

TILGÆNGELIGE  
ENGAGEREDE  
KOMPETENTE

# Developments in Membrane Technology

*Process water, recovery and cost reduction*

By Karsten Lauritzen, Head of Technology and R&D



# Agenda

- DSS Silkeborg
- Transport reduction and process water
- Milk recovery
- CIP Recovery
- Questions



# Company profile

Green technology for a green industry



**Niels Osterland**  
MSc Dairy Technology  
Managing Director



**Orla Nissen**  
BSc Dairy Technology  
Sales Director

- Leading supplier of membrane filtration technology for the dairy industry world-wide
- Supplier to a wide range of the world's leading dairy companies
- Nearly 50 employees with up to 25 years' individual experience with membrane filtration and dairy processes
- Membranes and complete plants
- Project management and integration
- Service, troubleshooting and process optimisation
- Pilot plants, tests, development



# DSS mission



To strengthen our present leading position within the area of development, design and supply of advanced membrane filtration systems and components for the dairy industry worldwide, always with due regard to people and environment



# DSS vision



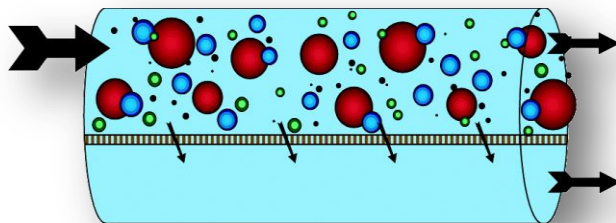
Based on a platform of know-how, product development, and our dedicated concern for people and environment we want to be recognized as the preferred worldwide supplier of a range of advanced liquid separation technologies.



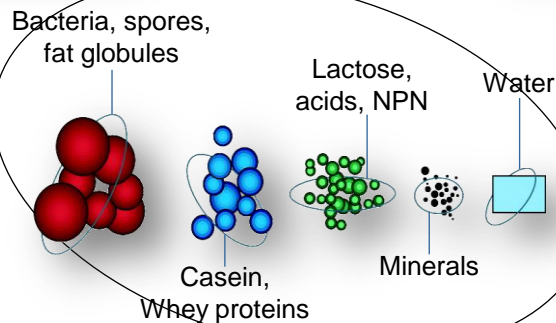
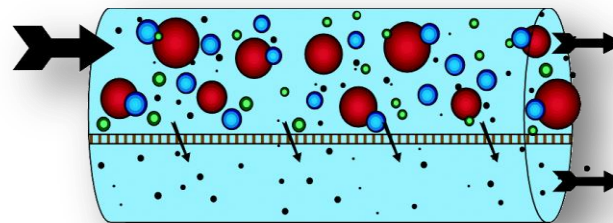


# Technology

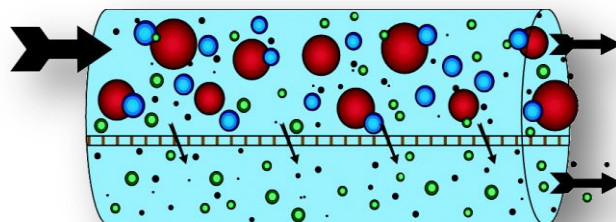
Reverse osmosis - RO



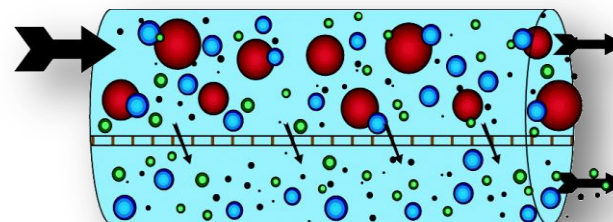
Nanofiltration - NF



Ultrafiltration - UF



Microfiltration - MF



# Why choose DSS?

**Expertise**



**Spareparts**



**Market-driven  
R&D**



**Non-stop service**



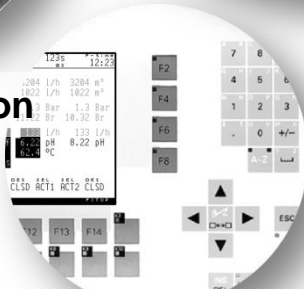
**Innovative  
technology**



**Fast delivery**



**Automation**



**Green technology**



Green technology for a green industry



# Competences and products

## Research & Development

- Membranes  
(in co-operation with membrane manufacturers)
- Complete systems and processes  
(for all known dairy applications)
- New applications

## Sales

- Analyse customer needs
- Identify optimal solutions
- Dimensioning, design, pricing
- International contracts

