Gerard Pasma

Commercial Manager
Evaporator Specialist

>25 years at Tetra Pak
(previously Stork)

High Quality Concentration Process

Dairy Products: skim milk & whey permeate

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Agenda

- **Concentration of Dairy products with Filtration and Falling Film Evaporation Technology**
- **How to ensure best concentrate quality**
  - Skim Milk Concentrate
  - Whey permeate concentrate
- **Sustainability**

Concentration of Dairy Products

Tetra Pak Filtration Technology

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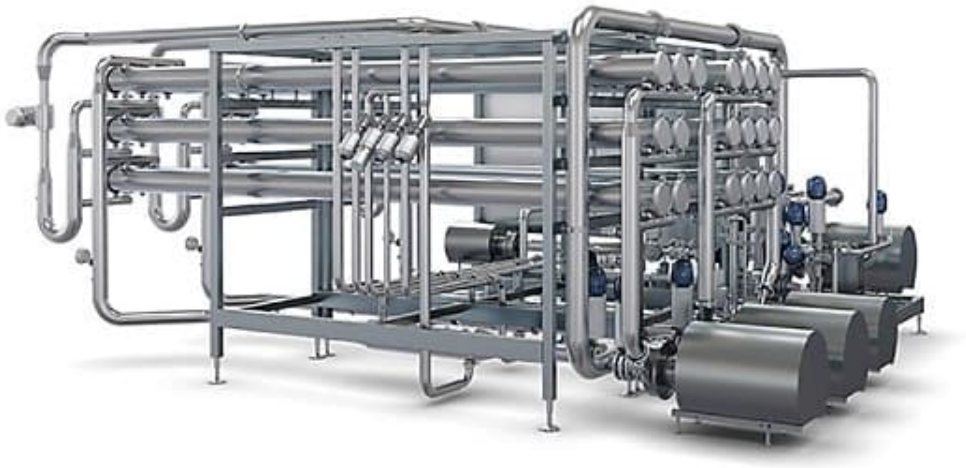
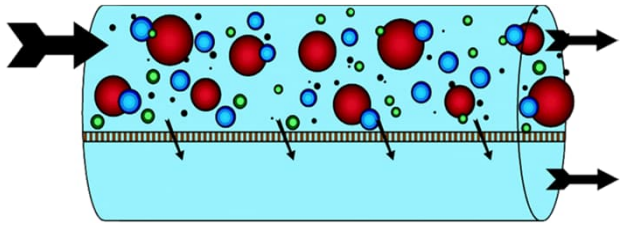
Concentration of Dairy Products using Filtration Technology

Membrane filtration is a technology that **separates a liquid into two streams using a semi-permeable membrane**.

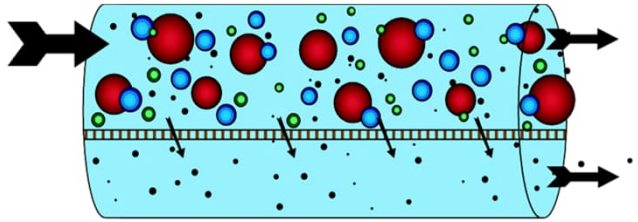
A difference in pressure forces the components that are smaller than the membrane pores through the membrane as "permeate". The remaining components are retained as "retentate".

