


PROCESSING AND FORMULATION INTERGRATION

CROWN FOOD GROUP

MILK STANDARDISING

PLATE HEAT EXCHANGER : A TYPICAL PROCESS FLOW DESIGN

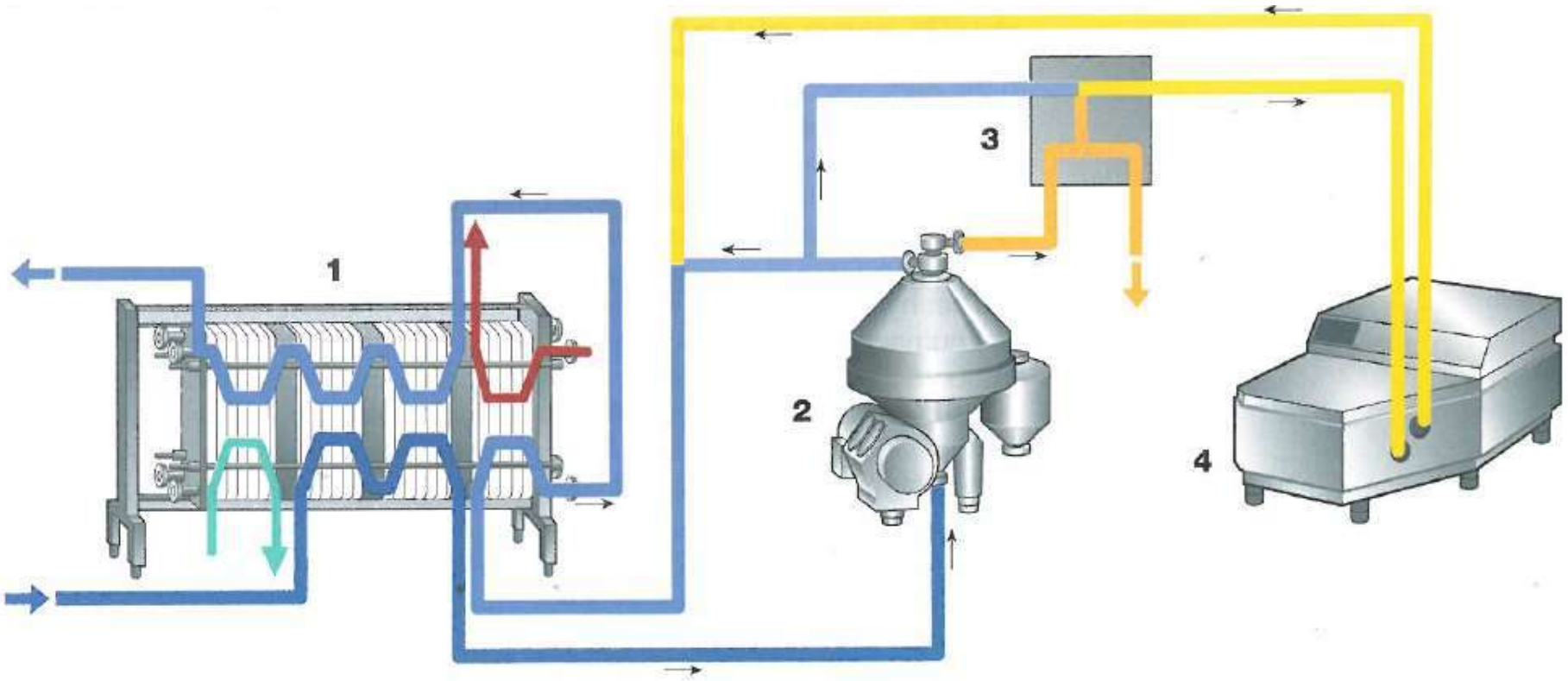

Fig. 6.3.10 *Product flow at partial stream homogenisation.*
1 Heat exchanger
2 Centrifugal separator