## Project Management

- Engineering
- Procurement
- Assembling, installation
- Training, commissioning

## After sales service

- Replacement membranes
- Service
- Trouble shooting
- Process optimisation
- Plant modifications





# Applications

## Whey

- Concentration
- Demineralisation
- WPC, WPI

## Milk

- Concentration
- Protein standardisation
- Casein standardisation
- MPC, MPI
- Feta, white cheeses
- Quark, cream cheese types

## Permeate

- Concentration (UF permeate)
- Demineralisation (UF permeate)
- Polishing (RO, NF permeate)

## Other

- Water and product recovery
- Cheese brine purification
- Condensate polishing



# 24-hour service concept

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Call us around the clock to order **service, spares, and replacement membranes** from:

- Alfa Laval
- Synder
- Koch
- Parker
- DOW Filmtec
- Hydranautics
- Microdyn-Nadir
- GE/Osmonics ... and more



**+45 7070 1661**

# DSS reference list, selected references



- Arla Foods (DK, S, F, RU)
- Skånemejerier (S)
- Tine (N)
- Goldsteig (D)
- Lactoprot (D)
- Milei (D)
- Nordmilch (D)
- Armor Proteines/Bongrain (F, SK, B)
- Lactalis (F, CZ, KZ)
- Inalco/GLT (Latina) (I)
- Kraft Foods (D, I, E)





# DSS reference list, selected references

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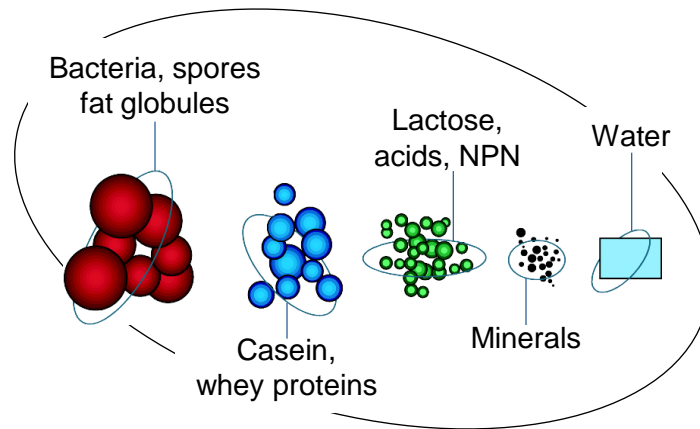
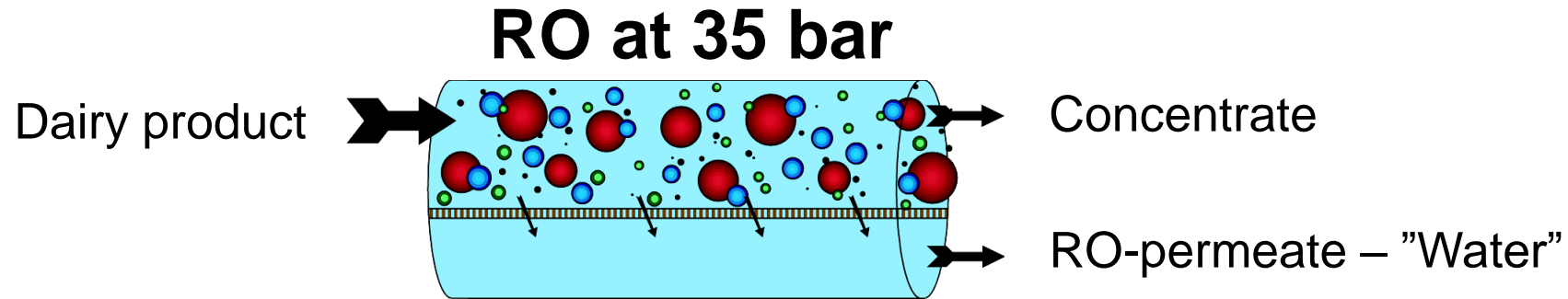
- Borculo Domo Ingredients (NL)
- DOC Kaas (NL)
- Friesland Foods (NL)
- Belgomilch (B)
- Dairy Gold (IRL)
- Glanbia (IRL)
- Kerry Ingredients (IRL)
- Murray Goulburn (AUS)
- Fonterra (NZ)
- Westland (NZ)
- Yili (CN)
- Wimm-Bill-Dann (RUS)



