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FOOD HYGIENE

OPTIMISATION OF CLEANING IN FILTRATION PLANT

Developing a membrane cleaning procedure

What do you need to know

- Soil types
- Membrane materials
- Membrane tolerances
  - » pH & temp. tolerances of the membrane, membrane support plates, membrane spacer material and glue
- Production temperatures
- Environment – local restrictions on chemical components

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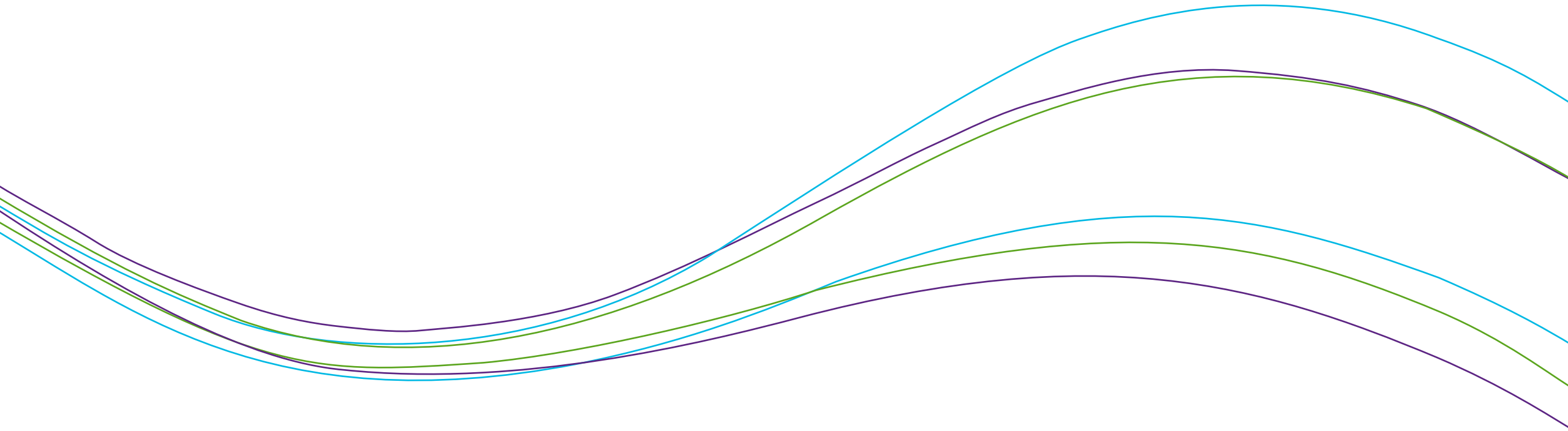
Process Soiling & Cleaning



Products

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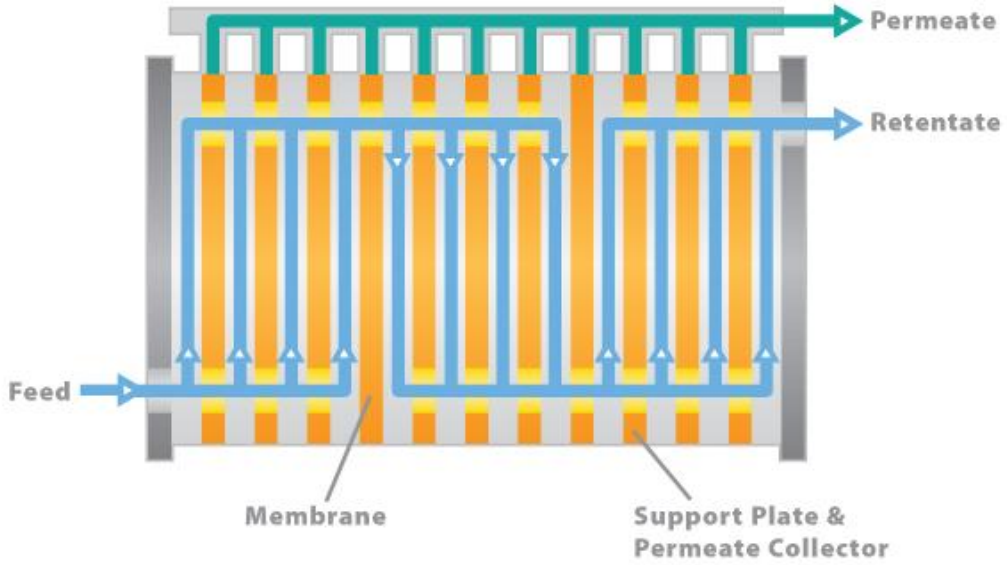
Plate & Frame (Flat Sheet) Membranes

