

Use of membranes in water recycle

Hydranautics, India



Nitto

HYDRANAUTICS
Nitto Group Company

Nitto Key Products



Optical Films for LCD



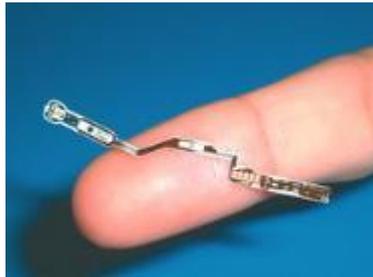
Transparent Conductive Film



Metal & Vinyl Sheets



Ultra-thin double-coated adhesive tape with PET carrier



Flexible Circuit Board: CISFLEX



Optically Clear Adhesive Tape



Clonidine Transdermal Patch



Nitto Phase Targeted Delivery Chemicals

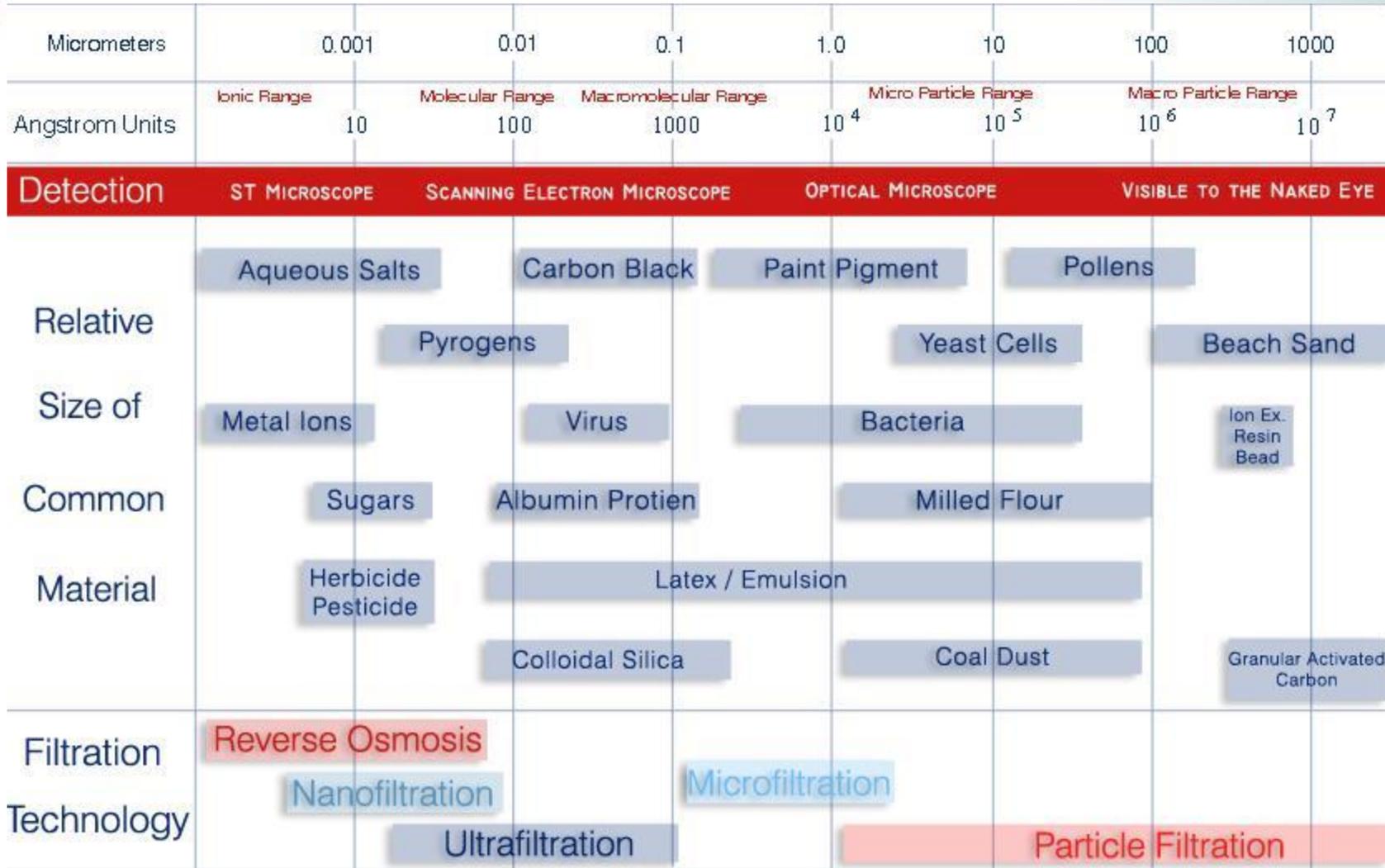
Hydranautics Membrane Products



Need for water recycle

- Sources of fresh water are depleting
- Contamination of existing sources.
- Higher demand to cater increasing population.
- Rapid industrialization needs more water.
- Higher water usage also generate more waste water. This is load of contaminants on rivers & sea.

The filtration spectrum



Why membrane-based treatment

- Positive barrier
- Excellent filtrate quality
- Possibility of automation
- Modular design
- Reduced space

Membrane technologies used in wastewater recycle

- Microfiltration/Ultrafiltration
- Nanofiltration
- Reverse Osmosis
- Membrane bioreactor

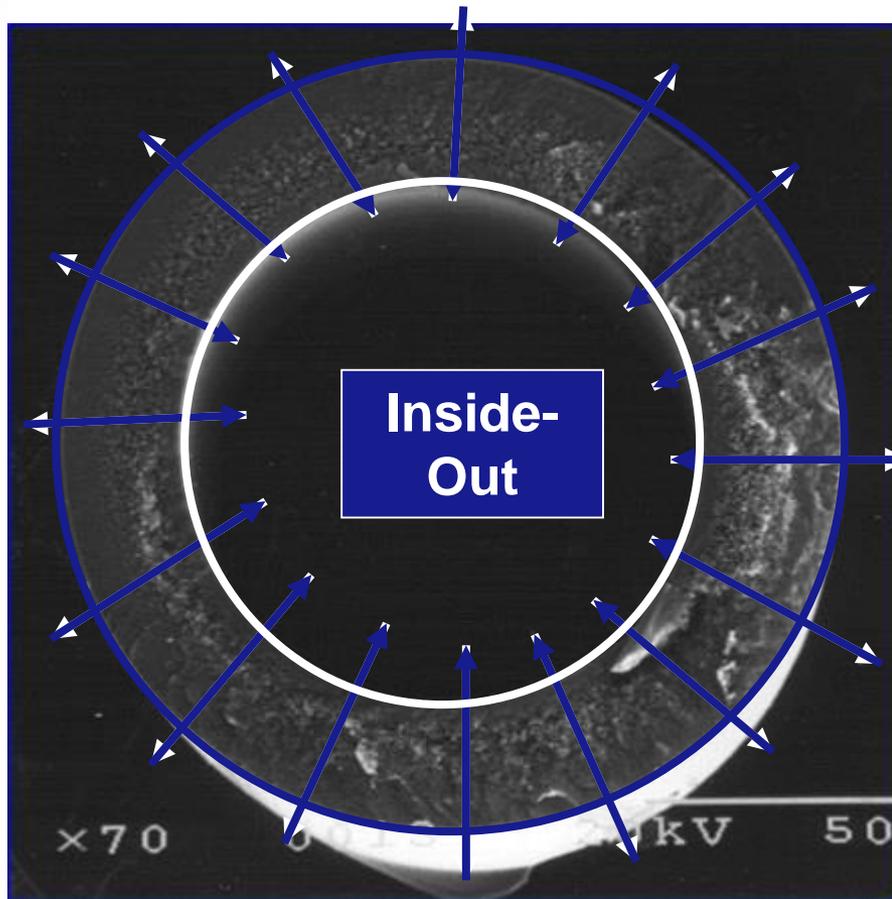
Ultrafiltration membranes



Desirable properties of UF/MF membrane

- **Ability to handle high suspended solids**
 - Clarifier/filter can be eliminated
- **Higher membrane area**
 - Reduced foot print.
 - Less no. of connections
- **Chemical and mechanical strength**
 - Ability to recover flow by aggressive cleaning.
 - Less fiber breaks/ consistent filtrate quality
- **High recovery**
 - Less pretreatment flow