# TRANSPORT REDUCTION AND PRODUCTION OF PROCESS WATER



# Concentration of Dairy products by RO



# Dairy Products and Concentrates

Feed	Typical Total Solid (TS)	Concentrate max. TS	Operation between CIP
Sweet UF permeate	5,5 %	25 %	20 hrs
Acid UF permeate	5,8 %	22 %	20 hrs
Sweet whey	6,0 %	30 %	20 hrs
Acid whey	6,5 %	22 %	10 hrs
Skim milk	9,2 %	26%	20 hrs
Whole milk	12,3 %	30%	20 hrs

# Transport reduction by RO concentration

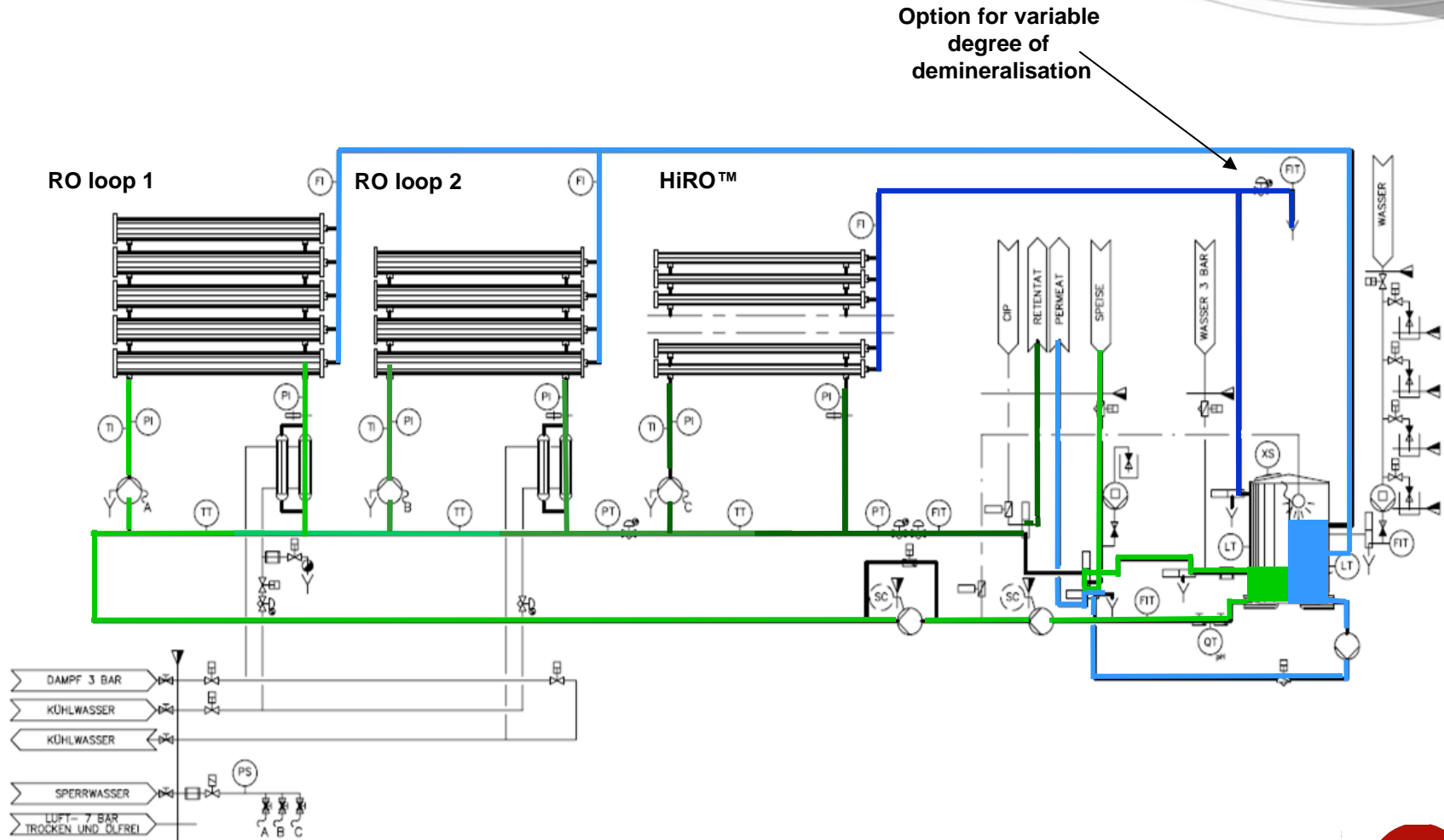
Case	Whole Milk	Sweet Whey
Feed Vol. (kg/day)	1.000.000	1.000.000
Truck loads pr. day	34	34
Concentrate (kg/day)	410.000	200.000
Truck loads pr. day	14	7
Transport Reduction	59 %	80 %
Water (m <sup>3</sup> /day)	590	800