How it works



Courtesy of Tetra Pak Dairy Processing Handbook

Courtesy of Alfa Laval

Products

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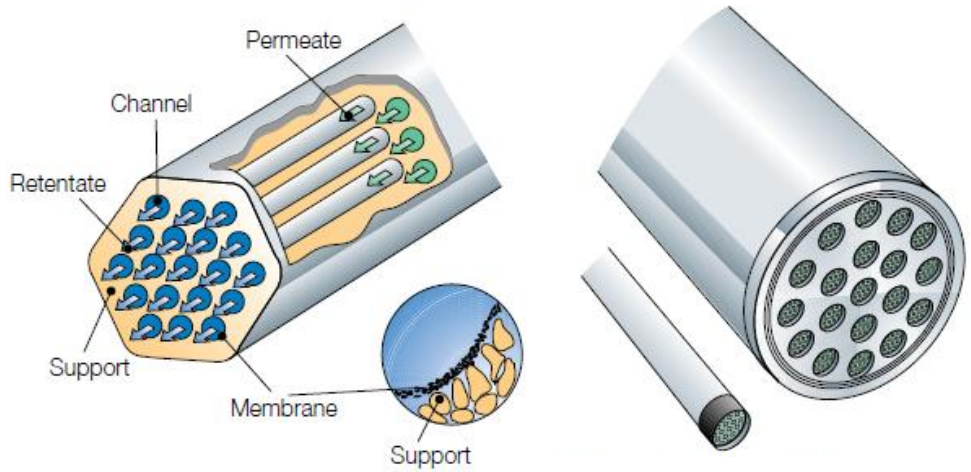
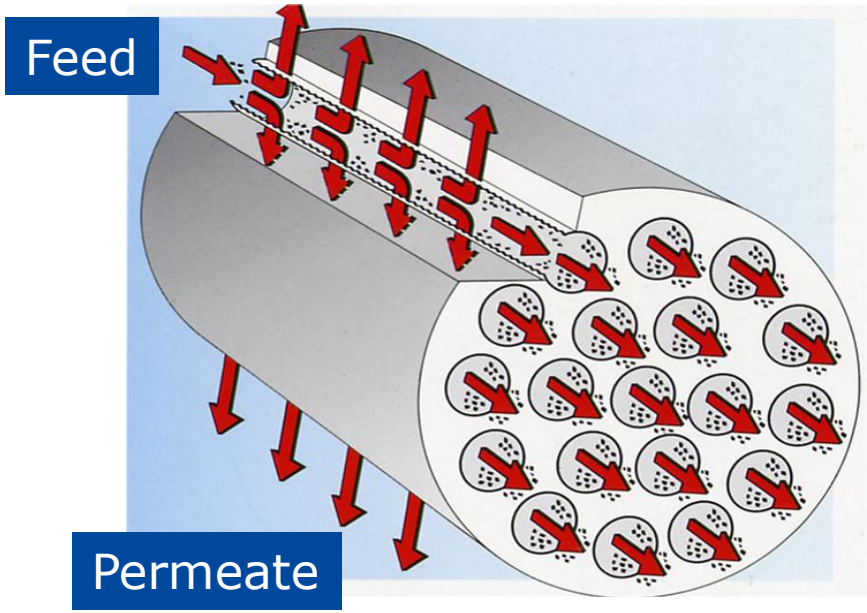
Ceramic Membrane Modules

