

Fundamentals of Membrane Processing in the Dairy Industry

What is Membrane Processing?

A filtration method that separates liquids at a molecular level using semi-permeable membranes, minimal heat & no chemicals.

Used to isolate valuable dairy components – proteins, lactose, and minerals with precision and consistency.



Permeate

The liquid that passes *through* the membrane

Retentate

The concentrated liquid *left behind*



Why Use Membranes in Dairy?



Gentle by Nature

Non-thermal process that preserves milk's natural qualities — no heat damage, no chemical additives



Better Products

Improves quality and yield by precisely separating and concentrating the components you want



Consistent Results

Enables continuous, automated processing — reducing human error and delivering repeatable outcomes

Key Terms to Know

1

Feed

The liquid entering the system – typically milk or whey

2

Permeate

The filtered liquid that passes through the membrane

3

Retentate

The concentrated liquid retained on the other side

4

Flux

The rate of permeate flow per membrane area (L/m²/hour)

5

TMP

Transmembrane Pressure – the driving force behind filtration

Types of Membrane Processes in Dairy

Four main processes, each working at a different scale – from bacteria down to individual water molecules.

1

Microfiltration (MF)

Removes bacteria; separates casein from whey proteins

2

Ultrafiltration (UF)

Concentrates proteins; separates whey proteins from lactose

3

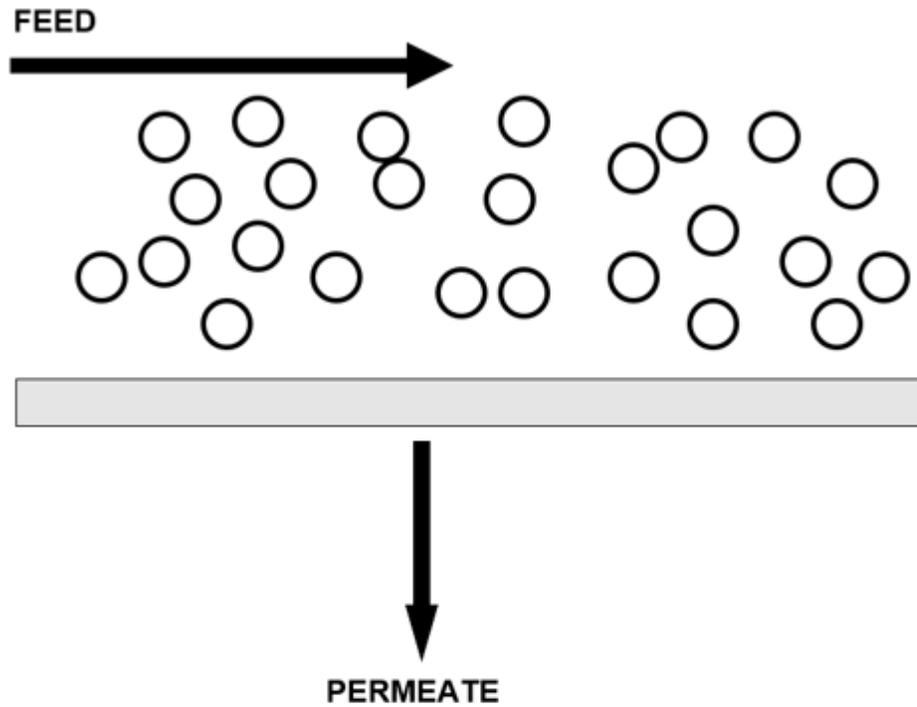
Nanofiltration (NF)

Partial removal of salts and lactose

4

Reverse Osmosis (RO)

Concentrates milk by removing water – the finest filtration



Cross-Flow Filtration: How It Actually Works

Unlike a simple coffee filter that quickly blocks up, dairy membranes use **cross-flow filtration** – the feed flows *across* the membrane surface rather than straight through it.



Self-cleaning action

The tangential flow sweeps particles away, preventing build-up



Continuous operation

No blockages means the process runs without interruption



Consistent performance

Flux stays stable, keeping output reliable over time

Benefits for Dairy Processing

Higher Yields

Concentrating milk proteins before cheesemaking boosts yield and reduces raw material waste