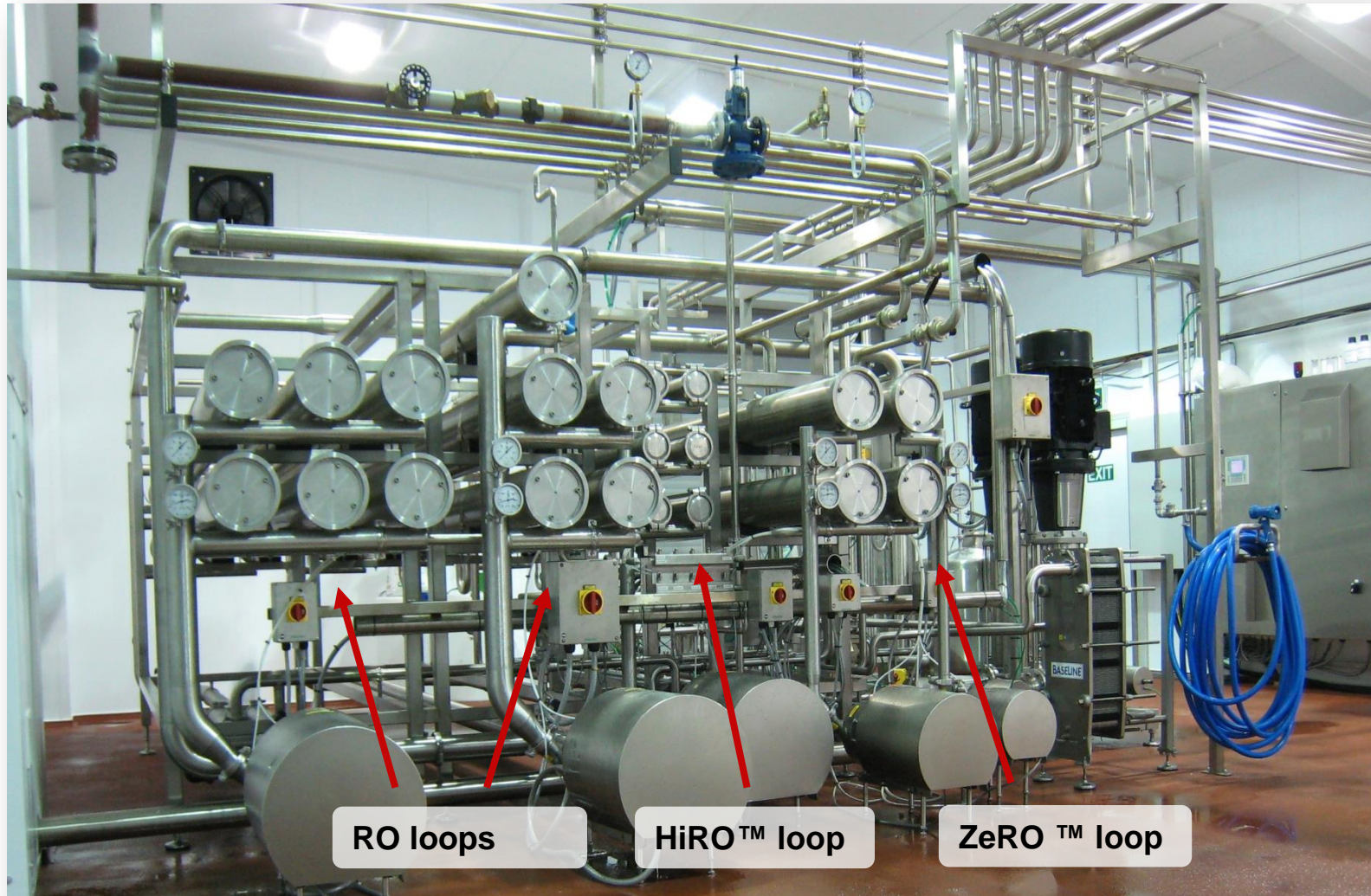
1 load = 30.000 kg



# HiRO™ Whey concentration plant

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# MILK RECOVERY



# Definition of milk flush water

Milk flush water is the first flush water in cleaning, containing a mixture of milk and water

Milk flush water typically contains 1/3 milk and 2/3 water

## Applications:

- Raw milk flush water from road tankers and milk silos
- Pasteurized flush water from pipes, pasteurizers, milk silos and filling machines
- A modern dairy typically wastes around 0.5% to 1% of the total milk volume in flush operations.