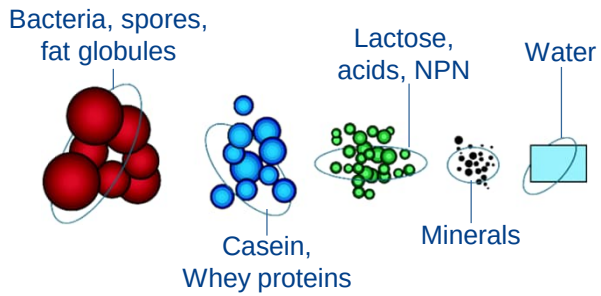


Reverse Osmosis - RO



Nano Filtration - NF





Concentration of Dairy Products

Tetra Pak Falling Film Evaporation Technology

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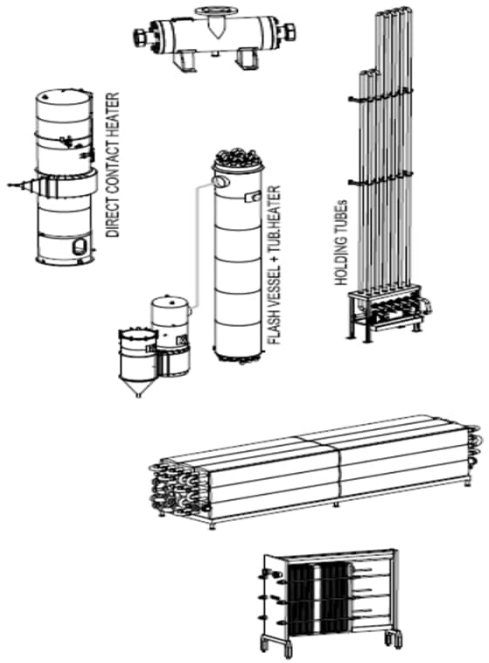
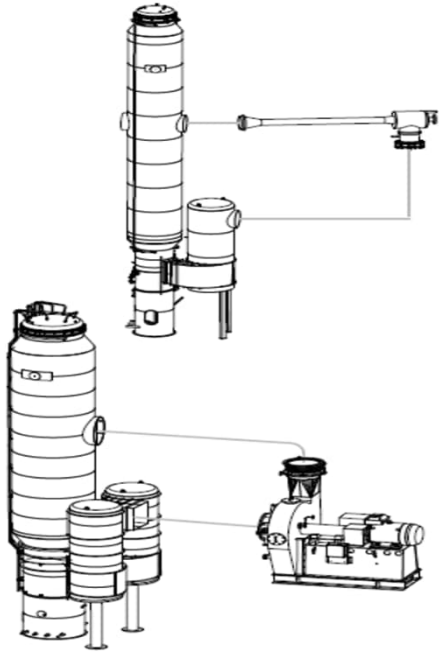
Concentration of Dairy Products using Falling Film Evaporation Technology

