

# **Industrial Utility Water**

DuPont Multi-Tech Solutions

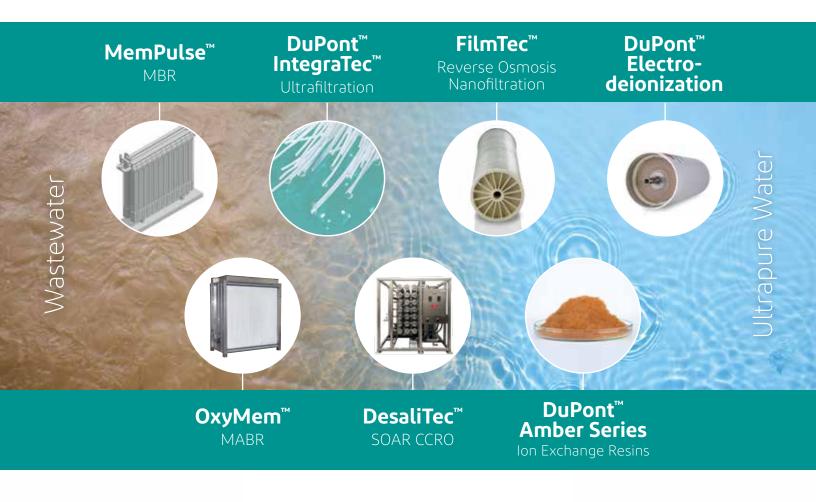


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# **DuPont Water Solutions Portfolio**

# The broadest in the industry





# **Industrial Utility Water**

# Needs and Challenges

- Water is a critical vector of nearly all industries, directly impacting both production uptime and profitability.
- The manufacturing industry accounts for 16% of global water demand, increasing to 22% by 2030.
- The United Nations Sustainable Development Goals 2030 target to substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from increasing water shortages.



# **DuPont can help industrial customers**

# address their key challenges



Optimize water footprint to battle constrained water access



Ensure consistent water quality under feed water quality fluctuations and complexity



Secure trouble-free operation to minimize unplanned downtime and maximize production



Provide solutions for **limited** footprint and mobile units



Reduce or even eliminate chemical consumption to achieve more environmentally-friendly operations

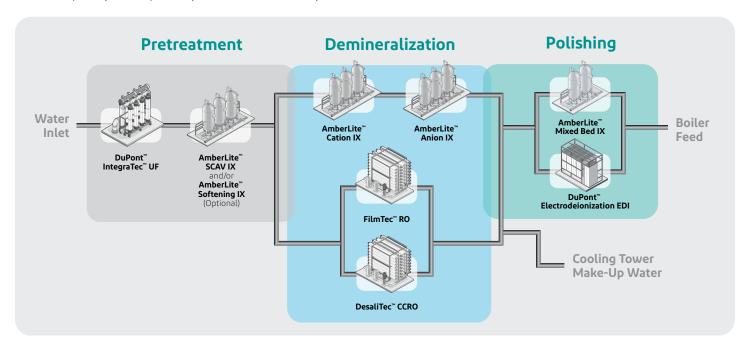


Optimize energy consumption to reduce manufacturing cost and carbon footprint

# **DuPont Multi-Tech Solutions**

# for Industrial Utility Water

At DuPont Water Solutions, we develop integrated and effective solutions that meet the world's growing water and energy demands. Our diverse portfolio of technologies and solutions addresses a broad range of water treatment applications and is designed to help you overcome water challenges to produce your desired quality and quantity of industrial utility water.



# DuPont can adapt the solution

# to meet specific customer needs

Our best-in-class technical team supported by R&D has accumulated decades of experience across all technologies to create solutions that address a broad variety of challenges. Our understanding of water chemistry and the complexity of individual constituents enables us to recognize project needs and critical requirements.