# What is the interesting aspects?

## Legal aspect

- Possible re-use of concentrate to consumer products

## Environmental aspect

- Environmental responsibility, green profile

## Financial aspects

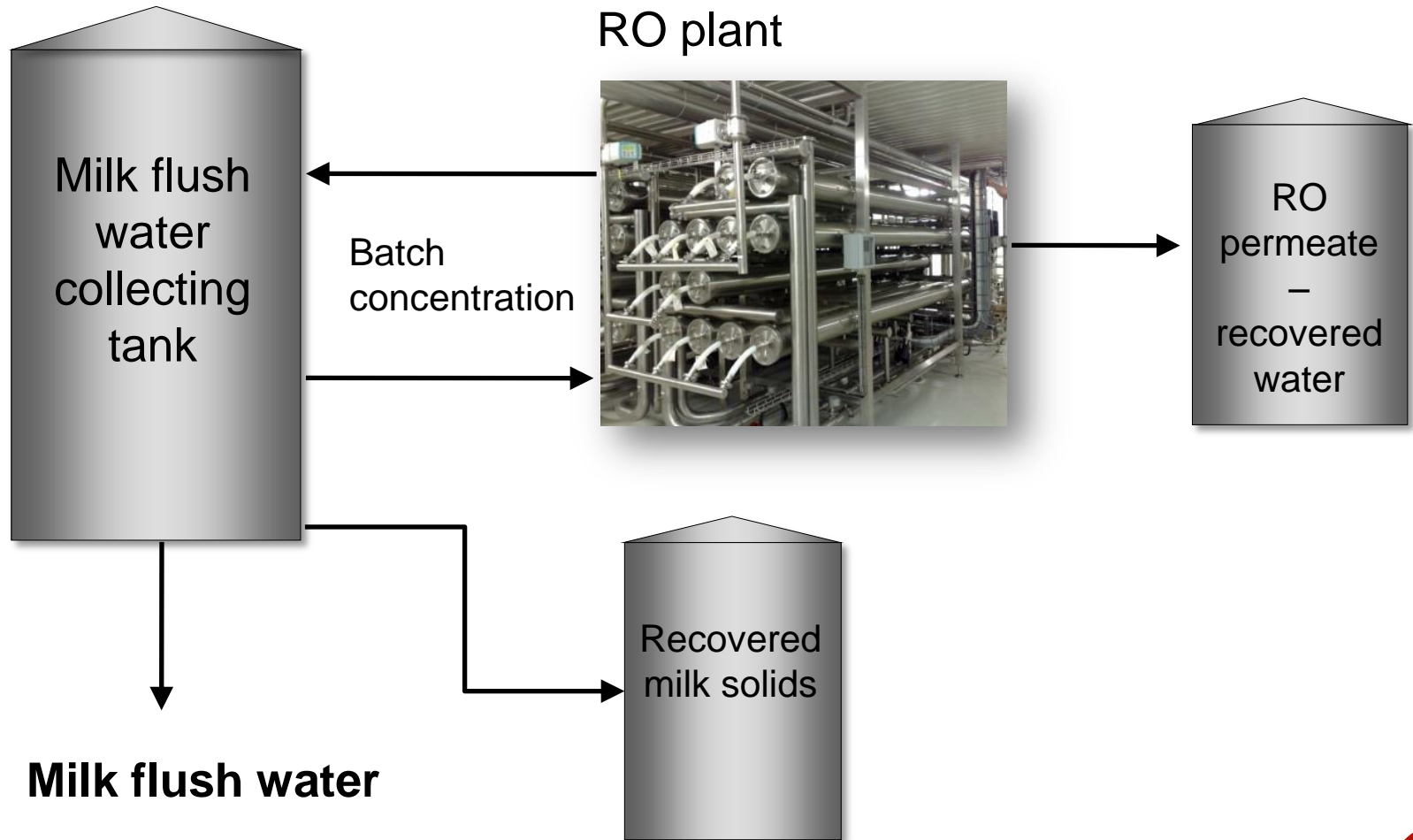
- Cost of raw material (milk price)
- Waste water treatment / effluent cost
- Cost of water

## Technical aspect

- Composition of milk flush water



# Milk Recovery proces (batch)



# Typical composition of milk flush water

## Typical composition of milk flush water

Fat free milk solids	2-6%
Fat	0-6 %

## Typical composition of milk flush water permeate

Total solids	<0.1%
COD approx.	150 ppm

## Typical composition of milk flush water retentate

Total Solids Non Fat	8-10%
Total solids	12-20%

# Case study – Milk Recovery

## 2 plants in Scandinavia:

### Milk reception Dairy factory A

- 500,000+ l/day
- Medium milk volume
- Daily volume of diluted milk:  
17,000 litres