Out/In flow advantage



Outside-In

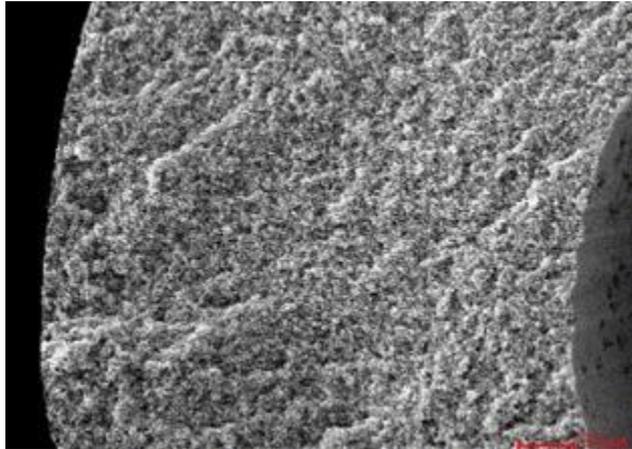


Increase in membrane area.
Area as high as 105 m² is possible

Ability to treat feed water up to 300 NTU

Reduced foot print

TIPS fiber technology

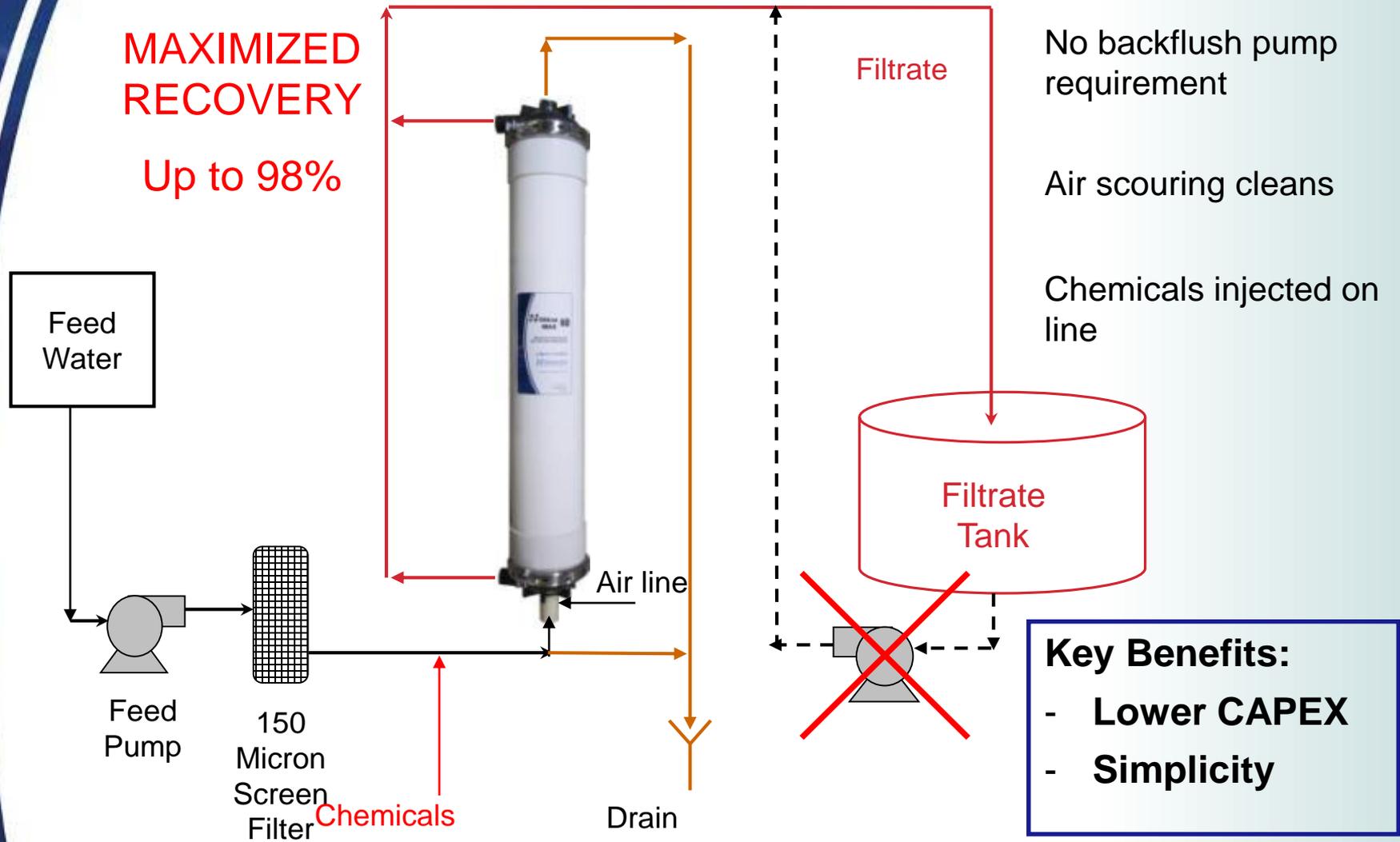


Cross section of the TIPS fiber



- **TIPS Fiber Technology:**
Microporous, crystalline structure resulting from thermally induced phase separation (TIPS) provides
 - Increased chemical resistance
 - Increased mechanical strength
- **TIPS Fiber Characteristics**
 - Tensile strength: 7–9 MPa
(3-4 times more than conventional PVDF fibers)
 - Burst pressure 0.8 Mpa
(3 times more than conventional PVDF fibers)
- **Key Benefits**
 - Lower OPEX
 - Reliability

UF membrane cleaning with air



Summary of properties new generation UF

<i>Features</i>	<i>Advantages</i>	<i>Benefits</i>			
		<i>Lower CAPEX</i>	<i>Lower OPEX</i>	<i>Simplicity</i>	<i>Reliability</i>
High membrane area	<i>Smaller footprint / Fewer skids</i>	✓		✓	
	<i>Reduced skid cost</i>	✓			
	<i>Fewer seals / connections</i>				✓
TIPS fiber technology	<i>Reduced fiber breakage</i>		✓		✓
	<i>Increased tolerance to aggressive cleans</i>		✓		✓
No backwash requirement	<i>Higher recovery</i>		✓		
	<i>No pump nor ancillary equipment necessary</i>	✓		✓	
PVDF membrane material	<i>Increased tensile and fatigue strength</i>				✓
	<i>Chlorine and other oxidant tolerant</i>		✓		✓
OUT/IN technology	<i>Ability to treat high turbidity feed water</i>	✓		✓	
	<i>Higher surface area per module volume</i>	✓	✓		