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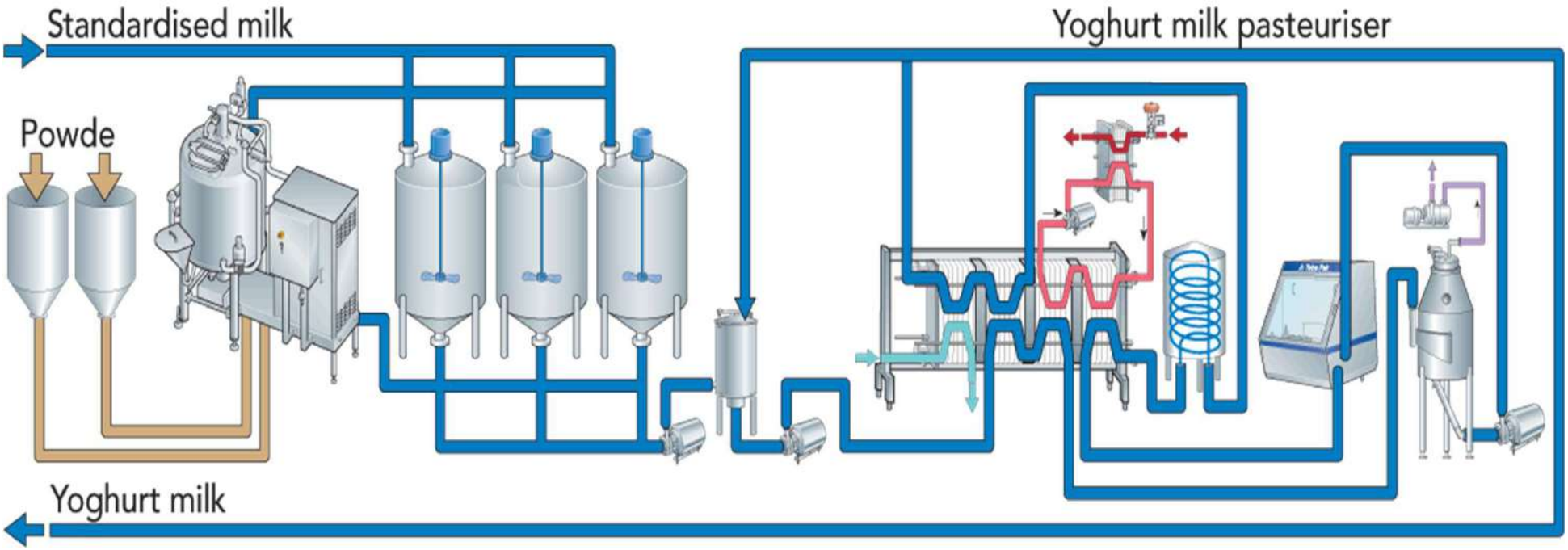
MILK PROCESSING

- The schematic on the screen is of a simple milk standardising plant. The heat treatment is via a plate pasteuriser HTST (High Heat Short time) 72-75^{o}C for 15 seconds this is used primarily for milk or liquid products.
- The process flow is of utter importance to achieve the maximum benefit out of the raw milk as supplied by the Milk Producers. Ie. standardising milk to specific fat class designations as per legal requirements and cooling to below 5^{o}C to extend shelf life and storage for further processing
- The schematic shows heat treatment and basic design as required Preheat, Separation of Fats at 60^{o}C and clarifying the milk, Homogenising, pasteurising and cooling.
- (I have come across factories where homogenising is set up before Separation and then asked why the cream off take is basically zero)Separator uses the varying fat globule sizes to take off cream, If the Fat globules are all uniform in size there will be an absolute minimum cream yield.
- The technology is controlling the milk flow rate through the bowl and the cream offtake by adjusting the control valve of the cream offtake. There are modern automated systems that control the process today.
- Cream is seen as white gold in the Industry so controlling butterfat content of various products to minimum percentage requirement as per legal specification is of utmost importance to maximise margins.
- I will deal with Homogenising on a separate slide but here we run at 60^{o}C soluble fat which can be treated with pressure by restricting the orifice on stage one and stage 2 to obtain equal globule sizes.
- Milk is treated at the minimum required temperatures to ensure hygienic storage for further processing namely 72-75^{o} C for 15 seconds (it is safer to pasteurise at 75^{o}C to allow for fluctuations in the system.
- Milk is then cooled to acceptable temperatures less 5^{o}C to prevent degradation during the storage process.

YOGHURT PROCESS FLOW



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EQUIPMENT AND PROCESS

- This slide is of a typical Yoghurt process flow.
- Before we even look at the process we need to understand how the added ingredients react to various processes, this information is in the ingredients specification data sheets which is obtained from the Suppliers.
- The selection of ingredients are of utmost importance as they have very specific properties and react to different stress levels, flows rates, acidity levels and temperatures.
- We have seen in some of our trials that some ingredients in the same categories are less harsh on equipment than others, this even affects the hydration step as it is easier to keep them in suspension. The heavier ingredients are easy to blend and often require higher blending temperatures and longer blending times.
- Ingredient blending and hydration times will contribute to the success or failure of the final product because it can result in powdery rough mouthfeel and can influence processing effectiveness.
- Blending tanks are specifically designed to ensure that the blend stays in suspension during the hydration period these tend to have a conical shape at the bottom with 35^{o} slope to reduce the risk of ingredients residues.
- We can see in the slide that the agitators are centrally mounted to create a vortex which allows for rotation of the blend from top to bottom thereby ensuring that the solids are in rotation for the entire blending and hydration periods and are properly dissolved. It is good practise to check the tanks after each blend for any ingredient remaining residues (slurry)
- If you have tanks with side mounted agitators which I refer to as Speed boat impellers. Inconsistencies in blending can occur. I have seen this in numerous factories. To over come slurry issues in these kinds of tanks it is good to circulate the blend through the blending plant tri-blender or similar for 10 minutes to assist if needed.