### Milk reception Dairy factory B

- 1,000,000+ l/day
- Large milk volume
- Daily volume of diluted milk:  
35,000 litres





# Case study – facts and figures

	Dairy factory A	Dairy factory B
Daily volume of milk flush water (litres)	17,000	35,000
Milk solids in feed product (%)	4.0	4.0
Milk solids in retentate (%)	12.24	14.16
Recovered milk/day (kgs)	5,533	9,839
Investment (EUR)	200,000	350,000
Cost of operation and capital (EUR)	84,000	146,000
Annual profit (EUR)	555,000	1,059,000
<b>Payback period/ ROI (months)</b>	<b>7</b>	<b>6</b>
Based on 350 production days and a milk price per kg of	0.33	0.35

# Benefits of Milk Recovery

- No waste of milk
- Significantly reduced discharge of waste water
- Re-use of water
- Reduced environmental impact
- Very short payback period



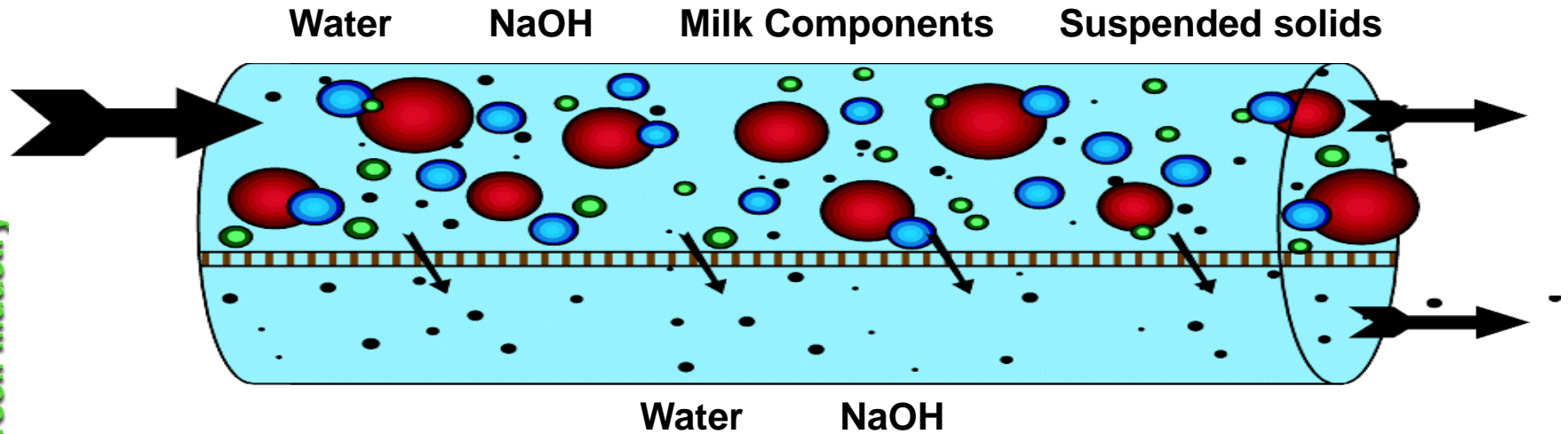


# CIP RECOVERY



# CIP Recovery

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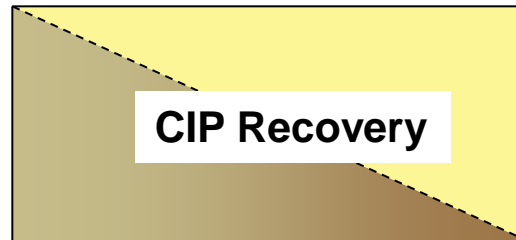
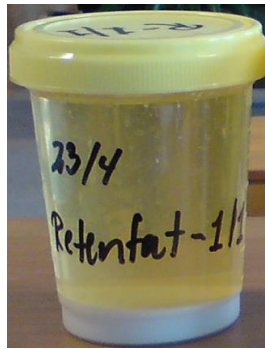


Protein, fat, lactose and suspended solids are retained and concentrated.