Ceramic



- Ceramic base coated with Zirconium, Aluminium or Titanium Oxide



Courtesy of Tetra Pak Dairy Processing Handbook

Products

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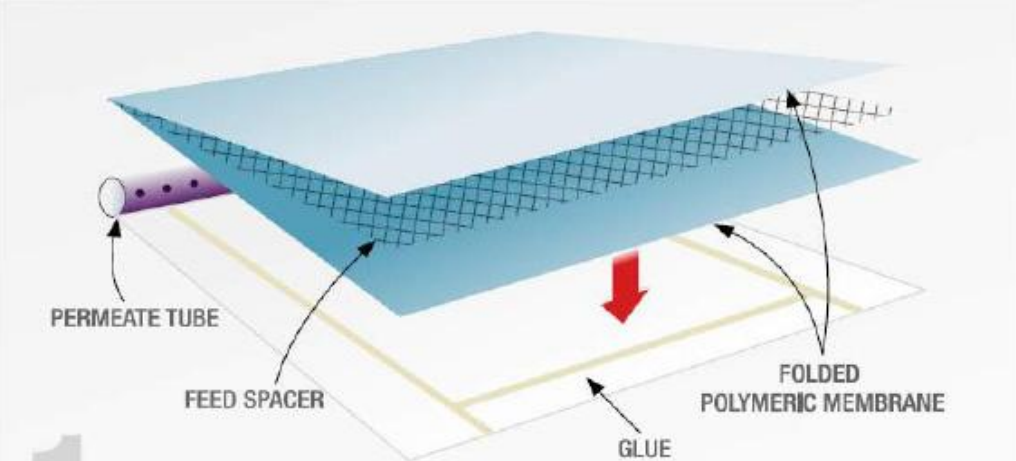
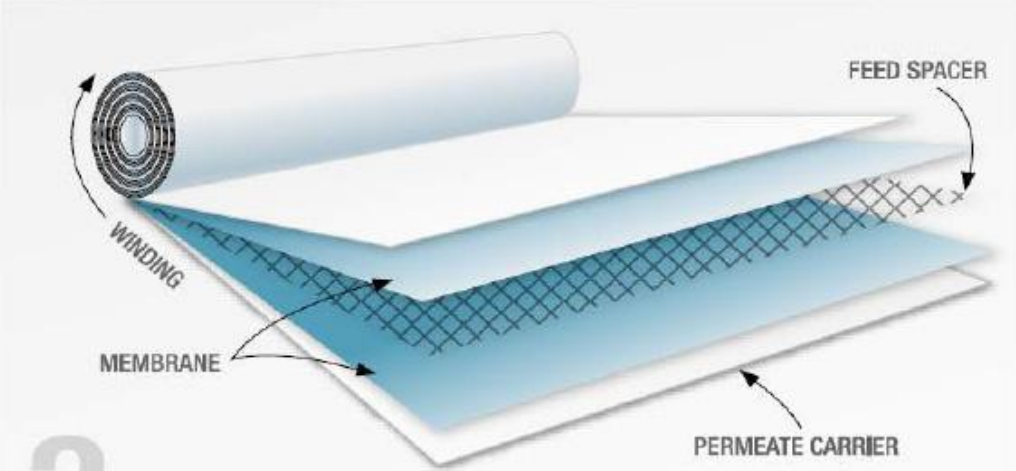
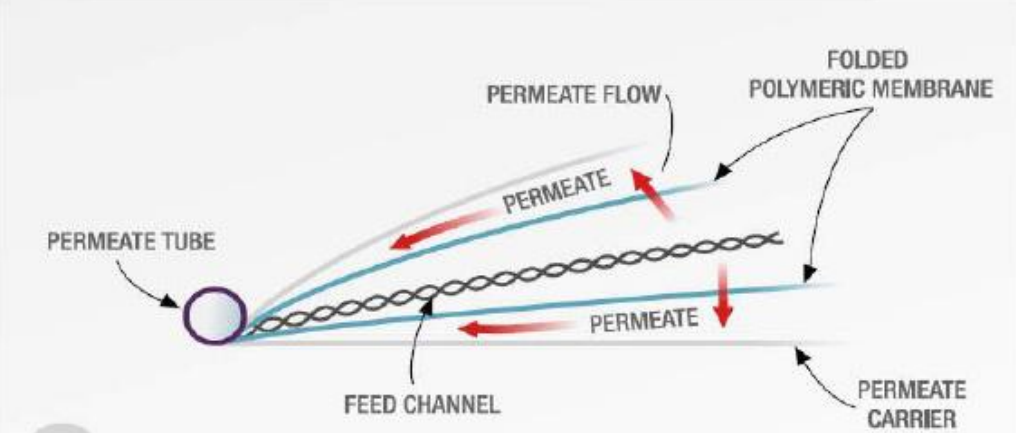
Spiral Wound Elements - A Dissection



1 Membrane leaf being glued onto the permeate carrier



2 Winding of a spiral element



3 Cross section of a membrane leaf

4 Finished spiral element

Soil type by sector

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soil type / sector	protein	sugar	carbohydrate	fat	mineral
dairy	+++	+		++	++
brewing	+	++	+		++
beverage		+++	+		+
process food	+++	++	++	+++	+++
wine	+	++	++		+
pharmaceutical	++	+	++		++