**High recovery schemes for limited water availability sites** with closed-circuit RO (CCRO) combined with the appropriate pre-treatment and polishing technologies



Chemical-free or minimum chemical usage solutions for plants facing sourcing problems or targeting to optimize EH&S profile with UF, RO, mechanical CO<sub>2</sub> and O<sub>2</sub> removal, and EDI



**Robust and reliable solutions to mitigate inlet water quality fluctuations** with a combination of our DuPont™ AmberLite™ HPR series resins for demineralization or fine tuned polishing, among other possible schemes.

# Suspended Solids Removal with Ultrafiltration

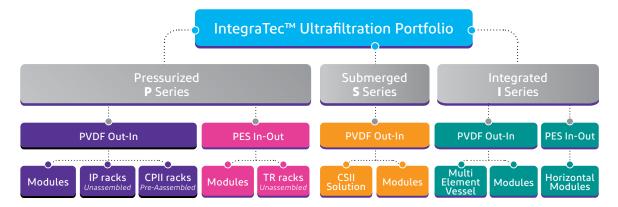
**DuPont™ IntegraTec™ Ultrafiltration (UF)** is a pressure-driven purification process that separates particulate matter from soluble compounds using ultrafine membrane media.

## Compared to traditional media & sand filters, UF technology offers:

- Better & consistent filtrate quality regardless of feedwater quality upsets
- Minimal to no use of pretreatment chemicals (polymers, coagulants, pH adjustment) and associated costs for sludge disposal
- Smaller footprint and lower weight

DuPont offers a wide selection of UF modules, skids and systems that provide industries with peace-of-mind solutions to address their challenges while maintaining lowest total cost of ownership and managing a reliable and profitable operation.





Sub technology	Туре	Brand name	Fiber	Best Used For
		IntegraTec™ XP 51 IP / XP 51 IP IG	PVDF Out-In	Containerized or small size plant     High recovery filtration with high chlorine resistance
		IntegraTec™ XP 77 IP / XP 77 IP IG	PVDF Out-In	Large size plant     High recovery filtration with high chlorine resistance
	Rack solutions	IntegraTec™ MB PRO 95 TR/MB 80 TR	PES In-Out	<ul> <li>Large size plant</li> <li>Low energy filtration with high TOC &amp; Virus log removal</li> </ul>
		IntegraTec™ MB PRO 82 / MB 60 / MB 40 TR S	PES In-Out	· Containerized or small size plant · Low energy filtration with high TOC & Virus log removal
		IntegraTec™ MB 50 TR	PES In-Out	<ul> <li>Large size plant</li> <li>High TSS water, Low energy filtration with high TOC &amp; Virus log removal</li> </ul>
		IntegraTec™ XP 51 / XP 51 IG	PVDF Out-In	Containerized or small size plant High recovery filtration with high chlorine resistance
		IntegraTec™ XP 77 / XP 77 IG	PVDF Out-In	Large size plant     High recovery filtration with high chlorine resistance
Pressurized P Series	Open platform modules	IntegraTec™ MB PRO 95 / MB PRO 82 / MB 80	PES In-Out	<ul> <li>Large size plant</li> <li>Low energy filtration with high TOC &amp; Virus log removal</li> </ul>
P Series		IntegraTec™ MB 60 / MB 40	PES In-Out	<ul> <li>Containerized or small size plant</li> <li>Low energy filtration with high TOC &amp; Virus log removal</li> </ul>
		IntegraTec™ MB 38	PES In-Out	<ul> <li>Smal size plant</li> <li>High TSS water, Low energy filtration with high TOC &amp; Virus log removal</li> </ul>
	Small Modules	IntegraTec™ SFP-2660	PVDF Out-In	Small scale plants and pilot units High recovery filtration with high chlorine resistance
	Sillatt Modules	IntegraTec™ MB 25	PES In-Out	<ul> <li>Small scale plants and pilot units</li> <li>Low energy filtration with high TOC &amp; Virus log removal</li> </ul>
		IntegraTec™ XP 55 UXA	PVDF Out-In	· Replace Pall & Asahi Modules
		IntegraTec™ N 68 AMU	PVDF Out-In	· Retrofit and Upgrade Pall & Asahi systems
	Retrofit and Upgrade	IntegraTec™ N 68 AMZ	PVDF Out-In	· Retrofit and Upgrade Veolia (Suez) systems
	opgrade	IntegraTec™ N 68 AMK	PVDF Out-In	· Retrofit and Upgrade Side Fed PVDF out-In systems
		IntegraTec™ MB 55	PES In-Out	Replace Pentair vertical Modules
	Horizontal	IntegraTec™ MB 40 HB	PES In-Out	Replace Pentair horizontal Modules
Integrated	Modules	IntegraTec™ MB PRO 64 H / MB 55 H	PES In-Out	Replace Pentair horizontal Modules
	Multi-Element- vessel MEV	IntegraTec™ XP 52 IC	PVDF Out-In	<ul> <li>Large size outdoor or mobile plants requiring high pressure and low footprint</li> <li>High recovery filtration with high chlorine resistance</li> </ul>