Caustic soda solution can pass through the membranes

# CIP recovery – the product and process

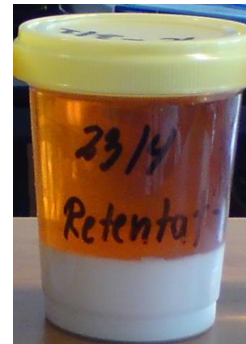
Used Caustic  
from milk evaporator



The permeate =  
recovered Caustic



The final  
concentrate  
after VCF 10





# Purification of spent CIP solutions

- Organic membrane
  - MW cut off: 150 - 300
  - expected membrane lifetime: minimum 1 year
- Limits
  - max 40 bar
  - pH 0-14
  - max temperature: 70°C
  - chlorine: 0 ppm
- Typical results
  - minimum 90% COD retention
  - 93% lactose retention



# CIP recovery – continuous system

Up to 90% recovery

Top up (48% NaOH)

Purified caustic (permeate)

Filtration unit

CIP tank  
cleaned  
2% NaOH  
65-70°C

CIP tank  
used  
caustic

Organic waste  
for discharge  
(concentrate)  
10% waste

Pre-filtering

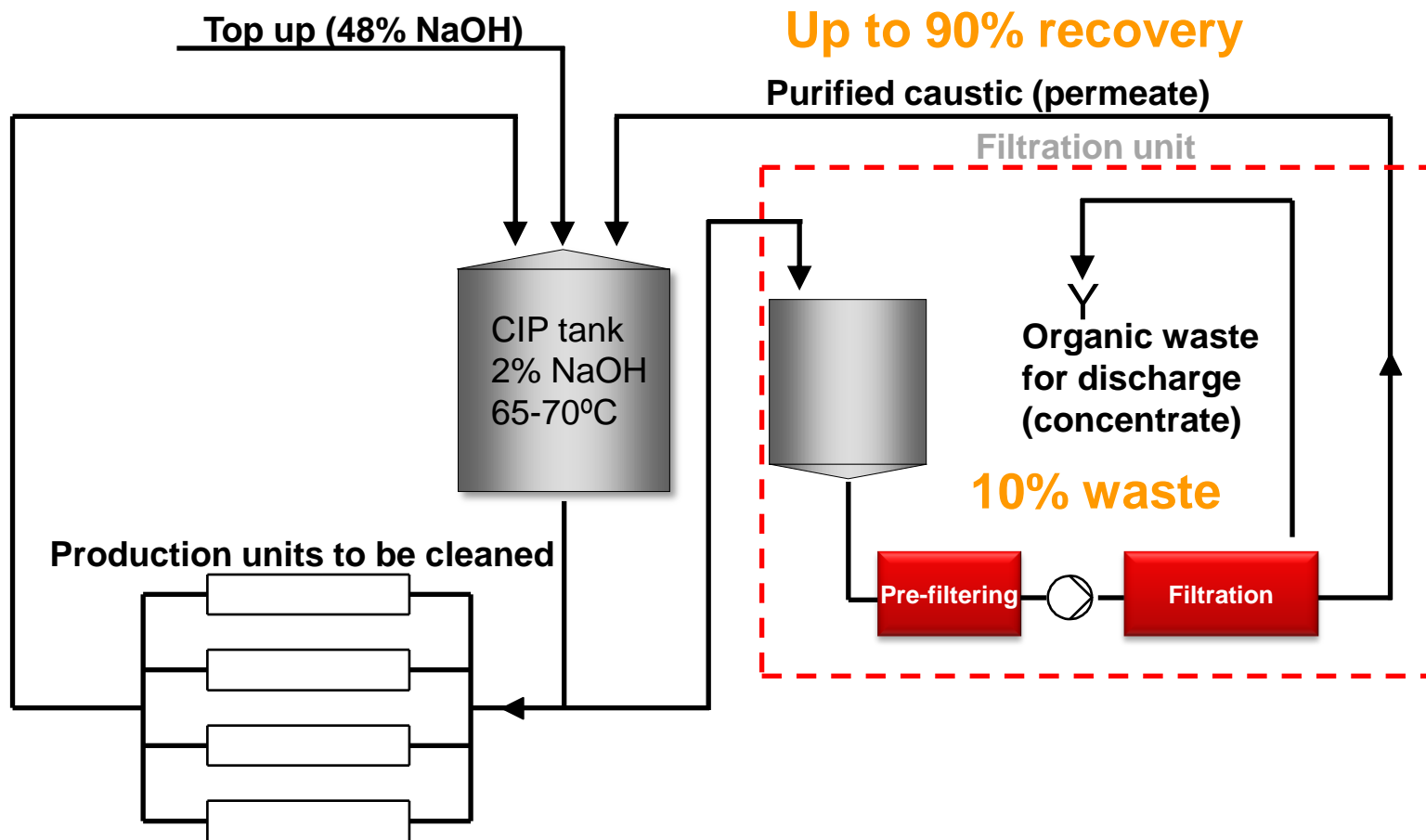
