



# X-Flow and Codeline portfolio

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# PENTAIR X-FLOW

Pioneering and advancing membrane technology



# Water.

It flows through everything we do – from the water we drink in our **homes**, to the infrastructure that shapes our **communities**, to the **industries** that drive our economy, to the resources that sustain our **planet**.

Water is a basic, universal human need. It is essential to our lives and our planet, and it's essential to every single one of us.

## And that's where we come in.



Our Impact

# Making Better Essential.

We live the belief that  
*making* life *better*  
for people and our planet  
is *essential*.





# Pentair At A Glance

A Global Leader in Smart, Sustainable Water Solutions

**~11,250** employees  
serving customers in

**150+** countries

**~\$4.1B<sup>^</sup>** in revenue

<sup>^</sup>2022 full year results

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**X-FLOW**





# A PIONEER

*in membrane technology*

# CUSTOMERS

*are our partners*

# SHARING KNOWLEDGE

*is part of our business model*





Pentair X-Flow delivers both the **membrane solutions** and the necessary **know-how** to OEMs and contractors. The Pentair X-Flow brand and organization is a leading developer of membrane-based filtration solutions, and one of the world's most renowned pioneers of membrane technology. We see it as our business to help secure access to the right water quality by delivering **the right solution and application expertise**, anywhere and anytime.

# X-Flow Competencies

## SERVICES (M+)

Pentair University, aftersales service

## ENGINEERING (M+)

Mechanical, automation, process

## UNITS

Design and fabrication

## CONNECTING PARTS

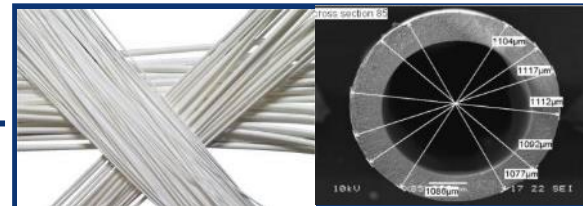
Proprietary

## ELEMENTS

Minimum scope

## MEMBRANES

Core value







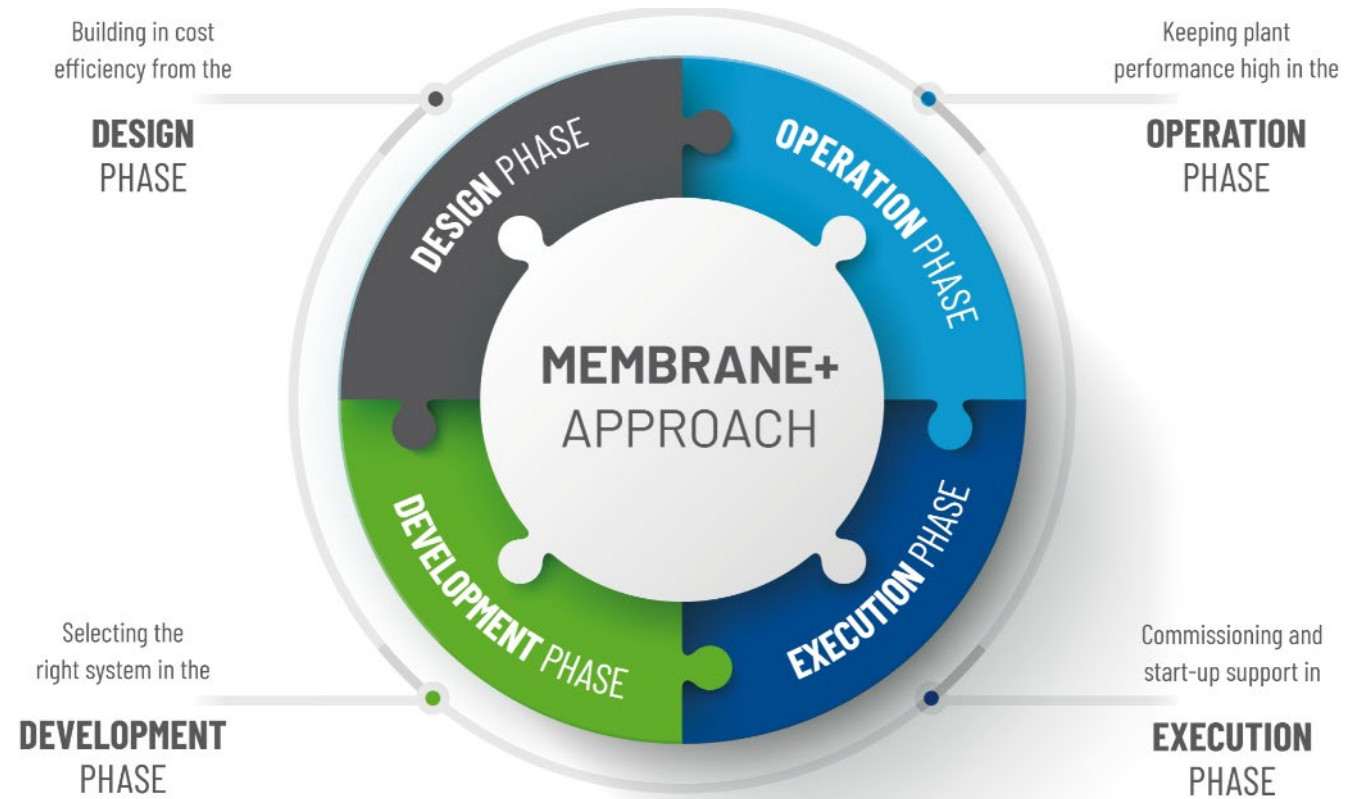
# MEMBRANE+ APPROACH

Pentair X-Flow uniquely combines high-quality membrane solutions with exceptional implementation know-how.

# Pentair X-Flow Membrane+ Approach



[Pentair X-Flow Membrane+ movie](#)

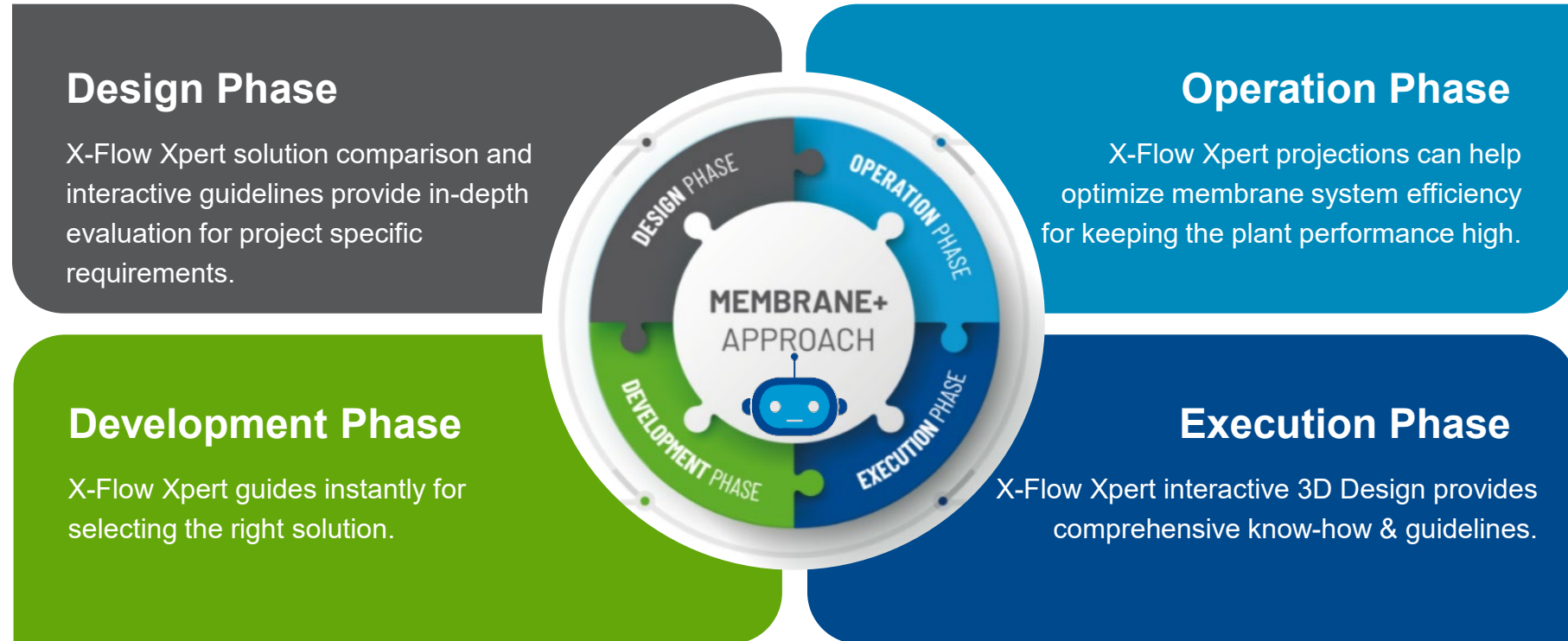


High Quality Solutions Combined With Exceptional Implementation Know-How



# Pentair X-Flow Xpert Web App

Guides you through helping to select the ideal Pentair X-Flow membrane filtration solution and configuration for water and wastewater treatment applications by answering a few questions.



**The World's First Conversational Interface In The Membrane Filtration Industry**

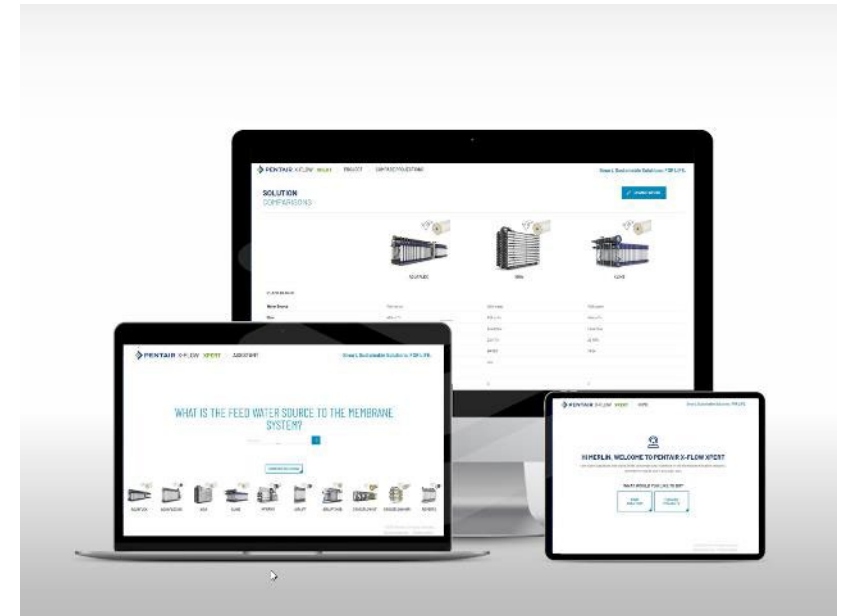
# Pentair X-Flow Xpert Web App

X-Flow Xpert, the **world's first conversational interface** in the membrane filtration industry.

