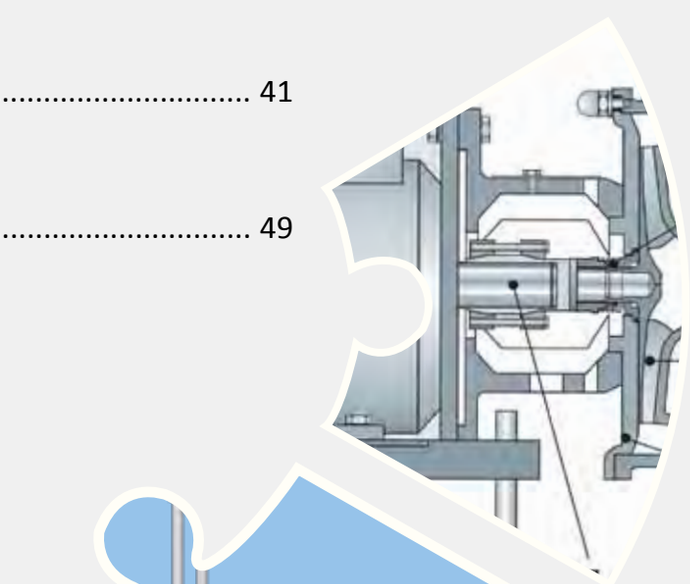
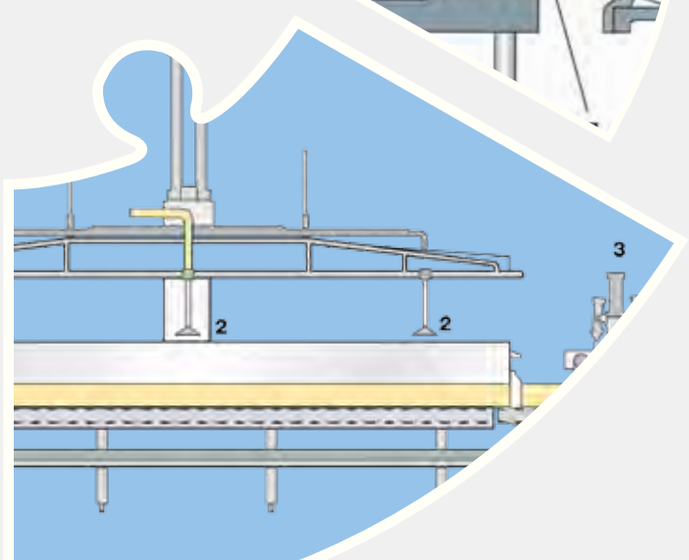
CHAPTER 3
PROCESSING OF DAIRY PRODUCTS







Chapter 3: Processing of Dairy Products

Milk is indeed a wonderful substance. Besides its use as a refreshing nutritious drink, the nature of the product allows for fermentation into cultured products, concentration into cheese or condensed milk and even spreads and powdered milk derivatives. This chapter briefly discusses the main types of processes encountered in commercial dairy processing plants with the emphasis on quality and safety requirements.

3.1 Pasteurised milk

1. Introduction

The heat treatment of milk prior to packaging for liquid consumption, or manufacturing into a milk-based product, is an important **c**ritical **c**ontrol **p**oint (CCP) to ensure that potentially pathogenic organisms are killed. It also ensures that spoilage organisms are eliminated, or at least reduced in number, for optimum keeping quality.

In the manufacture of milk-based products, a heat treatment process may also perform a technological function, for example to increase heat stability and prevent syneresis. It is often the case that one heat treatment process performs both functions and it is important that in such cases the hygienic aspects of the heat treatment are given full consideration.

The heat treatment process will vary in the temperature and time of heating according to the type of product, packaging and the required shelf life under anticipated storage conditions. Pasteurisation processes are normally used for products with a limited shelf life under refrigerated conditions, and for the treatment of milk during milk product manufacture, for example powder and cheese. Sterilisation and UHT processes are

normally used for products designed to be stable (when packaged) at ambient temperature. These products are discussed in more detail in the next section.

The heat treatment process will only be effective if carried out in a clean and sanitary plant. The equipment and the heat treatment plant should be cleaned and sanitised in the same way as any process plant.

2. A definition of pasteurisation

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Pasteurisation is a heat treatment process applied to a product with the aim of avoiding public health hazards arising from pathogenic microorganisms associated with milk. Pasteurisation as a heat treatment process is intended to result in only minimal chemical, physical and organoleptic changes.

3. Final product specifications

R 2581
SANS 10049, 8.2
SANS ISO 22000, 7.3.3
SANS 1679, 8
CGCSA FSI GMCP B.A.1.1
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Before any processing of any product can start, a final product specification (also known as a product description for HACCP) must be available. This provides the objective for the process. This specification must include at least the following information:

- Product category (chilled perishable product – milk stored at 0–5°C).
- Class designation (no fat, fresh full cream milk, fresh low fat milk).
- List of raw materials (milk and other ingredients) with full specifications.
- Processing parameters.
- Packaging requirements (including label specifications):
  - Packaging size (1 l sachet, 2 l bottle, 500 ml bottle).
  - Final packaging: crates, bags, shrink-wrap.
  - Batch code/sell by/date coding).
- Sensory characteristics.
- Storage specifications and shelf life of the product.
- Intended use.

SANS 10049, 8.7
SANS ISO 22000, 7.6.4
SANS 1679, 8
CGCSA FSI GMCP B.A.1.5

During processing, quality control checks must be done online to determine the adherence to the specifications. After final packaging a checklist for final product inspection must be done.

Typical final product specification

Product name	Full cream pasteurised milk	
Ingredient list	Full cream milk	
Allergen declaration	Contains cow's milk	
Pack size	500 ml, 1 l, 2 l, 3 l	
Temperature category	Chilled (0–4°C)	
Shelf life	Day of packaging plus eight days	
Production code	Sell by	
	Use by	
	Batch code	Batch, shift, machine
Storage conditions	0–4°C	

Composition

Ingredient	Specification	Weight	% added
Raw milk	See Chapter 2		100%
TOTAL			**100%**

Process flow

Production controls	Process steps	Quality controls
Temperature of milk <7 °C Foreign object inspection Milk to be kept for <48 hours	RECEIVING OF RAW MILK ↓	Milk intake tests: microbiological, chemical and physical Reject milk that does not conform to specifications
	SEPARATE ↓	
	STANDARDISE[1] ↓	Standardise to 3,3% butterfat Refer to notes
Pressure 1,2–1,5 bar	HOMOGENISE[2] ↓	Ensure correct pressure settings
Check divert valve 72°C minimum for 15 seconds	PASTEURISE ↓	Ensure correct temperature setting Thermographic recorder Phosphatase test
Rapid cooling of milk to <5°C	COOLING ↓	Ensure correct temperature <5°C
Check that % butterfat is correct	MILK ENTERS REFRIGERATED HOLDING TANK ↓	Ensure correct butterfat
Temperature <4°C Ensure that weight conforms to specifications	FILLING INTO CONTAINERS ↓	Filling weight checks Milk online tests: physical, microbiological and chemical Correct date coding

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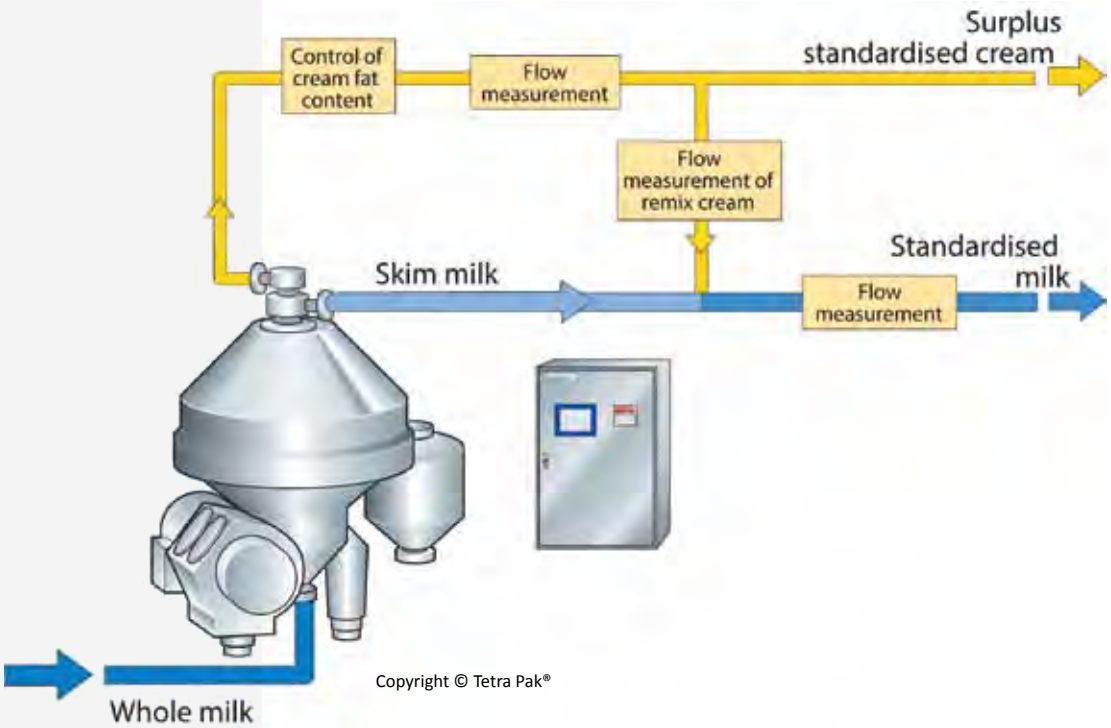
Storage of milk at <4°C	COLD ROOM ↓	Ensure that temperatures are kept below 4°C
Truck to conform to hygiene standards Truck temperature to maintain product temperature	DISTRIBUTE ↓	Maintaining of cold chain (<4°C)
	RECEIVED AT STORES	Delivery temperature <4°C

[1]The purpose of standardisation is to give the milk a defined, guaranteed fat content.

[2]Homogenisation must always be sufficiently efficient to prevent creaming. The result can be checked by determining the homogenisation index, as described in the following example: A sample of milk is stored in a graduated measuring glass for 48 hours at a temperature of 4 to 6°C. The top layer (1/10 of the volume) is siphoned off and the remaining volume (9/10) is thoroughly mixed, and the fat content of each fraction is then determined. The difference in fat content between the top and bottom layers, expressed as a percentage of the top layer, is referred to as the homogenisation index. If the fat content is 3,15 in the top layer and 2,9 in the bottom layer, the homogenisation index will be (3,15 – 2,9) x 100 ÷ 3,15 = 7,9. The index for homogenised milk should be in the range of 1 to 10 (Dairy Processing Handbook, 1995).

Figure 1: Principle for direct in-line standardisation of cream and milk.



Rejection criteria for Critical Control Point (CCP) deviation
If pasteurisation of 72–74°C for 15 seconds is not reached and maintained, the milk will be diverted to the balance tank by the flow-diversion valve and back to the heating section of the pasteuriser in order to be re-pasteurised.

Packaging and labelling

Material	Supplier	Reference
3 l HDPE bottle		
2 l HDPE bottle		
1 l HDPE bottle		
500 ml HDPE bottle		
1 l plastic sachet		
Full cream milk labels/sleeves		

Packaging process

- Milk pumped into correct hoppers for filling.
- Milk gravity-filled into bottles/sachets in a closed system.
- Use by date coded onto packaging material using appropriate printing technology.
- Packed off conveyor into crates (plastic liners for sachets).
- Packed product moved and stored in cold room until distribution.

Reasons for rejection

- Product temperature >5°C.
- Product does not conform to dairy regulations.
- Incorrect sell by dates.
- Illegible date code markings.
- It is possible to rub off date code markings.
- Filled volume out of specification.
- Incorrect weight.
- Non-adherence to process control specifications.
- Leaking containers.
- Dirty truck/lugs/containers.

Product standards

Analytical standards Pasteurised milk			
Test	**Limit**	**Reject**	**Frequency**
Phosphatase	Negative	Positive	Per batch
Added water	0%	>1%	Per batch
Freezing point	>–0,512°C	<–0,512°C	Per batch
pH	6,5–6,8	<6,5 or >6,8	Per batch
Full cream	>3,30%	<3,30%	Per batch
Volume: 3 l	3 000 ml	<3 000 ml	Per procedure
Volume: 2 l	2 000 ml	<2 000 ml	Per procedure
Volume: 1 l	1 000 ml	<1 000 ml	Per procedure
Volume: 1 l sachet	1 000 ml	<1 000 ml	Per procedure
Volume: 500 ml	500 ml	<500 ml	Per procedure
Weight: 3 l			Per procedure
Weight: 2 l			Per procedure
Weight: 1 l			Per procedure
Weight: 1 l sachet			Per procedure
Weight: 500 ml			Per procedure

Recommended microbiological standards Pasteurised milk			
Test	**Limit**	**Reject**	**Frequency**
Total plate count	<50 000 cfu/ml	>50 000 cfu/ml	Per batch
Coliforms	<10 cfu/ml	>10 cfu/ml	Per batch
E. coli	Absent	Present	Per batch
Staphylococcus aureus	Absent	Present	Quarterly
Listeria spp	Absent/25 g	Present	Quarterly
Salmonella spp	Absent/25 g	Present	Quarterly

Sensory evaluation/product description

Appearance	White to cream milk with no foreign matter. No separation of cream should be visible.
Colour	White to creamy-white.
Flavour	Characteristic sweet milk flavour with no off taints (rancid, sour, etc) or foreign taints.
Texture	Creamy and smooth liquid.
Aroma	Characteristic of milk with no off or rancid aroma.

Storage instructions
Refrigeration: Keep refrigerated below 4°C and use within expiry date.
Freezing: Suitable for home freezing at –18°C for homogenised milk.
Thawing: Place in refrigerator overnight.

Serving suggestions
Serve chilled.

Transport requirements
Packed product to be transported in clean and covered vehicles capable of maintaining the correct temperature for the required product. Vehicles also need to be clean and pest-proofed.

3.1 Control of milk processing

SANS 1679, 7

As mentioned in Chapter 2, the quality of the milk should be confirmed when collecting from the farm and again at milk reception at the processing facility.

! The shelf life of pasteurised milk is always dependent on the quality of the raw milk.

! Heating and cooling are the most important operations in the dairy.

SANS 10049, 8.7
SANS ISO 22000, 7.6.4
SANS 1679, 8
CGCSA FSI GMCP B.A.1.5

The processing activities should be monitored continuously to ensure that the process is under control. Records should be in place and action taken if the process is out of specification.

3.2 Final product inspection

SANS 10049, 8.9
SANS 1679, 10
CGCSA FSI GMCP B.A. 1.5, 2.5

Additional on-line checks are advisable for the packaging step to ensure that the product is not rejected due to errors at this stage.

3.3 Non-conforming product

SANS 10049, 8.7, 9
SANS ISO 22000, 7.10.3
SANS 1679, 8 &9
CGCSA FSI GMCP B.A. 4, 5, I.A.6

A comprehensive procedure should be in place for dealing with any product that does not conform to the specification. This procedure must clearly define the responsibilities and actions to be taken to ensure that the products are not dispatched if they are not safe for human consumption. All records of testing must be available, including any records of retesting after the product is reworked.

SANS 10049, 8.7,8.10
SANS ISO 22000, 7.8
SANS 1679, 8 &9
CGCSA FSI GMCP B.A.1.5, I.A.6
Chapter 1

Samples of the final packed product will also be tested to ensure conformance to the final specification.

4. Pasteurisation and other heat treatment processes

4.1 General

SANS 10049, 8.7
SANS ISO 22002-1, 8
CGCSA FSI GMCP I.A.3

Pasteurisation processes are normally used for products with a limited shelf-life. Pasteurisation can also be an integral process in the manufacture of milk-based products with limited shelf-life under refrigerated conditions and which are not stable at ambient temperatures.

Pasteurisation uses the principle of subjecting the product to a defined temperature range for a specified time period which reduces the microbiological load of the product, making it safe for human consumption. A common legal requirement is that this heat treatment must guarantee the destruction of unwanted spoilage organisms and all the pathogenic bacteria without affecting the quality of the product.

The pasteurisation process can either be carried out as a batch operation, with the milk heated and held in an enclosed tank, or as a continuous operation with the milk heated in a heat exchanger and then held in a holding tube for the required time.

Provision should be made to ensure that the milk or product does not contain suspended dirt particles.

Examples of the main categories of heat treatment in the dairy industry:

Process	Temperature	Time
Thermisation	63–65°C	15 seconds
[1]LTLT pasteurisation of milk and cream	>66°C	30 minutes
[2]HTST pasteurisation of milk	72–75°C	15–20 seconds
HTST pasteurisation of cream	>80°C	1–5 seconds
Ultra pasteurisation	125–138°C	2–4 seconds
[3]UHT (flow sterilisation) normally	135–140°C	a few seconds
Sterilisation in container	115–121°C	20–30 minutes

[1]LTLT: Low temperature long time (batch pasteurisation)
[2]HTST: High temperature short time (plate pasteurisation/continuous)
[3]UHT: Ultra-high temperature

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5. Legislation and pasteurisation

The process of pasteurisation of dairy products is defined by law and these time–temperature combinations must be adhered to.