# Total Organic Carbon Removal with Ion Exchange Resins

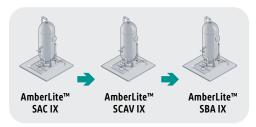
**DuPont™ AmberLite™ SCAV Resins** are organic traps that remove natural organic matter (NOM) from feedwater to protect the demineralization system from fouling-related operational issues and also reduce total organic carbon (TOC) in the treated water.

#### **Key Features**

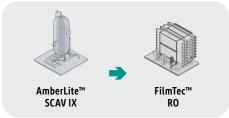
- Outstanding adsorption capacity of undesired NOM species during service
- High physical stability and excellent fouling resistance
- Offerings for conventional brine regenerated systems or new scavenger technology utilizing acid or caustic



# **Typical Design**







#### AmberLite™ SCAV1 or SCAV2

- Fouling protection and quality improvement
- Flexible and adjustable operation
- Switch operation from highest TOC capacity to highest TOC quality if circumstances ask for it
- Use of standard bulk chemicals for regeneration – no brine
- Can fit into every existing system

## AmberLite™ SCAV3 or SCAV4

- Fouling protection and quality improvement
- Regenerated with brine
- Helps protect primary strong acid cation (SAC) from suspended solids upsets
- Helps reduce TOC and protects downstream anion resins from fouling

#### AmberLite™ SCAV3 or SCAV4

- Reverse osmosis fouling protection for less cleanings
- Regenerated with brine
- Helps reduce TOC

DuPont Resin	Features	Best Used For
AmberLite™ SCAV1	Acrylic gel	Removal of hydrophobic and hydrophilic NOM species for high free mineral acidity (FMA) waters at acidic pH. Waters with medium to high TDS when the ratio of TOC to sulfate (ppm $C/meq SO_4$ ) is less than 3.
AmberLite™ SCAV2	Acrylic macroporous	Removal of high load hydrophilic and hydrophobic NOM for low FMA waters at acidic pH. Waters with low to medium TDS when the ratio of TOC to sulfate (ppm C/meq $SO_4$ ) is greater than 3.
AmberLite™ SCAV3 Cl	Styrenic macroporous	Removal of large, complex, hydrophobic NOM and color species (such as humic and fulvic components) and general polishing of organics remaining after bulk removal at neutral to alkaline pH. Recommended choice for drinking water production.
AmberLite™ SCAV4 Cl	Acrylic macroporous	Removal of high load hydrophilic and hydrophobic NOM at neutral to alkaline pH, with excellent resin lifetime and long, stable performance even under challenging operational conditions. The go-to organic scavenger for the bulk removal of NOM, and especially useful as RO pretreatment.

# Softening & Dealkalization with Ion Exchange Resins

**DuPont AmberLite™ Ion Exchange** softening resins remove cations associated with hardness (such as cacium and magnesium) from feedwater to avoid scale formation caused by precipitation of sparingly soluble salts like calcium carbonate. Ion exchange resins (IX) can also remove bicarbonate alkalinity associated with scaling.