- Instantly guidance for selecting the ideal membrane filtration solution
- Easy to discover the differences between our solutions to determine your ideal solution
- Directly get all the necessary know-how, design, equipment selection and operating guidelines



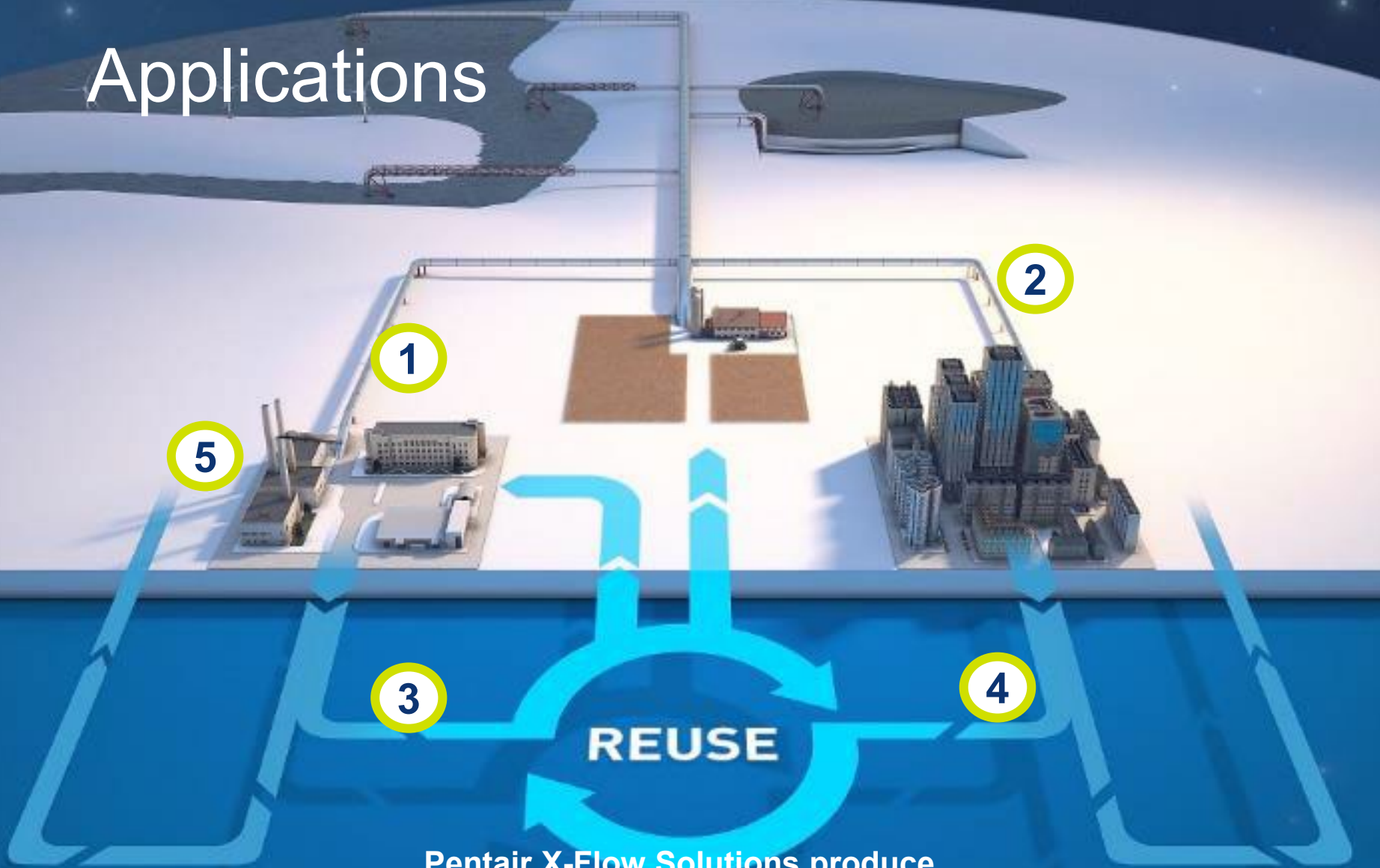
[Pentair X-Flow Xpert Web App Video](#)



World's first conversational interface in the membrane filtration industry



# Applications



**1**  
Process water

**2**  
Potable water

**3**  
Industrial  
wastewater

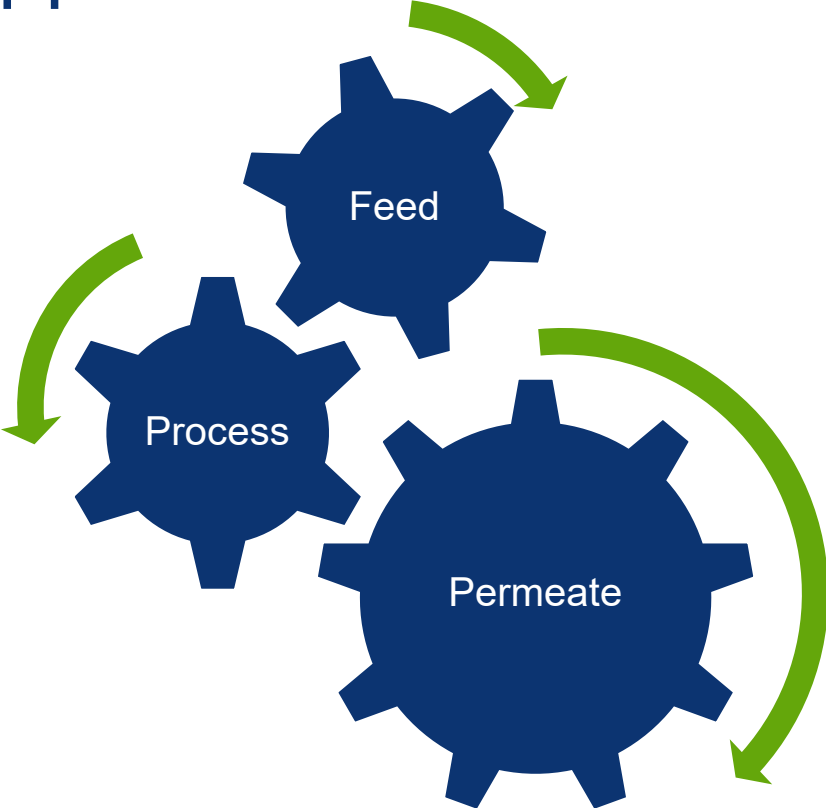
**4**  
Municipal wastewater

**5**  
Beverages

**Pentair X-Flow Solutions produce  
>5 Trillion liters of water per year worldwide**

*Did you know that the Netherlands (municipalities and industries combined) consume approximately 1 trillion liters of water per year?*