Reverse Osmosis

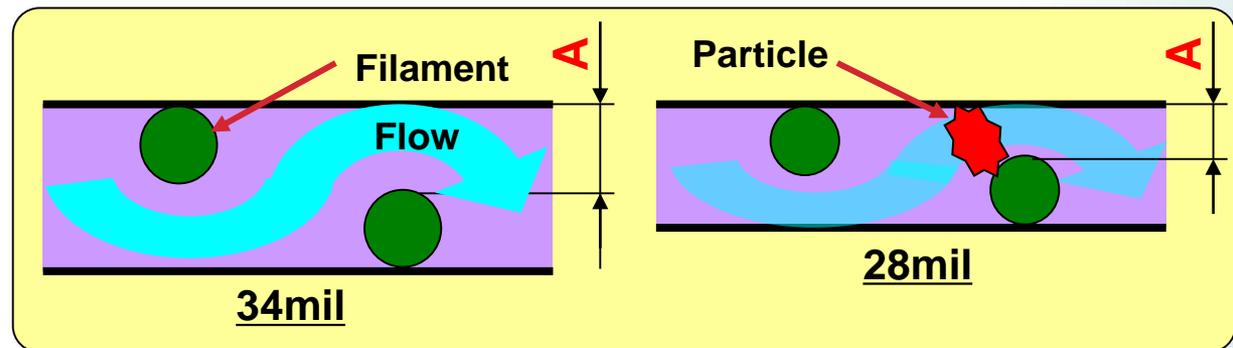
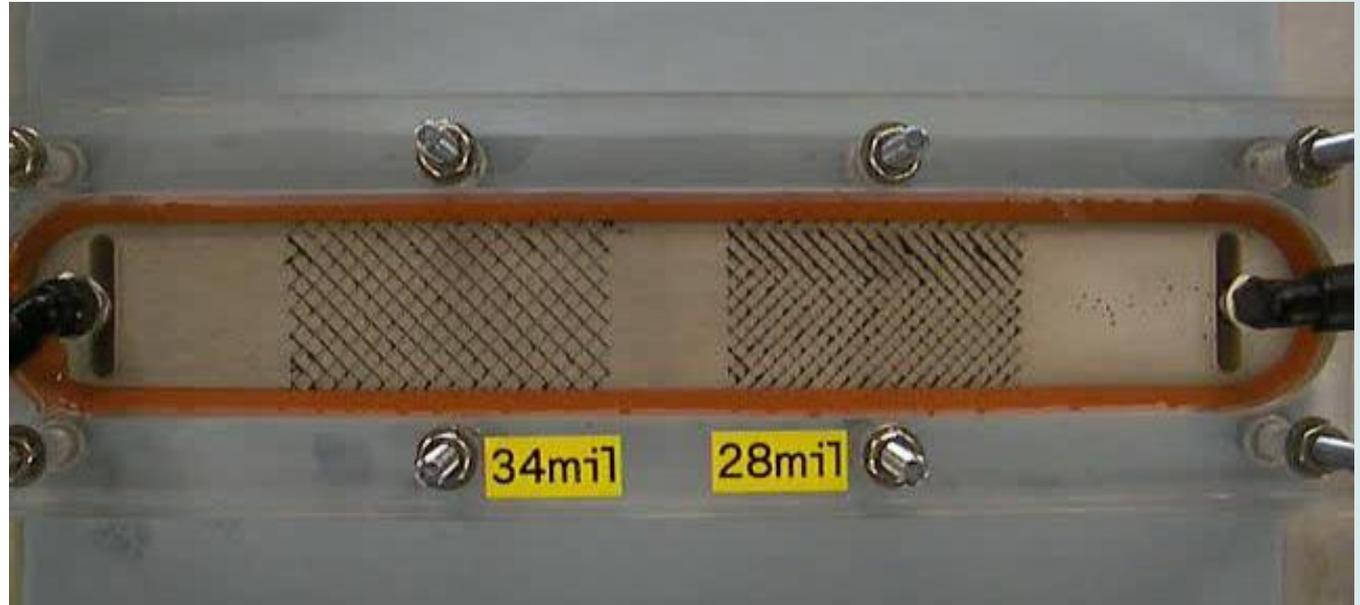
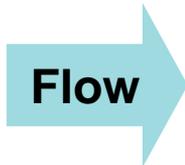


REVERSE OSMOSIS

Voice of the Customer of Reverse Osmosis Systems

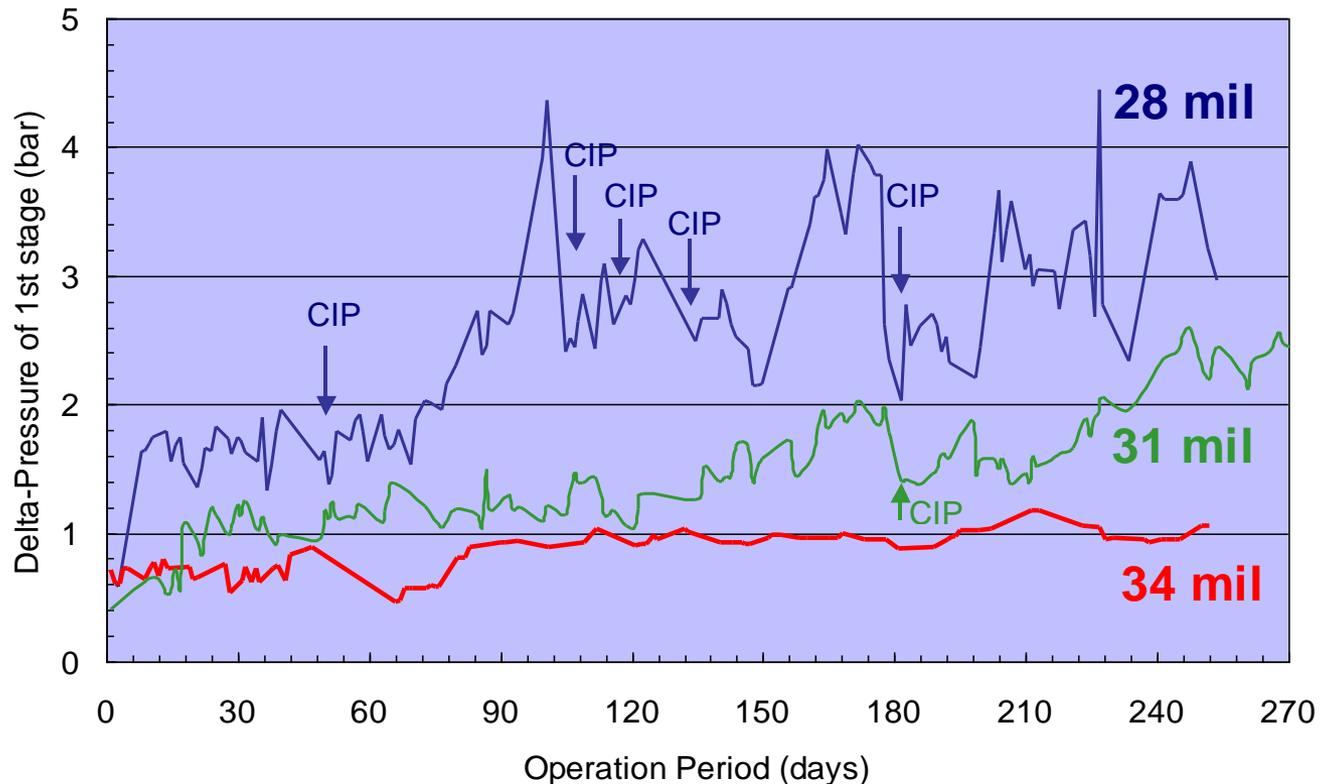
- Quality & Quantity Assurance
 - Innovative product.
 - 100% of product is tested.
 - Design & Technical support
- Lower Opex
 - High Membrane Life.
 - Less cleaning frequency.
 - Low Fouling
 - Low Energy

#1 Spacer Design: Thickness & Geometry



Clearance of 34 mils is 20% wider than 28mils

Performance of various feed spacers on a high fouling water



Actual operational test data

* Feed: city water with SDI 4-5 (Max = 6)