Dairy

Soiling ~ Cleaning Products

Soiling type	Types of cleaning chemicals
Fat	• High causticity • Medium causticity with surfactants
Protein	• High causticity with surfactants • Chlorinated alkalines • Low alkalinity with enzymes • Acid based detergents
Milkstone	• High causticity with high EDTA content • Nitric Acid
Micro-organisms	• Chlorinated alkalines • Disinfectants

Challenges

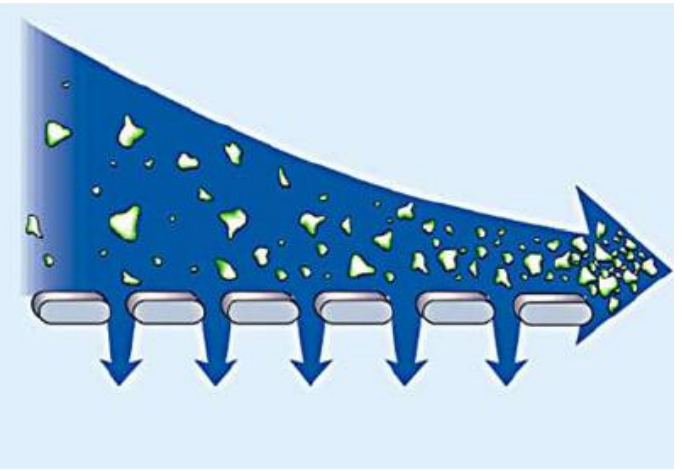
Feed quality

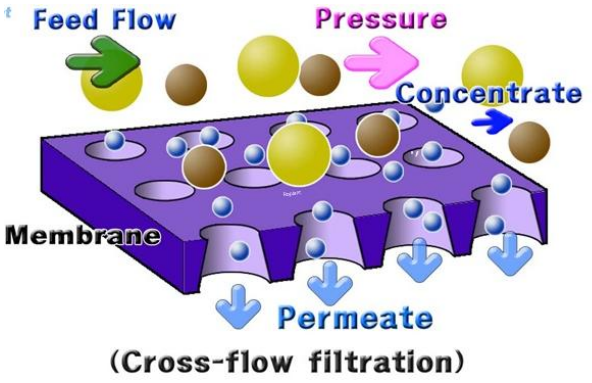
- Fines
- Fat
- pH
- Protein loss from UF
- Temperature
- Denatured protein
- viscosity

Challenges

Process

- Old plant
- Old filters
- Over pressure at start up
- Poor displacement
- Not designed for the current process
- Manual dosing
- Training
- Effective cross flow





Membrane Chemical Types

Main membrane filter materials

Polymers

- PS Polysulphone
- PES Polyethersulphone
- PVDF Polyvinylidenefluoride
- TFC Thin Film Composite - Polysulphone with Polyamide coating
- PP Polypropylene

Solids

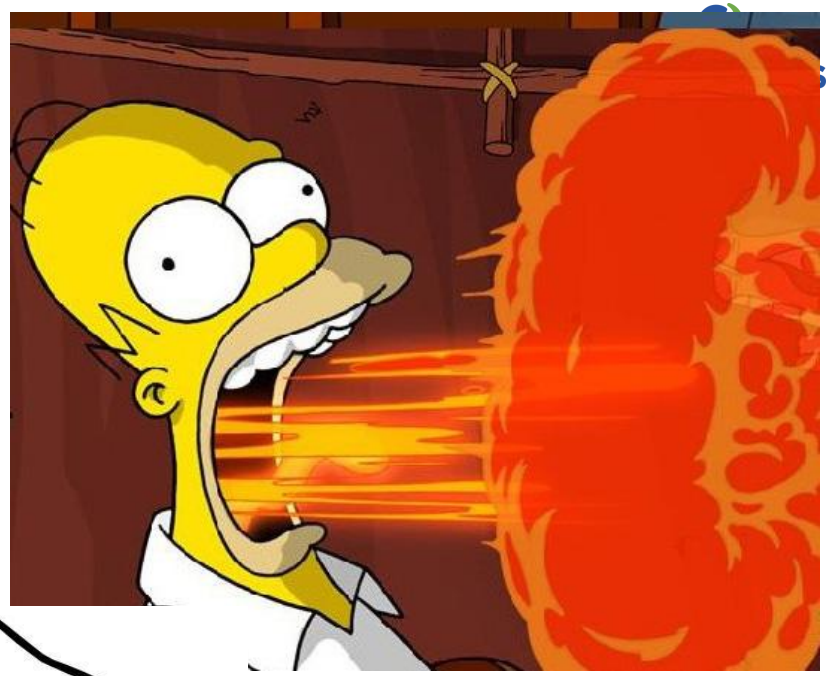
- Ceramic coated with either Zirconium, Aluminium or Titanium Oxide