In each case the product is cooled without delay to 5°C or below.

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The law further requires that the process be controlled in such a way that if the correct temperature is not achieved, the milk can be diverted mechanically. This diversion mechanism must be calibrated.

All temperature-monitoring equipment must be accurate to ±0,5°C

SANS 10049, 7.3.3
SANS ISO TS 22002-1, 8
CGCSA FSI GMCP I.A.5.2

It is advisable to fit this to a visual and audible alarm in the event of failure of the system. This alarm system should also be checked regularly with records.

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The law further requires thermographic recording of the pasteurisation process. These charts should be signed by the factory manager and retained for at least four weeks. However, it is advisable to keep records for at least three months.

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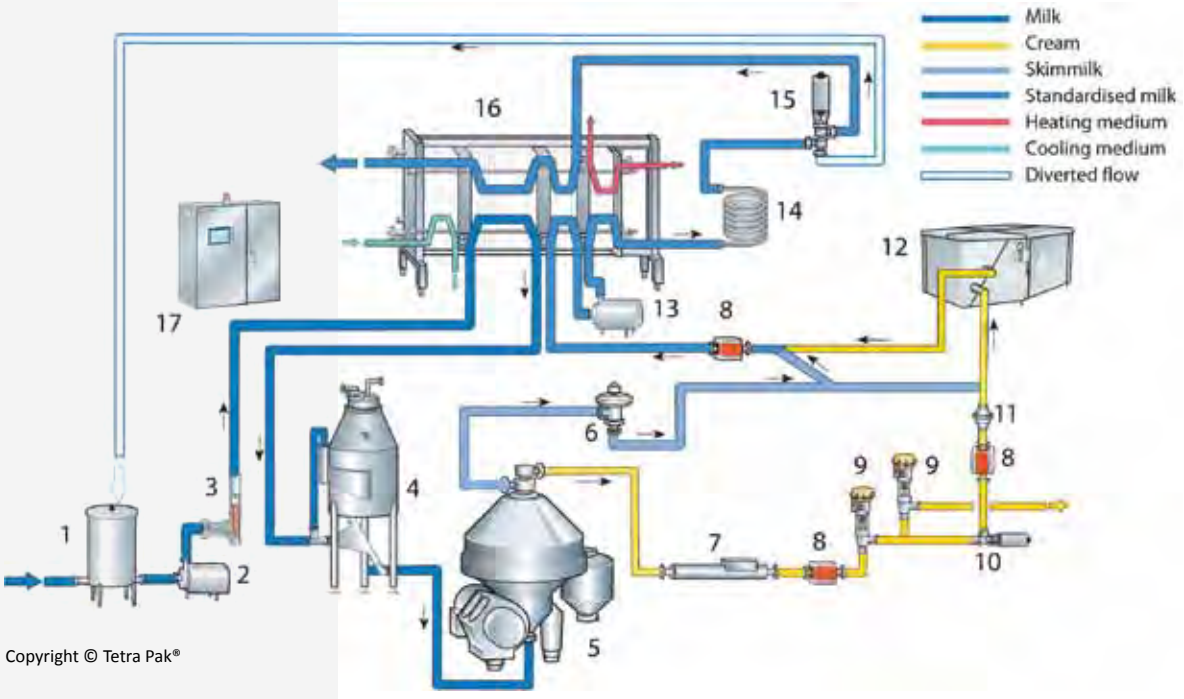
Pasteurisation effectiveness is confirmed by using the phosphatase test, which must be negative.

6. Equipment for pasteurisation

Note that the above temperatures refer to pasteurisation of milk for sale as drinking milk. Milk intended for the production of other products, such as cheese or yoghurt, might require a different time-temperature treatment.

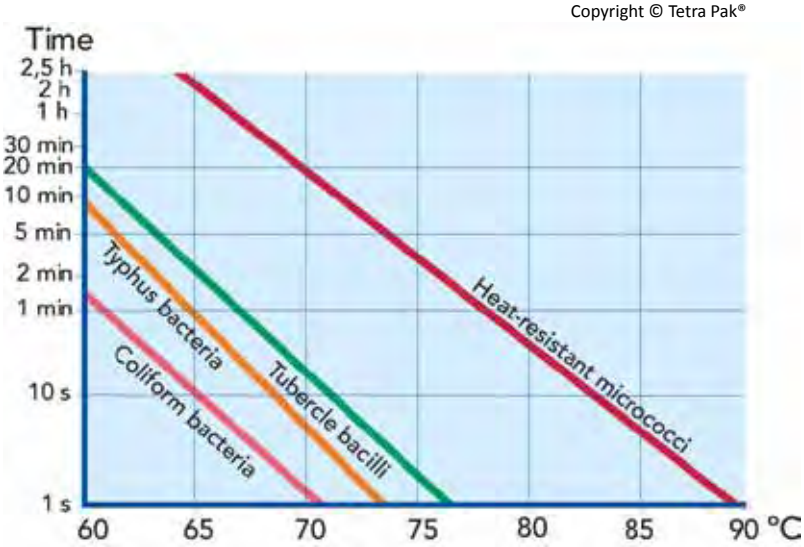
Figure 2: Example of production line for fresh milk pasteurisation and homogenisation.



6.1 Continuous (HTST) pasteurisers: milk

The HTST process for milk involves heating it to 72 to 75°C with a hold of 15 to 20 seconds before it is cooled. The phosphatase enzyme is destroyed by this time-temperature combination. The phosphatase test is therefore used to check that milk has been properly pasteurised. The test result must be negative; there should be no detectable phosphatase activity.

Figure 3: Lethal effect curves and time-temperature curves for destruction of some enzymes and microorganisms.



6.1.1 Typical equipment

SANS 10049, 7.3.1
SANS ISO TS 22002-1, 8
SANS 1679, 5.8

A typical milk pasteuriser would consist of the following:

- A balance tank.
- One or more product pumps. Flow control of the milk would be through the control of the timing pump and flow regulation valves.
- A regeneration section where cold incoming milk is heated by interchange of heat with the hot pasteurised milk. In modern machines more than 90% of the total heat requirement of the pasteuriser is achieved through regeneration.
- A heating section where the milk is brought to pasteurisation temperature by means of hot water in circulation (whether electrically or steam-heated).
- A holding tube where milk is held at the required pasteurisation temperature for the required time.
- A flow-diversion device (FDD), which ensures that milk that has not reached the pasteurisation temperature is diverted back to the balance tank.
- A cooling section where the milk is cooled by heat exchange with cold water.
- Service and control equipment items such as a separator and homogeniser may form a part of the pasteurisation section.

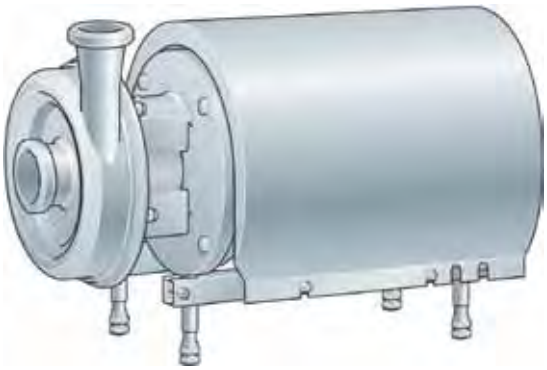
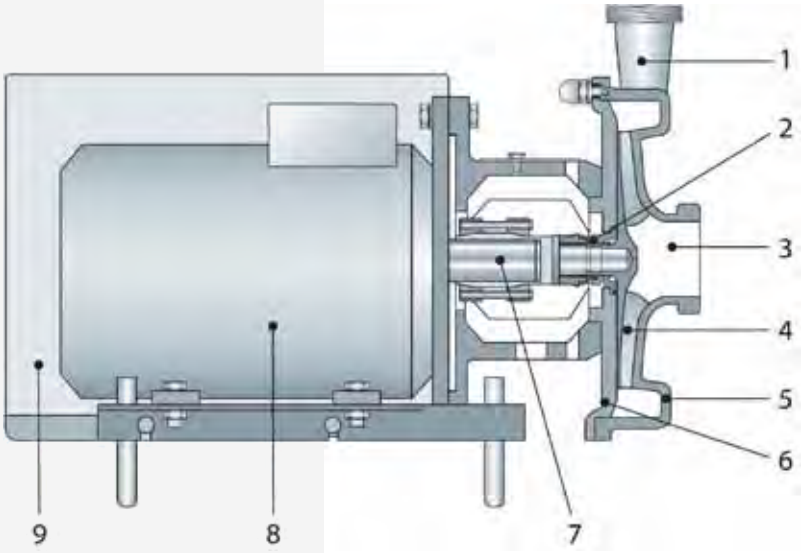


Figure 4: The most common type of sanitary pump in the dairy is the centrifugal pump.

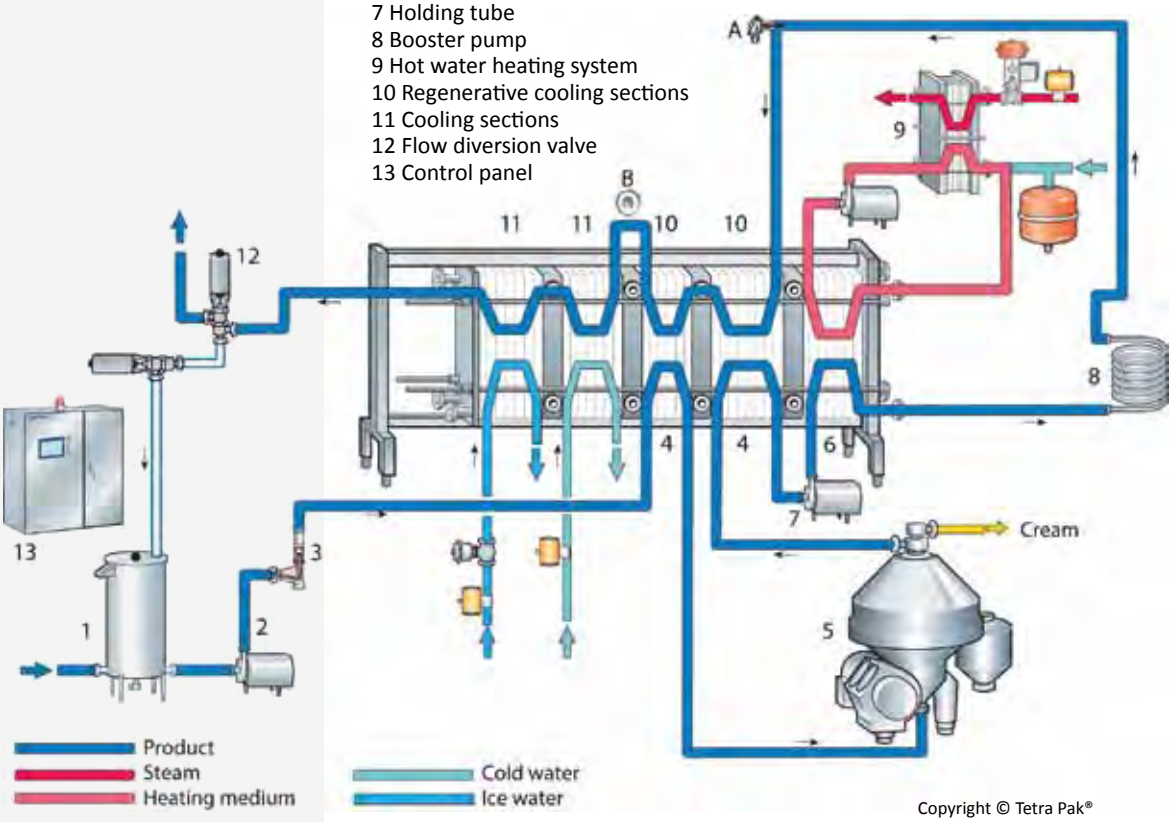
Figure 5: Main parts of a centrifugal pump.



1 Delivery line
2 Shaft seal
3 Suction line
4 Impeller
5 Pump casing
6 Back plate
7 Motor shaft
8 Motor
9 Stainless steel shroud and sound insulation

Figure 6: The complete pasteuriser plant consists of:

1 Balance tank
2 Feed pump
3 Flow controller
4 Regenerative preheating sections
5 Centrifugal clarifier
6 Heating section
7 Holding tube
8 Booster pump
9 Hot water heating system
10 Regenerative cooling sections
11 Cooling sections
12 Flow diversion valve
13 Control panel



SANS 10049, 7.3.1
SANS ISO TS 22002-1, 8
SANS 1679, 5.8

Pasteurisation equipment should be properly designed, installed, maintained and operated to ensure that all of the milk is heated to at least the minimum specified temperature for at least the specified time. The design of the pasteurisation equipment should comply with the hygiene requirements of food processing equipment. Note that any defects in the construction such as bad welding practice or dead ends will seriously affect the shelf life of the pasteurised milk. The use of more sophisticated valves on equipment could have a positive effect on the milk quality.

The balance tank feeding the pasteuriser should be of such design and capacity that no air will be drawn into the pasteuriser with the product when operating at minimum capacity. To achieve this, the bottom of the tank should be sloped with the outlet pipe at the lowest point.

Figure 7: Balance tank for constant inlet pressure to the pump.

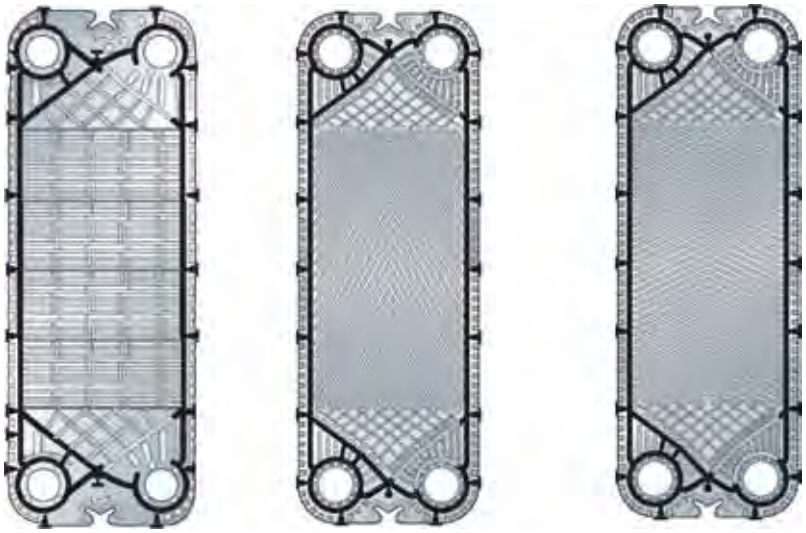
Figure 8: Balance tanks are available in different sizes.

The balance tank should be fitted with a hinged cover of suitable design to maintain atmospheric pressure and minimise the risk of contamination. It should also be fitted with an automatic device to control the level of milk or milk product within it.

The plate heat exchanger should be constructed in such a way that there is a gap between the gasket sections, which vents to the atmosphere, so that any gasket leak will go to the atmosphere. (Generally, any plate and gasket supplied by a reputable supplier will fulfil this requirement.)

Modern heat exchanger plates are pressed from thin stainless steel plate and have a large number of contact points for stability. Any pipeline hammer will lead to premature failure of the plates, e.g. leaks. The correct tightening of the plates will be specified by the supplier and must be adhered to by the user. Note that plates that are under-tightened may be as much at risk as plates that are over-tightened. Plates should be checked for leaks at regular intervals, either by pressure testing or by a visual dye test.

Figure 9: The shape of the partition in a plate heat exchanger may differ depending on the product to be treated and thermal efficiency requirements.



In the regeneration section of the pasteuriser, the pressure on the raw (unheated) side should always be lower than on the pasteurised side to avoid cross-contamination in the presence of leaks. This requirement generally requires the positioning of the timing pump after the first regeneration section and might require the installation of a second pump. Note that the installation of a second pump will not necessarily avoid the possibility of contamination due to leaks when the plant is in divert mode or when there is any pulsation or hammer in the pipelines. Regular checking of the plates is still required.

SANS 10049, 7.3.3
SANS ISO TS 22002-1, 8.4
CGCSA FSI GMCP B.C 1.5

The pasteuriser should be fitted with a flow-controlling device set to ensure constant flow throughout the system, such that the capacity is not exceeded and that the holding time is adequate. On larger pasteurisers, the use of a magnetic flow meter coupled to a flow-control valve or frequency inverter on the pump drive should be sufficient. On small pasteurisers, it may not be economically viable to install a sophisticated flow-control device. If control is dependent on the setting of a manual flow-control valve following a centrifugal pump, then the flow should be checked periodically. It is essential that the level in the balance tank be constant.

In the heating section of the pasteuriser, the milk (or milk product) pressure should be greater than that of the heating medium.