- 4 elements in a pressure vessel first stage
- 28 mils, 31 mils, 34 mils

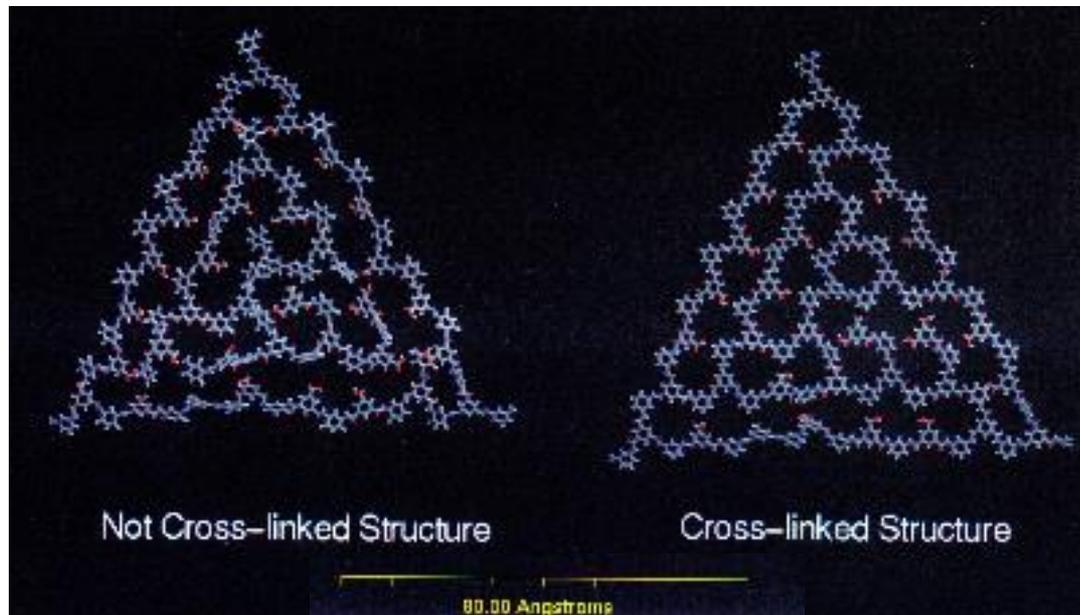
The LD Technology®

Features: Enhanced membrane chemistry

Evolved membrane chemistry achieves the highest salt rejection on the market

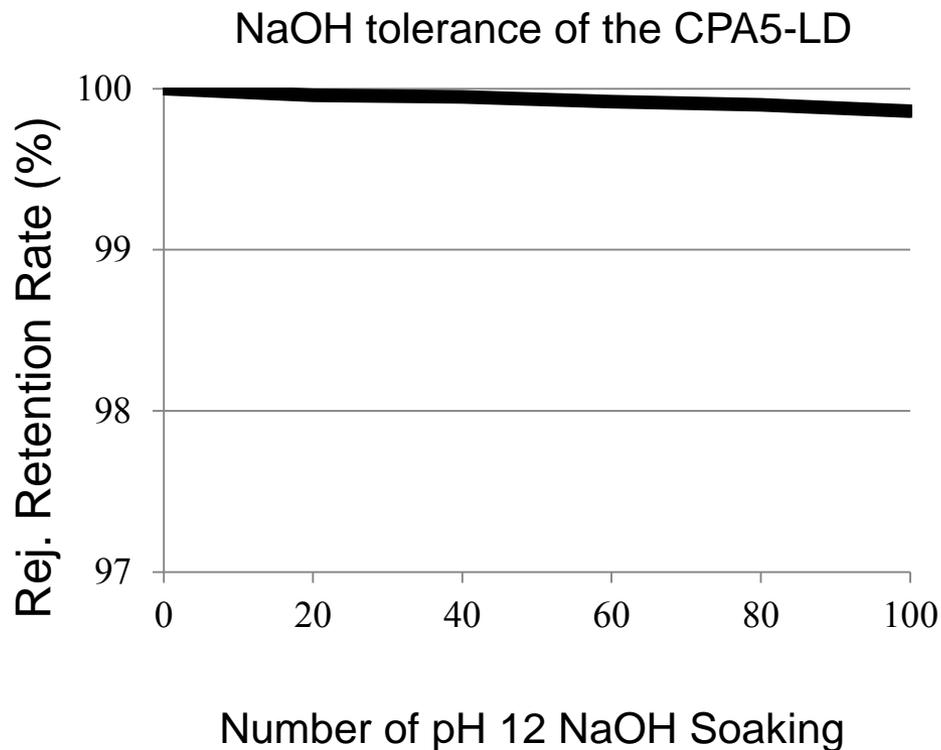
Our chemical reaction control technologies realized higher cross-linked structure

Chemically more robust to allow cleaning from pH 1 to 13



The LD Technology®

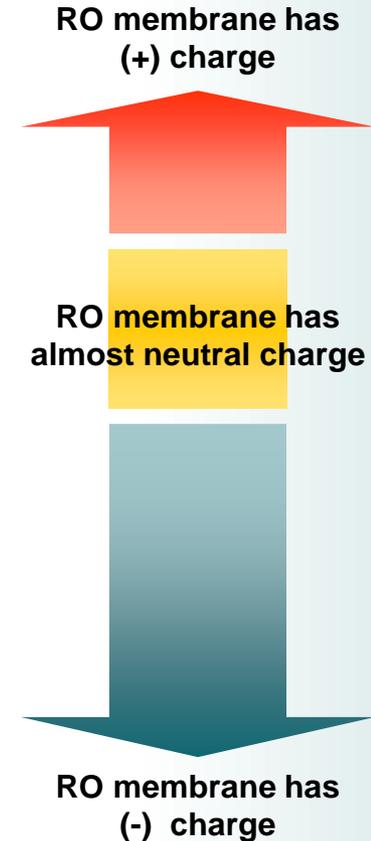
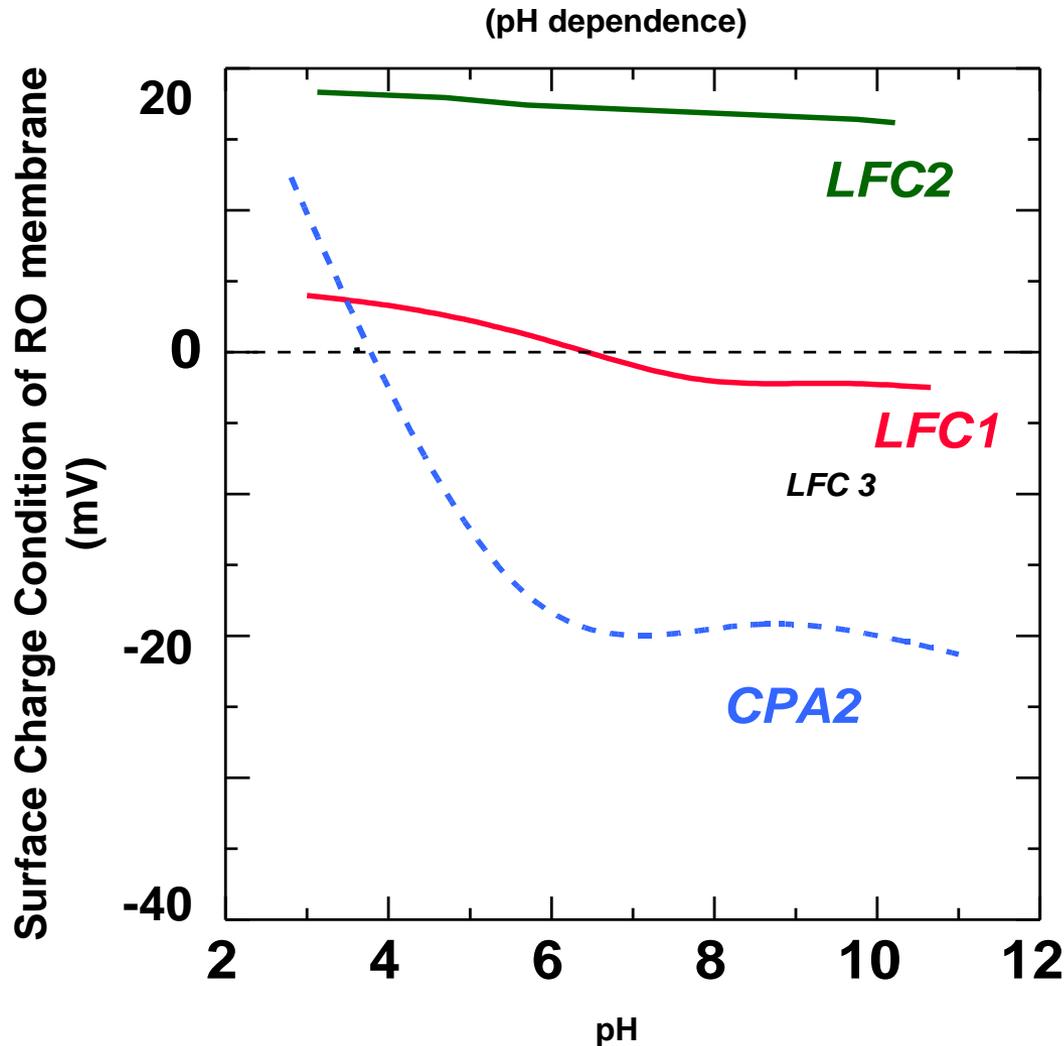
Benefits: Improved Membrane Durability