# Application



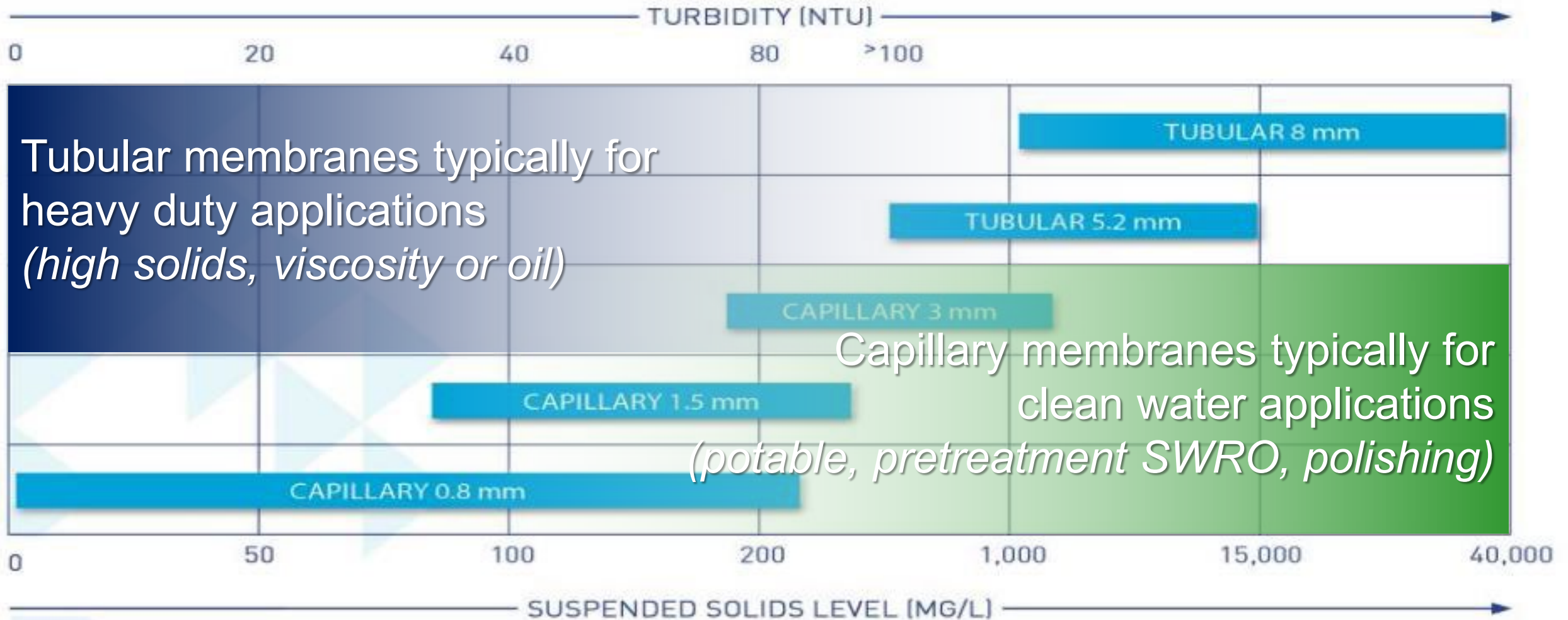
**Desired: permeate water quality**



**Given: feed water quality**

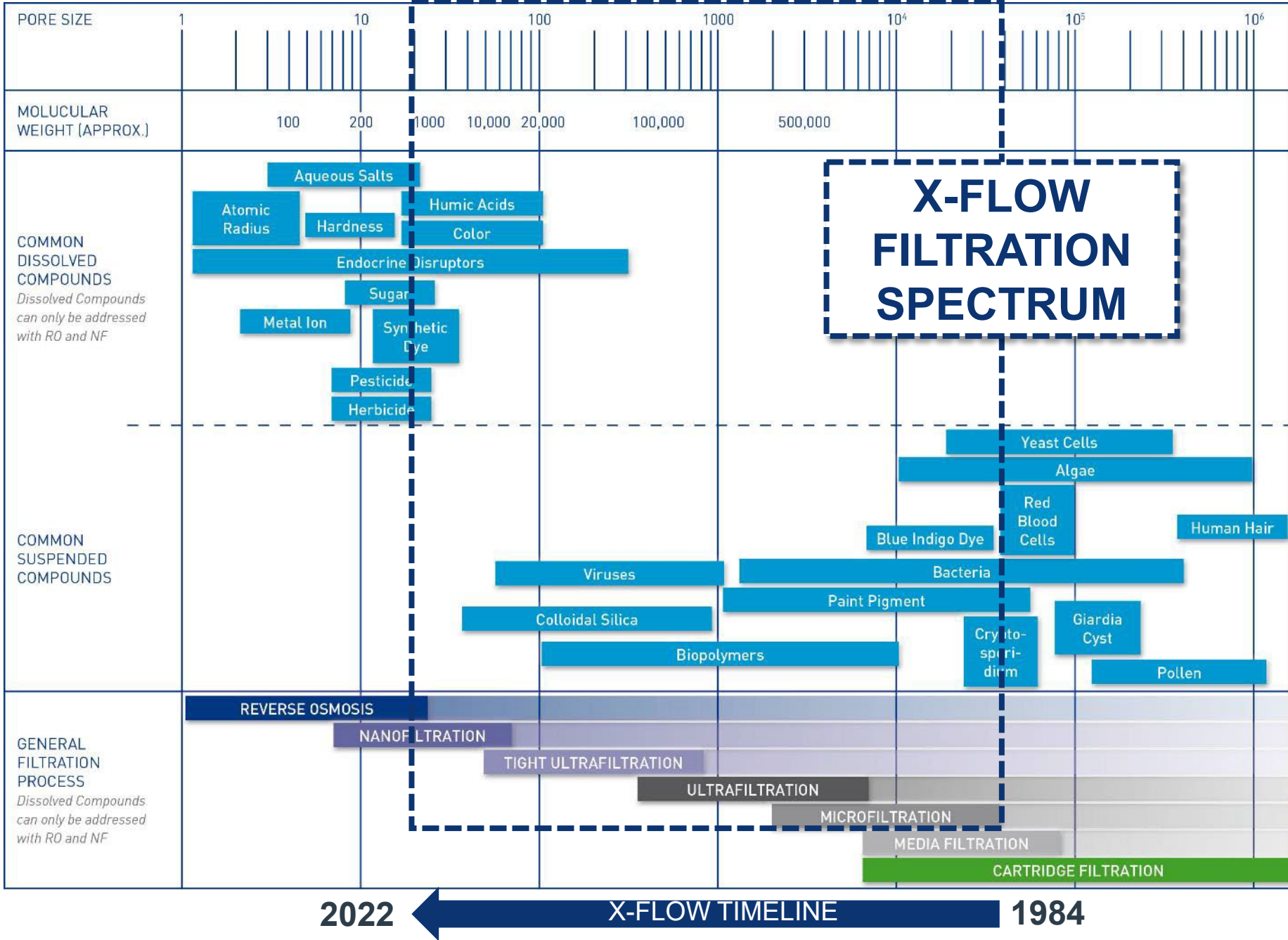


# X-Flow Membrane Portfolio



Tubular membranes typically for heavy duty applications (*high solids, viscosity or oil*)

Capillary membranes typically for clean water applications (*potable, pretreatment SWRO, polishing*)



# Innovation Track Record

1984 – X-Flow, A University Spin-off

2011 – Global UF market leader by GWI (35% Market share)

2011 – Water Technology Company of the Year by GWI

2011 – Aquatech Innovation Award for Hollow fiber NF Membranes

2012 – Pentair X-Flow HFS60 Membrane Element (Tight UF for colloidal silica removal)

2013 – Aquatech Innovation Award for Anaerobic MBR

2013 – Pentair X-Flow X-line Solution (Pre-engineered concept)

2014 – Pentair X-Flow HFW1000 Membrane Element (Hollow fiber NF Membrane for organics removal)

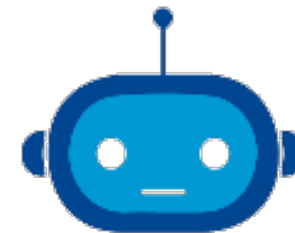
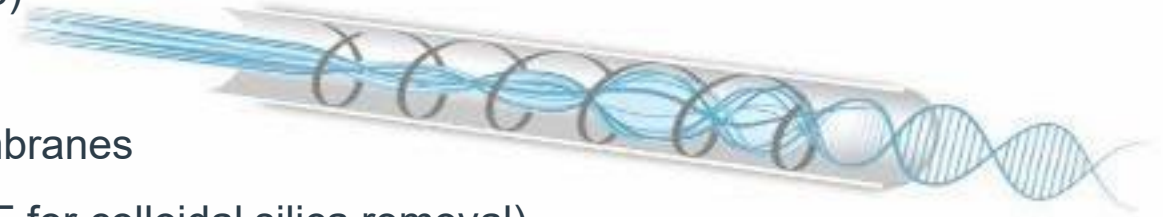
2015 – Pentair X-Flow Helix Technology and 12” Compact 75G

2015 – Aquatech Innovation Award for Helix technology

2020 – Pentair X-Flow XF75 Membrane Element

2021 – Pentair X-Flow Xpert Web App

Pentair X-Flow Nanoqube







# X-FLOW FUNDAMENTALS

# X-Flow Fundamentals

Drive superior performance

## CAPFIL

1. PES delivers superior characteristics
2. Single fiber fit the best
3. Inside-out reliable

## COMPACT

1. Small pore size & High permeability
2. Inside-out reliable
3. Pressurized vs. Submerged
4. Why PVDF
5. Helix Flux Enhancement Technology for Pentair X-Flow Wastewater Solutions

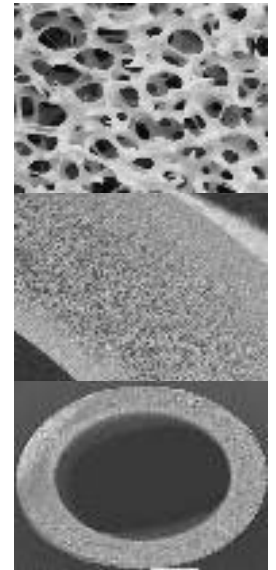


**X-Flow Competitive Advantages**

# X-Flow Fundamental 1: PES

PES as a base material delivers superior membrane characteristics over PVDF for hollow fibers:

- Best mechanical and thermal properties
- Widest pH-range
- Smaller pore size and narrower Pore Size Distribution



**PES Delivers Superior Characteristics**



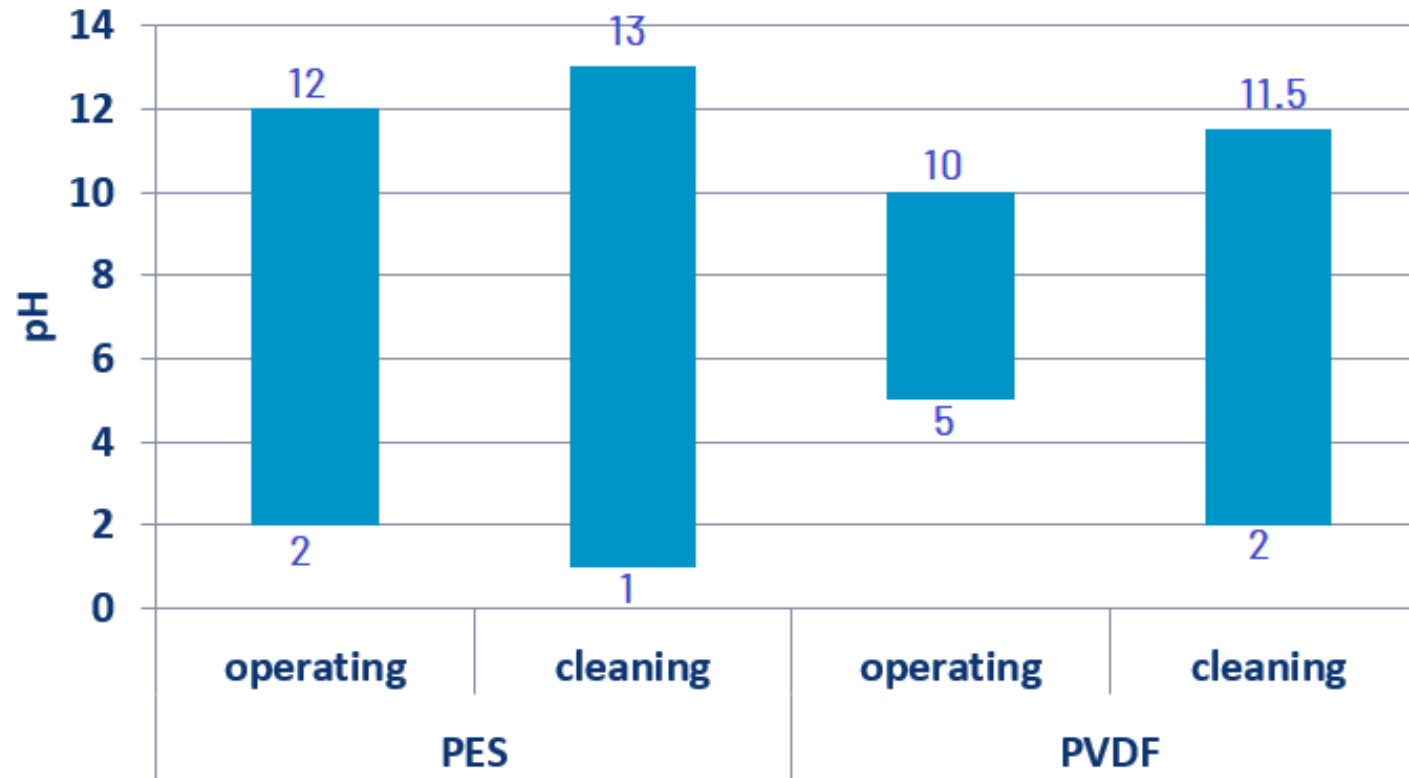
# Best Mechanical And Thermal Properties