After the heating section, milk (or product) is held in a holding tube to ensure that the entire product is held at the specified temperature for the specified period of time. The holding tube should be sized to provide the required holding period and should be installed with a small upward slope (2%), with the slope maintained by permanent mechanical supports.

The holding tube should be uniform in diameter and should be designed in such a way that provision is made for carrying out holding time determinations.

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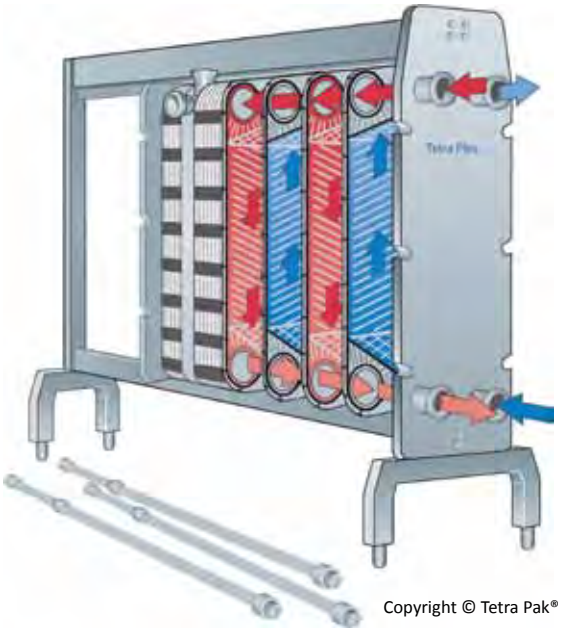
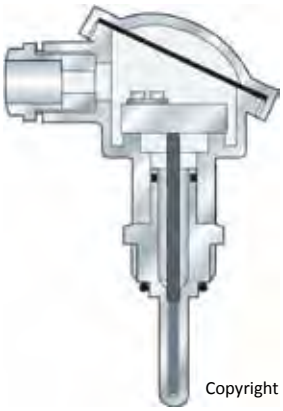
Temperature sensors to measure the temperature of the milk should be located at the end of the holding tube. The accuracy of the temperature sensors should comply with national standards and ensure that the minimum pasteurisation temperature is achieved.

Figure 10: Principles of flow and heat transfer in a plate heat exchanger.



A temperature recording sensor should be provided to enable the recording of the hot milk temperature continuously by means of automatic temperature recorders.

Figure 11: Resistance type temperature transmitter



An indicating thermometer should be included in close proximity for use as a check on the hot milk recording sensor. (Note that the indicating thermometer might have a different response time to the recording sensor.) The temperature recorder should be equipped to produce a continuous permanent record of all pertinent information, that is, time of day, temperature, position of flow-diversion device (see below). Different colour pens should be used to record the different parameters (on certain types of recorders).

SANS 10049, 7.3.3
SANS ISO TS 22002-1, 8.4
CGCSA FSI GMCP B.C 1.5, I.C.1.6

For the pasteurisation of milk and cream for liquid consumption, an automatic FDD should always be fitted to ensure that the product is automatically diverted from the process when pasteurisation conditions are not achieved. For other products, an FDD is also recommended.

R 1555
SANS 10049, 7.3.1
SANS ISO 22000, 7.6.5
CGCSA FSI GMCP B.C 1.5, I.C.1.8

All FDDs should have free draining diversion lines back to the balance tank. These lines should be equipped with an appropriate restriction so that the holding time is maintained at the required period during diverted flow. In case of loss of electrical power or air supply, the FDD should automatically return to the divert position.

The operation of the FDD will be controlled from the temperature sensor at the end of the holding tube. There should be sufficient distance between the sensor and the FDD to ensure that the response time of the sensor and valve are taken into account in the design. This response time might be as high as several seconds. Furthermore, the possibility of fouling on the temperature probe should be taken into account in the determination of the distance between the probe and the sensor.

SANS 10049, 8.7
SANS ISO TS 22002-1, 8.4
CGCSA FSI GMCP I.C.1.9

Auto-divert checks should be carried out daily and results must be recorded.

Pasteuriser controls may not be accessed by any staff member and must be locked.

In the cooling section of the pasteuriser, the milk (or milk product) pressure should be greater than that of the cooling medium.

Ideally, provision should be made for the use of computer control and data logging of the temperatures of product, heating and cooling media.

Figure 12: Analog control can be exemplified by the control of the pasteurisation temperature.

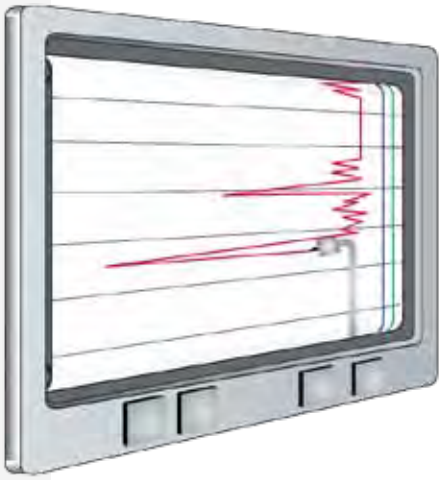


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Figure 13: Management Information makes it possible to improve productivity.

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SANS 10049, 7.3.3, Appendix B & C
SANS ISO TS 22002-1, 8.5, 11
SANS 1679, 6.6.4, 6.7.1
CGCSA FSI GMCP B.B 3

6.1.2 Cleaning and sanitisation of pasteurisers and post-pasteurisation lines

Equipment that is to be cleaned in place (CIP) should include only components (e.g. pipe unions) that are designed for CIP. Equipment, particularly pipe unions should be correctly installed.

CIP of post-pasteurisation equipment and pipelines should be on a different circuit than that used for pre-pasteurisation lines.

SANS 10049, 7.2.14, 7.4.5
SANS ISO TS 22002-1, 6.2
SANS 1679, 5.10
CGCSA FSI GMCP B.B.6

Where hot water sanitisation is to be used, hot potable water at 95°C for 20 minutes is recommended. Longer times might be required if construction is not optimum, e.g. long loops and dead ends.

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Removal of chemical residues from equipment by adequate rinsing is essential. This should be checked after each cleaning. The rinse water can also be tested to confirm the efficacy of the CIP on microorganisms

Figure 14: Spray turbine for tank cleaning.
The spray turbine consists of two rotating nozzles on the same pipe. One rotates in the horizontal plane and the other in the vertical. Rotation is produced by jet reaction from the backward- curved nozzles.

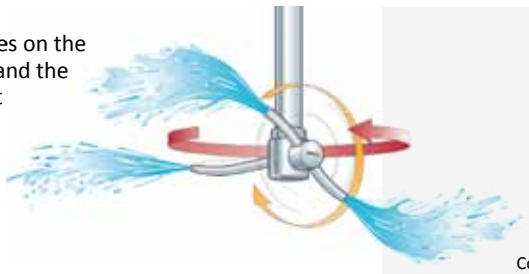
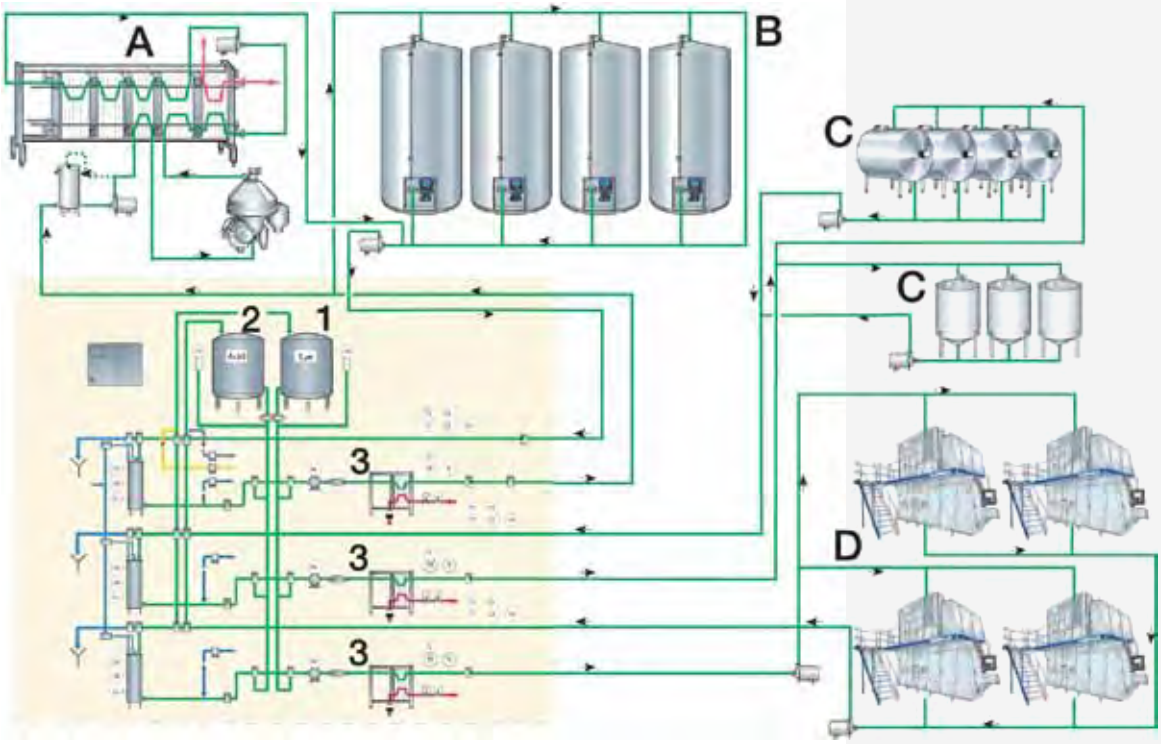


Figure 15: Examples of positions difficult to clean in a pipe system.

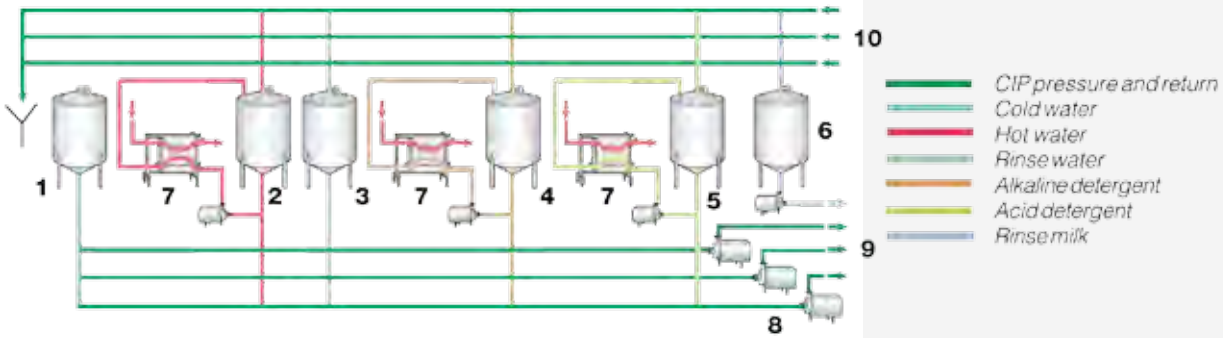
Figure 16: Principle of the centralised 2 1 CIP system.



Cleaning unit (within the broken line)
1 Tank for alkaline detergent
2 Tank for acid detergent

Object to be cleaned:
A Milk treatment
B Tank garden
C Silo tanks
D Filling machines

Figure 17: General design of a central CIP station.



1 Cold water tank
2 Hot water tank
3 Rinse water tank
4 Alkaline detergent tank
5 Acid detergent tank
6 Rinse milk tank
7 Plate heat exchanger for heating
8 CIP pressure pumps
9 CIP pressure lines
10 CIP return line

SANS 10049, 7.3.2
SANS ISO TS 22002-1, 8.6
CGCSA FSI GMCP I.B 1

6.1.3 Maintenance and control of equipment

Pasteurisation equipment should be subjected to a planned maintenance schedule to ensure its effective operation.

Important checks include:

- Gaskets for leaks or excessive wear.
- Heat exchanger plates for pin-holes (by dye or pressure testing).
- Balance tank components (floats, level controllers) for general condition and effective functioning.
- Flow-control device for mechanical soundness and effective functioning and accuracy.
- Temperature recorder to ensure functioning according to specification.
- The temperature recorder should be fully serviced and calibrated at least once a year.
- Flow-diversion device components for mechanical soundness and effective functioning

Records of daily checks should be available for the accuracy of gauges and pressure-measuring devices. The best practice is to conduct these checks during the CIP cycle to ensure that the temperature sensors are functioning correctly.

Records should be kept of all maintenance that was done on equipment, including date, type of repair and person responsible for repairs.

Validation of equipment must be done yearly and certificates of validation must be available.

SANS 10049, 7.3.3
SANS ISO TS 22002-1, 8.4
SANS ISO 22000, 8.3
CGCSA FSI GMCP I.A. 5

6.1.4 Temperature recording, calibration and verification

The indicating thermometer/PT100 should be calibrated on installation and on a regular basis (monthly) thereafter, against a reference thermometer/ calibrated master fluke. Any correction factor required should be clearly indicated on a tag or label permanently attached to the thermometer if required.

! Please note that glass thermometers are not recommended in the processing facility.

The temperature chart recorder should be monitored regularly, in particular the correct operation of event pens (their working and ink colour). Charts should also be reviewed regularly to ensure that the correct temperature is being achieved. These charts should be signed off daily and kept as records. The accuracy of the temperature recorder, including that of the cut-in/cut-out temperature, should be checked against the indicating thermometer on a daily basis.

The FDD should be checked regularly to verify that it is functioning within its specification limits. This should be done daily in the case of milk processed for liquid consumption. The FDD should be verified to be functioning within its specified temperature limits (72°C for 15 seconds for fresh milk).

The effectiveness of the cleaning of the pasteurisation equipment should be continuously monitored to ensure that the cleaning operation is working effectively. In particular, the temperature of heating water and product should be recorded so that any increase in the temperature differential is noted (indicating fouling). Similar consideration should be given to changes in back pressure.

The effectiveness of the pasteurisation process should be checked daily by carrying out phosphatase tests on treated milk, and by carrying out regular checks on the residence time in the holding tube.

R 1555 Annexure B

6.1.5 Prevention of post-pasteurisation contamination in plate pasteurisers

All pipelines carrying pasteurised products should be bacteria-tight, e.g. no cracks, leaky welds or gasket leaks.

Pipelines used to carry raw milk should not be used to carry pasteurised milk and should not be designed to be interchangeable. Particular care should be taken to guard against interconnecting lines between raw and pasteurised milk lines. Drawings of flow lines should be reviewed on a periodic basis and updated to reflect existing piping arrangements. The validity of drawings should be checked by walking them through the plant. Piping changes should not be carried out until authorised by qualified personnel.

SANS 10049, 7.3.1
SANS ISO TS 22002-1, 10.2
SANS 1679, 6.7.4

Special care must be taken to clean and sanitise all utensils prior to contact with milk or product downstream of the pasteuriser.

Chilled water services applied to pasteurised milk and product lines should preferably be independent of that supplied for raw milk duties. This may not always be an economic possibility in small dairies. Regular checking of pasteuriser plates is essential in such cases. Contamination of the factory environment must be minimised to avoid risk to the product, e.g. dust, flies, insects, rodents, footbaths.

Personnel involved in post-pasteurisation processes should be aware of the possibilities of recontamination through their own person as well as other reasons. Hygiene and safety training should also be done.

Personnel involved in the handling of raw milk should not, as far as is reasonably practicable, have duties in any post-pasteurisation area.

SANS 10049, 7.2.1.9, 7.2.10
SANS ISO TS 22002-1, 10.2
SANS 1679, 5.2.2
CGCSA FSI GMCP B.B 2.1, 2.2, 4.1

6.2 Batch pasteurisation (long temperature long time – LTLT)

6.2.1 Equipment

The batch pasteuriser should provide means for agitating the milk or milk product contained in it, while the design should ensure that filling and agitation minimise the amount of foaming. Agitate while heating.

The milk or milk product may be heated externally, in a heat exchanger, or within the pasteuriser. Whichever is used, the equipment should be capable of heating the milk to the required temperature 63°C for 30 minutes (not exceeding 65.5°C).

R 1555 Annexure B
SANS 10049, 7.3.1
SANS ISO TS 22002-1, 8
CGCSA FSI GMCP B.C 1.4, 1.5

The batch pasteuriser should be provided with a cover to prevent contamination.

The batch pasteuriser should be equipped with a temperature probe for the product temperature, and a product temperature recorder.

SANS 10049, 7.3.3
SANS ISO 22002-1, 8.4
CGCSA FSI GMCP B.C 1.4, 1.5

Batch pasteurisation equipment should be subject to a planned maintenance schedule to ensure its effective condition.

SANS 10049, 7.3.2
SANS ISO TS 22002-1, 8.4
CGCSA FSI GMCP B.B 2.2< I.B 1

SANS 10049, 7.3.3
SANS ISO 22000, 8.3
CGCSA FSI GMCP I.A. 5

6.2.2 Temperature recording, calibration and verification

Indicating thermometers should be calibrated on installation and on a regular basis thereafter, against a reference thermometer. Any correction factor required should be clearly indicated on a tag or label permanently attached to the thermometer.