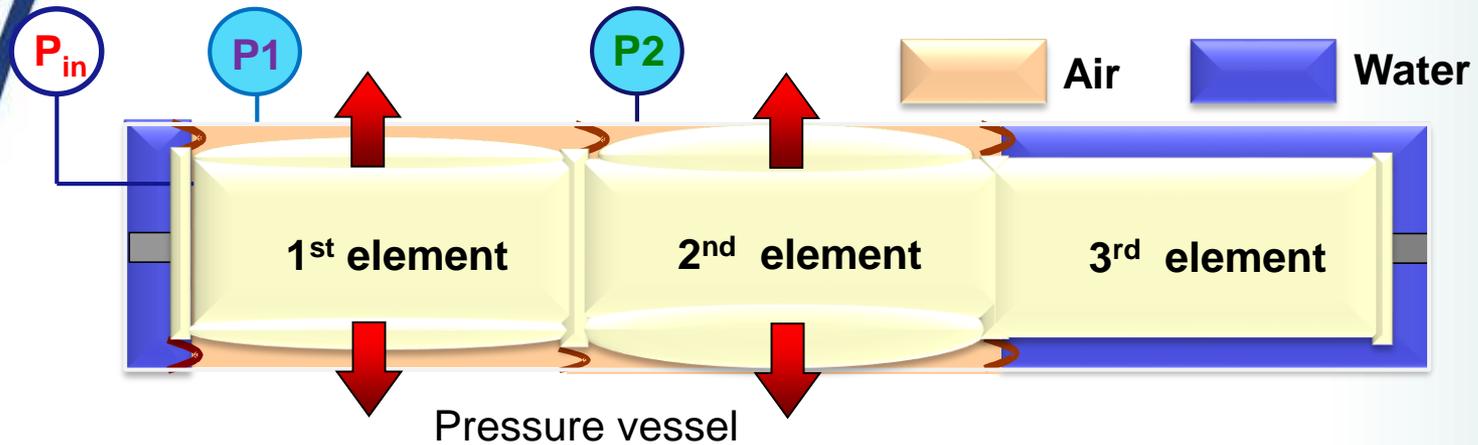
Testing Conditions:

- pH 12 NaOH soln.
- 3 hrs/soaking
- Temp 20° C
- NaCl Conc.: 2000 mg/l
- Pressure: 225 psi (1.55 MPa)
- Recovery: 15%

Neutrally Charged Membrane



Element Burst Phenomena



Excessive feed flow and rapid P increase at system start up

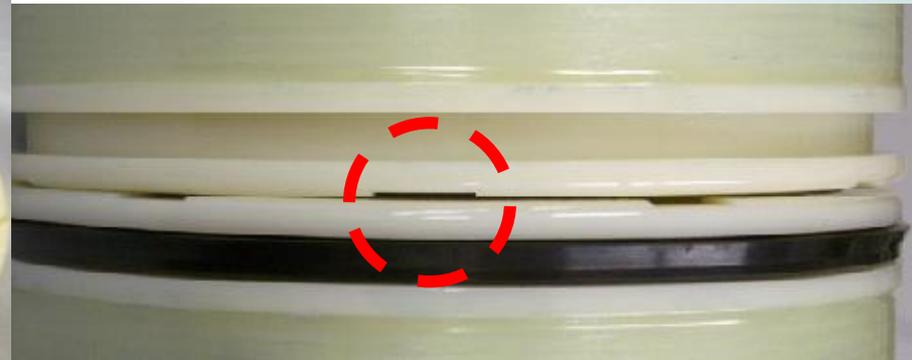
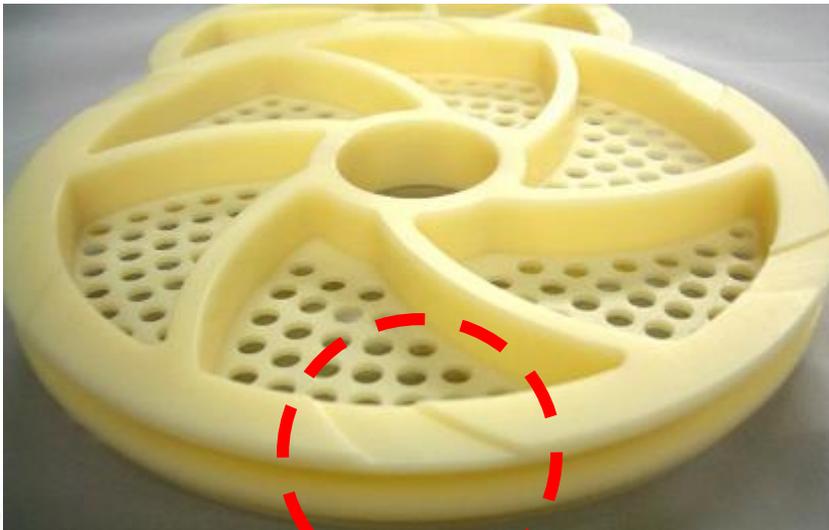
$$P_{in} > > P1, P2$$

Burst trouble

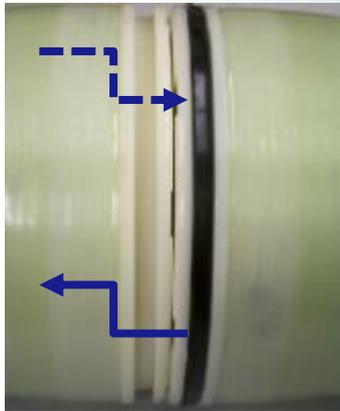
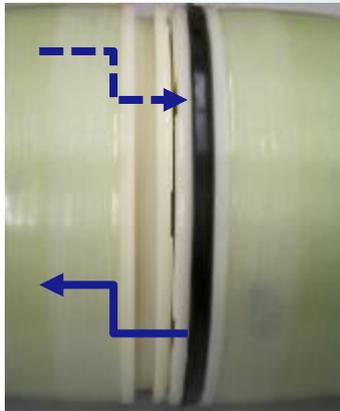
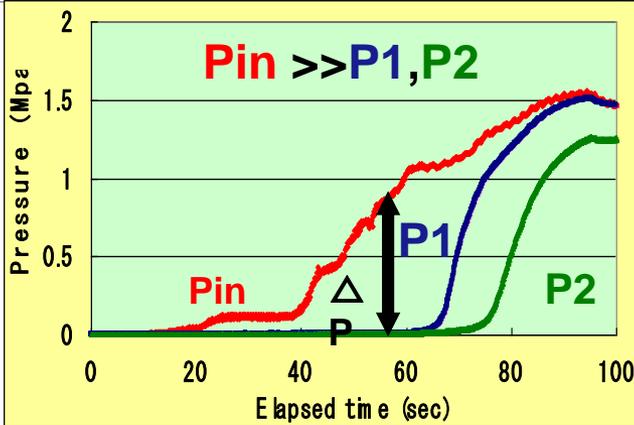
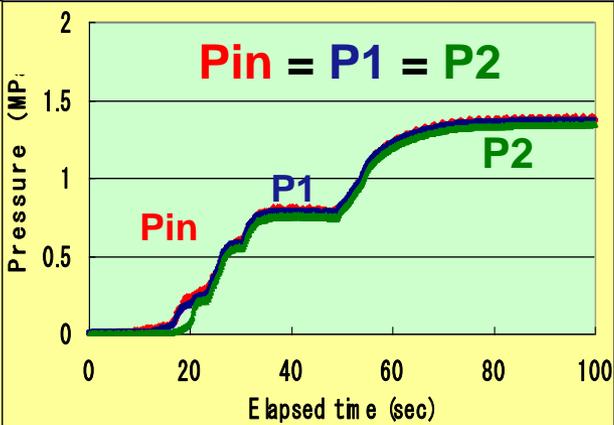
The LD Technology®

Features: Patented vented seal carrier

- Patented air release vent on the seal carrier
- Allows to release the air from the membrane during startup, reducing the risk of element burst during start up



Pressure profile after start up

	Conventional	CPA5-LD
Connecting portion		<p>Air </p> <p>Water </p>
Pressure profile after start up	<p>Pin >> P1, P2</p> <p>Pin: inside pressure of the 1st element P1: outside pressure of the 1st element P2: outside pressure of the 2nd element</p> 	<p>Pin = P1 = P2</p> 