Other

- CA Cellulose Acetate
- RCA Recovered cellulose Acetate
- ACN Acrylonitrile

Membrane Materials

- Variations in
  - » pH tolerances
  - » Temperature tolerances
  - » Chemical tolerances



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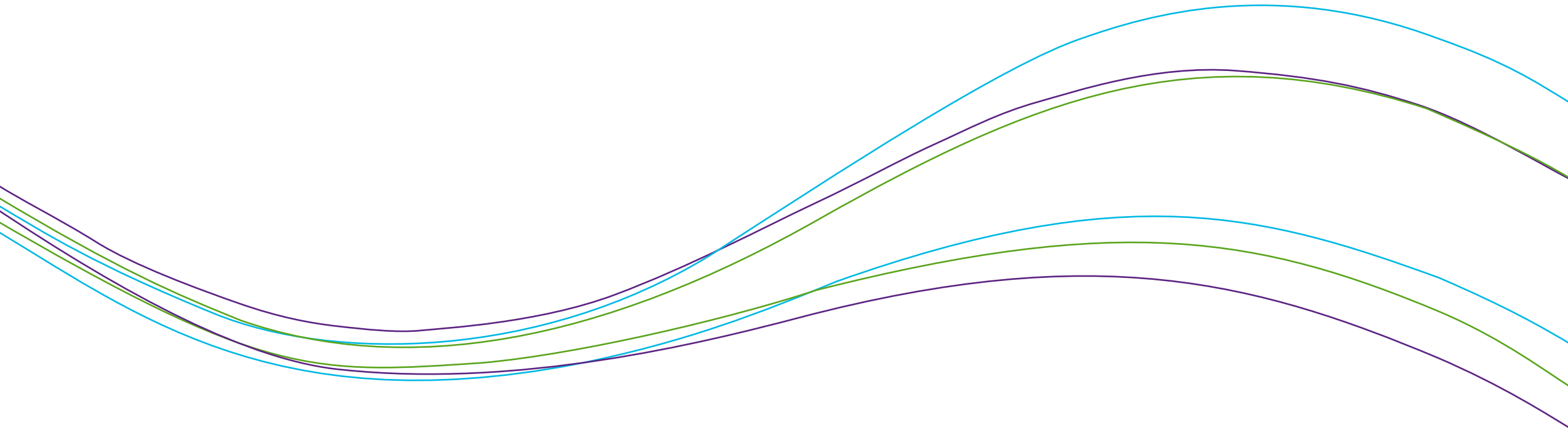
Membrane cleaning chemicals



MAIN CONSTITUENTS

- Alkalinity
- Sequestrants
- Surfactants
- Enzymes
- Acids
- Oxidizing compounds

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MIDA

MEMCARE

Alkalinity

- Products contain NaOH or KOH
  - » Preferred components to achieve a high level of alkalinity and cleaning efficacy
  - » Small ions enhance membrante penetration and solubility
- Tolerance to alkalinity depends on membrane type.
- Buffer products can maintain pH in a certain range
  - » important for membrane cleaning in dairy plant : pH 9-11

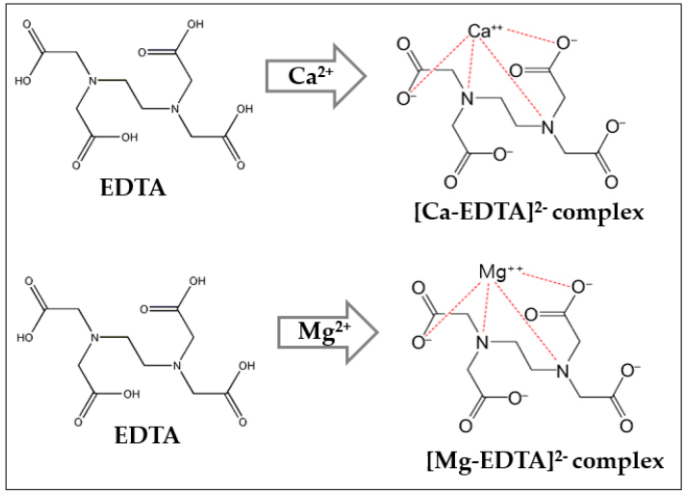
Sequestrants – EDTA

EDTA is the best for food applications

- It **binds** polyvalent cations (like Ca^{2+}, Mg^{2+},..)