Mechanical properties	Parameter	PVDF Value	PES Value	Unit	Key takeaway
Tensile strength	50mm/min	62	89	MPa	Higher tensile strength means more resilient material
Flexural strength	2mm/min, 10N	77	122	MPa	Higher flexural strength means less creep and a longer lifetime
Impact strength	Max. 7.5J	150	175	kJ/m <sup>2</sup>	Higher impact strength means more resistant to sudden process changes, e.g. water hammer
Thermal expansion	23-100°C, long.	18	6	10 <sup>-5</sup> K <sup>-1</sup>	Thermal expansion results in increased pore size, thus decreased retention

Source: [Ensinger-online.com](https://www.ensinger-online.com)

## Key Findings

# Widest pH-range

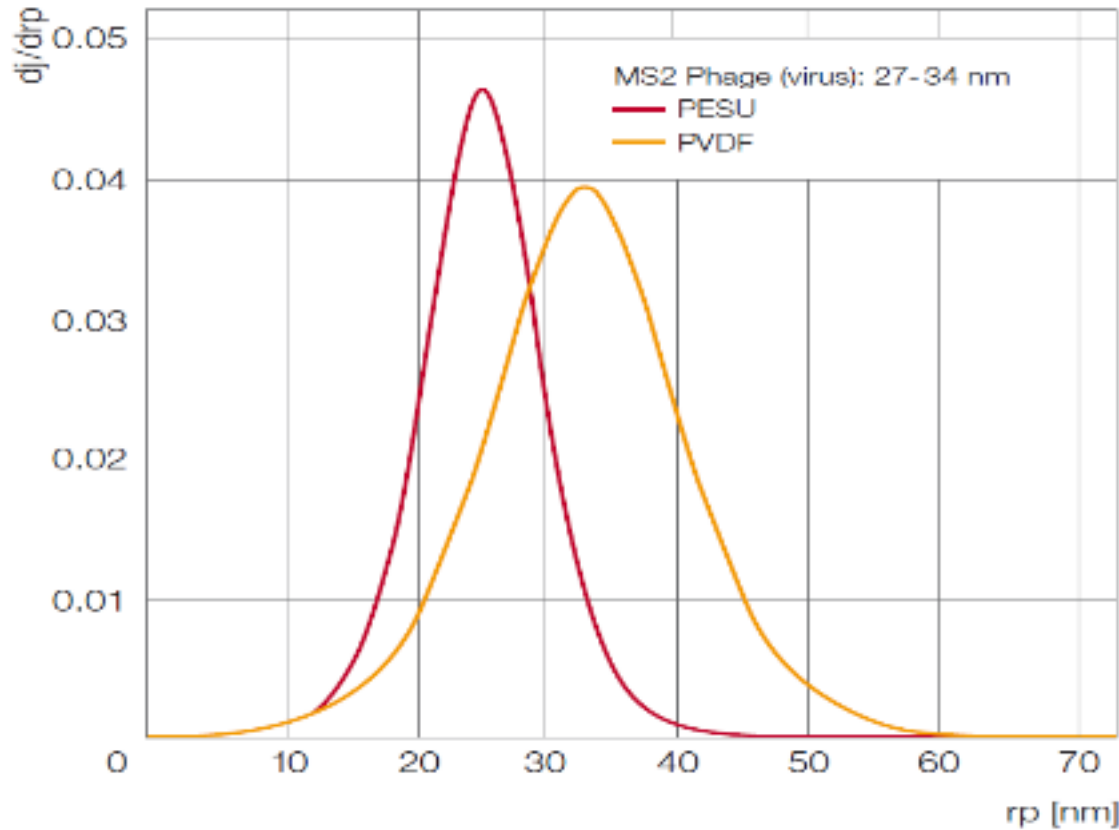


Source: Datasheet X-Flow and DOW



PES has a wider pH-range. This allows for cleaning at a higher pH-value. Cleaning becomes more effective at higher pH-values. This is specifically relevant for emergency recovery cleaning of heavily fouled membranes.

# Smaller Pore Size And Narrower Psd



Pore size distribution of two commercial membranes with nominal pore size “20 nm”

Source: *Ultrapure Water*, (4 /2010), 33 ff)



Smaller pore size means higher effluent quality. A narrower Pore Size Distribution (PSD) means more pores per m<sup>2</sup>, means higher permeability, means lower energy consumption.



# Smaller Pore Size And Narrower Psd

Jubail Project – Saudi SWRO – 10 months piloting

Technology	UF	UF	UF
Supplier	X-Flow	Supplier 1	Supplier 2
Membrane material	PES/PVP	PES	PVDF
Configuration	In-out	In-out	Out-in
Filtration flux (lmh)	85	80	65
Operating TMP (bar)	0.3 – 0.6	1.0 – 1.3	0.9 – 1.2
Permeability (lmh/bar)	190	70	60

Qingdao Boot Project – China SWRO – 24 months piloting

Technology	UF	UF	MF
Supplier	X-Flow	Supplier 1	Supplier 2
Membrane material	PES/PVP	PVDF	PVDF
Configuration	In-out	Out-in	Out-in
Filtration flux (lmh)	85	64-73	80-85
Operating TMP (bar)	0.2 - 0.8	0.8 – 1.5	0.7 – 2.5
Permeability (lmh/bar)	150	60	50

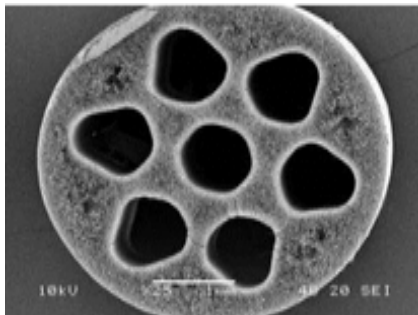


Pentair X-Flow membrane permeability is up to 3 times higher than competition. So with X-Flow membranes, the same volume of water can be produced at only a third of the energy required.

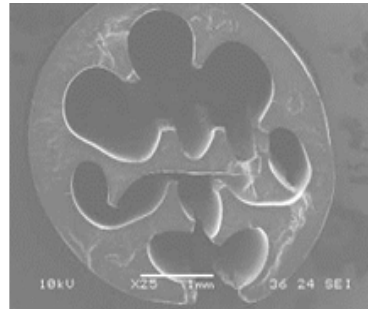
# X-Flow Fundamental 2: Single Fibers

A single fiber has the best geometry for membrane fibers:

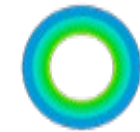
- Highest burst and collapse pressure
- 100% integrity
- Effective membrane cleaning



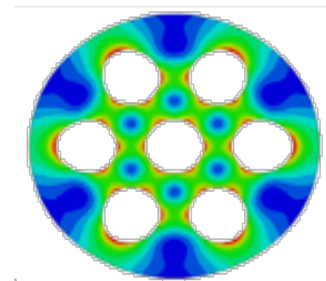
Structural weakspots



Complete collapse



Even tension distribution



Potential collapse area

Single Fibers Fit Best

# Highest Burst And Collapse Pressure



X-Flow fiber collapse pressure: 15 bar  
Multibore collapse pressure: 11 bar

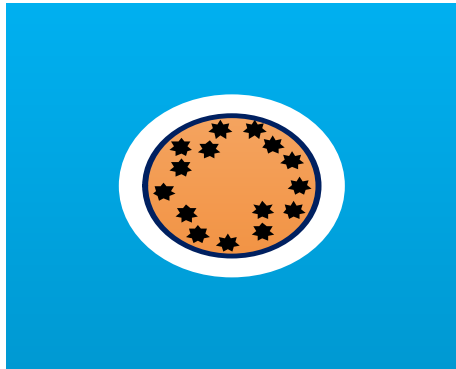


## Key takeaway

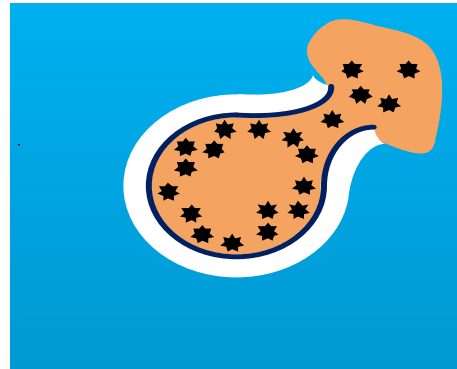
The critical mechanical properties of a membrane are the burst and collapse pressure. Collapse pressure is challenged during backwash, being the most critical load on a membrane. This movie proves that a single fiber is much stronger, since it only collapses at considerable higher pressure.