Heat Sanitizable Membranes



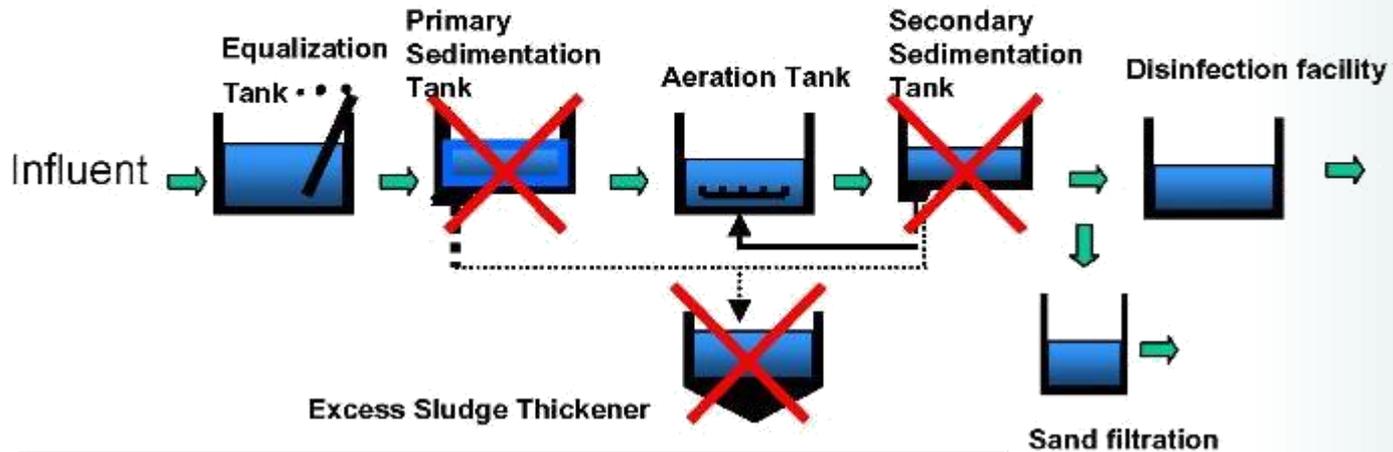
- 100% Wet-tested for performance accountability and traceability
- Pre heat sanitized at manufacturers place

Membrane Bio Reactor (MBR)

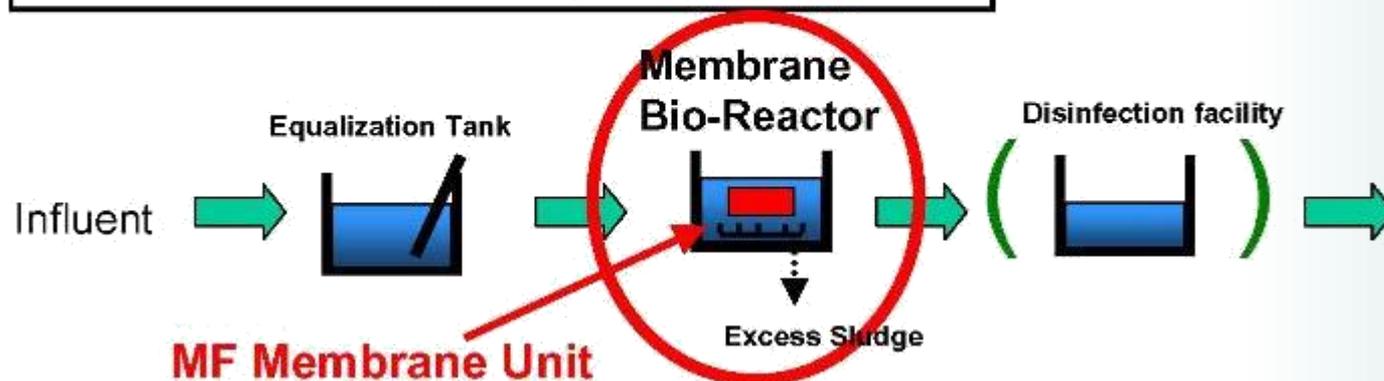


Conventional Process and MBR

Conventional Activated Sludge Process with Filtration



Membrane Bio-Reactor (MBR) Process



Why MBR?

1

Elimination of sedimentation tanks

- Less footprint requirement

2

High MLSS, shorter HRT

- Compact space
- Less excess sludge
- Treat high BOD wastewater

3

Good quality of treated water

- Produce recyclable water
- Reduce disinfection cost

4

Solution to sludge bulking problem

Typical MBR system layout



MBR applications

Small communities (malls/offices)

Flow | 0.05 – 0.4 mgd



Industrial wastewater treatment plant

Low flow | 0.1 – 2 mgd

High flow | 2 – 20 mgd



Municipal wastewater treatment plant

Low flow | 0.1 – 2 mgd

High flow | 2 – 50 mgd



Process Separation Membranes



Membrane properties

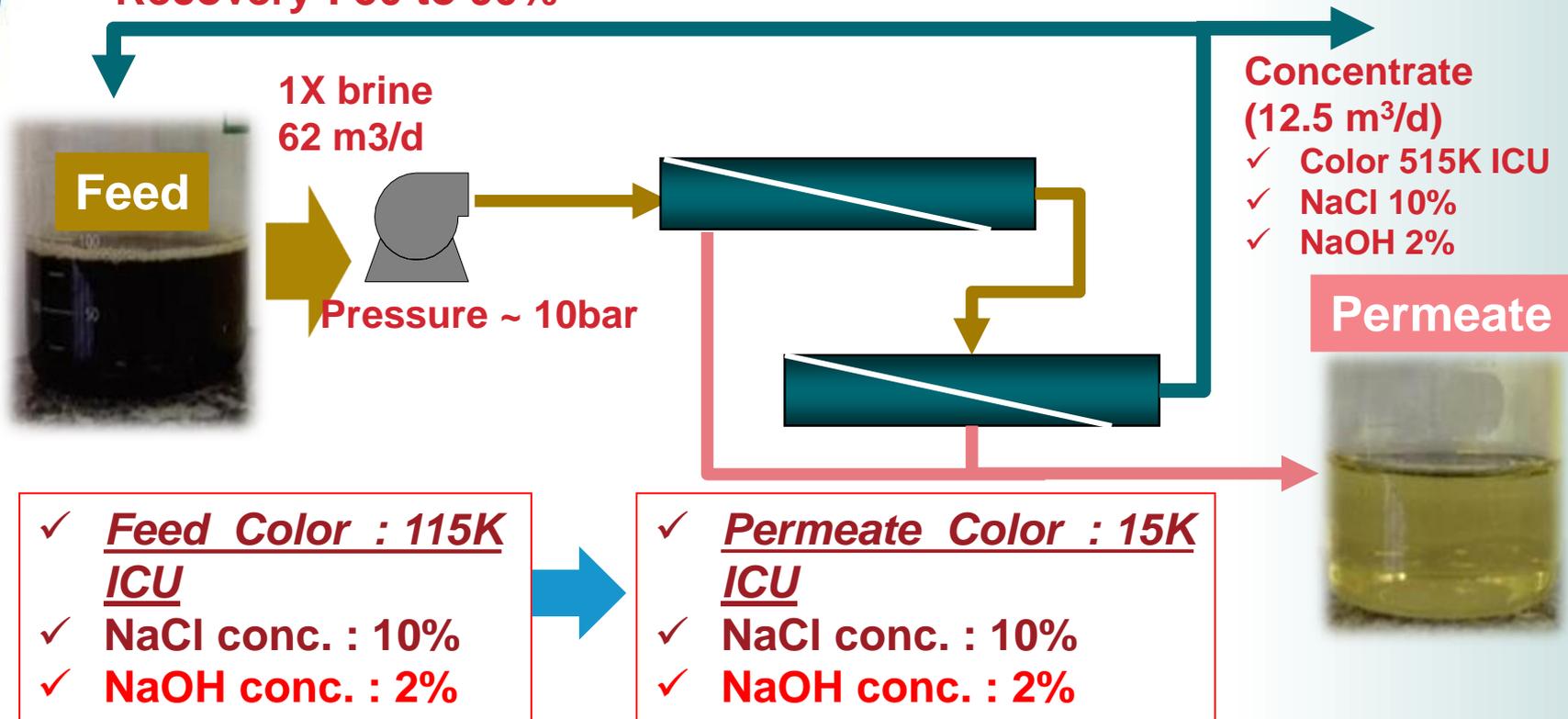
- Molecular weight cutoff 1000-3000 Dalton
- Chlorine tolerant
- High negative charge
- Can withstand temperature up to 80 deg C
- Can withstand pH up to 14.0