and

- **Improves the cleaning**
  EDTA is the only compound that can break Ca-soap deposit



- Not compatible with chlorine

EDTA

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- EDTA (Ethylenediaminetetraacetic acid)
- The best stoichiometric sequestrant for Dairy Hygiene

- Bonds with heavy metals

- Conventional water treatment does not break down EDTA

- Environmental pollution through heavy metal complexes

The solution

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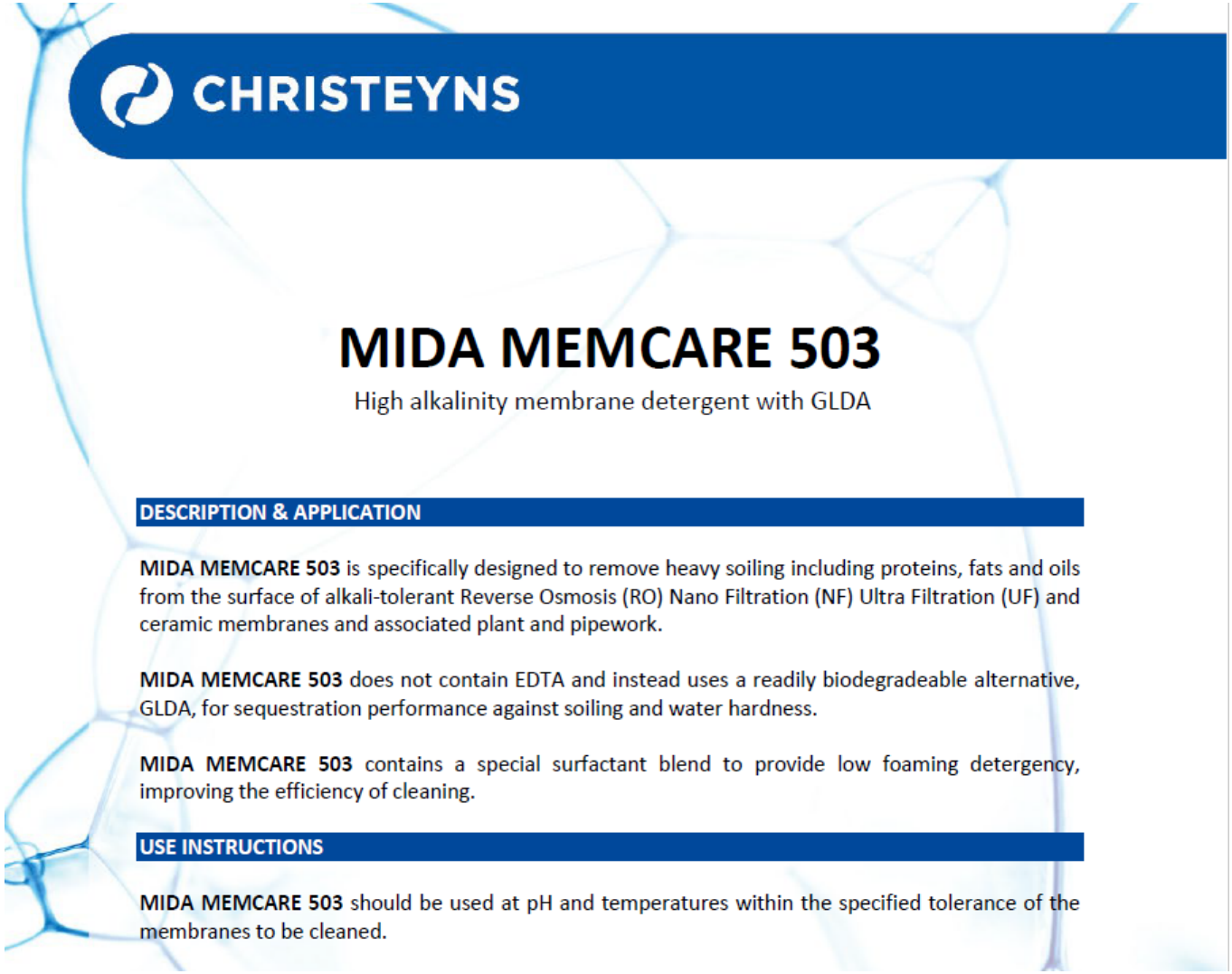