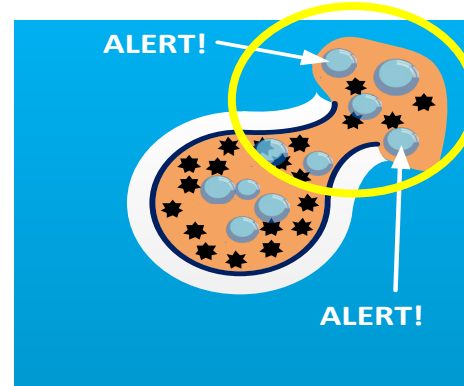
# 100% Integrity For Single Fiber



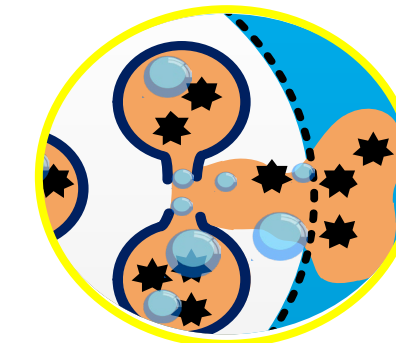
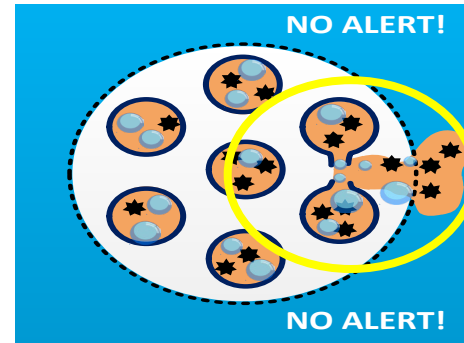
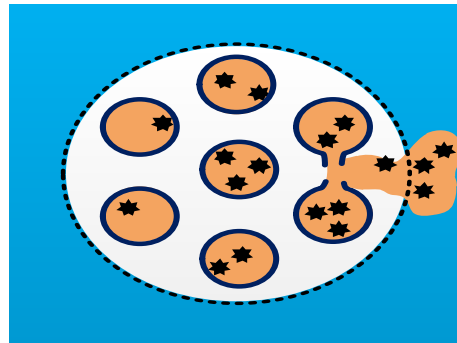
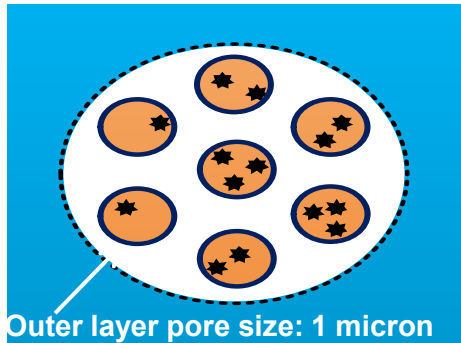
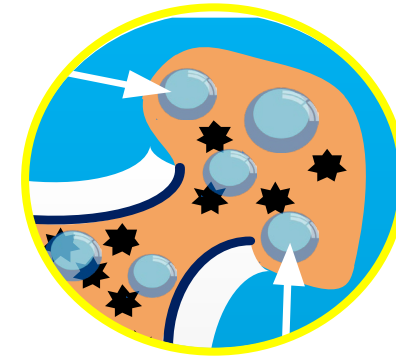
OPERATION



FIBER BREAKAGE



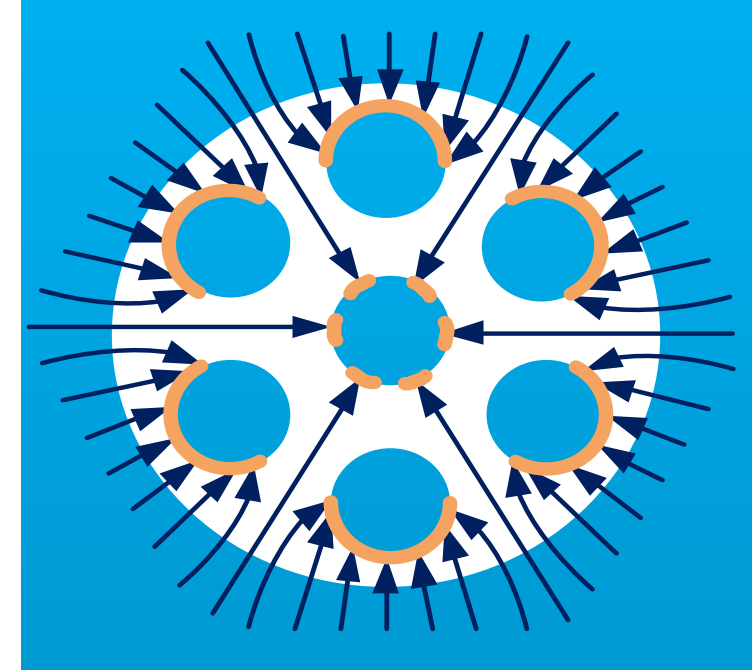
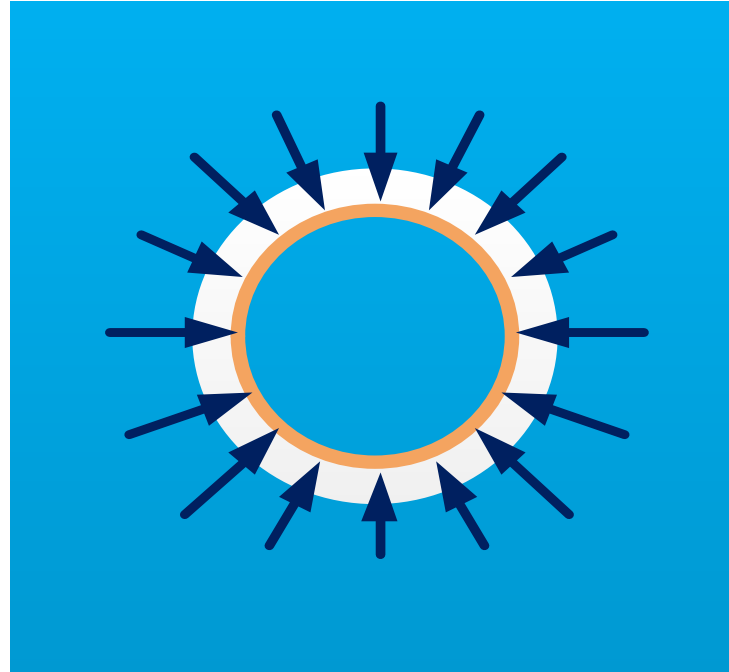
AIR INTEGRITY TEST



Multibore cannot guarantee a retention of sub-micron particles, as on the outside of a multibore a support layer with micron size pores is present. Viruses and even some bacteria will pass the micron pores in the support layer, not preferable for drinking water applications.

# Effective Membrane Cleaning

 **BACKWASH FLOW**  
**EFFECTIVE BACKWASH AREA**

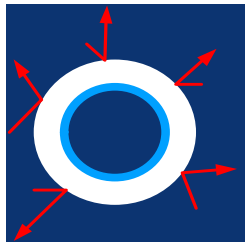


In a single fiber geometry, the backwash flow is equally distributed of the active membrane surface area. In a multibore fiber, preference flows will occur which will result in unequal backwash flow distribution. In turn, this results in ineffective or incomplete membrane cleaning.

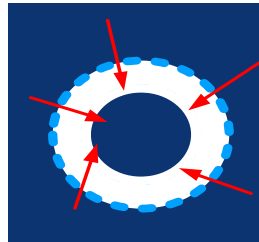
# X-Flow Fundamental 3: Inside-out

With inside-out filtration, the active membrane surface is optimally protected:

- Gentle cleaning without the use of air-scour
- No risk of abrasive wear of fibers during operation
- Separating layer fully isolated from outside influences



Protected separating layer on inside



Unprotected separating layer on outside



Abrasive wear on unprotected separating layer on outside

**Inside-out Is Reliable**



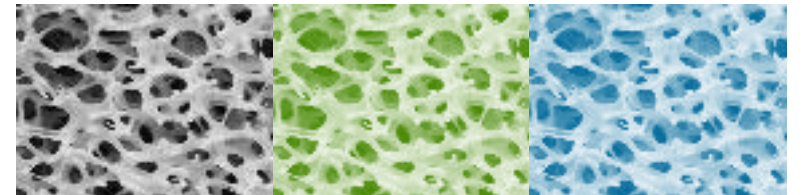


# X-FLOW FUNDAMENTALS COMPACT

# X-Flow Fundamentals 1: Small Pore Size

Tubular ultrafiltration membranes applied in wastewater treatment, deliver constant high quality at low operational cost:

- 30 nm pore size
- Instant high quality effluent
- Proven log 4 MS2 phage (unique for MBRs)



Small Pore Size, High Effluent Quality

# Constant High Effluent Quality

Pentair X-Flow has the smallest pore size for wastewater MBR systems:

Competitor	Technology	Pore size
1	MF	200nm
2	UF	40nm
3	UF	40nm
<b>Pentair</b>	<b>UF</b>	<b>30nm</b>



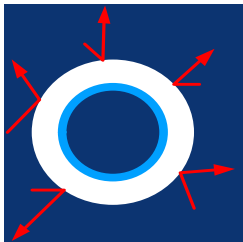
Most competitors rely on the cake layer being built up on the membrane wall, for separation performance. Due to the small pore size in our membranes, we can immediately and always deliver high effluent quality. How well a cake-layer is built up and how well it functions can be uncertain.



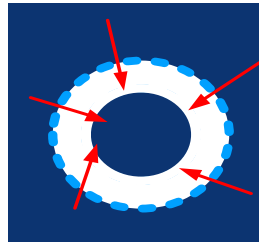
# X-Flow Fundamental 2: Inside-Out

With inside-out filtration, the active membrane surface is optimally protected:

- Gentle cleaning without the use of air-scour
- No risk of abrasive wear of fibers during operation
- Separating layer fully isolated from outside influences



Protected separating layer on inside



Unprotected separating layer on outside



Abrasive wear on unprotected separating layer on outside

**Inside-out Is Reliable**

# X-Flow Fundamentals 3: Pressurized vs Submerged

Encased systems bring no operational hazards:

- No large, open tanks which allow for aerosol formation
- Easy draining of the system to remove debris
- No handling, automated cleaning

**PRESSURIZED**



**SUBMERGED**



**Encased Is Clean, Simple And Clean**

# X-Flow Fundamentals 4: Why PVDF

We apply pvdf in our tubular membranes, because:

1. PVDF has a higher chemical (e.g. chlorine) resistance
2. Virus retention is not (so) critical for wastewater applications



We understand membranes and membrane materials. For every specific application, we are able to supply the best suited membrane.