Filtration

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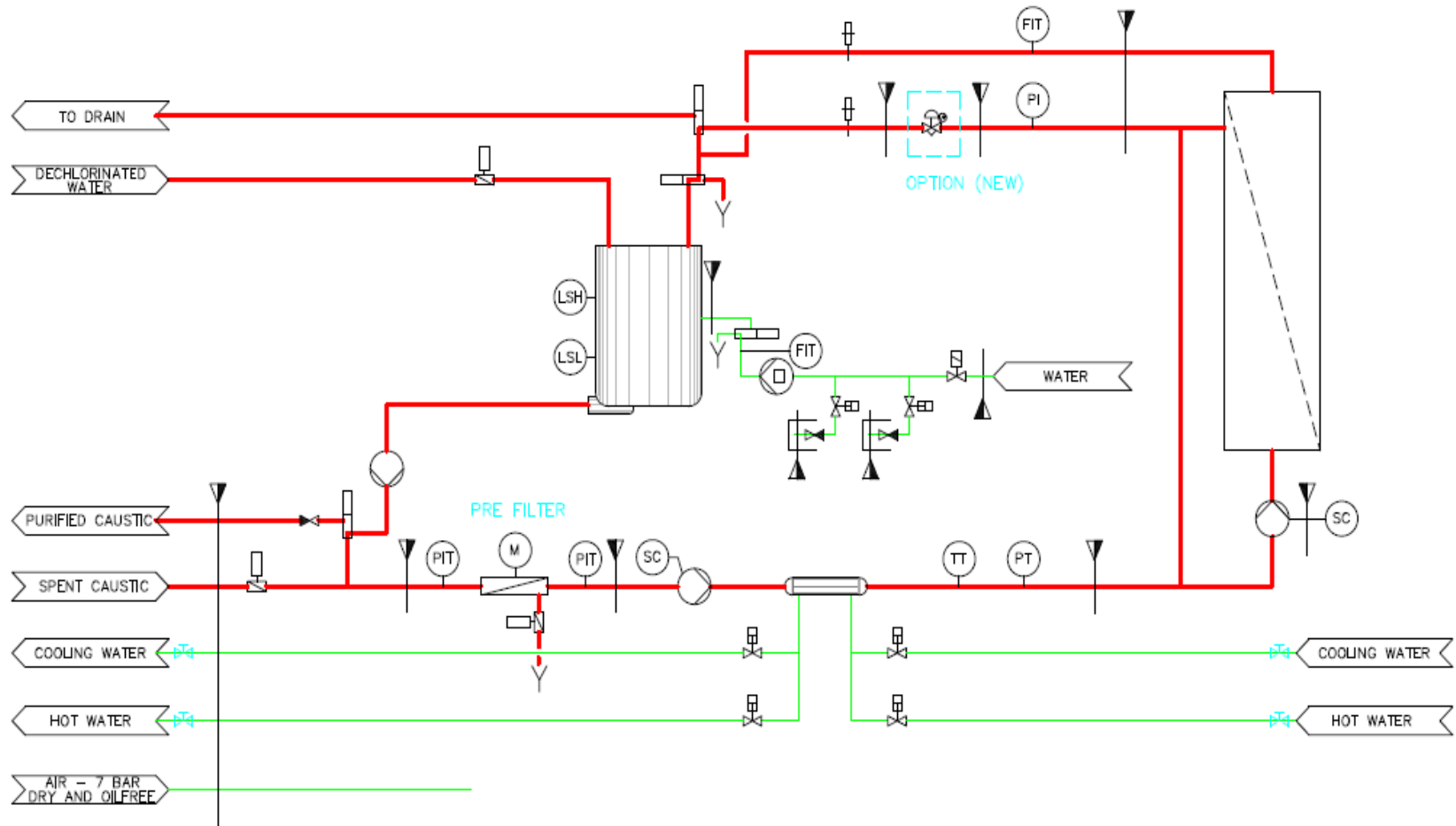
Production units to be cleaned



# CIP recovery – batch system



# CIP recovery – example of CIP Recovery plant flow sheet



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# Advantages of CIP Recovery

- Up to 90% recovery of Caustic = huge savings in detergent consumption
- Up to 90% savings in water consumption = protection of natural resources
- Significant reduction of waste water discharge
- Reduced requirement for heating = energy saving
- Short payback period
- Improved environmental conditions = green profile
- Available as batch and continuous systems
- Stand-alone or integrated control systems

**Note: Pilot tests are normally required in order to define exact filtration plant configuration**







# Questions!