SANS ISO 22000, 7.8
CGCSA FSI GMCP I.C.1.9

The temperature chart recorder should be regularly monitored, in particular the correct operation of event pens. Charts should be regularly reviewed to ensure that the correct temperatures and holding times are being achieved.

SANS 10049, 7.3.3
SANS ISO 22000, 8.3
CGCSA FSI GMCP I.A. 5

The accuracy of the temperature recorder should be checked against the indicating thermometer on a daily basis.

SANS 10049, 7.4.5
SANS ISO TS 22002-1, 8.5, 11.4
SANS 1679, 6.7.1
CGCSA FSI GMCP B.B 3.1
Chapter 7

The effectiveness of the cleaning of the pasteuriser and associated equipment should be monitored.

R 1555 Annexure B
SANS 10049, 8.7
SANS ISO 22000, 7.8
SANS 1679, 9
CGCSA FSI GMCP I.C.1.9
Chapter 7

The effectiveness of the pasteurisation process should be checked per batch by carrying out phosphatase tests on treated milk.

6.2.3 Prevention of post-pasteurisation contamination for batch pasteurisers

The measures required for the prevention of post-pasteurisation contamination in HTST pasteurisation are also recommended for batch pasteurisation.

6.4 Other heat-treatment processes

6.4.1 Heat process requirements

Any milk and milk for milk-based product designed to be microbiologically stable should be sufficiently heat-treated to prevent the growth of microorganisms.

SANS ISO 22000, 7.4.4
CGCSA FSI GMCP B.C. 1.4, I.C 1.4-1.6

Low-acid products or ingredients (i.e. with a relatively high pH of 4 to 5 or above), intended for storage under non-refrigerated conditions, should be subjected to a scheduled heat treatment process. This should be designed to reduce the probability of survival of *Clostridium botulinum* by a factor of at least 10^{12} (the "minimum botulinum process"), unless it can be demonstrated that conditions of product formulation cannot support growth of the organism. *Clostridium botulinum* is used to test in-container sterilisation processes – similar *Bacillus subtilis* and *Bacillus stearothermophilus* are used to validate UHT treatment.

Some bacterial spores that may cause spoilage are more heat-resistant than *Clostridium botulinum* spores (thermoduric spores) and when these are identified as a problem, a more severe heat treatment should be considered to achieve microbiological sterility.

Milk and milk for milk-based products designed for refrigerated storage should receive a heat treatment process designed to reduce

the probability of survival of *Listeria monocytogenes, Mycobacterium tuberculosis* and *Coxiella burnetti* by at least a factor of 10^4, unless it can be demonstrated that conditions in the product formulation cannot support growth of the organism.

Milk and milk products designed for an extended refrigerated shelf life should, in addition, receive a heat treatment process (or filtration or centrifuge-bactofuge) that ensures that the products remain safe for the designated shelf life plus an adequate safety margin. The so-called Extented Shelf Life (ESL) products are examples of this.

To achieve effective heat treatment, the physical, chemical and microbiological characteristics of the milk or milk product should be taken into account for plant design and processing regimes. These characteristics include density, viscosity, water activity, pH, thermal properties, microbial loading and composition.

Dry ingredients used in a product formulation should be completely dispersed, wetted and dissolved before heat treatment. Dissolved gases should also be removed before heat treatment.

Products that are not commercially sterile or that are not shelf-stable at ambient temperature should carry clear instructions on storage conditions, including maximum storage temperatures.

6.4.2 General requirements for heat treatment equipment

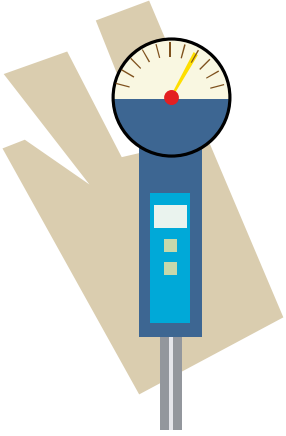
SANS 10049, 7.3.1
SANS ISO 22000, 8.3
CGCSA FSI GMCP I.A. 5

The heat treatment equipment should be capable of fulfilling the required time/temperature combination at all times. All batch and continuous heat-processing equipment should be fitted with direct (indicating) thermometers and automatic time and temperature recording instruments. Where electronic measuring devices are used to control the process, these should be independent of measuring devices used to generate process records.

Heat treatment equipment should be internally clean and sanitised, correctly assembled, free from “dead-ends” and other design faults and with control systems that have instruments of reducible accuracy. Sludge from self-cleaning separators should not be discharged on the floor or in open buckets, but should be collected without presenting any risks of contamination to its environment.

Heat treatment equipment must at least be fitted with:

- Automatic temperature control.
- Recording thermometer.
- Automatic safety device preventing insufficient heating.
- Adequate safety system preventing the mixture of pasteurised or sterilised milk with incompletely heated milk.
- Automatic recording device for the safety system.



7. Filters

A filter system or clarifier should be used either cold on reception of the milk into the dairy or hot during the pasteurisation process.

SANS ISO 22000, 7.4.4
SANS ISO TS 22002-1, 10.4
CGCSA FSI GMCP B.C 1.4, I.C.1.4-1.6

Figure 18: Automatic temperature control loop.

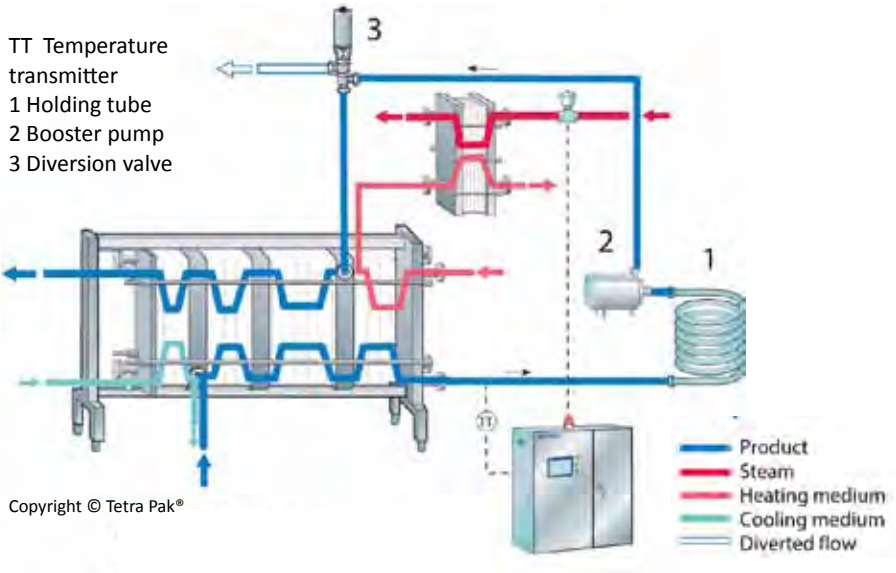
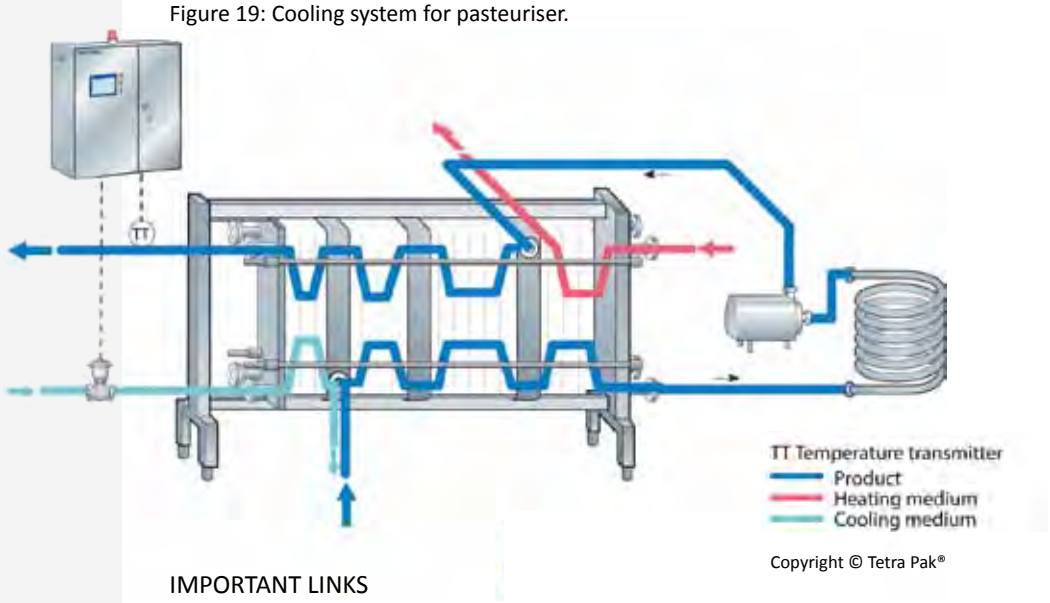


Figure 19: Cooling system for pasteuriser.



IMPORTANT LINKS

HACCP

Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION

Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling

TESTING

Remember to refer back to Chapter 7 for more details on sampling and testing methods

Section 3.2 Long-life (UHT) milk

1. Overview of the process

Three technologies are used to process raw milk in order to produce long-life milk. Take note that for each of these manufacturing technologies an initial pre-sterilisation step is included. Typical temperatures used range between 80 and 90°C and may serve as germination prompt for spores to vegetate. The final heat treatment, however, kills vegetative cells much more effectively than spores.

The first, called indirect heating, employs the same principles as pasteurisation in a plate pack and may well entail using a plate pack. In recent times the development of tubular heat exchangers (tube within a tube) has greatly improved the efficacy of ultra-high temperature processes. In this way the heating medium does not come into contact with the product.

The second, called direct heating, employs the principle of bringing the heating medium into direct contact with the product. Two methods may be used, namely steam injection and steam infusion. In the former, steam is injected into the milk under high pressure and removed again by vacuum withdrawal of the generated vapour. In the latter, a steam chamber is created into which the milk is sprayed with nozzles. Again, the generated vapour is removed in a vacuum chamber. The balance that needs to be struck here is to remove as much generated vapour as was injected or infused, so as to prevent dilution. It stands to reason that the heating medium used in both methods of direct heating should be of culinary quality. These systems are equipped with water softeners and steam scrubbers to ensure the prevention of contamination by both unwanted minerals and microorganisms (especially spores). The product obtained from these processes (indirect and both direct heating methods) are called UHT products. The required temperatures and exposure times may vary from 135 to 152°C for anything from four to two seconds (inversely). The products are deemed to be “commercially sterile”.

Figure 20: Vessel in which the product is heated by infusion into the steam

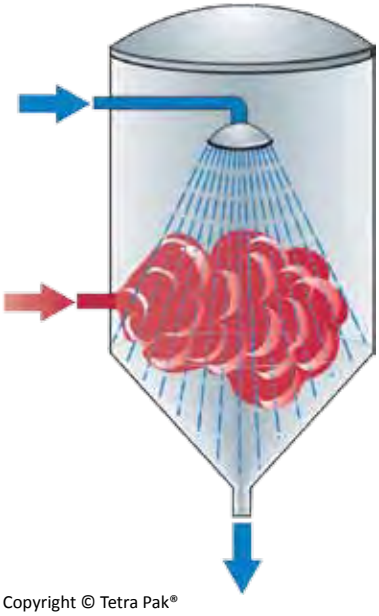
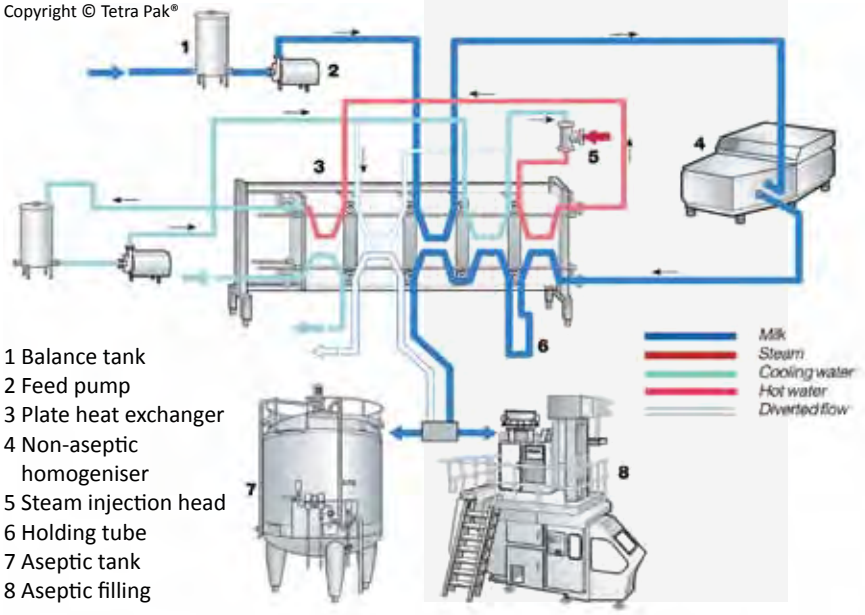


Figure 21: Indirect UHT system based on indirect heating in a plate heat exchanger



1 Balance tank
2 Feed pump
3 Plate heat exchanger
4 Non-aseptic homogeniser
5 Steam injection head
6 Holding tube
7 Aseptic tank
8 Aseptic filling

The third technology is used for producing sterilised milk (also known as "steri-milk"). This is used for both "white" milk and sweetened, flavoured milk. In effect it is an in-container heat treatment in which the standardised or formulated, mixed and/or homogenised product is filled and sealed prior to heat treatment. A steri-tower or autoclave type retort (steam pot) may be used which creates sufficient pressure so that the filled and sealed product's packaging integrity is not breached. Temperatures used depend on the product and may range from 115 to 130°C for 30 to 18 minutes (inversely).

Figure 22: Batch processing in a static pressure vessel (autoclave)

2. Typical product specification

Product description

Product name	Full cream UHT milk	
Ingredient list	Full cream milk	
Allergen declaration	Contains: cow's milk	
Pack size	1 l	
Temperature category	Ambient (<25°C)	
Shelf life	Day of packaging plus six months	
Production code	Sell by	
	Use by	
	Batch code	Batch, shift, machine codes
Storage conditions	<25°C	

Composition

Ingredient	Specification	Weight	% added
Raw milk	See Chapter 2		100%
TOTAL			**100%**

Process flow

Production controls	Process steps	Quality controls
Temperature of milk <7°C Foreign object inspection Milk to be kept for <48 hours	RECEIVING OF RAW MILK ↓	Milk intake tests: microbiological, chemical and physical Reject milk that does not conform to above specifications
	STANDARDISE ↓	Standardise to 3,3% butterfat
Temperature: 65°C minimum	THERMODISE ↓	Ensure correct temperature
First stage: 200 bar at 75–80°C Second stage: 40 bar	HOMOGENISE ↓	Ensure correct pressure setting
136–138°C for 4 seconds	UHT PROCESS ↓	Ensure correct temperature Thermographic recorder
Fill into containers	ASEPTIC FILLING ↓	Ensure correct filling weights Packaging integrity tests Correct date coding Maintain aseptic conditions
Finished product into outer packaging	OUTER PACKAGING ↓	Check integrity of outer packaging Correct date coding
Palletisation to conform to pallet configuration	PALLETISE ↓	Check for damaged stock on pallets
Products to be placed in holding store for 7 days	QUARANTINE ↓	Incubation period 30°C for 14 days Incubation tests
Truck to conform to transportation standards	DISTRIBUTE ↓	Ensure products are adequately covered in transit
	RECEIVED AT STORES	Delivery temperature <25°C

Chapter 7

Rejection criteria for Critical Control Point (CCP) deviation

If sterilisation of 136–138°C for four seconds is not reached and maintained, the milk will be diverted back to the heating section of the steriliser in order to be re-sterilised.

Packaging and labelling

Material	Supplier	Reference
Aseptic carton		
Outer carton		

Packaging process

- Milk filled aseptically into UHT cartons in a closed system.
- Best before date coded onto primary packaging material using appropriate printing technology.
- Packed into outer packaging.
- Best before date coded onto secondary packaging material using appropriate printing technology.
- Packed product moved and kept in holding store for a seven day incubation period.

Reasons for rejection

- Product does not conform to dairy regulations.
- Incorrect best before dates.
- Illegible date code markings.
- It is possible to rub off date code markings.
- Filled volume is out of specification.
- Incorrect weight.
- Non-adherence to process control specifications.
- Leaking containers.
- Damaged containers.
- Dirty truck/lugs/containers.