Brine Stream Recovery in sugar industry

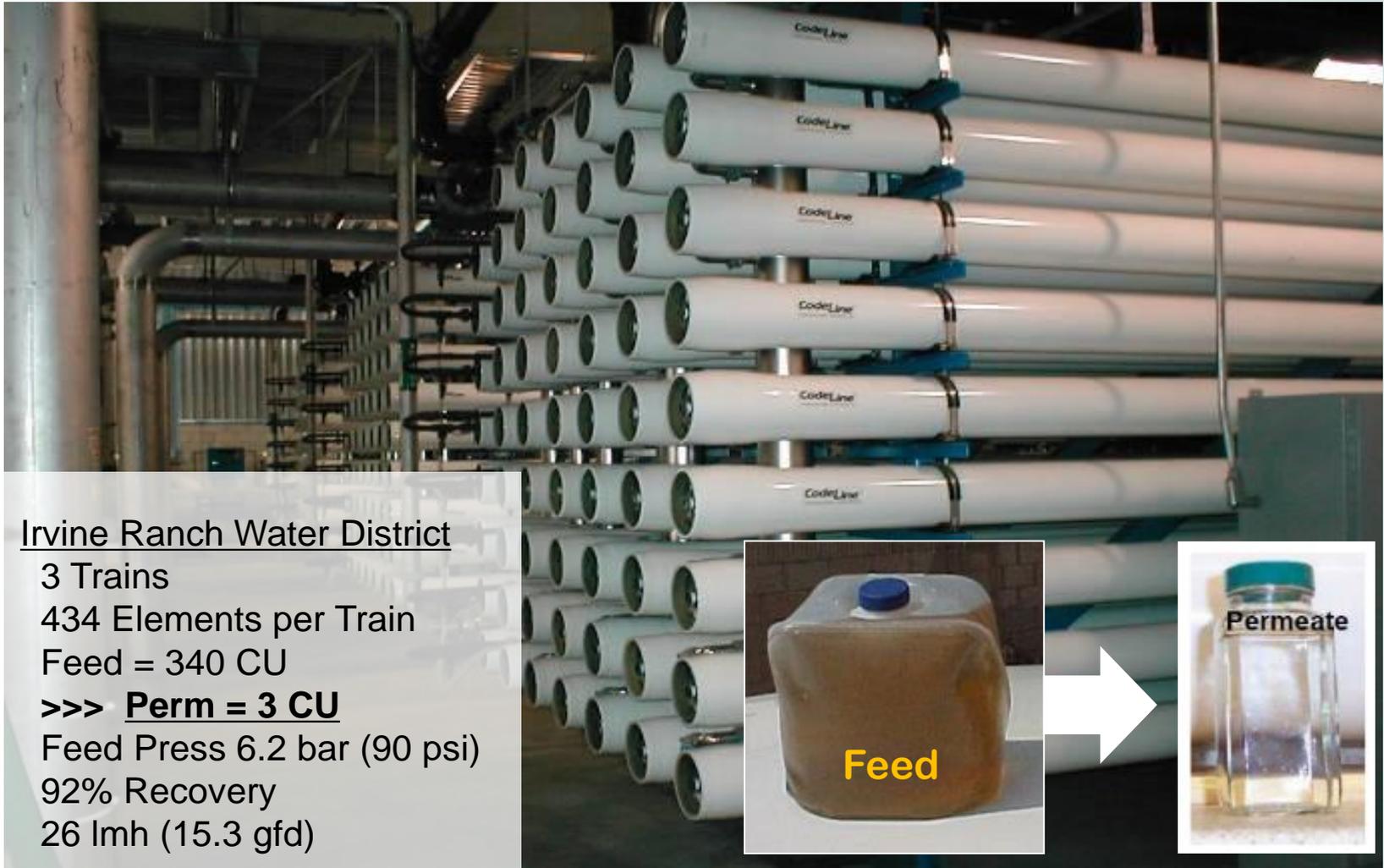
2 Vessels X 4 Elements/Vessel

Recovery : 50 to 90%

HydraCoRe70pHT



Groundwater/Surface water color removal



Irvine Ranch Water District

3 Trains

434 Elements per Train

Feed = 340 CU

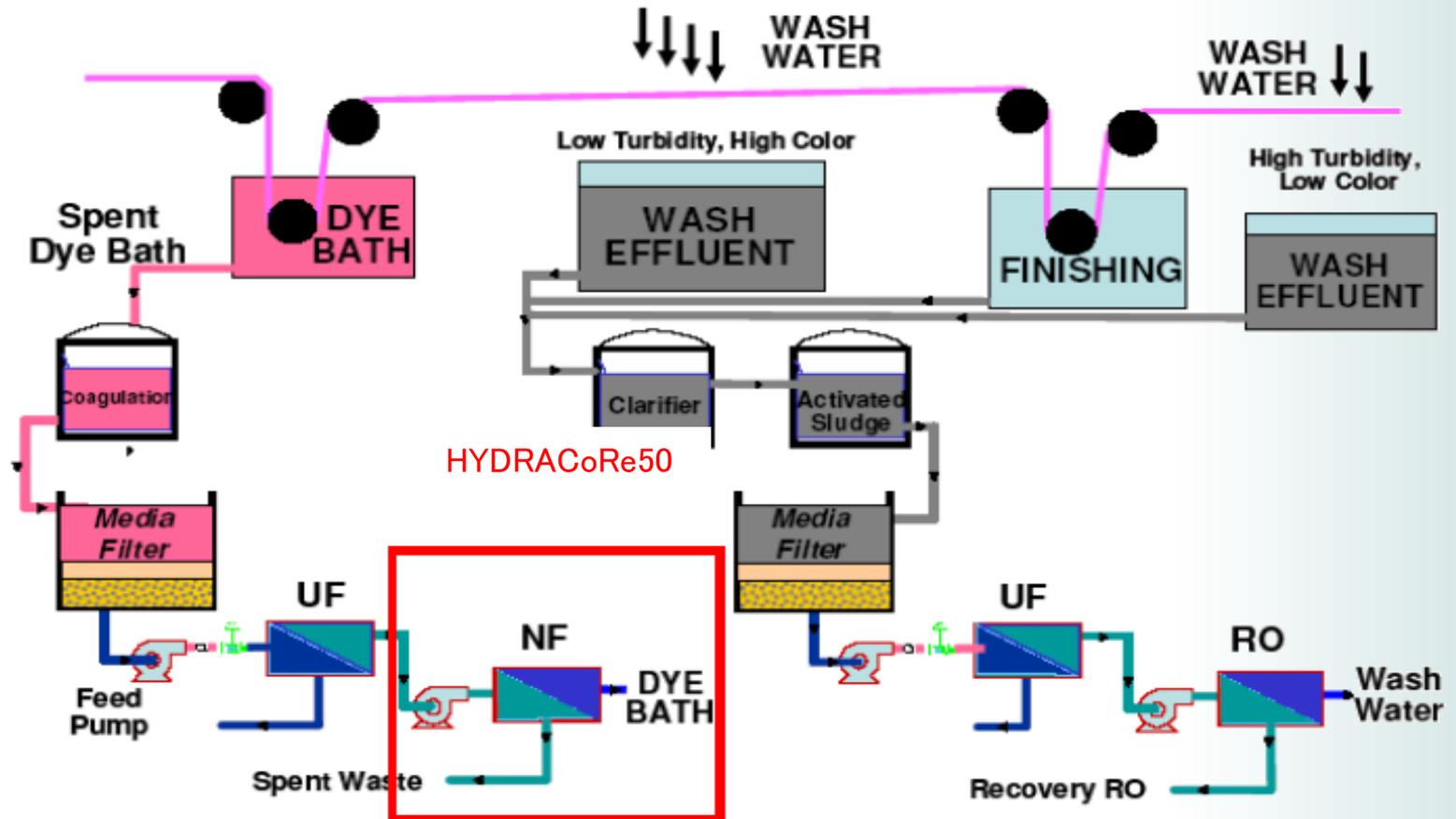
>>> **Perm = 3 CU**

Feed Press 6.2 bar (90 psi)