IX softening consists of using a strong acid cation (SAC) resin in the sodium form to replace hardness ions with sodium ions. For softening high TDS waters, a high capacity weak acid cation (WAC) resin in the sodium form is used. And for dealkalization and partial softening of water, a weak acid cation resin in the hydrogen form is used to remove hardness associated with alkalinity and convert bicarbonate alkalinity to CO2 which can be later removed by degasification. Alternately, a strong base anion (SBA) resin in the chloride form can also dealkalize by exchanging carbonate and bicarbonate anions for chloride ions.





# **Key Benefits**

- Prevent scaling in downstream RO and avoid complication and expense of using antiscalants
- Prevent scaling in downstream process by removing or reducing hardness and or bicarbonate alkalinity
- Protect RO and/or UF by using strong acid cation resin softeners to also remove certain cationic polymers present from upstream coagulation systems.

# **Typical Design**







DuPont Resin	Featu	Features Best Used For			
AmberLite™ IRC120 Na	SAC	Gel	General purpose softening resin for co-flow systems		
AmberLite™ HPR1100 Na	SAC	Gel	Softening resin with excellent physical stability and low rinse profile. Compatible with all system technologies.		
AmberLite™ IRC200 Na	SAC	Macro	Highest physical stability for harsh application such as hot process softeners and other systems involving appreciable oxidative potential or high temperatures. For co-flow systems.		
AmberLite™ IRC83 H	WAC	Macro	High-capacity dealkalization and softening resin with improved operating capacity demonstrated in high-TDS Na-form operation. For co-flow systems.		
AmberLite™ HPR8300 H	WAC	Macro	High capacity dealkalization and softening resin with demonstrated improved operating capacity over other available WAC resins.  Compatible with all system technologies.		
AmberLite™ HPR4100Cl	SBA	Gel	The go-to Type II SBA resin. Compatible with all system technologies.		

# **Demineralization with Ion Exchange Resins**

**DuPont™ AmberLite™ Ion Exchange Resins** for demineralization are used to remove all cations, anions and large organic contaminants from feed water. IX demineralization consists of at least 2 resin beds: a hydrogen form strong acid cation resin followed by a hydroxide form strong base anion resin. A degassifier may be used between them to remove bicarbonate alkalinityc reducing anionic load. Weak acid cation and/or weak base anion resins may also be incorporated depending on level of hardness, TOC and alkalinity.

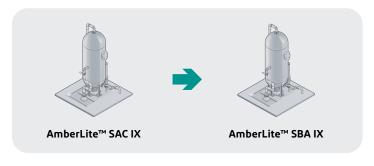
DuPont has over 80 years of experience manufacturing the widest range of industry-leading, reliable ion exchange resins from world-class manufacturing facilities.

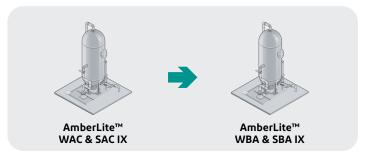
# **Key Features**

- Reduce key ionic contaminants down to microgram per liter concentrations required for steam generation.
- Save up to 40% in OPEX and receive up to 10x better water quality by using reverse flow beds over conventional co-flow systems.
- Further reduce cost by 25% using AmberPack™ and Upcore™ packed beds which use less regenerant and service water.



# Typical Designs of IX demineralization systems





DuPont Resin	Features	Best Used For
AmberLite™ HPR1200 H	SAC	Designed to be the go-to high quality gel SAC resin. Compatible with all system technologies.
AmberLite™ HPR1300 H	SAC	Higher crosslinked DVB gel SAC resin for layered beds or where very low sodium leakage and conductivity is a chief concern. Compatible with all system technologies.
AmberLite™ HPR8300 H	WAC	High Capacity WAC resin for improved chemical efficiency. Compatible with all system technologies and bed configurations including layered beds.
AmberLite™ HPR9500	WBA	Good organic fouling resistance and high kinetics yielding good operating capacity even in low temperature operations. Offers a quick start up in a single bed or when paired with and OH-form SBA in layered bed systems. Compatible with all system technologies.
AmberLite™ HPR4200 Cl or OH	SBA	Designed to be the go-to high quality SBA resin. Good balance of capacity and strength and silica leakage. Compatible with all system technologies and bed configurations including layered beds.