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MIDA MEMCARE 503

High alkalinity membrane detergent with GLDA

DESCRIPTION & APPLICATION

MIDA MEMCARE 503 is specifically designed to remove heavy soiling including proteins, fats and oils from the surface of alkali-tolerant Reverse Osmosis (RO) Nano Filtration (NF) Ultra Filtration (UF) and ceramic membranes and associated plant and pipework.

MIDA MEMCARE 503 does not contain EDTA and instead uses a readily biodegradeable alternative, GLDA, for sequestration performance against soiling and water hardness.

MIDA MEMCARE 503 contains a special surfactant blend to provide low foaming detergency, improving the efficiency of cleaning.

USE INSTRUCTIONS

MIDA MEMCARE 503 should be used at pH and temperatures within the specified tolerance of the membranes to be cleaned.

- Use more environmentally friendly sequestrants
- New formulations required

Sequestrants – Other

- Phosphonates & Polyacrylates
  - » Prevent formation of scale
  - » Prevent re-deposition of soil
  - » Are **stable in chlorinated** alkaline products

Surfactants

Some general reflections

- Are usually needed, esp. for fat removal
- Improve wetting and emulsification of soils

- Membrane materials made of polymeric materials are prone to '**stress cracking**' if they come into contact with certain surfactants

Surfactants

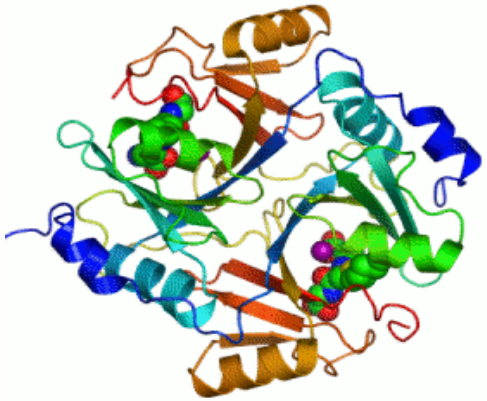
Some general reflections

- Morphology of membranes makes rinsing of surfactants difficult

- **Foaming** can be issue. This depends on the soil type and mechanical action

Enzymes

- Are **substrate specific**, organic catalysts which speed up a reaction by lowering the activation energy.
  - » Most common enzymes used in food industry are protease, lipase, amylase..
- Can reduce the need for conventional (aggressive) cleaning chemicals and offer a safer way to the removal of organic soiling
- Enzymes are chemically involved but not chemically changed



Oxidizing agents

- Are often used to improve or **accelerate the removal of organic soiling** in alkaline environment

- **HYDROGEN PEROXIDE** → max. 1000ppm (*)
  - » Additional effect on **fats**
  - » Oxidation of **tenacious** natural or added **components in fruit and wine** processes (pectins, gums (xanthan, carrageenan), gelatine, …

- **HYPOCHLORITE** → max. 150ppm or 1000ppm (for ceramics) (*)
  - » Only used in UF & MF applications

(*) dependent on manufacturers specifications

Oxidizing agents

- Not all membrane materials tolerate the use of Cl_2 or H_2O_2
- Oxidizing agents are **progressively added** to alkaline detergents at concentrations not exceeding 150ppm Cl_2 / 500-1000ppm H_2O_2
- The level of available oxidizing agents is **monitored** during cleaning and maintained
  - » The reduction in oxidizing activity can be used as a measure of organic soil removal