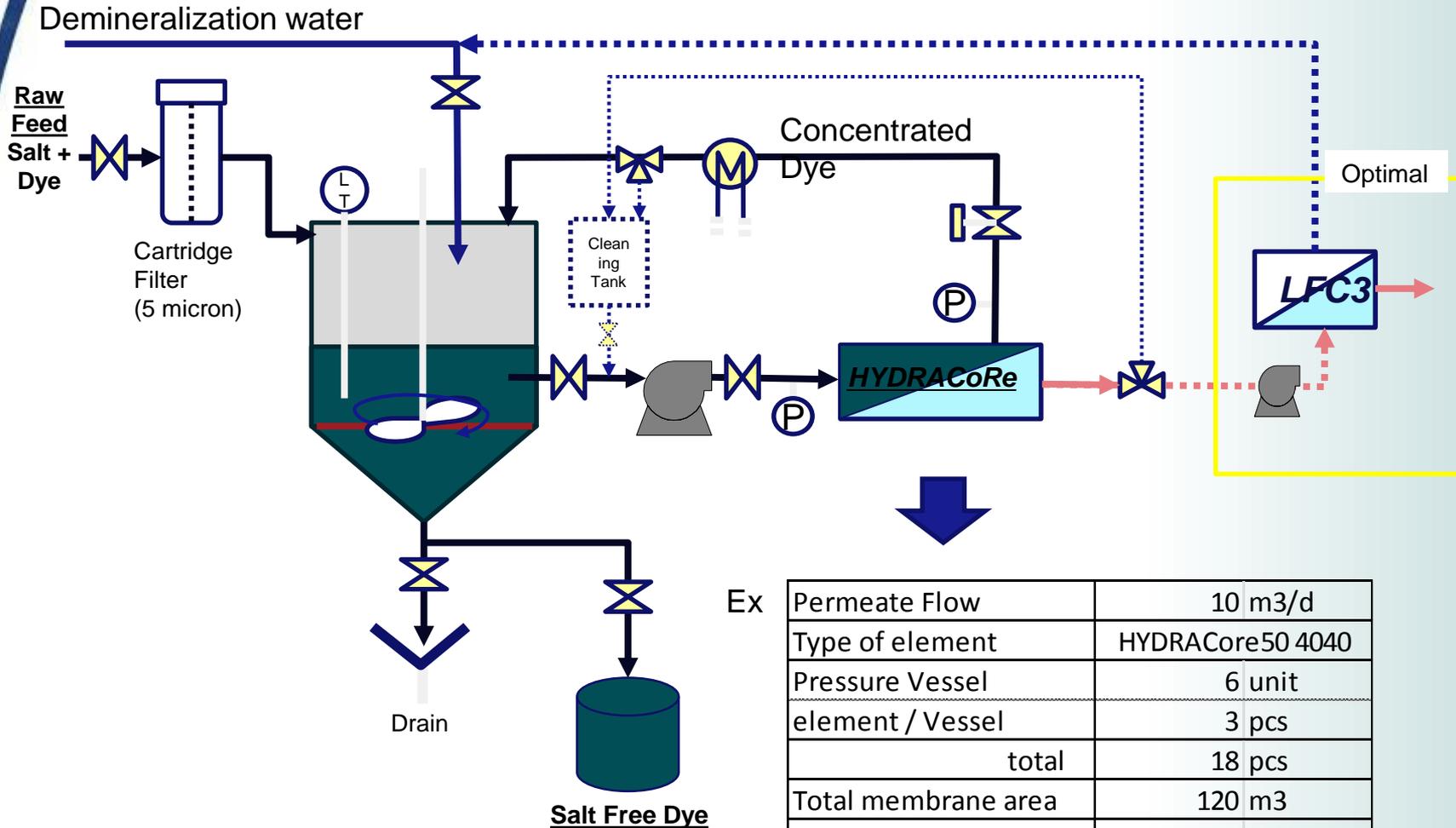
92% Recovery

26 l/mh (15.3 gfd)

Recycle of wastewater at dying process



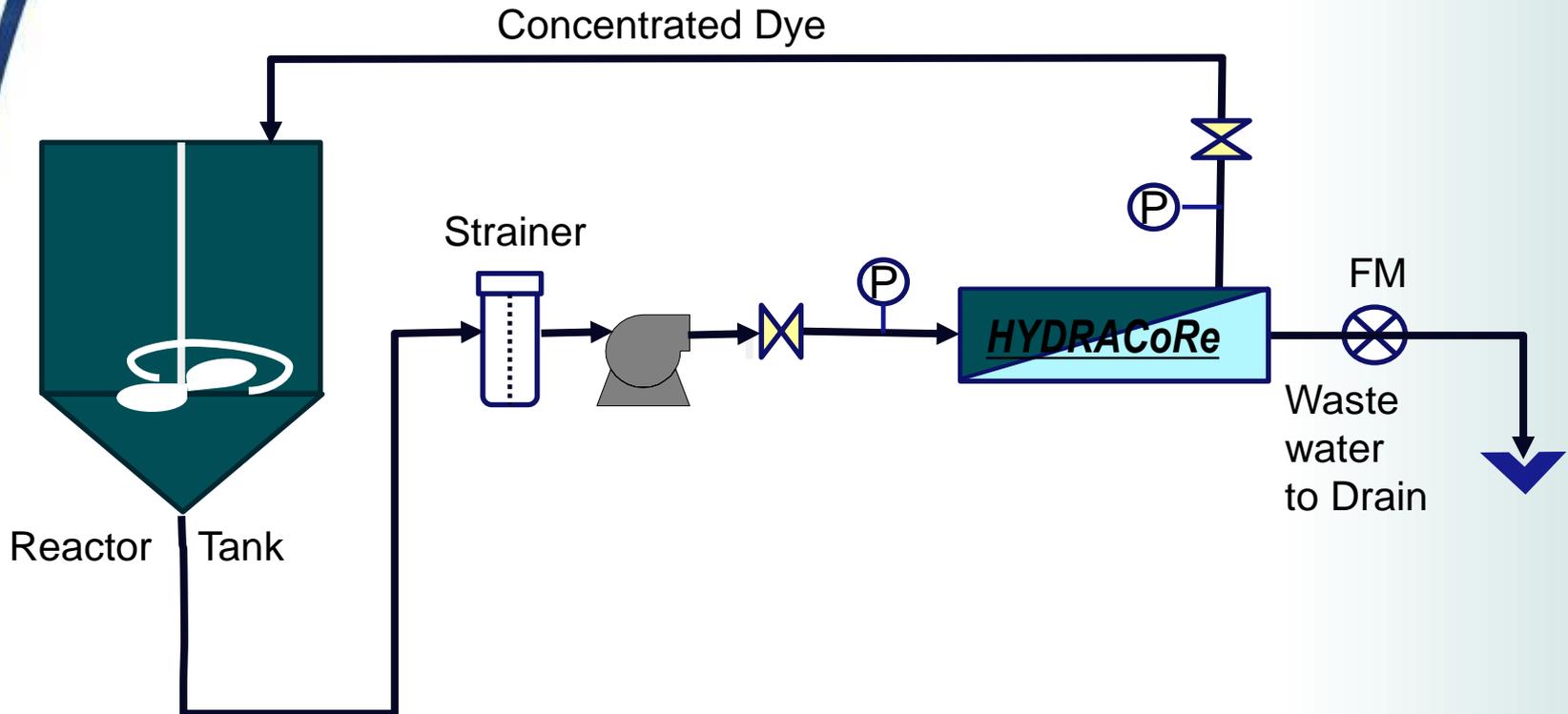
Dye desalting flow chart



Ex

Permeate Flow	10 m ³ /d
Type of element	HYDRACore50 4040
Pressure Vessel	6 unit
element / Vessel	3 pcs
total	18 pcs
Total membrane area	120 m ²
Pressure	1.5 ~ 2.5 Mpa

Dye & OBA Concentration Flow Chart



Summary

- Membrane technology has become integral part of waste water recycle.
- Membranes are improving & new applications of membrane are emerging.
- Selection of right membrane product is critical for long term operation of plant.

Thank You