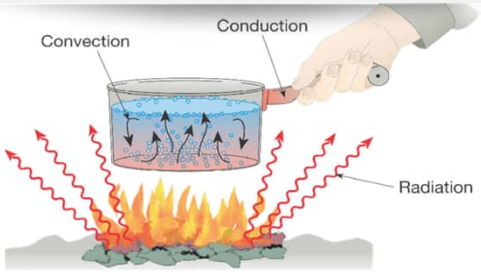
Preheating components



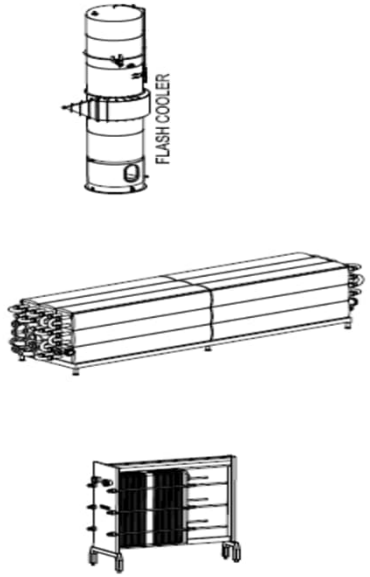
Direct Heaters & Indirect Heaters

Concentration components



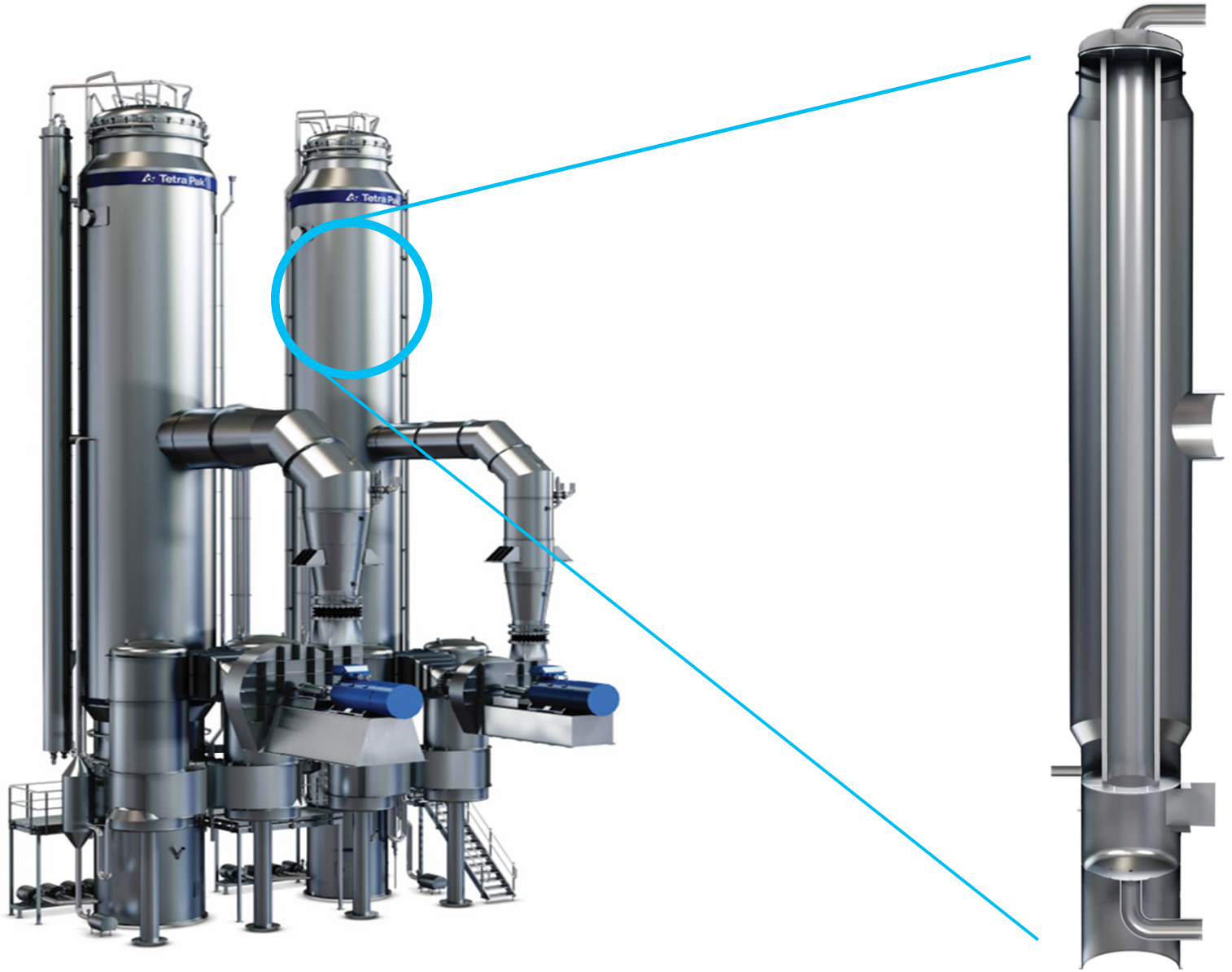


Concentrate cooling components (sometimes)