FURTHER PROCESSING

- Hydration times are quite often around 1 hour but this depends mostly on how well the added ingredients are dissolved into the milk/water blend. Some ingredients need longer hydration times or higher temperatures to hydrate correctly due to micron sizes of crystal and hardness of the ingredient.
- These can cause damage to the homogeniser pistons(little pock marks on the face of the pistons)and can also cause the orifice to be blocked. This in turn causes cavitation and pressure drops in the homogenisation.
- Most Factories run at a standard preheating temperature of between 58^{o}C and 65^{o} with pressure of 50/150 bar. This is determined by the type of ingredients used in the formulation. Some ingredients are less dense than others which can facilitate lower pressure giving a better body, taste profile. Dry mouth feel is caused by incorrect ingredient choices or to high homogenising pressures. To achieve a good closed body with a good shine an even distribution of the fat globules is needed. This can be checked under a microscope by the technical department and should be checked regularly to control the effectiveness of homogeniser.
- As a note cooled water which is treated to a neutral PH 7 to 8 is sprayed onto the pistons and main block to reduce wear and tear on the pistons and the packing seals. The first signs of packing seals and piston damage is milk leaking into the water and drain below the machine.(I have rebuilt a homogeniser over a weekend because of damage caused by hard water which resulted in grooves in the pistons, which in turn had the iron fillings causing oil nozzles blockages in the bearings nozzles. We had to replace the bearings and the drive shaft as they were bent, at huge expense)
- In some Factories air extraction or vacuum pumps are inserted before the homogenisers to reduce risk of cavitation.
- Every homogenisers will have dampers on the supply and exit lines to control the flow pressure through the heads of the machine. These must be cleaned daily before CIP.
- I also want to clarify one other point around Homogenisers when we talk pressure we talk about combined pressure so for example 50/150 is 200 bar on a 2 stage homogeniser. If you want more info.

TRI- BLENDER

- Blending equipment can also vary the one in the schematic is more a batch blender. I do prefer the continuous flow blender or a tri-blender with a high shear pump which breaks up the powder into finer particles and a liquid ring pump which creates the circulation of the liquid the be blended. These spread the dry ingredient load more evenly through out the blend.
- The blending, hydration and process vary from factory to factory. There are systems that are designed to reduce shear load on the product, which in turn reduces foaming risk. The schematic system is designed for this reason.

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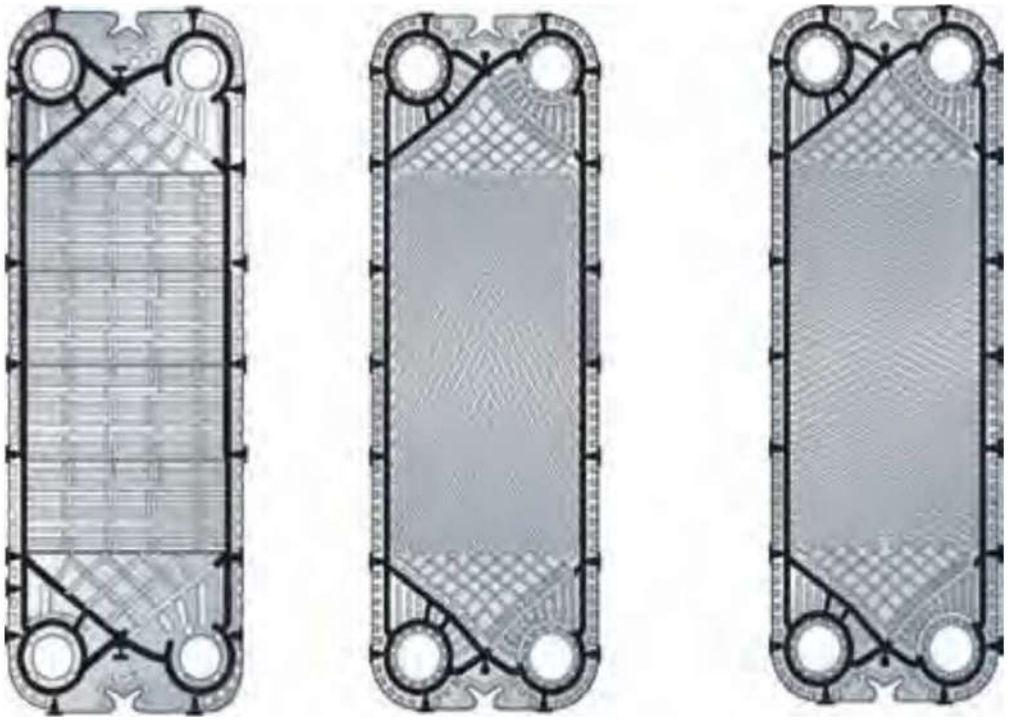
YOGHURT PROCESSING