# X-Flow Fundamentals 5: Pentair X-Flow Helix

## Flux enhancement via:

1. Helically wound ridge on membrane wall
2. Turbulence right at the membrane wall
3. Enhanced mixing of the feed stream
4. Efficient continuous cake removal

## At lower crossflow velocity

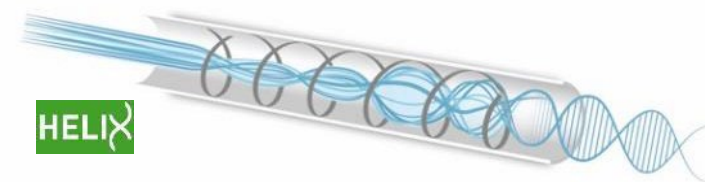
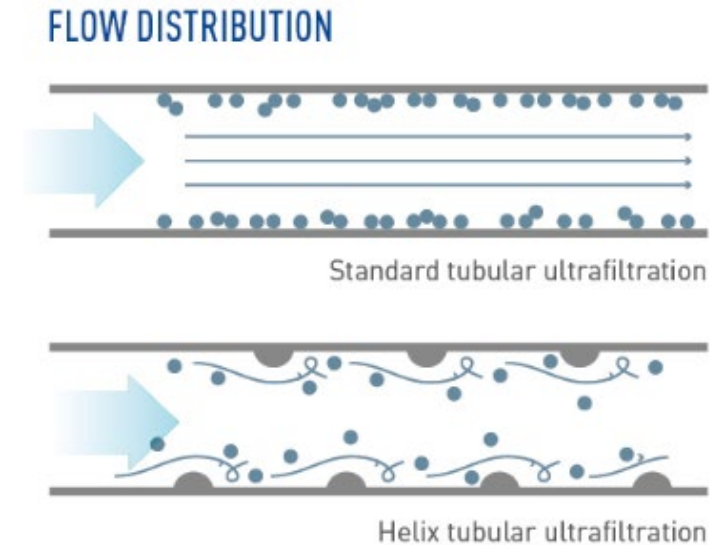
## Benefits:

Higher productivity

up to 100% more permeate

Lower operational expenses

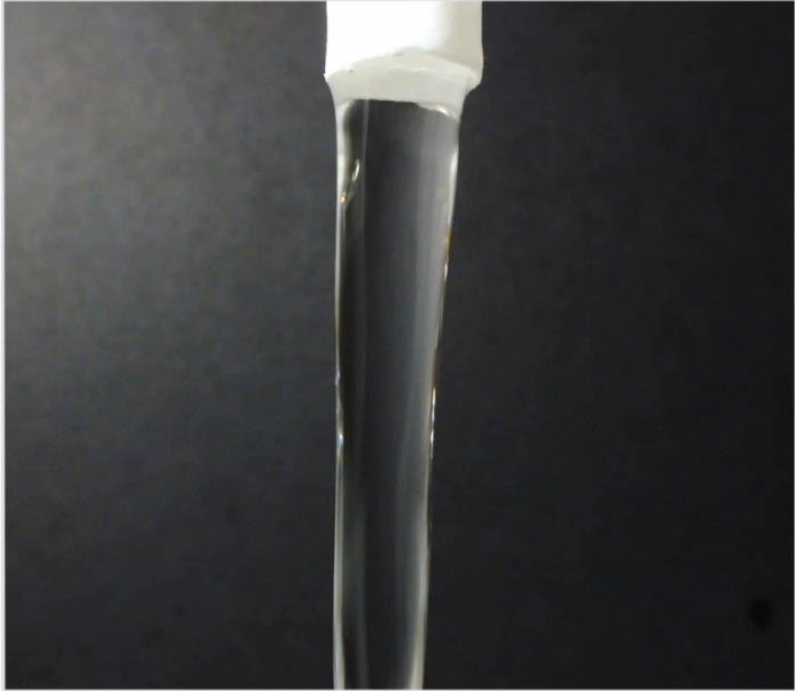
up to 42% savings



Pentair X-Flow Helix Technology sustains and boosts the productivity of membrane systems with helically winding ridges that provide turbulence and enhanced feed water mixing. The prevention of cake formation allows for higher permeate flows at lower crossflow velocities.



# Pentair X-Flow Helix Technology - Seeing is believing



STANDARD  
TUBULAR MEMBRANE



HELIX  
TUBULAR MEMBRANE

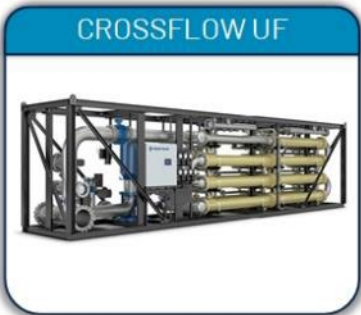


PORTFOLIO

# X-Flow Solutions Overview



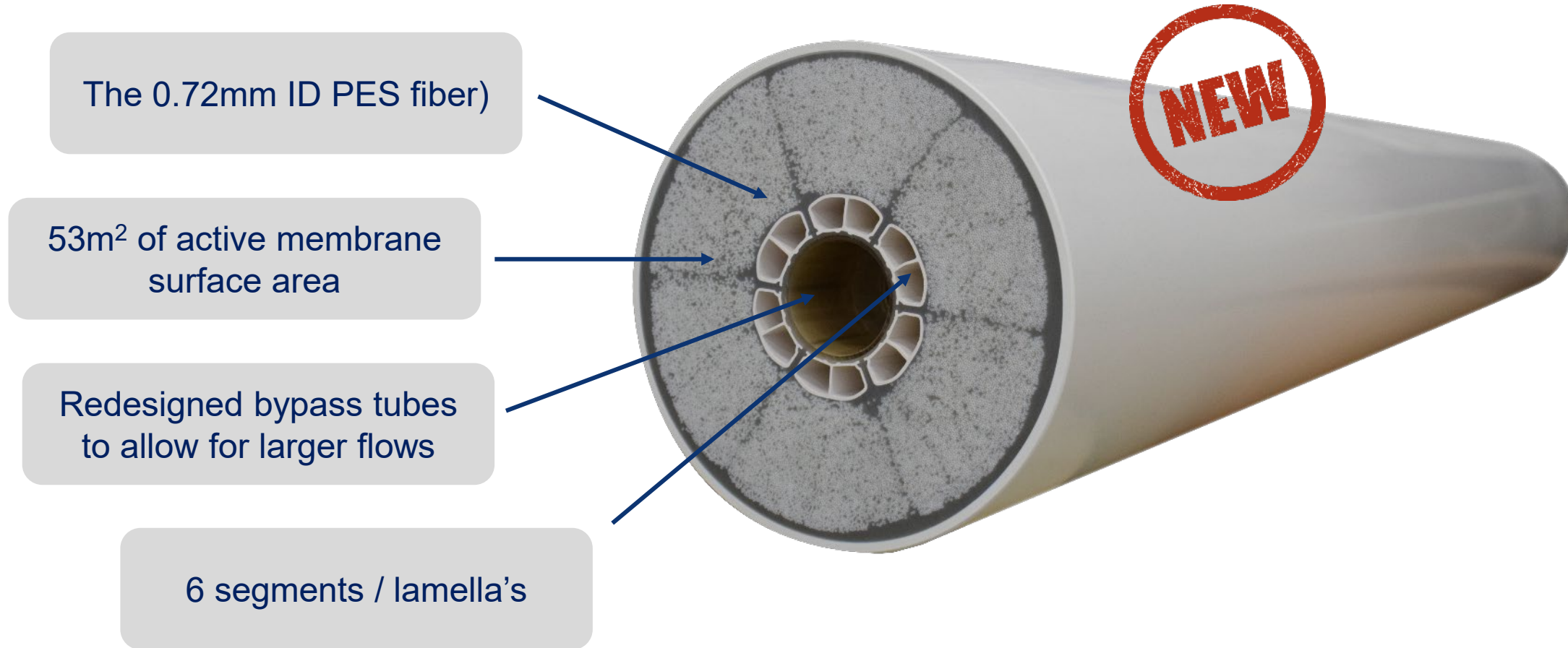
Now with XF75



An Extensive Portfolio Of Water and Wastewater Membrane Filtration Solutions

# NEW: XF53

Innovative membrane element for XF40 replacement to increase the plant capacity or decrease OPEX





# XF53 replacement scenarios



- Scenario 1 – Maintain current settings
- Scenario 2 – Increase plant robustness
- Scenario 3 – Decrease OpEx
- Scenario 4 – Increase capacity
- Scenario 5 – Maximize plant utilization



# XF53 replacement scenarios

*Surface water (5 NTU; Temperature avg 20 degC)	Installed Base	Membrane surface area-to-area replacement		Membrane element quantity-to-quantity replacement		5. Maximize plant utilization
		1. Maintain current settings	2. Increase plant robustness	3. Decrease OpEx	4. Increase capacity	
Membrane element type	XF40	XF53	XF53	XF53	XF53	XF53
Number of units	8	8	6	8	8	
Membrane Housings per unit	24	18	24	24	24	
Elements per Housing	4	4	4	4	4	
Number of elements in plant	768	576	576	768	768	
Total membrane surface area (m2)	30,720	30,528	30,528	40,704	40,704	
Gross filtration flux (lmh)	85	85	85	63	85	
Average yearly filtration TMP (bar)	0.37	0.37	0.37	0.28	0.37	
Filtration time (min)	40	40	40	60	40	
CEB frequency (hrs once)	24	24	24	36	24	
Recovery	94.8%	94.8%	94.8%	95.3%	94.8%	
Permeate capacity (m3/h)	2340	2340	2340	2340	3150	
Pump Capacity Requirements						
Feed pump capacity (m3/h)	2,611	2,611	2,611	2,564	3,460	Max available capacity
Backwash pump capacity (m3/h)	922	916	1,221	1,221	1,221	Max available capacity
<b>XF53 Replacement Benefits</b>						
Membrane element quantity decrease	-	-25%	-25%	-	-	
Footprint decrease	-	-	-25%	-	-	
Average energy demand decrease (based on TMP)	-	-	-	-24.3%	-	
Average chemical consumption (based on CEB frequency)	-	-	-	-33.3%	-	
Permeate production increase (m3/h)	-	-	-	-	34.6%	

# Scenario 1 - Maintain current settings

## Reduction of UF housings and elements

- Reload with 25% less elements
- Dismantle 25% of vessels per skid
- Total plant membrane surface area remains unchanged
- Total skid membrane surface area remains unchanged
- Maintain operation of plant
- Lowest Replacement Cost Scenario



Feed pump capacity	=
Backwash pump capacity	=

*Surface water (5 NTU; Temperature avg 20 degC)	Installed Base	Membrane surface area-to-area replacement	
		1. Maintain current settings	2. Increase plant robustness
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Backwash pump capacity (m3/h)	922	916	1,221
<b>XF53 Replacement Benefits</b>			
Membrane element quantity decrease	-	-25%	-25%
Footprint decrease	-	-	-25%
Average energy demand decrease (based on TMP)	-	-	-
Average chemical consumption (based on CEB frequency)	-	-	-
Permeate production increase (m3/h)	-	-	-

# Scenario 2 – Increase plant robustness

## Reduction in no. of UF skids in operation

- Reload skids fully with XF53
- Total skid membrane surface area increases with 32.5%
- Reload part of skids
- Options in described case:
  - Dismantle 2 skids and safe footprint
  - Dismantle 1 skid, refurbish key ancillaries and use one skid as stand-by → safe footprint, increase plant continuity and performance
- Lowest Replacement Cost Scenario for membranes
- Backwash pump capacity increases
- Capacity remains unchanged with more stable operation