# **Demineralization with Reverse Osmosis Brackish Water Elements**

Reverse Osmosis (RO) Elements are pressure-driven purification products that separate ions, dissolved salts, and minerals using a semi-permeable membrane.

FilmTec™ Prime RO Portfolio The next generation of FilmTec™ brackish water RO (BWRO) elements were designed specifically for industrial utility water treatment.

- **Key Benefits PROven:** Based on historical FilmTec™ BW30 chemistry and over 40 years of manufacturing experience
  - PROgressive: Continuous innovation to reach unparalleled performance, durability, and cleanability
  - PROductive: Up to 20% in energy savings and improved permeate quality by up to 60%
  - PROficient: Outstanding performance and durability compared to alternative options
  - **PROminent:** Global sustainability benefit of up to 85,000 Metric Tons of  $CO_2$  emissions reduced per year

FilmTec™ Prime RO 8" Elements		ction (%) Minimum	Flow gpd (m³/d)	Spacer (mil)	Features
FilmTec™ BW30 PRO-365	99.55	99.35	10,000 (38)	28	· High rejection & high-performance industry-standard
FilmTec™ BW30 PRO-400	99.6	99.4	11,000 (42)	28	BWRO membrane elements Consistent water quality and higher rejection and
FilmTec™ BW30 PRO-400/34(i)	99.6	99.4	11,000 (42)	34	flow than previous generation BW30 products
FilmTec™ BW30XHR PRO-400/34(i)	99.8	99.6	11,500 (43.5)	34-LDP	• Extra high rejection BWRO membrane elements
FilmTec™ BW30XHR PRO-440	99.8	99.6	12,650 (48)	28	<ul> <li>Exceptional permeate quality including excellent silica, boron, nitrate, TOC and ammonium rejection</li> </ul>

FilmTec™ ECO RO Portfolio FilmTec™ ECO Elements offer excellent rejection with significantly lower energy and reduced chemical consumption than traditional brackish water reverse osmosis elements

- **Key Benefits** Enhanced permeate water quality: exceptionally robust performance over a longer element life
  - Lower energy consumption: up to 33% energy savings compared to the standard brackish water products
  - Improved operational efficiency: up to 40% higher salt rejection and up to 40% savings in regeneration costs for downstream MB systems

FilmTec™ ECO 8" Elements		ction (%) Minimum	Flow gpd (m³/d)	Spacer (mil)	Features
FilmTec™ ECO PRO-400(i)	99.7	99.4	11,500 (43.5)	34-LDP	· High rejection, low energy
FilmTec™ ECO PRO-440(i)	99.7	99.4	12,650 (48)	28	· Exellent element robustness and wide cleaning range
FilmTec™ ECO PLATINUM-440(i)	99.7	99.4	12,650 (48)	28-LDP	· Tough water quality (ECO PRO-400(i))

FilmTec™ Fortilife™ RO portfolio The FilmTec™ Fortilife™ brackish water RO (BWRO) product family offers solutions for industrial-users to improve water efficiency by incorporating membrane and element design innovations that enable systems to clean less, recover more, and waste less.