Direct Coolers & Indirect Coolers

Tetra Pak® Evaporator MVR

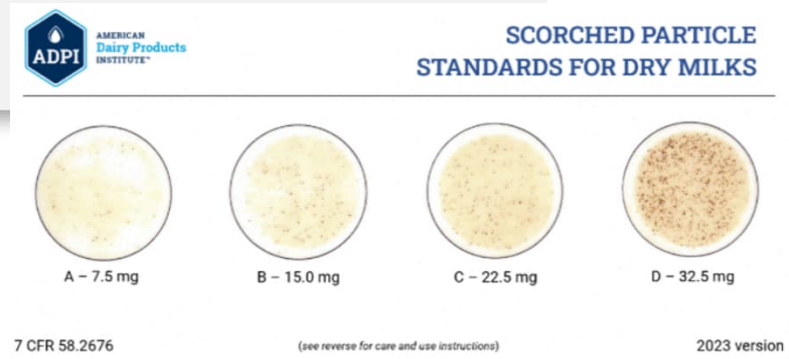


Skim Milk concentrate quality

Skim Milk Concentration

Concentration from 9%TS to high solids feeding a Spray Dryer

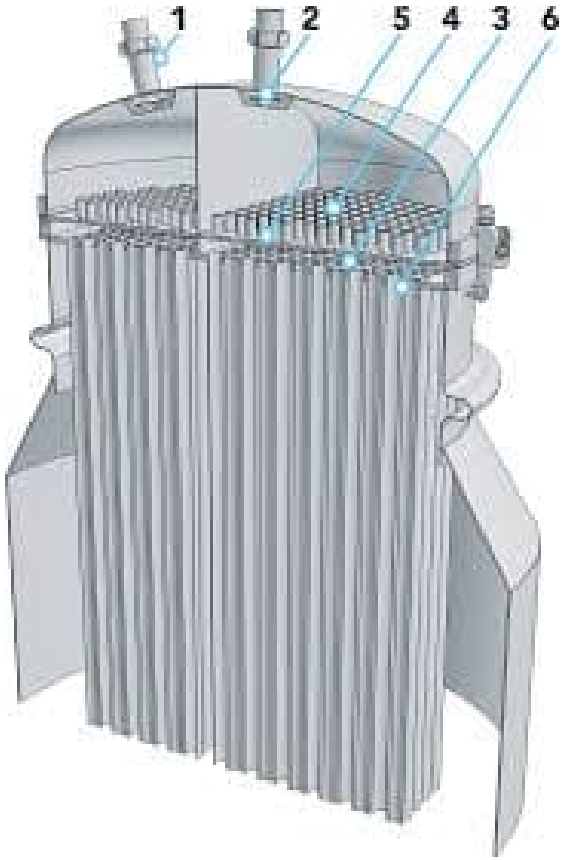
Concentrate quality	WPNI	Typical heat treatment	Concentrate solids	Typical concentrate quality
Low Heat (LH)	>6	75°C & 20 sec holding	50-51%TS	**Insolubility Index:** <0.2
Medium Heat (MH)	1.5 - 6	80-100°C & 30-60 sec	49-50%TS	**Bacterial count:** no increase in spores apart from concentration factor (in case of HHHS, the spore count will be <10cfu/ml)
High Heat (HH)	<1.5	105-110°C & 120-180 sec holding	48-49%TS	**Scorched particles:** A (7.5)
High Heat Heat Stable (HHHS)	<1 & specific oil bath test	120-125°C & 180 sec holding	48%TS	



Reverse Osmosis (RO) can be used before evaporator as pre-concentrator.
Tetra Pak has references where RO pre-concentrates to 15-30%TS.

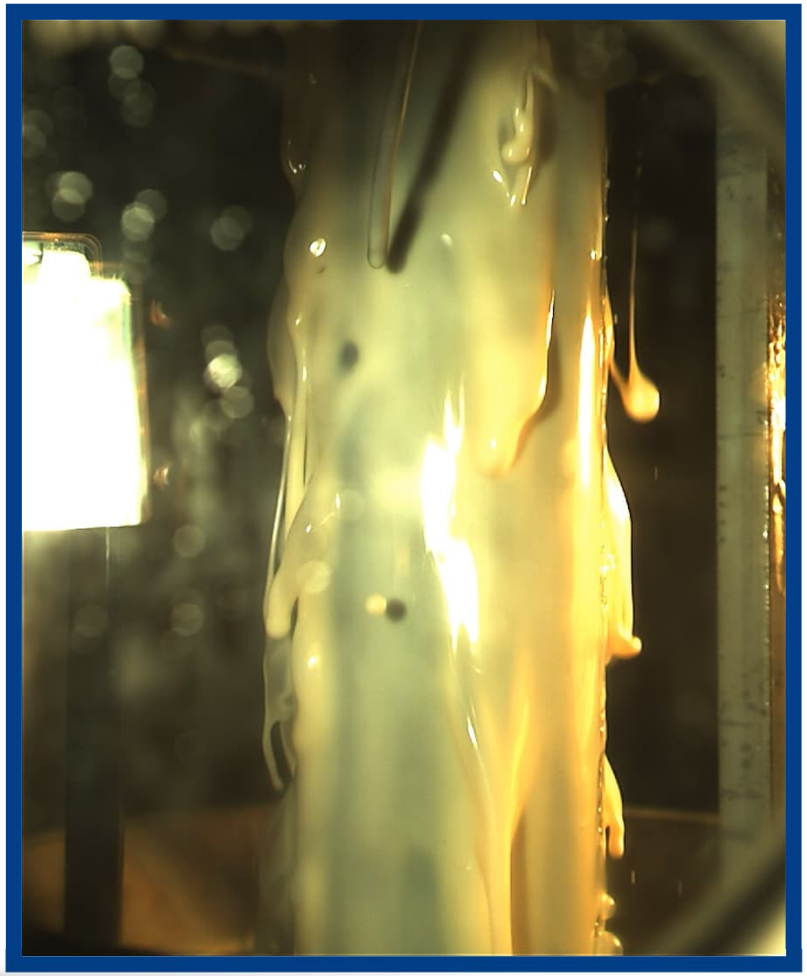
What if the skim milk concentrate quality deviates ?