- It is important to have a flow control valve on the delivery line from the balance tank to the plate pasteuriser. This is used to balance the flow rate between the Blending tank, Plate pack and Homogeniser. None must run dry to prevent temperature drop, burn on in the heating section of the system and cavitation on the homogeniser.
- Correct design of the individual plates in the Pasteuriser is also very important. Higher viscosity product have wider and deeper flow channels these are typically used for yoghurt processing which carry extra solids. Although the blend can be run on the normal milk pasteuriser there is a higher risk of fouling and great care must be taken in balancing process flows. The fouling will reduce batch sizes as a result of more regular washing intervals and increase yield losses.
- Yoghurt processing requires denaturing of the whey protein to improve the texture and taste profiles developed using starter cultures. This is achieved through temperature and time 90-92^{o}C for 5-6 minutes. Holding tubes are specifically designed to achieve the correct holding time these can vary in design from factory to factory. Ingoing and exit temperatures must be monitored to achieve correct protein structure for most efficient culture performance.
- The blend is then cooled to fermentation temperatures 40-42^{o}C for 6 hours or 38^{o}C for12 – 16 hours and pumped to fermentation tanks. Some systems in more modern Factories are designed with inline Culture dosing units, which reduces contamination risks through opening tanks and handling of Cultures.
- There are cultures in the system which allow for easier control of the fermentation process and this simplifies the production planning for the Factory operations. Cultures are also propagated for specific yoghurt types it is advisable to Contact Yoghurt culture suppliers to assist with making those choices. .

DESIGN OF PLATES

- The design configuration of the flow direction and flow channels of a plate pasteuriser are very specific to viscosity of the product to be processed.
- Plate 1 is specific to carry fibres
- Plate 2 for low viscosity liquids
- Plate 3 higher viscosity generally larger design with deeper grooves and less acute corrugations.



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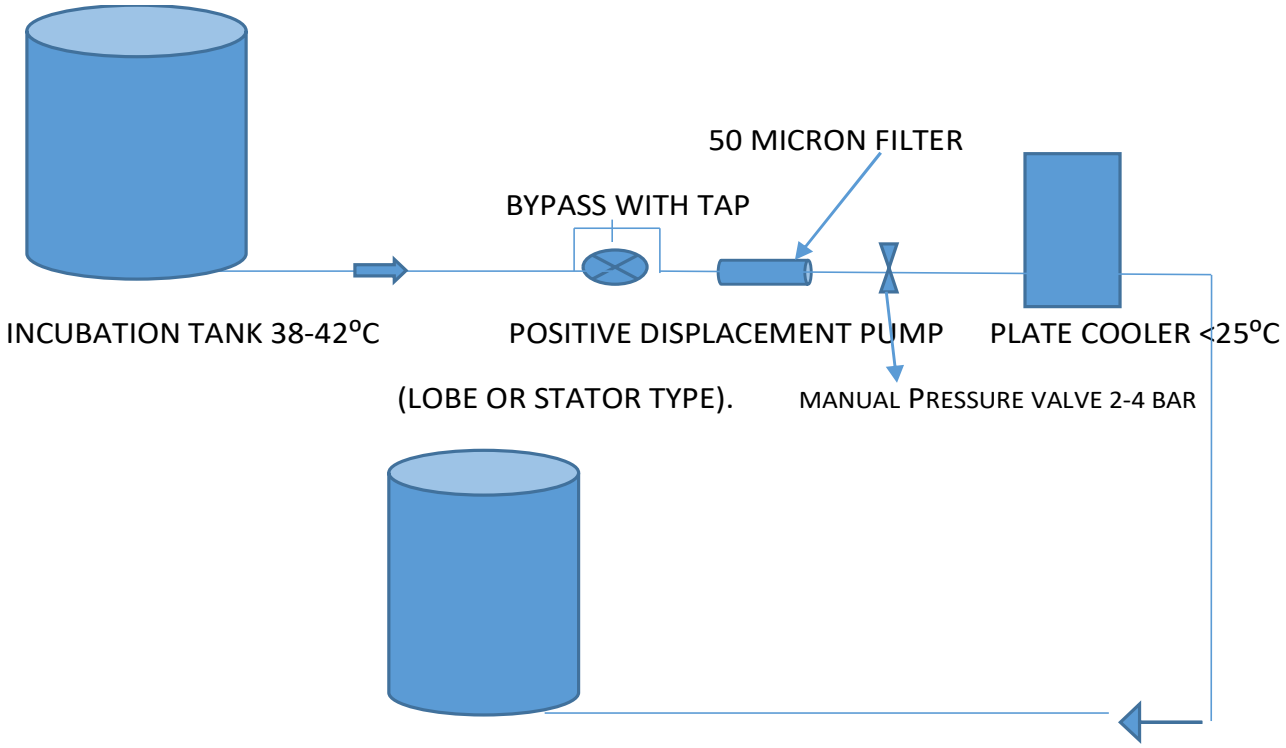
YOGHURT TEXTURISING