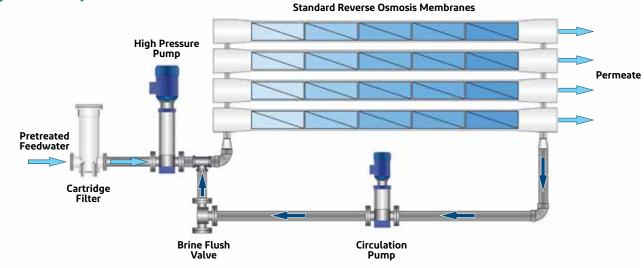
- Key Benefits Reduce water costs and lower operating expenses
  - Achieve sustainability goals
  - Minimize biofouling problems

FilmTec™ Fortilife™ RO 8" Elements	Salt Rejection (%) Stabilized Minimum		Flow gpd (m³/d)	Spacer (mil)	Features
FilmTec™ Fortilife™ CR50(i)	99.6	99.4	11,000 (42.0)	34-LDP	Long-lasting lifetimes, contaminant resistant
FilmTec™ Fortilife™ CR100(i)	99.7	99.4	11,500 (43.5)	34-L2DP	Ultra-low pressure drop element designed with durable, biological fouling resistant membrane
FilmTec™ Fortilife™ CR200	99.7	99.4	12,500 (47.3)	34-L2DP	Ultra-low pressure drop element designed with high productivity, durable, biological and organic fouling resistant membrane

# High Recovery Demineralization with Closed Circuit Reverse Osmosis

The patented **DesaliTec™ SOAR Closed Circuit Reverse Osmosis (CCRO)** system works by circulating water through a single stage of membrane elements until the desired recovery level is achieved instead of using complex traditional multi-stage methods. Brine is periodically replaced with fresh feedwater without stopping permeate flow. Recovery is flexible and can be set at the system control panel. The cross flow required for RO membrane operation is controlled with an internal circulation pump. Frequent and complete brine flushing prevents scale precipitation and disrupts biofouling, making very high recovery rates possible even with mineral-laden or contaminated feedwaters.

# **Design of CCRO system**



## **Key Benefits**

- Flexibility DesaliTec™ SOAR CCRO systems automatically adapt to changing feedwater and allow the operator to modify recovery, cross flow, and flux in real time.
- Reliability DesaliTec<sup>™</sup> SOAR CCRO systems naturally mitigate the fouling and scaling that typically plagues reverse osmosis systems. Automated operation with online monitoring provides additional protection.
- Maximum Recovery DesaliTec<sup>™</sup> SOAR CCRO systems come with an industry-leading maximum recovery, operating at up to 98% recovery, allowing you to achieve your sustainability goals.
- **Energy Savings** DesaliTec<sup>™</sup> SOAR CCRO systems apply the optimal pressure to maintain constant permeate flow, reducing the average energy consumption by up to 35%.
- **Return On Investment** DesaliTec<sup>™</sup> SOAR CCRO systems minimize the largest cost associated with reverse osmosis system operation, wastewater disposal, which can be reduced by 50% to 75%.

FilmTec™ SOAR RO 8" elements	Area ft² (m²)	Features
FilmTec™ SOAR 3000	400 (37)	Lowest energy (lowest pressure)
FilmTec™SOAR 4000	400 (37)	Low energy, high fouling resistance
FilmTec™ SOAR 5000	400 (37)	Great rejection, medium pressure, highest fouling resistance
FilmTec™ SOAR 6000	440 (41)	High rejection (medium pressure)
FilmTec™ SOAR 7000	440 (41)	Highest rejection (highest pressure)

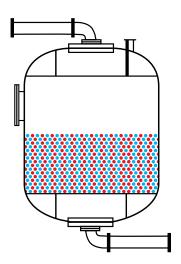
# Polishing with Ion Exchange Resins

DuPont™ AmberLite™ Mixed Bed (MB) Ion Exchange Resins are the standard final polishing step for boiler make-up water and are a critical part of steam condensate treatment. MB polishers remove low ppm to ppb range contaminants but can also protect a system in the event of condenser leaks, thereby improving plant reliability.

DuPont offers a wide selection of polishing resins including premixed resins for non-regenerable systems. We have the world-leading ion exchange brands that offer superior strength and quality for high performance in working and polishing MB applications.