Feed pump capacity	
Backwash pump capacity	



*Surface water (5 NTU; Temperature avg 20 degC)	Installed Base	Membrane surface area-to-area replacement	
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<b>XF53 Replacement Benefits</b>			
Membrane element quantity decrease	-	-25%	-25%
Footprint decrease	-	-	-25%
Average energy demand decrease (based on TMP)	-	-	-
Average chemical consumption (based on CEB frequency)	-	-	-
Permeate production increase (m3/h)	-	-	-



# Scenario 3 – Decrease OpEx

## Lower flux and CEB frequency



- Reload all skids in full, with XF53
- Lower the filtration flux with approx 25%
- Lowest OpEx replacement scenario:
  - Lower TMP, hence lower energy demand
  - Lower CEB frequency, hence lower chemical consumption
  - Slight recovery increase
- Plant capacity remains unchanged
- Backwash pump capacity increases

Feed pump capacity	
Backwash pump capacity	

*Surface water (5 NTU; Temperature avg 20 degC)	Installed Base	Membrane element quantity-to-quantity replacement	
		3. Decrease OpEx	4. Increase capacity
Membrane element type	XF40	XF53	XF53
Number of units	8	8	8
Membrane Housings per unit	24	24	24
Elements per Housing	4	4	4
Number of elements in plant	768	768	768
Total membrane surface area (m2)	30,720	40,704	40,704
Gross filtration flux (lmh)	85	63	85
Average yearly filtration TMP (bar)	0.37	0.28	0.37
Filtration time (min)	40	60	40
CEB frequency (hrs once)	24	36	24
Recovery	94.8%	95.3%	94.8%
Permeate capacity (m3/h)	2340	2340	3150
Pump Capacity Requirements			
Feed pump capacity (m3/h)	2,611	2,564	3,460
Backwash pump capacity (m3/h)	922	1,221	1,221
<b>XF53 Replacement Benefits</b>			
Membrane element quantity decrease	-	-	-
Footprint decrease	-	-	-
Average energy demand decrease (based on TMP)	-	-24.3%	-
Average chemical consumption (based on CEB frequency)	-	-33.3%	-
Permeate production increase (m3/h)	-	-	34.6%

# Scenario 4 – Increase capacity

Maintain no. of UF housings and elements, increase m2 and maintain flux

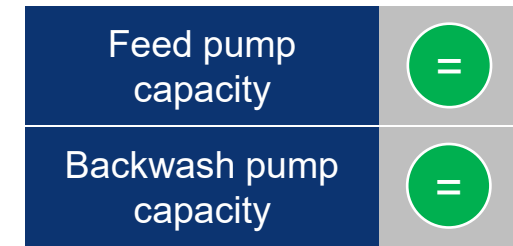
Feed pump capacity	
Backwash pump capacity	

- Reload all skids in full, with XF53
- Maintain process settings
- Increase capacity by approx 35%:
  - Without adding skids
- Backwash pump capacity increases
- Feed pump capacity increases

*Surface water (5 NTU; Temperature avg 20 degC)	Installed Base	Membrane element quantity-to-quantity replacement	
		3. Decrease OpEx	4. Increase capacity
Membrane element type	XF40	XF53	XF53
Number of units	8	8	8
Membrane Housings per unit	24	24	24
Elements per Housing	4	4	4
Number of elements in plant	768	768	768
Total membrane surface area (m2)	30,720	40,704	40,704
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CEB frequency (hrs once)	24	36	24
Recovery	94.8%	95.3%	94.8%
Permeate capacity (m3/h)	2340	2340	3150
Pump Capacity Requirements			
Feed pump capacity (m3/h)	2,611	2,564	3,460
Backwash pump capacity (m3/h)	922	1,221	1,221
<b>XF53 Replacement Benefits</b>			
Membrane element quantity decrease	-	-	-
Footprint decrease	-	-	-
Average energy demand decrease (based on TMP)	-	-24.3%	-
Average chemical consumption (based on CEB frequency)	-	-33.3%	-
Permeate production increase (m3/h)	-	-	34.6%

# Scenario 5 – Maximize plant utilization

## Load m2 up to max (feed or backwash) capacity



- Assessment of capacity of:
  - Feed pump
  - Backwash pump
- Identify potential ‘over capacity’
- Reload membrane surface to what identified pump capacities allow

*Surface water (5 NTU; Temperature avg 20 degC)	Installed Base	5. Maximize plant utilization
Membrane element type	XF40	XF53
Number of units	8	
Membrane Housings per unit	24	
Elements per Housing	4	
Number of elements in plant	768	
Total membrane surface area (m2)	30,720	
Gross filtration flux (lmh)	85	
Average yearly filtration TMP (bar)	0.37	
Filtration time (min)	40	
CEB frequency (hrs once)	24	
Recovery	94.8%	
Permeate capacity (m3/h)	2340	
Pump Capacity Requirements		
Feed pump capacity (m3/h)	2,611	Max available capacity
Backwash pump capacity (m3/h)	922	Max available capacity
<b>XF53 Replacement Benefits</b>		
Membrane element quantity decrease	-	
Footprint decrease	-	
Average energy demand decrease (based on TMP)	-	
Average chemical consumption (based on CEB frequency)	-	
Permeate production increase (m3/h)	-	

# Pentair X-Flow Aquaflex Solution

## UF solution for challenging feed water qualities with unmatched operational flexibility

- Offers unmatched flexibility in operation: dead-end flow, circulation with feed-and-bleed, AirFlush is possible to improve performance and maximize output.

### With Pentair X-Flow ultrafiltration membranes that:

- tackle feed water fluctuations and consistently remove suspended solids, silt density index causing particles, colloids, bacteria, and viruses.
- reduce the color and dissolved organics to meet stringent water-quality requirements with upfront direct coagulation.



**Ideal Ultrafiltration Solution For Challenging Feed Waters**



# Pentair X-Flow Aquaflex High Solids Solution

## Treating challenging feed water qualities with one-step UF

- Benefits from the versatile operating concepts of X-Flow Aquaflex Solution combined with the Pentair X-Flow XF33R 3 mm or 5 mm Compact Membrane Elements.
- Eliminates the need for conventional pretreatment requirements of traditional ultrafiltration (UF) systems.

### Reduces:

- the overall footprint and total cost of ownership by one-step direct high solids filtration with the X-Flow Aquaflex HS Solution.
- the color and dissolved organics to meet stringent water-quality requirements with upfront direct coagulation.



**One-step, Direct High-solids Ultrafiltration Solution**

# Pentair X-Flow Xiga Solution

**UF solution for water treatment and wastewater reuse with low total cost of ownership**

- Ensures a minimum membrane footprint.
- Delivers up to 20 barg to operate inline with the downstream reverse osmosis (RO) system.
- Eliminate the intermediate break tank by reducing the capital investment that makes an ideal configuration for large desalination projects.

**With Pentair X-Flow ultrafiltration membranes that:**

- tackle feed water fluctuations and consistently remove suspended solids, silt density index causing particles, colloids, bacteria, and viruses.
- reduce the color and dissolved organics to meet stringent water-quality requirements with upfront direct coagulation.



Now with XF75



**Ideal Solution For Large-scale Ultrafiltration Applications In A Small Footprint**

# Pentair X-Flow X-line Solution

**A cost-effective ready-to-assemble UF for water treatment and wastewater reuse applications**

- Provides a pre-engineered solution with higher scalability and flexibility.
- Reduces investment cost and assembly time with integrated Pentair X-Flow OptiFlow Caps in addition to a high flow-to-footprint ratio compared to any vertical ultrafiltration system.

**With Pentair X-Flow ultrafiltration membranes that:**

- tackle feed water fluctuations and consistently remove suspended solids, silt density index causing particles, colloids, bacteria, and viruses.
- reduce the color and dissolved organics to meet stringent water-quality requirements with upfront direct coagulation



**Pre-engineered Ultrafiltration Solution**

# Pentair X-Flow Airlift Solution

Treating low and medium strength wastewater and producing high-quality filtrate in bioreactor applications.

- Synergizes the crossflow filtration principle at low velocities enhanced with the Airlift process to create sufficient turbulence to solve cake layer build-up and operate at high flux rates.
- Eliminates the build-up of debris at the membrane inlet with the drain step.
- Helps assure effective cleaning of the membranes and easy maintenance with Pentair X-Flow sidestream membrane bioreactor solutions.
- Requires a small footprint and lowers the total cost of ownership compared to the submerged MBR systems.



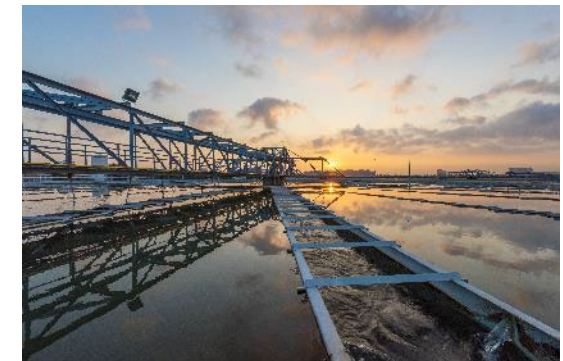
**Energy-efficient Sidestream Membrane Bioreactor Solution**



# Pentair X-Flow Airlift Megablock Solution

**Treating low and medium strength wastewater and producing high-quality filtrate in bioreactor applications with a small footprint.**

- Adopts the X-Flow Airlift principle in pre-engineered membrane filtration blocks with the Pentair X-Flow 3mm XF32 Membrane Elements.
- Revolutionizes the construction of the MBR system with pre-engineered assembly components that reduce the total construction time and a minimum membrane footprint.
- Provides a simple, reliable mounting of Membrane Elements to the segments and easy connections to the bioreactor.
- Be assured of effective cleaning of the membranes and easy maintenance with Pentair X-Flow sidestream membrane bioreactor solutions.



**Pre-engineered Membrane Bioreactor Solution For Large-scale Wastewater Treatment**

# Pentair X-Flow Crossflow MBR Solution

Treating high strength wastewater and producing high-quality filtrate in wastewater treatment applications

- Operates based on turbulence using the Pentair X-Flow 5.2 or 8 mm Compact Tubular Membrane Elements.
- Benefitting from the Pentair X-Flow Helix Technology, it prevents cake formation on the membrane layer by creating more turbulence at lower crossflow velocities which saves energy compared to the traditional crossflow membrane filtration systems with smooth membranes.
- In combination with the bioreactor, the X-Flow Crossflow Solution is the sidestream membrane bioreactor system assuring simple operation with easy maintenance.