3. Product standards

Analytical standards UHT milk			
Test	**Limit**	**Reject**	**Frequency**
Added water	0%	>1%	Per batch
pH	6,5–6,8	<6,5	Per batch
Full cream	>3,30%	<3,30%	Per batch
Volume: 1 l	1 000 ml	<1 000 ml	Per procedure
Weight: 1 l	1 031 g	<1 031 g	Per procedure
Dye penetration test	Negative	Positive	Per procedure
Recommended microbiological standards UHT milk			
Test	**Limit**	**Reject**	**Frequency**
Total plate count	Absent	Present	Per batch
Coliforms	Absent	Present	Per batch
E. coli	Absent	Present	Per batch
Spore count	<10 cfu/ml	>10 cfu/ml	Per batch
Bacillus cereus	Absent	Present	Quarterly
Clostridium spp	Absent	Present	Quarterly
Anaerobic thermophiles	Absent	Present	Quarterly
Listeria spp	Absent/25 g	Present	Quarterly
Salmonella spp	Absent/25 g	Present	Quarterly

4. Sensory evaluation/product description

Appearance	White to cream milk with no foreign matter. No separation of cream should be visible.
Colour	White to creamy-white.
Flavour	Characteristic slightly cooked milk flavour with no off taints (rancid, sour, etc.) or foreign taints.
Texture	Creamy and smooth liquid.
Aroma	Characteristic of milk with no off, rancid or chemical aroma.

Storage instructions
Refrigeration: Store in a cool, dry place prior to opening and use within expiry date. Once opened, keep refrigerated and use within three to five days.
Freezing: Not recommended.

Serving suggestions
Serve chilled.

Transport requirements
Packed product to be transported in clean and covered vehicles capable of maintaining the correct temperature for the required product. Vehicles also need to be clean and pest-proofed.

IMPORTANT LINKS

HACCP
Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION
Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling

TESTING
Remember to refer back to Chapter 7 for more details on sampling and testing methods

Section 3.3 Yoghurt

1. Overview of the process

Yoghurt is manufactured using a fermentation process. A formulation which may include fat, standardised liquid milk, additional milk solids, stabiliser, sweetener, flavouring and colouring and fruit pulp or fruit pieces, are subjected to fermentation using a combination of cultures, usually of the thermophilic type. Preservatives are also added to prevent especially yeast and mould growth as these prefer the more acid environment of a fermented product such as yoghurt.

The so-called sweet base consisting of all the ingredients except the flavouring and colouring, or fruit pulp or fruit pieces is heat treated to prevent competition for the culture to be used. Thereafter the yoghurt culture is inoculated at the desired fermentation temperature (38 to 42°C). Effective temperature control is exercised to lower the pH to approximately 4,6 and the formation of a coagulum, after which cooling is rapidly performed to stop the fermentation process. The final pH of the product is normally 4,3.

All this time the integrity of the coagulum is maintained (i.e. no stirring) to prevent wheying off. Once cooling has lowered the temperature of the coagulum to approximately 15 to 25°C (depending on the type and amount of stabiliser used), the coagulum can be stirred and pumped. The flavouring and colouring or fruit pulp or pieces are simultaneously pumped through a mixing valve with the cooled coagulum to mix the product thoroughly prior to packaging.

Figure 23: Set yoghurt
1 Cup filler
2 Incubation room
3 Rapid cooling room

Fig. 24: Stirred yoghurt
1 Incubation tank
2 Cooler
3 Cup filler

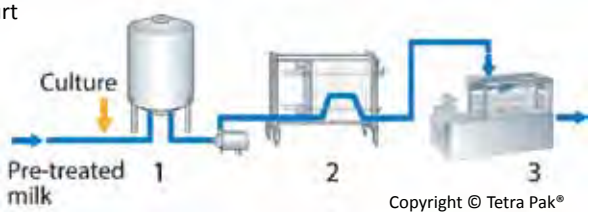


Fig. 25: Drinking yoghurt
1 Incubation tank
2 Cooler
3 Homogeniser
4 Filling machine

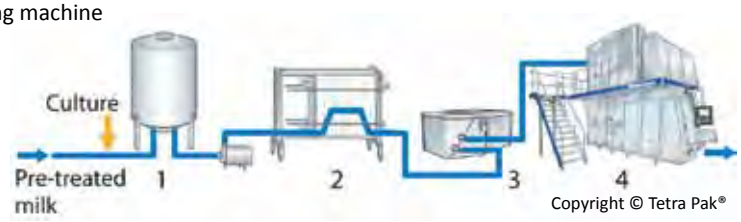


Fig. 26: Frozen yoghurt
1 Incubation tank
2 Ice cream bar freezer
3 To hardening tunnel

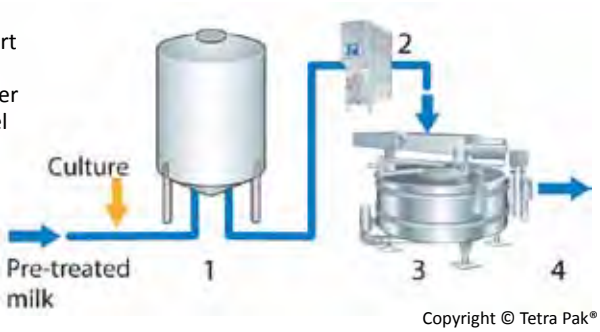


Fig. 27: Concentrated yoghurt
1 Incubation tank
2 Separator
3 Cup filler

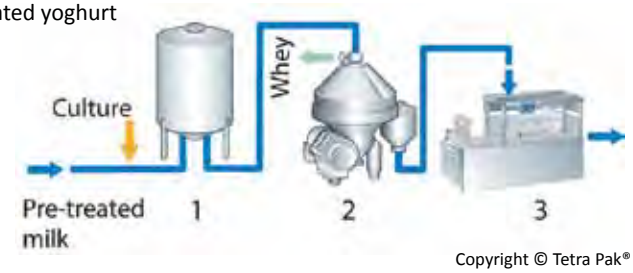
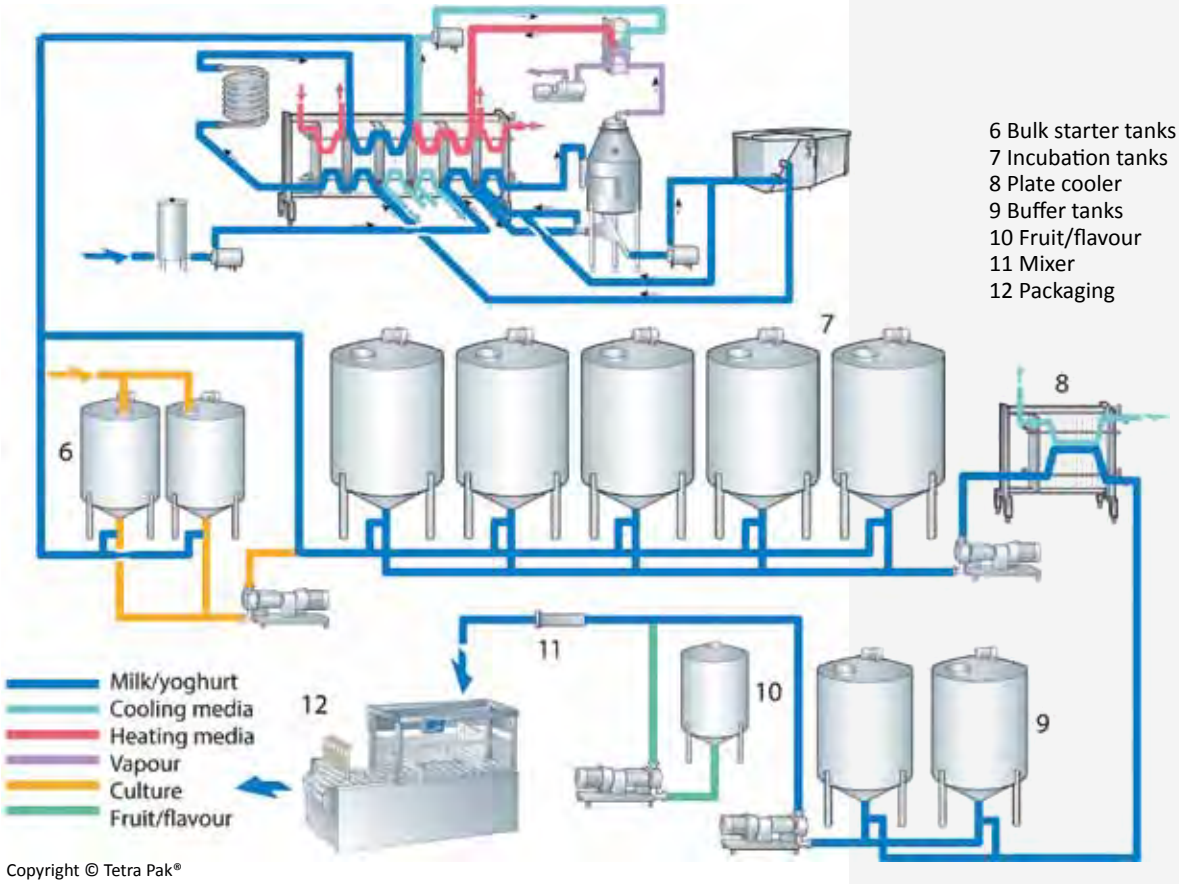


Figure 28: Production line for stirred yoghurt



6 Bulk starter tanks
7 Incubation tanks
8 Plate cooler
9 Buffer tanks
10 Fruit/flavour
11 Mixer
12 Packaging

2. Typical product specification

Product description

Product name	Full cream yoghurt	
Ingredient list	Full cream milk, milk powder, stabilisers, yoghurt cultures, preservative (e.g. pimaricin)	
Allergen declaration	Contains: cow's milk	
Pack size	175 g, 500 g, 1 kg	
Temperature category	Chilled (0–7°C)	
Shelf life	Day of packaging plus 38 days	
Production code	Sell by	
	Use by	
	Batch code	Batch, shift, machine codes
Storage conditions	0–7°C	

Composition

Ingredient	Specification	Weight	% added
Full cream milk	See Chapter 3.1		75%
Fresh cream	Butterfat >30%		21%
Stabiliser			3%
Yoghurt culture			0,5%
Preservative			0,5%
TOTAL			**100%**

Process flow

Production controls	Process steps	Quality controls
Temperature of milk <7°C Foreign object inspection Milk to be kept for <48 hours	RECEIVING OF RAW MILK ↓	Milk intake tests: physical, microbiological and chemical Reject milk that does not conform to above specifications
Check that % butterfat is correct	STANDARDISE ↓	Standardise to 3% butterfat
Check divert valve 72°C minimum for 15 seconds	PASTEURISE ↓	Ensure correct temperature setting Thermographic recorder Phosphatase test

Chapter 7

Document weight of dry ingredients Hydrate for 1 hour	MIXING OF DRY INGREDIENTS AND HYDRATE ↓	Ensure correct weight of dry ingredients
	PRE-HEAT to 65°C ↓	Ensure correct temperature setting
Pressure 80 bar	HOMOGENISE ↓	Ensure correct pressure setting
92–95°C for 7 minutes Temperature and time	PASTEURISE ↓	Ensure correct temperature setting Thermographic recorder
Cool to 40°C Temperature 40°C pH 4,50–4,55	COOL AND ADD PRESERVATIVE ↓	Ensure correct temperature 40°C Record batch code of preservative added Check temperature and pH
	PUMP INTO BATCH TANK AND INOCULATE WITH YOGHURT CULTURE ↓	Use viable yoghurt culture
Temperature 40°C Time ±6 hours	INCUBATE ↓	Ensure correct temperature is maintained Monitor time and temperature Record pH Ensure correct pH is reached
Stir	AGITATE ↓	
Temperature ±25°C	COOL ↓	Ensure correct temperature and record
Monitor weight of product	FILL CONTAINERS ↓	Fill at <25°C Ensure packaging integrity and correct date coding Record all findings Weight checks Yoghurt online tests: microbiological, chemical and physical Correct date coding Positive release system
Temperature <7°C	COLD ROOM ↓	Maintain cold chain (<7°C)
Truck to conform to hygiene standards Truck temperature to maintain product temperature	DISTRIBUTION ↓	
	RECEIVED AT STORES	Delivery temperature <7°C

Rejection criteria for CCP/CP deviation

If pasteurisation of 92–95°C for seven minutes is not reached and maintained, the milk will be diverted back to the heating section of the pasteuriser in order to be re-pasteurised.

If the pH is lower than specification during incubation time, stop the incubation. If the pH is still higher than the specification after the required incubation time, continue incubation until the optimum pH is reached.

Packaging and labelling

Material	Supplier	Reference
Cup		
Lid/foil		

Packaging process

- Yoghurt pumped into correct hoppers for filling.
- Yoghurt gravity filled into correct containers.
- Use by date ink jet coded onto packaging material.
- Packed off conveyor into crates (plastic liners for sachets).
- Packed product moved and stored in cold room until distribution.

Reasons for rejection

- Product temperature incorrect.
- Product does not conform to dairy regulations.
- Incorrect sell by and use by dates.
- Illegible date code markings.
- It is possible to rub off date code markings.
- Filled volume is out of specification.
- Incorrect weight.
- Non-adherence to process control specifications.
- Leaking containers.
- Dirty truck/lug/containers.

3. Product standards

Analytical standards Full cream yoghurt			
Test	**Limit**	**Reject**	**Frequency**
pH	4,2–4,4	<4,2	Per batch
Total solids content	>18%	<18%	Per batch
Butterfat	>4,5%	<3%	Per batch
Weight: 175 g			Per procedure
Weight: 500 g			Per procedure
Weight: 1 kg			Per procedure
Recommended microbiological standards Full cream yoghurt			
Test	**Limit**	**Reject**	**Frequency**
Coliforms	<10 cfu/g	>10 cfu/g	Per batch
E. coli (faecal type)	Absent/g	Present	Per batch
Yeasts	<50 cfu/g	>50 cfu/g	Per batch
Moulds	<50 cfu/g	>50 cfu/g	Per batch
Salmonella spp and other pathogens if required	Absent/25 g	Present	Quarterly
Staphylococcus aureus (coagulase positive)	Absent/g	Present	Quarterly

4. Sensory evaluation/product description

Appearance	Thick, creamy and smooth texture. No foreign matter. No separation should be visible. No lumps or graininess.
Colour	Creamy-white.
Flavour	Mild, typical yoghurt flavour with no off taints (rancid, sour, etc.) or foreign taints.
Texture	Creamy and smooth mouth feel. Yoghurt needs to be spoonable and not runny.
Aroma	Characteristic of yoghurt with no off or rancid aroma.

Storage instructions
Refrigeration: Keep refrigerated below 7°C and use within expiry date.
Freezing: Not suitable for home freezing.

Serving suggestions
Serve chilled.

Transport requirements
Packed product to be transported in clean and enclosed vehicles capable of maintaining the correct temperature for the required product. Vehicles also need to be clean and pest-proofed.

IMPORTANT LINKS

HACCP
Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION
Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling

TESTING
Remember to refer back to Chapter 7 for more details on sampling and testing methods

Section 3.4 Cultured milk and cultured buttermilk

1. Overview of the process

Cultured milk (also known as maas) is sour milk that has been fermented under controlled conditions and with a culture of choice. In terms of compositional regulations maas may not contain anything but milk and culture. Two products can be manufactured, namely a set maas or a stirred maas. Both are fermented with mesophilic cultures that are mostly acid formers only, but may contain flavour-forming cultures as well.

Standard practice entails the fat standardisation of the milk and pasteurisation thereof at 85 to 93°C for as long as 10 minutes or as required, to eliminate microbial competition for the culture used. This is followed by a lowering of the temperature to the required fermentation temperature (approximately 25°C). The culture is then added and mixed thoroughly into the milk. The product is filled and sealed in the container and incubated in an incubation chamber. Stirred maas, however, is fermented in a double-sided, temperature-controlled tank.

After fermentation in its container, the fermented product is then packed in cold rooms to limit any further unwanted fermentation. Both short set and long set maas can be manufactured, depending on the type of culture and inoculation dosage. Similar to yoghurt manufacturing, the fermentation is slowed once the pH reaches 4,6 to ensure a final pH of approximately 4,3 (below which the acidification is excessive). Stirred maas then needs to be poured into containers and sealed prior to retail distribution.

Cultured buttermilk in South Africa is the equivalent of maas and is generally not manufactured from actual buttermilk, which is a by-product of the butter churning process (the volume of available buttermilk is inhibitive). It is made in the same way as the maas, but a culture containing flavour-forming bacteria is used instead of only acid formers. This is to impart the typical butter flavour (diacetyl) to the product.