Acids

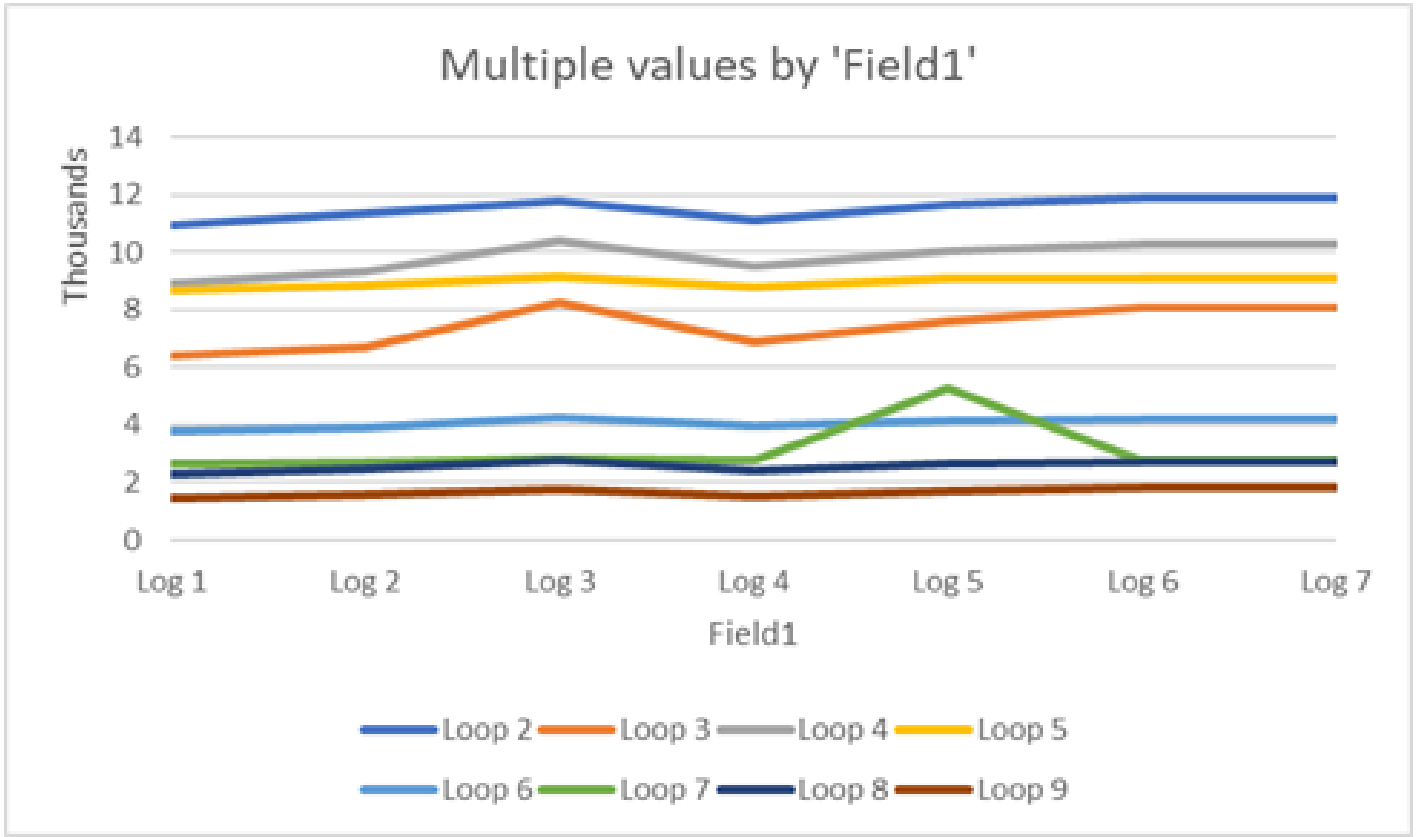
- Acidic step is present in most processes

- **Blend** Citric and Nitric acid
  - » Citric Acid
    - – Cleaning activity + Formation of secondary complexes
  - » Nitric Acid
    - – Removal of the secondary complexes

} Complementary activity of both acids

Summary

- Flux is the delta we use for verification
- A close collaboration between customer, OEM, and chemical supplier required
- Be open to change
- Build on strong collaborations



Summary

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Proactive Cleaning Triggers

Initiate cleaning early based on indicators like 10–15% permeability drop or 15% pressure rise for better membrane recovery.

Targeted Cleaning Chemistry

Use cleaning agents selected from fouling diagnosis to efficiently remove foulants without damaging membranes.

Optimised Cleaning Conditions

Maintain ideal pH, temperature, and flow rates during cleaning to enhance chemical effectiveness and results.

Continuous Monitoring and Analysis

Use data-driven analysis and regular monitoring to refine cleaning strategies and improve membrane lifespan.

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ANY QUESTIONS