Texturizing we refer to the restructuring of the yoghurt after we have denatured proteins and created a coagulum. Flow rate with the aid of a lobe, stator or diaphragm pump is used to pump the yoghurt through 40 to 50 micron filter to restructure the yoghurt blend. Modern process also include a texturizing valve to create more pressure to assist with the closing of the structure. This is at 38 - 42°C before the plate cooler as it creates a better texture the entire process of texturizing should take around 45 minutes and be a gentle process to preserve the yoghurt structures.



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UHT TECHNOLOGY

The demand for UHT value added products is increasing rapidly due to not been reliant in refrigeration.

Specialised equipment is required as in almost all cases UHT technology was designed to run only milk.

There are two popular methods of doing UHT processing in RSA and it keeps on evolving:

1. Indirect steam application is technology is what we refer too as pipe within a pipe system sterilising energy flows through the outer pipe and this transfer energy through the wall of the inner pipe to generate the heat transfer.

- The product milk flows in the inner pipe and heats during a specific holding time to achieve predetermined F value heating ratios. This is calculated to kill all bacteria include Sporeformers. The excessive heating causes a slight change in the milks profile with a caramelisation of the lactose. This if not controlled causes browning of the milk.
- Shelf life can be extended to 12 months at ambient storage temperatures

2. Direct steam application is more effective for higher viscosity and higher sugar content products e.g. Custard, Imitation Cream, Etc.

- This technology is becoming more popular in Africa, as value added products demand is growing.
- Most value added products contain extra sugars and solids making them more vulnerable to the mallard reaction the direct steam technology works beautifully in these cases.
- Energy consumption and chilling requirements makes the services costs more expensive but the quality of the end product is worth the cost. Batch sizes are increased resulting in lower yield losses.
- Contact service providers for more info.

CASE STUDIES

Case 1 Mixing Tanks

A while back I was appointed as a production Manager at one of our big Dairies. When I reviewed the Yoghurt recipe I could not understand the amount of ingredients used in the formulation. I investigated the process in an attempt to identify the reason for the excessive solids. When the blending tanks were emptied after a run, there was a thick layer of solids(Slurry) on the bottom surface of the tank, this immediately showed that the agitation in the tank was ineffective. Remember most of the functional ingredients are only activated during heat treatment. We had to install new blending tanks with correct agitators, this in turn reduced formulation costs across the board.

Case 2 Aseptic Tank

During my Nigeria experience the Factory was designed to run Yoghurts and UHT sachet milks. The UHT line was a 2000ltrs an hour tubular system, which was a very nice plant but the shortcoming was cost cuts made by the Management group, they decided not to include the Aseptic tank so no room for breakdowns. Any equipment has breakdowns. A UHT system does not allow for circulation because the high temperatures 138- 140^{o}C cause rapid burn on, giving the milk burnt notes and browning due to maillard reaction after 2 to 3 weeks. The result we had to choose between aborting the milk project or buying an aseptic Tank due to poor information from equipment suppliers and lack of UHT systems knowledge of the project leaders. We aborted the project and sold the excess milk resulting in failure of the project at huge expense.

Case 3 SOS processing

SOS Equipment choices incorrect equipment due to product brief and cheese application not clear. Project was delayed by 13 months due to equipment not been able to perform functionality that we required. The equipment was returned to the manufacturer and we had a local company design the purpose built equipment. When installed we achieved immediate results.

VIDEOS

- Slice on Slice

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