2. Typical product specification

Product description

Product name	Amasi/maas or cultured buttermilk	
Ingredient list	Full cream milk, starter culture	
Allergen declaration	Contains: cow's milk	
Pack size	1 l and 2 l	
Temperature category	Chilled (0–7°C)	
Shelf life	Day of packaging plus 30 days	
Production code	Sell by	
	Use by	
	Batch code	Batch, shift, machine
Storage conditions	0–7°C	

Composition

Ingredient	Specification	Weight	% added
Raw milk	See Chapter 2		99%
Starter culture	Butterfat 3,3%		1%
TOTAL			**100%**

Process flow

Production controls	Process steps	Quality controls
Temperature of milk <7°C Foreign object inspection Milk to be kept for <48 hours	RECEIVE RAW MILK ↓	Milk intake tests: physical, microbiological and chemical Reject milk that does not conform to above specifications
Check divert valve 85–93°C for 10 minutes	PASTEURISE ↓	Ensure correct temperature setting Thermographic recorder Phosphatase test
Temperature of milk should be 22–24°C	COOLING ↓	Ensure correct temperature
	INOCULATE WITH STARTER CULTURE ↓	Use viable starter culture
	STIR FOR ±20 minutes ↓	
Temperature not less than 22°C	INOCULATED MILK ENTERS FILLING HOPPER ↓	Ensure correct temperature
Ensure that weight conforms to specifications	FILLING INTO CONTAINERS ↓	Weight checks Product online tests: microbiological and chemistry Correct date coding Ensure that container is properly sealed
Storage of milk at ambient temperature pH 4,3–4,55	STORE IN INCUBATION ROOM UNTIL OPTIMUM pH IS REACHED ↓	Ensure that temperatures are kept at ±25°C Record pH reading
Cold room temperature to be <7°C	REFRIGERATE ↓	Ensure correct temperature of 7°C
Truck to conform to hygiene standards Truck temperature to maintain product temperature	DISTRIBUTE ↓	Maintain cold chain (<7°C)
	RECEIVED AT STORES	Delivery temperature <7°C

Chapter 7

Rejection criteria for CCP deviation

If pasteurisation of 85–93°C for 10 minutes is not reached and maintained, the milk will be diverted back to the heating section of the pasteuriser in order to be re-pasteurised.

Packaging and labelling

Material	Supplier	Reference
2 l HDPE bottle		
1 l HDPE bottle		
Full cream maas labels/sleeves		

Packaging process

- Inoculated milk pumped into correct hoppers for filling.
- Maas gravity-filled into bottles in a closed system.
- Use by date coded onto packaging material using appropriate printing technology.
- Packed off conveyor into crates (plastic liners for sachets).
- Packed product moved and stored in temperature-controlled incubation room until optimum pH is reached.
- Packed in cold room until distribution.

Reasons for rejection

- Product temperature incorrect.
- Product does not conform to dairy regulations.
- Incorrect sell by or use by dates.
- Illegible date code markings.
- It is possible to rub off date code markings.
- Fill volume out of specification.
- Incorrect weight.
- Non-adherence to process control specifications.
- Leaking containers.
- Dirty truck/lug/containers.

3. Product standards

Analytical standards Maas			
Test	**Limit**	**Reject**	**Frequency**
pH	4,2–4,5	<4,2	Per batch
Full cream	>3,30%	<3,30%	Per batch
Volume: 2 l	2 000 ml	<2 000 ml	Per procedure
Volume: 1 l	1 000 ml	<1 000 ml	Per procedure
Weight: 2 l			Per procedure
Weight: 1 l			Per procedure
Recommended microbiological standards Maas			
Test	**Limit**	**Reject**	**Frequency**
Coliforms	<10 cfu/ml	>10 cfu/ml	Per batch
E. coli (faecal type)	Absent/g	Present	Per batch
Yeasts	<50 cfu/g	>50 cfu/g	Per batch
Moulds	<50 cfu/g	>50 cfu/g	Per batch
Staphylococcus aureus (coagulase positive)	Absent/g	Present	Quarterly
Salmonellae (and other pathogens if required)	Absent/25 g	Present	Quarterly

4. Sensory evaluation/product description

Appearance	White to cream in colour resembling curdled, semi-thick liquid with no foreign matter.
Colour	White to creamy-white in colour.
Flavour	Characteristic fermented milk flavour with no off taints (rancid, sour, etc.) or foreign taints.
Texture	Curdled, semi-thick liquid.
Aroma	Characteristic of fermented milk with no off or rancid aroma.

Storage instructions
Refrigeration: Keep refrigerated below 7°C and use within expiry date.
Freezing: Not recommended.

Serving suggestions
Use as an ingredient in recipes.
Serve chilled.

Transport requirements
Packed product to be transported in clean and covered vehicles capable of maintaining the correct temperature for the required product. Vehicles also need to be clean and pest-proofed.

IMPORTANT LINKS

HACCP
Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION
Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling

TESTING
Remember to refer back to Chapter 7 for more details on sampling and testing methods

3.5 Butter

1. Overview of the process

Butter is made by the churning of cream. In effect, this means the induced collision of fat globules, to such an extent that the fat globule membranes rupture and allow the fat to coalesce into a continuous phase. The fat globule membranes are lost in the buttermilk.

Even though this seems to be a mechanical action only, decades of experience have indicated that the fat content of the cream used to churn butter plays a vital role in the final yield. It is now known that 38 to 42% fat cream churns the most effectively and delivers the highest yield. Obviously the design of the beaters in the churn, as well as the speed at which it operates, will have an influence and may be adjusted to accommodate the actual fat percentage, but is has been indicated that the value ought to be between the stated limits.

Once butter formation is visually present, various further steps of washing and brining follow (depending on whether salted or unsalted/sweet butter is manufactured). A final pressing is performed to consolidate the final product, remove all excess water and/or buttermilk and transfer the butter to the packaging machine. Some manufacturers also perform an extra 'homogenisation' step in what is called microfixing , which reportedly renders a product with improved thawing and spreading properties.

Butter spread is a modified dairy product and contains a certain percentage of vegetable fat, but is churned in a process very similar, if not identical, to that of pure butter.

Figure 29: Traditional hand churn, formerly used for domestic buttermaking.

Figure 30: Butter churn for batch production.
1 Control panel
2 Emergency stop
3 Angled baffles

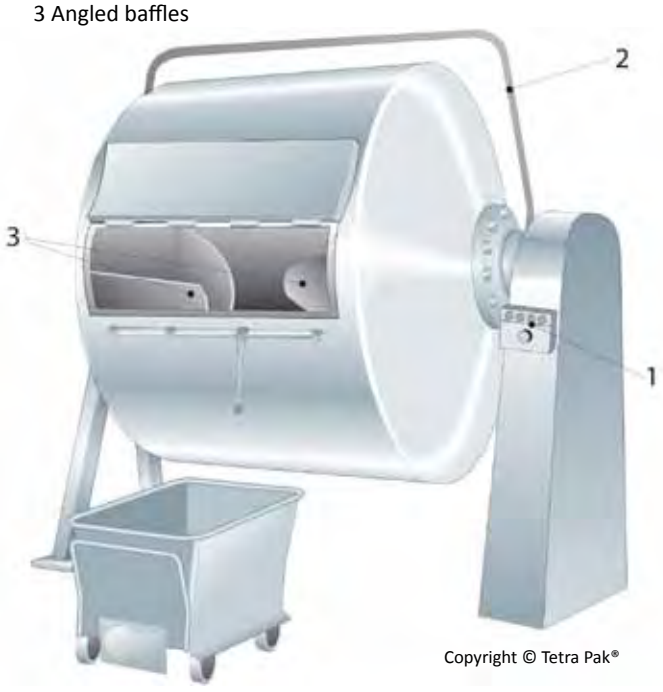
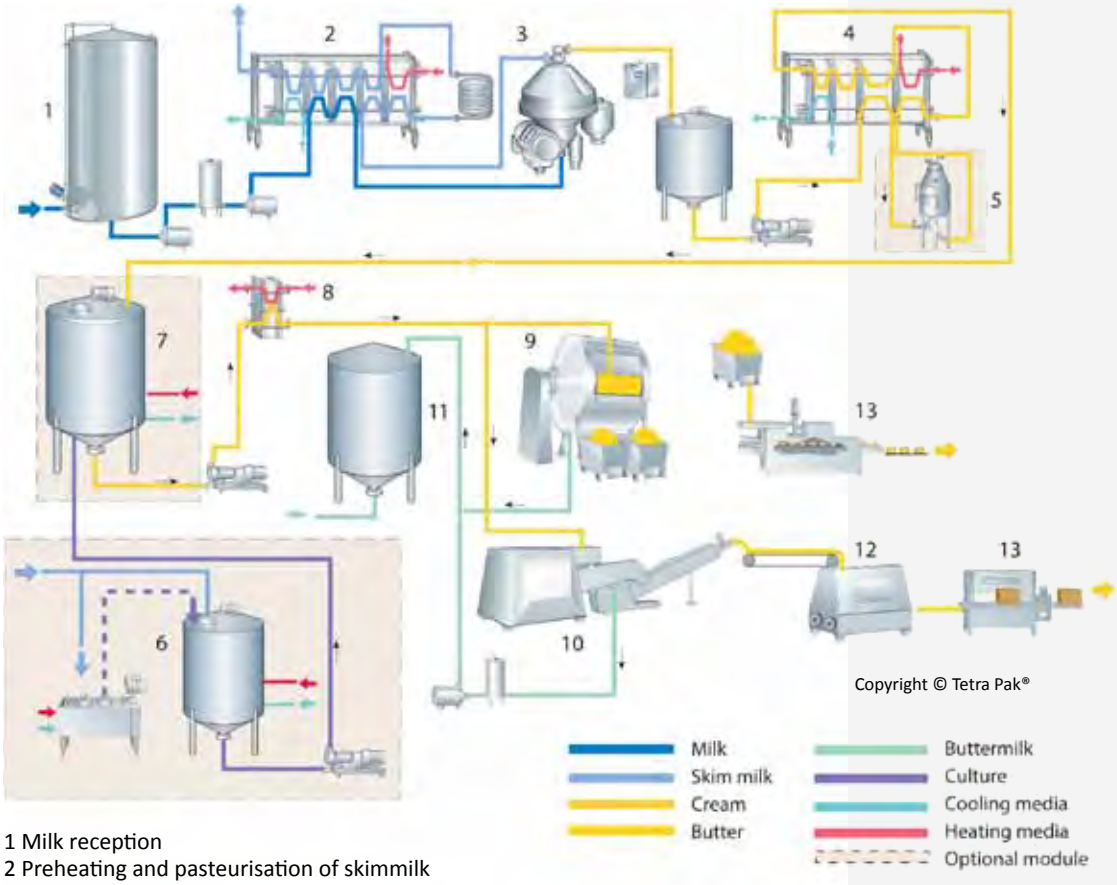
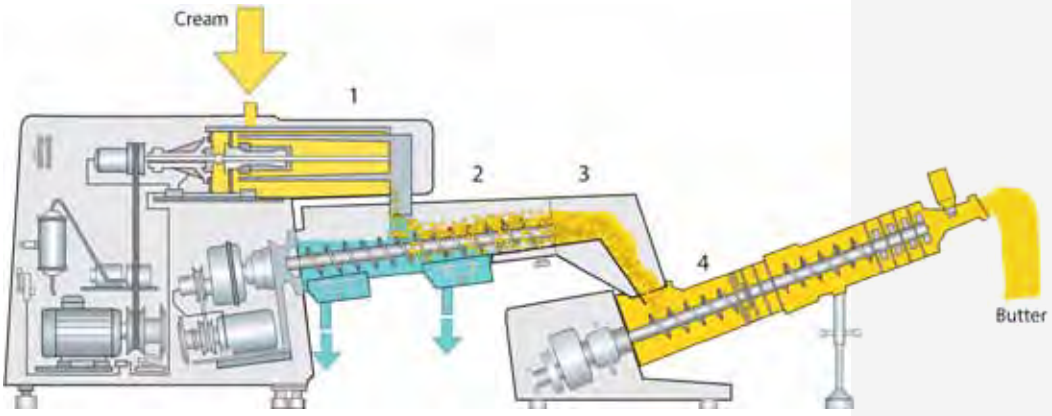


Figure 31: General process steps in batch and continuous production of cultured butter



1 Milk reception
2 Preheating and pasteurisation of skimmilk
3 Fat separation
4 Cream pasteurisation
5 Vacuum deaeration, when used
6 Culture preparation, when used
7 Cream ripening and souring, when used
8 Temperature treatment
9 Churning/working, batch
10 Churning/working, continuous
11 Buttermilk collection
12 Butter silo with screw conveyor
13 Packaging machines

Figure 32: A continuous buttermaking machine
1 Churning cylinder
2 Separation section
3 Squeeze-drying section
4 Second working section



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2. Typical product specification

Product description

Product name	Salted butter	
Ingredient list	Cream (milk); salt	
Allergen declaration	Contains cow's milk	
Pack size	500 g; 250 g	
Temperature category	Chilled (0–7°C)	
Shelf life	Day of packaging plus six months	
Production code	Sell by	
	Use by	
	Batch code	Batch, shift, machine codes
Storage conditions	0–7°C	

Composition

Ingredient	Specification	Weight	% added
Cream	Butterfat >35% (38–42% ideal)		98%
Salt			Max 2%
TOTAL			**100%**

Process flow

Production controls	Process steps	Quality controls
% Butterfat Foreign object inspection	PASTEURISED CREAM ↓	Cream intake tests: physical, microbiological and chemical Reject cream that does not conform to above specifications
% Butterfat >35%	STANDARDISE ↓	Standardise to >35% butterfat
Temperature and time (85°C for 15 seconds)	PASTEURISE ↓	Ensure correct temperature setting Thermographic recorder Phosphatase test
Rapid cooling of cream (10°C)	COOLING ↓	Ensure correct temperature
Check that % butterfat is correct	CREAM PUMPED TO CREAM BATCH HOLDING TANK ↓	Cream intake tests: microbiological and chemical
10°C for 8–10 hours	CRYSTALLISATION ↓	Ensure correct temperature and time
% moisture (max 16%) % salt (max 2%)	BUTTER CHURN (ADD SALT) ↓	Ensure correct % moisture Ensure correct salt content
Temperature Ensure that weight conforms to specifications Parchment paper	PACKAGING ↓	Weight checks Butter online tests: microbiological and chemical Correct parchment paper Correct date coding

Storage of butter at <7°C	COLD ROOM ↓	Ensure that temperatures are kept below 7°C
Truck to conform to hygiene standards Truck temperature to maintain product temperature	DISTRIBUTE ↓	Maintain cold chain (<7°C)
	RECEIVED AT STORES	Delivery temperature <7°C

Rejection criteria for CCP deviation

If pasteurisation limit of 85°C for 15 seconds is not reached and maintained, the cream will be diverted back to the heating section of the cream pasteuriser in order to be re-pasteurised.

Packaging and labelling

Material	Supplier	Reference
Parchment paper		
Cardboard boxes		

Packaging process

- Cream pumped into cream batch holding tank to age (crystallisation).
- Cream pumped to butter churner.
- Addition of salt into butter churner.
- Butter blocks wrapped into parchment paper.
- Use by date coded onto packaging material on-line using appropriate printing technology.
- Packed off conveyor into cardboard boxes (plastic liners).
- Packed product moved and stored in cold room until distribution.

Reasons for rejection

- Product temperature incorrect.
- Product does not conform to dairy regulations.
- Incorrect sell by and use by dates.
- Illegible date code markings.
- It is possible to rub off date code markings.
- Weight out of specification.
- Incorrect weight.
- Non-adherence to process control specifications.
- Deformed blocks.
- Torn parchment paper.
- Dirty truck/lugs/containers.

3. Product standards

Analytical standards Salted butter			
Test	**Limit**	**Reject**	**Frequency**
Moisture	<16%	>16%	Per batch
pH	>6,3	<6,3	Per batch
Milk fat	>80%	<80%	Per batch
Salt	<2%	>2%	Per batch
Weight: 500 g			Per procedure
Weight: 250 g			Per procedure

Recommended microbiological standards Salted butter			
Test	**Limit**	**Reject**	**Frequency**
Total plate count	<50 000 cfu/g	>50 000 cfu/g	Per batch
Coliforms	<10 cfu/g	>10 cfu/g	Per batch
E. coli	Absent	Present	Per batch
Yeasts	<50 cfu/g	>50 cfu/g	Per batch
Moulds	<50 cfu/g	>50 cfu/g	Per batch
Staphylococcus aureus	Absent/10 g	Present	Quarterly
Salmonella spp	Absent/25 g	Present	Quarterly
Listeria spp	Absent/25 g	Present	Quarterly

4. Sensory evaluation/product description

Appearance	Smooth block with no foreign matter.
Colour	Light yellow colour.
Flavour	Characteristic butter taste with no off taints (rancid, sour, etc.) or foreign taints.
Texture	Creamy and smooth.
Aroma	Characteristic of butter with no off or rancid aroma.

Storage instructions
Refrigeration: Keep refrigerated below 7°C and use within expiry date.
Freezing: Suitable for home freezing.

Serving suggestions
Ideal to use as an ingredient in cooking and baking.

Transport requirements
Packed product to be transported in clean and covered vehicles capable of maintaining the correct temperature for the required product. Vehicles also need to be clean and pest-proofed.

IMPORTANT LINKS

HACCP
Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION
Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling

TESTING
Remember to refer back to Chapter 7 for more details on sampling and testing methods

3.6 Cheddar cheese

1. Overview of the process

Of all dairy products, the greatest variety can be found in cheese. Literally hundreds of different cheeses – some proprietary – exist, with small differences in composition or manufacturing method.