Evaporator area	Likely cause	Potential remedial actions
Scorched particles	Fouling inside evaporator	• Plan regular inspections • Identify fouling areas • Make an action plan with a specialist to fix it
Insolubility Index	Fouling inside evaporator	
Bacterial spore counts	Product feed quality	• Plan regular inspections • Plan concentrate sampling per area • Make an action plan with a specialist to fix it
	CIP cleanliness	
	Evaporator process allows for spores to grow/develop	



Mastering the boiling process

Falling Film behavior inside the boiling tubes



Low Milk solids vs **High milk solids**

Sweet Whey Permeate concentrate quality

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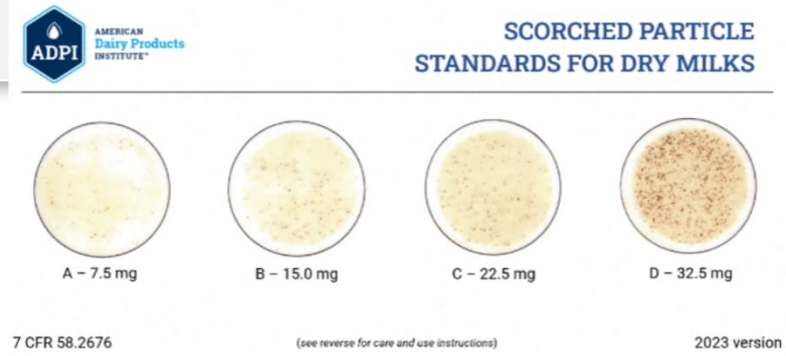
Sweet Whey Permeate Concentration

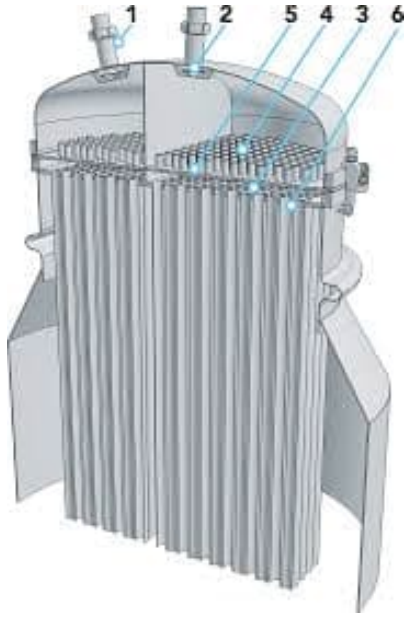
Concentration from low solids to 18-20%TS typically with RO or NF
Concentration to ~60-68%TS with Falling Film Evaporator

Concentrate quality	Typical heat treatment	Concentrate solids	Typical concentrate quality
Sweet whey permeate	80°C	60-68% TS After flash cooling	**Insolubility Index:** <0.2 **Crystals:** Avoid lactose crystallization inside the evaporator **Bacterial count:** no increase in spores apart from concentration factor **Scorched particles:** A (7.5)



What if the sweet whey permeate concentrate quality deviates?

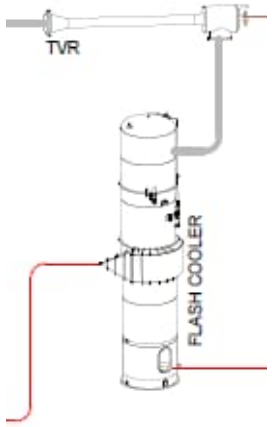
	Likely cause	Potential remedial actions
Scorched particles	Fouling inside evaporator	• Plan regular inspections • Identify fouling areas (except calcium fouling) • Make an action plan with a specialist to fix it
Insolubility Index	Fouling inside evaporator	
Bacterial spore counts	Product feed quality	• Plan regular inspections • Plan concentrate sampling per area • Make an action plan with a specialist to fix it
	CIP cleanliness of RO/NF and evaporator	
	Evaporator process allows for spores to grow/develop	