Membrane Filtration Solution For Challenging Wastewater Treatment

# Pentair X-Flow Crossflow UF Solution

Treating high strength wastewater and producing high-quality filtrate in wastewater treatment applications.

- Operates based on turbulence using the Pentair X-Flow 5.2 or 8 mm Compact Tubular Membrane Elements.
- Benefitting from the Pentair X-Flow Helix Technology, it prevents cake formation on the membrane layer by creating more turbulence at lower crossflow velocities which saves energy compared to the traditional crossflow membrane filtration systems with smooth membranes.



**Membrane Filtration Solution For Challenging Wastewater Treatment**

# Pentair X-Flow Reverta Solution

**Treating high strength wastewater and producing high quality filtrate in bioreactor applications**

- Adapts the combination of crossflow filtration principle with Feed Flow Reversal operation.
- Helps ensure no accumulation of debris at the membrane elements' feed by reversing the feed flow.
- Installed with the Pentair X-Flow Compact Membrane Element's Flux Enhancement Helix Technology, it prevents cake formation on the membrane layer while producing higher permeate flows at lower cross-flow velocities.
- Helps ensure effective cleaning of the membranes and easy maintenance.



**Sustainable Membrane Filtration Solution With Flow Reversal**





# CASE STUDIES WATER

# Building A State-of-the-art Drinking Water Plant

CLIENT	Municipality of Kungälv
Country	Sweden
Start-up	2018
Market	Municipal
Application	Potable water
Solution	Xiga and Aquaflex
Membrane Element	Pentair X-Flow XF57 Membrane Element
Results	Removes NOM and microbiology in a single process step. Reacts to peaks in NOM, for example after a storm.
	Biological filter improves water quality and membrane performance in terms of process stability and coagulant usage.
	Coagulant dosing combined with feed forward control actively reacts to changes in feed water quality
	Operates with minimum dosages and thus contributes to maximum permeate quality.



**Increase in demand for drinking water and existing plant was at maximum capacity**

# Pentair X-Flow Replaces UF Membranes

CLIENT	Asia Symbol
Country	China
Start-up	2013, replacement in 2018
Market	Pulp and paper
Application	Municipal wastewater reuse
Solution	X-line
Membrane Element	Pentair X-Flow XF64 Membrane Elements
Results	Water reuse as boiler feed, saving the equivalent of the fresh water demand of 600,000 people.
	Eliminating significant pressure surges.
	Excellent permeate quality



**High efficiency and performance**



A wide-angle photograph of a wastewater treatment plant during sunset. The scene features two large, curved aeration tanks filled with water, separated by a concrete walkway with a metal railing. In the background, a city skyline is visible with several high-rise buildings under construction, each topped with a crane. The sky is filled with dramatic, colorful clouds in shades of orange, yellow, and blue. The foreground shows a paved path and some greenery. The image is overlaid with a large green triangle on the right side and a blue triangle at the bottom right corner.

# CASE STUDIES WASTEWATER

# Leachate treatment with Pentair X-Flow Helix Technology

CLIENT	Hooge Maey
Country	Belgium
Start-up	2002
Market	Leachate
Application	Wastewater treatment
Solution	Pentair X-Flow Crossflow Solution
Membrane Element	Pentair X-Flow Compact 33
Results	Pentair X-Flow Helix Technology lowered energy use by more than a third and provided spare filtration capacity.



**Flux increased from 135 to an impressive 180 lmh**



# Zero Liquid Discharge at Textile Mill

CLIENT	The Sangam Group
Country	India
Start-up	2016
Market	Textile
Application	Reuse of wastewater
Solution	Pentair X-Flow Crossflow MBR Solution
Membrane Element	Pentair X-Flow Compact 27 Helix Membrane Elements
Results	Eliminated the need for traditional secondary clarifiers and tertiary treatment, allowing better system performance.
	Footprint is up to ten times smaller than in traditional setups with settling ponds.



**Reusing high strength wastewater with Crossflow MBR and Helix**

# Treating Dairy Wastewater For Reuse

Client	Woodlands Dairy
Country	South-Africa
Start-up	207
Market	Dairy
Application	Reuse wastewater
Solution	Pentair X-Flow Reverta Solution
Membrane Element	Pentair X-Flow Compact 33V Helix
Results	Significantly reducing wastewater treatment costs compared to conventional technologies.
	Permeate free of suspended solids
	Biogas used to heat the on-site boilers



Significant reduction in treatment costs



# PENTAIR CODELINE PORTFOLIO

The prevailing choice for pressure vessels on a global scale

# SUPERIOR

*pressure vessel technology*

## RECOGNIZED FOR

*high quality, smart product portfolio and market  
changing innovations*

## CUSTOMERS

*are our partners*



Codeline is the prevailing choice for pressure vessels on a global scale. It is widely recognized and appreciated for its **high-quality products** and **smart portfolio**, which includes game-changing innovations such as the Quick Lock and OCTA. Codeline's superior pressure vessel technology helps our partners and customers to **maximize the operational safety, reliability, availability and performance** of water treatment and purification systems.





# Codeline

## Superior Pressure vessels

- Worldwide brand since 1976
- Market leader in global market share
- More than 600,000 membrane housings in service globally
- Maximize the performance of water treatment and purification systems
- ASME (Sec. X) certification
- State-of-the-art manufacturing facility in Goa, India
- Continuous & benchmarking innovation with proven quality standard for about five decades



# Applications



**INDUSTRIAL**



**MUNICIPAL**



**COMMERCIAL**



**DESALINATION**



**POWER**



**PHARMA**

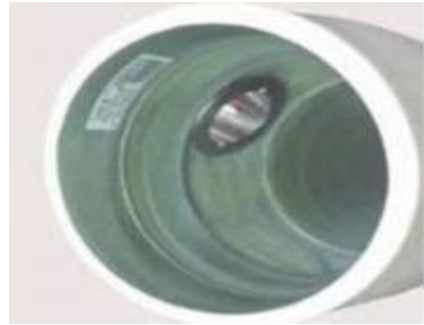


**FOOD & BEVERAGE**



**OIL & GAS**

# Pressure Vessel Uniqueness



**FLAT SEALING**



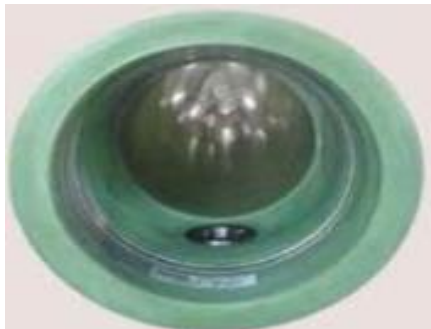
**THREADED SIDE PORTS**



**QUICK LOCK SYSTEM**



**MULTI PORT**



**FAIL SAFE SHELL**



**ONE PIECE HEAD**

# Codeline Certifications

Codeline manufactures its products to its highest standards of quality and safety. Pentair's quality certifications follow independent and separate accreditations for materials, standards and practices at its manufacturing facility.

- **ISO 9001:2015/ISO 45001 : 2018/ ISO 14001 : 2015**
- **ASME - American Society of Mechanical Engineers**
- **CE - European Conformity Marking**
- **NSF (National Sanitation Foundation) International**
- **DWI - Drinking Water Inspectorate**







CODELINE

# PRODUCT PORTFOLIO



# Product Portfolio

## characteristics

- Wide range of end entry, side entry & multi port vessels
- Standard product / size - 2.5", 4", 8" diameter & customized\* product / size - 8.7", 9", 11" diam.
- Standard operating pressure range - 150, 300, 450, 600, 1000 & 1200 psi
- Element length - multiple
- Product models available in ASME / CE etc. certifications
- Available models for high flow, ultra high flow, and standard flow of feed water



# NEW: Codeline 80K Series

Experience superior durability with our new membrane housing solution

- Streamlined, durable design
- Advanced composite materials
- Seamless and corrosion resistant ports for various water types
- Optimized head locking mechanism as per pressure rating



# Pressure Vessels Overview

Series	Diameter [Inch]	Application	Operating Pressure [ PSI ]
 40E	4"	Commercial, Industrial	300 - 600 - 1000
 40S	4"	Commercial, Industrial, Dairy, Pharmaceutical use	300 - 450 - 600
 80E	8"	Commercial, Industrial	300 - 450 - 600 - 1000 - 1200
 80K	8"	Commercial, Industrial, Municipal	300 - 450 - 600 - 1000 - 1200
 80S	8"	Commercial, Industrial, Municipal	150 - 300 - 450 - 600 - 1000 - 1200
 80H	8"	Industrial, Municipal	150 - 300 - 450 - 600 - 1000 - 1200
 80U	8"	Industrial	300 - 450 - 600 - 1000 - 1200



# Pressure Vessels Overview

## Various Series

Series	Diameter [Inch]	Application	Operating Pressure [ PSI ]
 Ecoline 2.5 Inch	2.5"	Light Commercial	300
 Ecoline 4 Inch	4"	Commercial	300
 Ecoline 8 Inch	8"	Commercial	300 - 450

# Aqualine

## Cost-effective Filtration

Aqualine is a liquid filtration solution which provides superior flow rates and guarantees long-lasting performance.

- High flow filtration with a wide range of cartridge micron rating to suit your application
- High-performance pleated media filtration technology
- Long lasting rugged FRP housings from Codeline, available in 150 & 300 psi pressure rating
- ASME complaint FRP housings for critical applications
- Labor-saving quick module change
- Can be installed both vertically and horizontally







CODELINE

# CASE STUDIES

# Major installations across the globe

COUNTRY	VESSELS (QTY)
Saudi Arabia	8281
Saudi Arabia	6810
Algeria	1016
Saudi Arabia	2808
Oman	3320
Saudi Arabia	4464
Australia	4592
Saudi Arabia	3075
UAE	3034
Algeria	2080
Spain	2832
Saudi Arabia	2580
Trinidad	2290
Kuwait	2276
Oman	1448
Spain	1580
USA	1176
India	1037
India	510



PROJECT SWRO III  
Capacity – 240,000 m<sup>3</sup>/day  
No. of Codeline pressure vessels: : 11" – 3616 / 8" - 848



PROJECT – SYDNEY, AUSTRALIA  
No. of Codeline pressure vessels: 4592



Project UAE  
No. of Codeline pressure vessels: 3034



PROJECT KUWAIT  
No. of Codeline pressure vessels: 2276



**PENTAIR**