Mainly two techniques are used in the manufacture of cheese. Cheese may be made as iso-electric (acid-induced) product, or as a result of a combination of the actions of acid and enzymes. The resulting coagulum can be formed into cheese by pressing or moulding under its own weight, or the product may not be pressed or formed whatsoever.

Cheese is mainly the product of the casein fraction of milk, but cheeses like Ricotta are made mainly from the whey fraction. In addition, variety may be brought about by the allowed or curtailed development of acid in the curd (typically acid curd and sweet milk types).

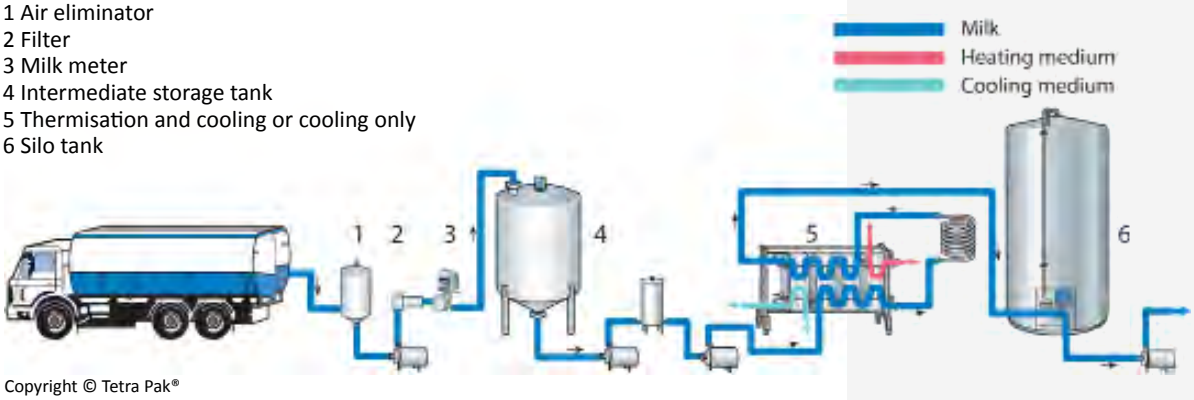
The typical manufacture of cheese starts with the standardisation of the fat content (which influences both the yield and product flavour and texture), normally during pasteurisation. Cheeses in which a measure of induced rancidity is required may also be homogenised to induce some damage to the fat globule membrane and thus enhance enzymatic action (such enzymes are added for this purpose during manufacturing).

Starter culture (for acidification) and rennet (proteolytic enzyme), which destabilise the casein structure and induce coagulum formation at a higher pH than the iso-electric point, pH 4,6, are added to milk at the required temperature for the optimal activity of the culture. Rennet is not always added, especially in freshly consumed cheeses of the cottage cheese type (or very little rennet in comparison to that in ripened cheeses).

Upon coagulum formation and strengthening to the required consistency, the coagulum is cut and the whey drained in different ways. The curd is separated and processed depending on the type of cheese made. Pressing may follow as well as brining, whether through dry salting (e.g. Cheddar) or by exposure in brine tanks of which the salt and calcium concentrations as well as the pH are carefully controlled (e.g. Gouda). Many other ways exist in which the curd is managed to a final product. Ripening may follow at controlled temperatures and humidity and surface ripening agents may be applied.

Figure 33: Reception arrangements for cheese milk.

1 Air eliminator
2 Filter
3 Milk meter
4 Intermediate storage tank
5 Thermisation and cooling or cooling only
6 Silo tank



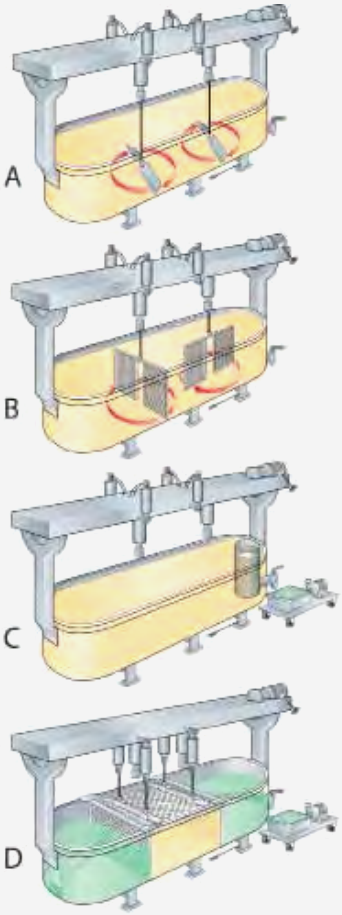


Figure 34: Conventional cheese vat with tools for cheese manufacture.
A Vat during stirring
B Vat during cutting
C Vat during whey drainage
D Vat during pressing

1 Jacketed cheese vat with beam and drive motor for tools
2 Stirring tool
3 Cutting tool
4 Strainer to be placed inside the vat at the outlet
5 Whey pump on a trolley with a shallow container
6 Pre-pressing plates for round-eyed cheese production
7 Support for tools
8 Hydraulic cylinders for pre-pressing equipment
9 Cheese knife

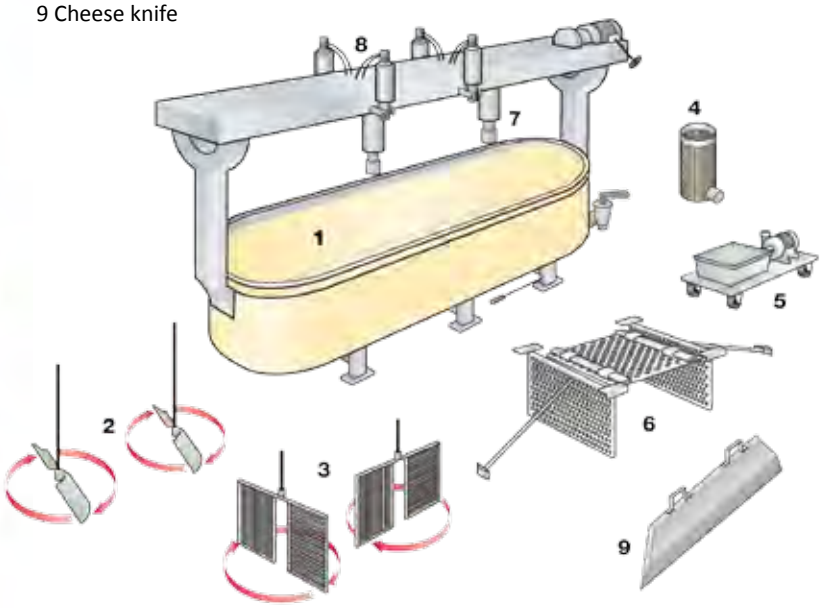


Figure 35: Horizontal enclosed cheese tank with combined stirring and cutting tools and hoisted whey drainage system.
1 Combined cutting and stirring tools
2 Strainer for whey drainage
3 Frequency-controlled motor drive
4 Jacket for heating
5 Manhole
6 CIP nozzle

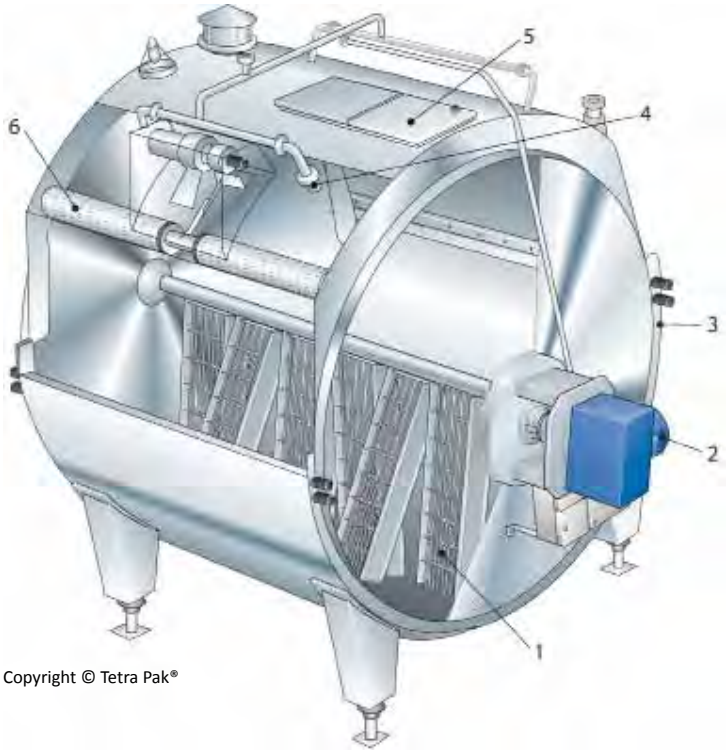


Figure 36: Mechanically operated prepressing vat with unloading and cutting device.

1 Pre-pressing vat (can also be used for complete pressing)
2 Curd distributors, replaceable by CIP nozzles (2a)
3 Unloading device, stationary or mobile
4 Conveyor

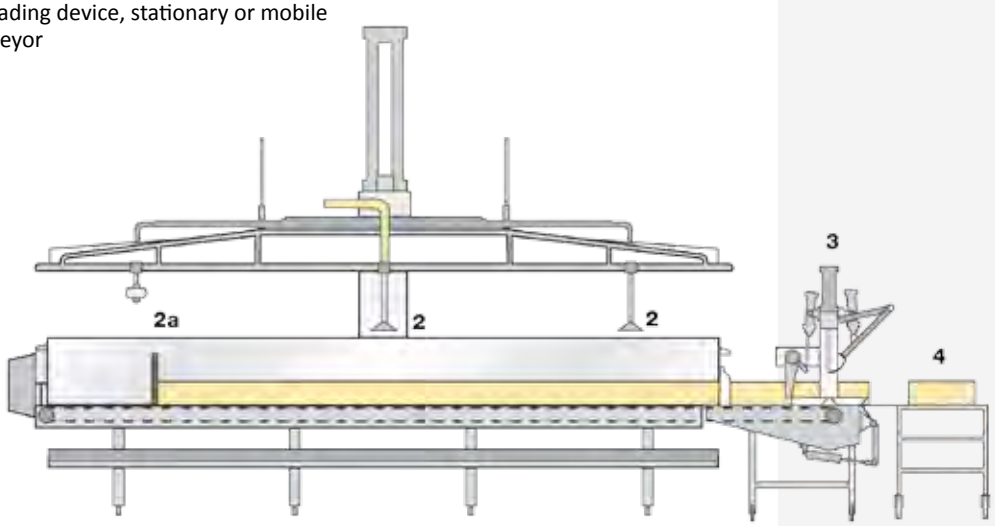


Figure 37: Brine bath system with containers and brine circulation equipment.

1 Salt dissolving container
2 Brining containers
3 Strainer
4 Dissolution of salt
5 Pump for circulation of brine

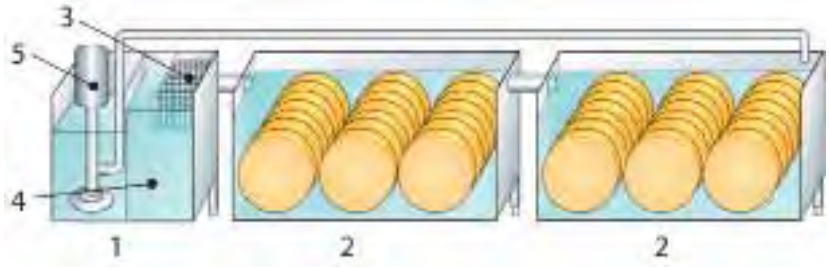


Figure 38: Mechanised cheese storage. Humidified air is blown through the plastic nozzles at each layer of cheese.

Figure 39: Cheese storage using pallets

2. Typical product specification

Product description

Product name	Cheddar cheese	
Ingredient list	Full cream milk, rennet (non-animal), cheese cultures, calcium chloride, salt, colouring (annatto)	
Allergen declaration	Contains cow's milk	
Pack size	Prescribed quantities as per SANS 289	
Temperature category	Chilled (0–7°C)	
Shelf life	Day of packaging plus 6 months	
Production code	Sell by	
	Use by	
	Batch code	Batch, shift, machine codes
Storage conditions	0–7°C	

Product name

Ingredient	Specification	Weight	% added
Raw milk	See Chapter 2		95%
Rennet			Max 2%
Cheese cultures			As per recipe
Calcium chloride			As per recipe
Salt			As per recipe
Annatto			As per recipe
TOTAL			**100%**

Process flow

Production controls	Process steps	Quality controls
Temperature of milk <7°C Foreign object inspection Milk to be kept for <48 hours	RECEIVE RAW MILK ↓	Milk intake tests: physical, microbiological and chemical Reject milk that does not conform to above specifications
Check divert valve 72°C for 15 seconds	PASTEURISE ↓	Ensure correct temperature setting Thermographic recorder Phosphatase test
Temperature	INOCULATE WITH STARTER CULTURE ↓	Ensure correct temperature Ensure correct culture
Temperature 32°C and pH 6,3	RENNET ADDITION ↓	Ensure correct temperature and pH
Temperature minimum 30°C and pH 5,4	CUTTING CURD ↓	Ensure correct temperature and pH
Temperature 32°C and pH 5,4 Pressure	DRAIN WHEY ↓	Ensure correct temperature and pH Ensure draining directly into whey pipe (not directly on floor)

Chapter 7

Temperature 38–40°C	CHEDDAR PROCESS ↓	
pH 5,3–5,5	MILLING ↓	Equipment check pH Microbiological sample
Salt dosage ±1,0–1,5%	SALTING ↓	Ensure correct pH Check salt
	CHEESE MOULDS ↓	Ensure correct pressure setting
pH 5,2	PACKING ↓	Ensure correct pH Ensure adequate seal
Controlled temperature <12°C	MATURING ↓	Ensure correct storage temperature Ensure correct quarantine period – six weeks minimum
	GRADING ↓	Ensure conformance to grading specification
	CUTTING ↓	Ensure correct temperature setting Ensure packaging integrity Ensure correct weight Microbiological and chemical tests Correct date coding
Storage of cheese at <7°C	COLD ROOM ↓	Ensure temperatures are kept below 7°C
Truck to conform to hygiene standards Truck temperature to maintain product temperature	DISTRIBUTE ↓	Maintain cold chain (<7°C)
	RECEIVED AT STORES	Delivery temperature <7°C

Figure 40: Flowchart for mechanised production of Cheddar cheese.
1 Cheese vat
2 Cheddaring machine
3 Block former and bagger
4 Vacuum sealing
5 Weighing
6 Palletiser
7 Ripening store