Better Products

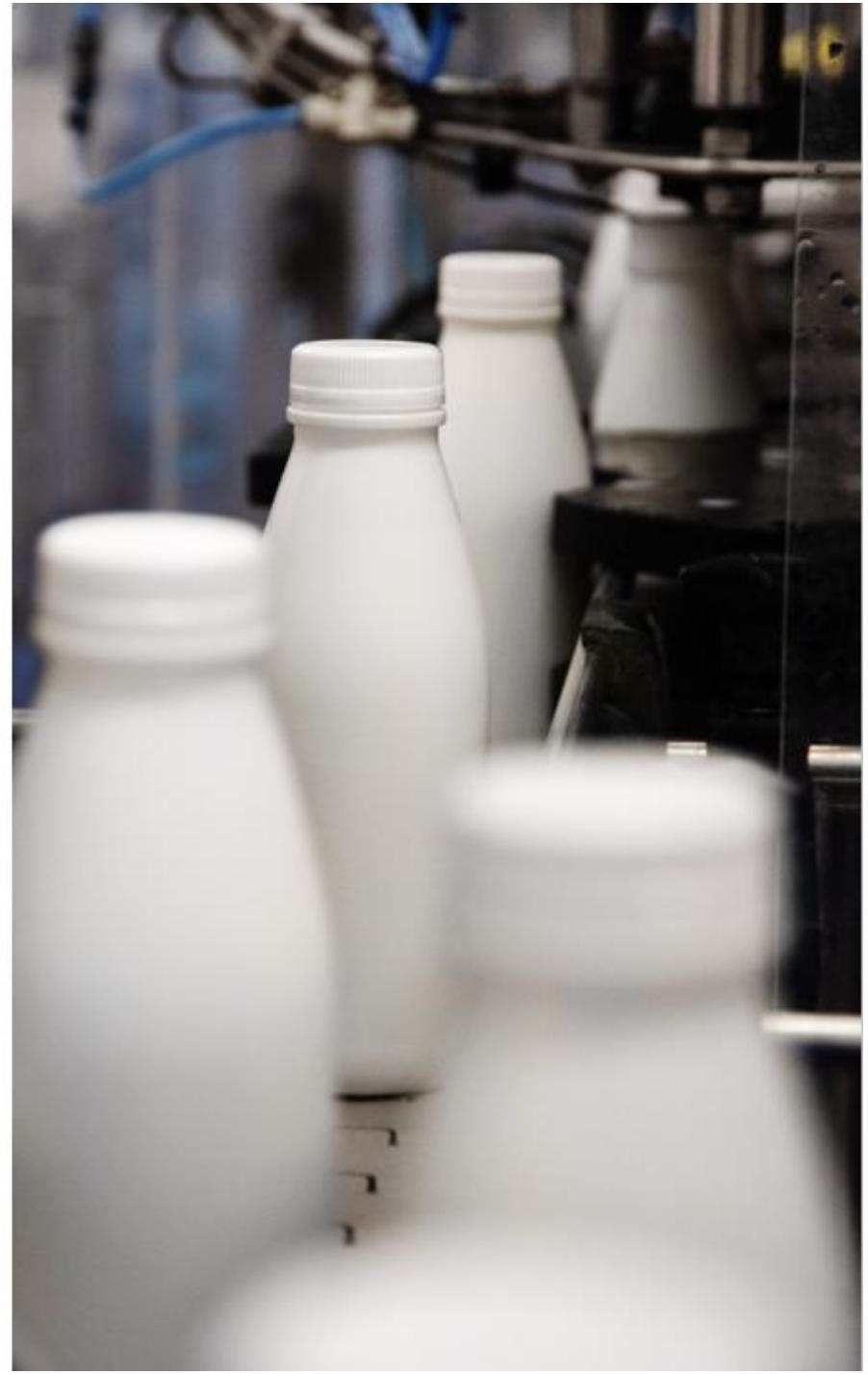
Enables lactose-reduced and protein-enriched products that meet growing consumer demand

Energy Savings

Far less energy-intensive than evaporation or distillation — a meaningful cost and carbon advantage

Greener Production

Supports cleaner processes with reduced effluent and better use of every drop of milk



Challenges to Keep in Mind

Membrane Fouling

Proteins, fats, and minerals build up on the membrane surface over time, reducing flux and efficiency

Cleaning Requirements

Regular Clean-in-Place (CIP) are essential to restore performance & must be done right

Membrane Lifespan

Lifespan varies depending on product type, operating conditions and cleaning quality



Where Does This Fit in the Bigger Picture?



Advanced membrane solutions

Focused on hollow fibre microfiltration & whey protein isolation



Spiral Membranes

The design, advantages, and practical applications of spiral-wound membrane modules



Water Recovery

Reducing water consumption and recovering valuable streams from membrane operations



Sustainability to profitability

Advanced membrane technology for Smarter Operation.
Smarter use of raw material & utilities



Smarter Use of Raw Materials

How membranes help extract maximum value from every litre of milk and whey



Optimising Cleaning

Best-practice CIP protocols that extend membrane life and reduces downtime