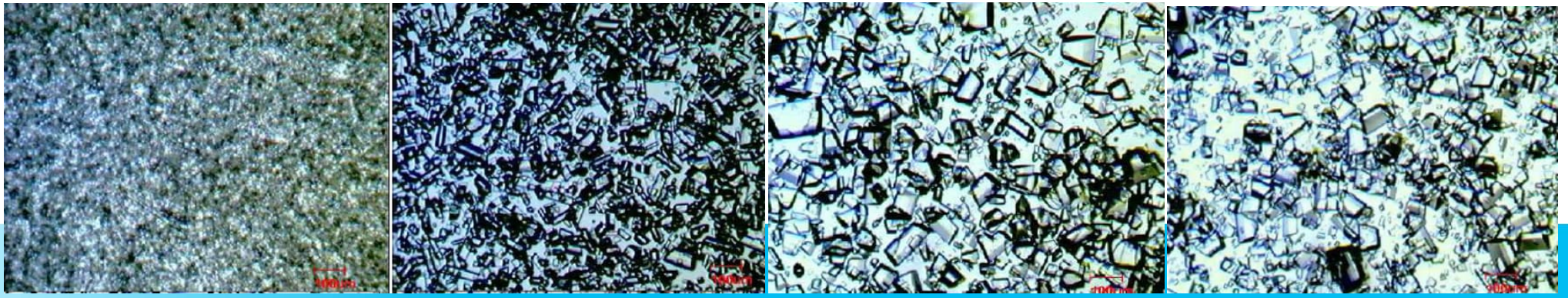
Whey permeate evaporator + flash cooler + crystallization

Evaporator

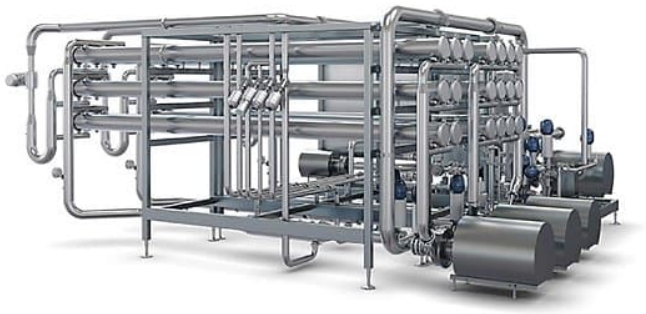
Flash cooler



Crystallization



0hr 1hr 5hr 9hr



Sustainability
Filtration vs Falling Film Evaporation

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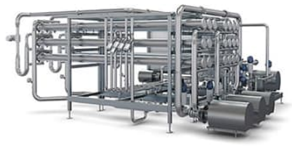
Skim Milk Concentration (9-50%TS)

Sustainability journey



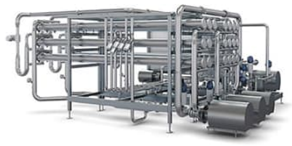



Period	TVR Evaporator (steam usage)	MVR Evaporator (electricity usage)	Filtration (RO)	Heat pump usage	Typical Steam and Electricity consumption (WE = water evaporated)
1960 – 1985	9-50%TS		-	-	0.2 - 0.3 Ton steam/Ton WE 2 kW/Ton WE
1985 – 2005	36-50%TS	9-36%TS	-	-	0.1 Ton steam/Ton WE 15 kW/Ton WE
2005 – 2015	-	9-50%TS	-	-	0.02 Ton steam/Ton WE 20 kW/Ton WE
2015 – 2020	-	18-50%TS	9-18%TS	-	0.02 Ton steam / Ton WE 15 kW/Ton WE
2020 – 2025	-	30-50%TS	9-30%TS	Providing hot water, chilled water and/or steam	0 steam usage 25 kW/Ton WE

Whey Permeate Concentration (5-60%TS

Sustainability journey






Period	TVR Evaporator (steam usage)	MVR Evaporator (electricity usage)	Filtration (RO)	Heat pump usage	Typical Steam and Electricty consumption (WE = water evaporated)
1990 – 2000	5-60%TS		-	-	0.2 - 0.3 Ton steam/Ton WE 2 kW/Ton WE
2000 – 2010	30-60%TS	5-30%TS	-	-	0.1 Ton steam/Ton WE 15 kW/Ton WE
2010 – 2015	40-60%TS	15-40%TS	5 -15 %TS	-	0.02 Ton steam/Ton WE 25 kW/Ton WE
2015 – 2020	-	18-60%TS	9-18%TS	-	0.02 Ton steam / Ton WE 20 kW/Ton WE
2020 – 2025	-	18-60%TS	9-18%TS	Providing hot water, chilled water and/or steam	0 steam usage 30 kW/Ton WE

Tetra Pak contact

Evert Faber

Process Sales Manager
at Tetra Pak Netherlands

evert.faber@tetrapak.com