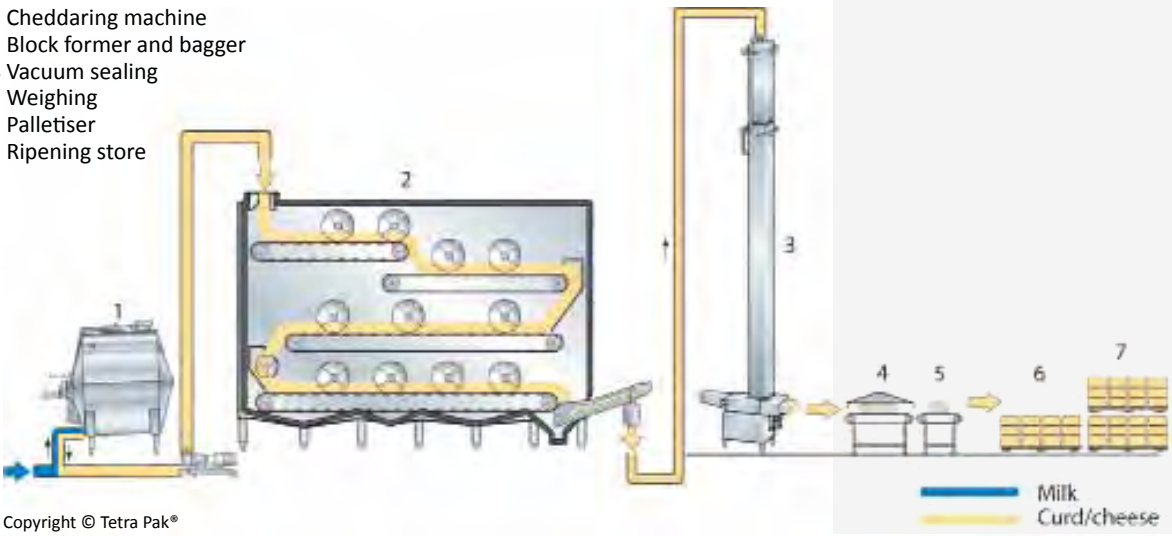
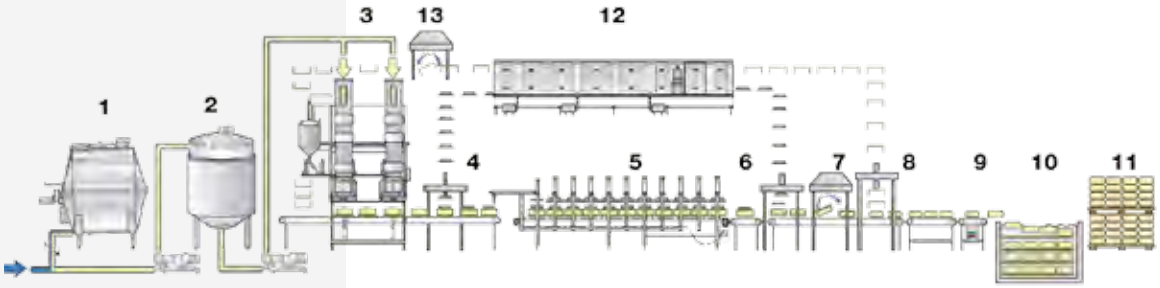
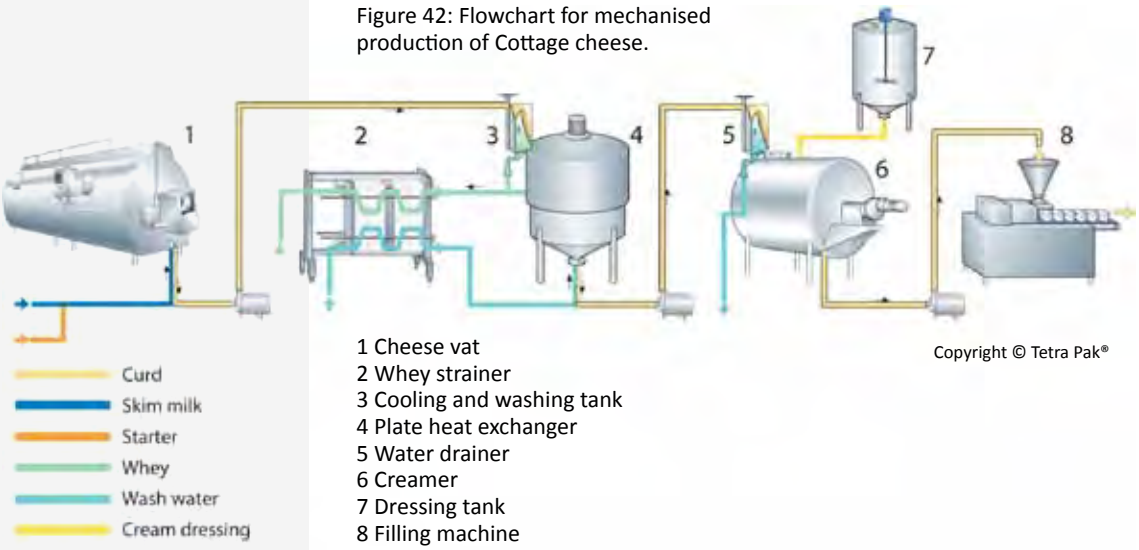


Figure 41: Flowchart for mechanised production for Gouda cheese.



1 Cheese vat
2 Buffer tank
3 Casomatic pre-pressing machine
4 Lidding
5 Conveyor press
6 De-lidding
7 Mould turning
8 Mould emptying
9 Weighing
10 Brining
11 Ripening store
12 Mould and lid washing
13 Mould turning

Figure 42: Flowchart for mechanised production of Cottage cheese.



1 Cheese vat
2 Whey strainer
3 Cooling and washing tank
4 Plate heat exchanger
5 Water drainer
6 Creamer
7 Dressing tank
8 Filling machine

Rejection criteria for CCP deviation

If pasteurisation of 72–74°C for 15 seconds is not reached and maintained, the milk will be diverted back to the heating section of the pasteuriser in order to be re-pasteurised.

Packaging and labelling

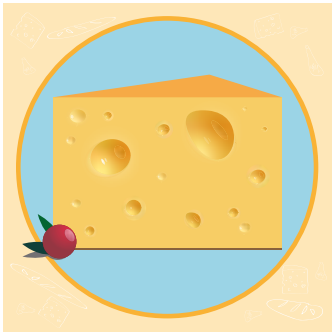
Material	Supplier	Reference
Vacuum bags		
Cheddar labels		

Packaging process

- After correct maturation, cheese is cut into a specified size.
- Packed and vacuum-sealed.
- Sell by/use by date coded onto packaging material using appropriate printing technology.
- Packed off conveyor into crates.
- Packed product moved and stored in cold room until distribution.

Reasons for rejection

- Product temperature incorrect.
- Product not conforming to dairy regulations.
- Incorrect sell by dates.
- Illegible date code markings.
- Date code markings able to rub off.
- Filled volume out of specification.
- Incorrect weight.
- Non-adherence to process control specifications.
- Vacuum seal no longer intact.
- Dirty truck/lugs/containers.



3. Product standards

Recommended microbiological standards Cheddar cheese			
Test	**Limit**	**Reject**	**Frequency**
Coliforms	<1 000 cfu/g	>1 000 cfu/g	Per batch
E. coli	Absent	Present	Per batch
Yeasts	<500 cfu/g	>500 cfu/g	Per batch
Moulds	<300 cfu/g	>300 cfu/g	Per batch
Staph aureus	Absent/25g	Present	Quarterly
Salmonella spp	Absent	Present	Quarterly
Clostridium perfringens	Absent	Present	Quarterly
Clostridium botulinum	Absent	Present	Quarterly

4. Sensory evaluation/product description

Appearance	Firm, solid and compressed with no foreign matter.
Colour	Consistently yellow in colour; uniform colour throughout cheese.
Flavour	Characteristic cheddar flavour with no off (rancid, sour, etc.) or foreign taints.
Texture	Smooth.
Aroma	Characteristic of cheddar cheese with no off or rancid aroma.

Storage instructions
Refrigeration: Keep refrigerated below 7°C and use within expiry date.
Freezing: Suitable for home freezing at -18°C but not recommended.
Thawing: Place in refrigerator overnight

Serving suggestions
Serve chilled.

Transport requirements
Packed product to be transported in clean and covered vehicles capable of maintaining the correct temperature for the required product. Vehicles also need to be clean and pest-proofed.

IMPORTANT LINKS

HACCP
Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION
Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling

TESTING
Remember to refer back to Chapter 7 for more details on sampling and testing methods

3.7 Cream/whipping cream

1. Overview of the process

Cream is obtained by skimming milk, either partially or fully. The technology used to skim milk is based on the sedimentation theory and is affected by centrifugal force to speed up the separation of the two naturally insoluble liquids in milk – the aqueous/watery phase (in which the proteins, minerals and lactose are dissolved/suspended) and the lipid/fatty phase.

In terms of the dairy product's compositional standards regulations, a variety of products clustered together as "cream" may be marketed in South Africa. In laymen's terms the following types exist: coffee cream (11% fat), thin cream (18% fat), double/whipping cream (35% fat) and cultured cream (35% fat, being made from double cream). This is placed in sequence of increased fat content, which is regulated for all cream. There is a product called whipped cream, which started out as double/whipping cream, but as result of the incorporation of air to fill the product in an aerosol can, the product subsequently has a lower fat content (28% vs 35%).

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Cream has a higher solids content than milk, so when pasteurised it needs to be subjected to higher temperatures and longer exposure times than milk. This is because the higher solids content acts protectively towards microorganisms. Although the process is similar to that of milk pasteurisation, cream pasteurisation requires positive displacement pumps to transfer the product, whilst a rotor-driven centrifugal pump is sufficient for milk. When cream is marketed as pasteurised, it must exhibit a negative phosphatase test result (Aschaffenburg-Mullen test), which applies to milk as well.

A traditional steam injection pasteurisation method called Vacreation is still applied by some manufacturers.

Figure 43: Production line for whipping cream according to the Scania method.
1 Holding tank
2 Product pump
3 Pasteuriser
4 Booster pump
5 Holding tube
6 Ripening tanks
7 Product pump

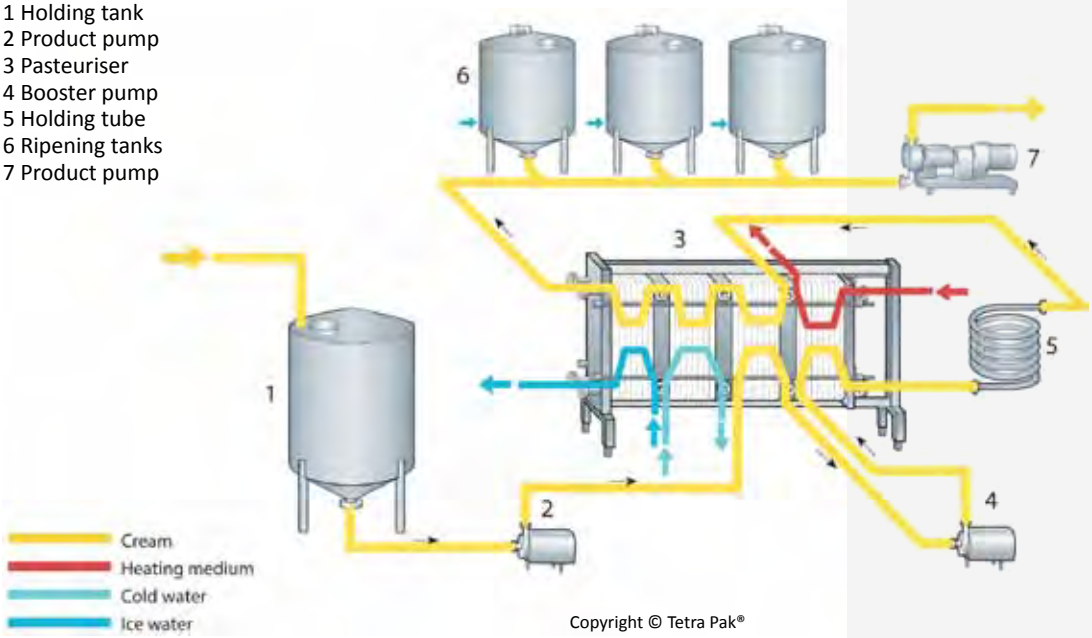
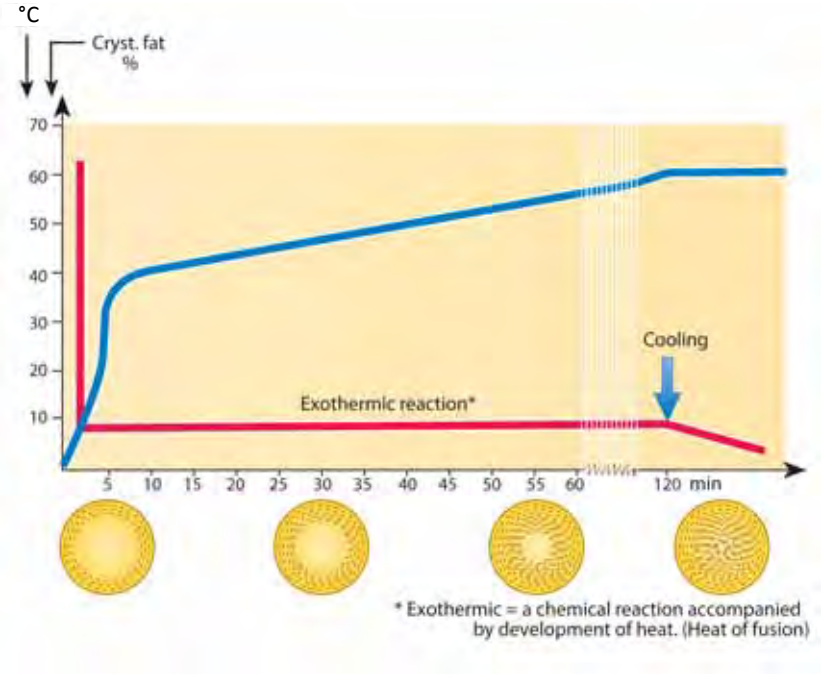


Figure 44: The crystallisation process for40% cream at 8°C.



2. Typical product specification

Product description

Product name	Pasteurised cream/whipping cream	
Ingredient list	Cream (milk)	
Allergen declaration	Contains cow's milk	
Pack size	250 ml, 1 l	
Temperature category	Chilled (0–4°C)	
Shelf life	Day of packaging plus eight days	
Production code	Sell by	
	Use by	
	Batch code	Batch, shift, machine codes
Storage conditions	0–4°C	

Composition

Ingredient	Specification	Weight	% added
Cream	Butterfat >35%		100%
TOTAL			**100%**

Process flow

Production controls	Process steps	Quality controls
Temperature of milk <7°C Foreign object inspection Milk to be kept for <48 hours	RECEIVE RAW MILK ↓	Milk intake tests: physical, microbiological and chemical Reject milk that does not conform to above specifications
	SEPARATE ↓	

	STANDARDISE ↓	Standardise to >35% butterfat
Temperature and time (66°C minimum for 30 minutes/85°C minimum for 15 seconds)	PASTEURISE ↓	Ensure correct temperature setting Thermographic recorder Phosphatase test
Rapid cooling of cream	COOLING ↓	Ensure correct temperature
Check that % butterfat is correct	CREAM PUMPED TO CREAM BATCH HOLDING TANK ↓	Cream intake tests: microbiological and chemical
Temperature Ensure that weight conforms to specifications	FILLING INTO CONTAINERS ↓	Weight checks Cream on-line tests: microbiological and chemical Correct date coding
Storage of cream at <4°C	COLD ROOM ↓	Ensure that temperatures are kept below 4°C
Truck to conform to hygiene standards Truck temperature to maintain product temperature	DISTRIBUTE ↓	Maintain cold chain (<4°C)
	RECEIVED AT STORES	Delivery temperature <4°C

Rejection criteria for CCP deviation

If pasteurisation temperature (66°C for 30 minutes/85°C for 15 seconds) is not reached and maintained, the cream will be diverted back to the heating section of the cream pasteuriser in order to be re-pasteurised.

Packaging and labelling

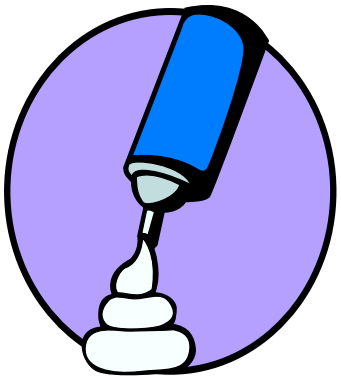
Material	Supplier	Reference
1 l HDPE bottle		
250 ml cup		
Plastic cap		
Foil for 250 ml cup		

Packaging process

- Cream pumped into cream batch holding tank prior to filling.
- Cream pumped to hoppers of filling machine in a closed system.
- Cream poured into containers and sealed.
- Use by date coded onto packaging material using appropriate printing technology.
- Packed off conveyor into crates (plastic liners for sachets).
- Packed product moved and stored in cold room until distribution.

Reasons for rejection

- Product temperature incorrect.
- Product does not conform to dairy regulations.
- Incorrect sell by and use by dates.
- Illegible date code markings.
- It is possible to rub off date code markings.
- Filled volume out of specification.
- Incorrect weight.
- Non-adherence to process control specifications.
- Leaking containers.
- Dirty truck/lugs/containers.



3. Product standards

Analytical standards Fresh whipping cream			
Test	**Limit**	**Reject**	**Frequency**
pH	6,5–6,8	<6,5	Per batch
Butterfat	>35%	<35%	Per batch
Volume: 250 ml	250 ml	<250 ml	Per procedure
Volume: 1 l	1 000 ml	<1 000 ml	Per procedure
Weight: 250 ml			Per procedure
Weight: 1 l			Per procedure
Recommended microbiological standards Pasteurised/whipping cream			
Test	**Limit**	**Reject**	**Frequency**
Total plate count	<50 000 cfu/ml	>50 000 cfu/ml	Per batch
Coliforms	<10 cfu/ml	>10 cfu/ml	Per batch
E. coli	Absent/g	Present	Per batch
Staphylococcus aureus	Absent/25 g	Present	Quarterly
Listeria spp	Absent/25 g	Present	Quarterly

4. Sensory evaluation/product description

Appearance	Off-white cream with no foreign matter.
Colour	Off-white colour.
Flavour	Characteristic cream taste with no off taints (rancid, sour, etc.) or foreign taints.
Texture	Creamy and smooth liquid.
Aroma	Characteristic of cream with no off or rancid aroma.

Storage instructions

Refrigeration: Keep refrigerated below 4°C and use within the expiry date.
Freezing: Not suitable for home freezing.

Serving suggestions

Ideal to use as an ingredient in cooking and baking. Can also be used as a topping, either whipped or pouring.

Transport requirements

Packed product to be transported in clean and covered vehicles capable of maintaining the correct temperature for the required product. Vehicles also need to be clean and pest-proofed.

IMPORTANT LINKS

HACCP

Remember to refer back to Chapter 1 to recap on the hazards identified and preventive measures in the handling of raw milk and the DVD

DOCUMENTATION

Remember to refer back to Chapter 12 and the DVD for more details on the suggested documentation required for raw milk handling

TESTING

Remember to refer back to Chapter 7 for more details on sampling and testing methods