# **Key Benefits**

- Great combination of trace contaminant removal, reliability, and cost effectiveness
- Great balance between performance, stability, efficiency, and lifetime, with uniform particle size resins that minimize pressure drop while optimizing separation for effective regeneration



## DuPont™ AmberLite™ Resin Pairs for Mixed Bed

DuPont Resin	AmberLite™ HPR650 H	AmberLite™ HPR1300 H	AmberLite™ HPR1200 H	AmberLite™ HPR2800 H	AmberLite™ HPR252 H	AmberLite™ HPR2900 H
AmberLite™ HPR550 OH	0					
AmberLite™ HPR4700 OH		0	А			
AmberLite™ HPR4200 OH		0	O			
AmberLite™ HPR4800 OH		0	0	0		
AmberLite™ HPR9000 OH	0			0	0	
AmberLite™ HPR900 OH		0				
AmberLite™ HPR9200 Cl		А		Α		Α

O = Optimum, P = Promoted, A = Acceptable

#### DuPont™ AmberLite™ Pre-Mixed resins

DuPont Resin	Features	Best Used For		
AmberLite™ MB9L H/OH	SAC/SBA	Non-regenerable, premixed resin characterized by a highly cationic exchange capacity. The light color enables visualization upon exhaustion. The reference mixed bed for electroerosion applications.		
AmberLite™ MB20 H/OH	mberLite™ MB20 H/OH  SAC/SBA  Premixed resin developed for the production of high-purity water in general-purpose po applications. The reference mixed bed for service deionization.			
AmberLite™ MB6113 H/OH	SAC/SBA	Non-regenerable, premixed resin developed for the production of high-purity water.  A color indicator allows easy visualization of the exhaustion point of the resin. The reference mixed bed for the production of demineralized water in small cartridge systems.		

# Polishing with Electrodeionization (EDI)

**DuPont™ Electrodeionization (EDI)** is a continuous and chemical-free process of removing ionized and ionizable species from the feedwater using DC power. DuPont™ EDI modules optimize performance, maintain continuous product quality and can produce up to 18 mega ohm-cm high purity water with high silica and boron removal.

The patented DuPont™ EDI module utilizes a unique, leak free, low maintenance spiral-wound design containing membrane and ion exchange resins sealed in a high-strength fiberglass-reinforced plastic (FRP) pressure vessel.

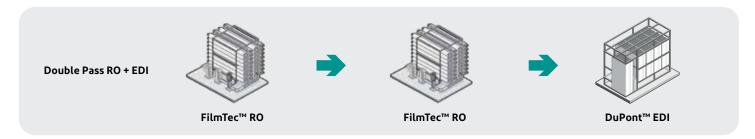
## **DuPont™ EDI Advantages**

- Eliminates the need for hazardous regeneration/neutralization chemicals
- Is a clean technology, the only consumable is electricity
- Is a continuous process, there's no need for offline regeneration
- Smaller footprint than conventional DI
- Situational cost advantages

## **Typical Designs**

EDI is typically used to polish reverse osmosis (RO) permeate and to replace conventional mixed bed ion exchange by eliminating the need to store and handle hazardous chemicals used for resin regeneration and associated waste neutralization requirements.





DuPont™ EDI	Features
Model EDI-310	<ul> <li>Produce water up to 18 megaohm-cm for high-purity and ultra-pure industrial water applications.</li> <li>Allow system integrators to build systems that have both lower capital and operating costs when compared to conventional mixed bed ion exchange.</li> </ul>

# **Expertise Beyond the Product**



#### **Design Software**

integrate our leading technologies -



#### **Online Normalization Tool**



#### Webinars

- Water Education Resource
- Technology and Design Best Practices
- 30+ Webinars Available Online



#### **Value Calculators**

- Cost Savings Calculator
- Resin Replacement Calculator



#### **R&D Capabilities**

- 4 world-class R&D centers
- Industrial scale assets
- Best-in-class analytical lab



#### **System Optimization Services**

- Testing, evaluation, and troubleshooting of
- FilmTec™ Fortilife™ DIRECTOR™,





# You can learn more about our products here

# Just scan QR-code



Ion Exchange Resins for Industrial Water Treatment





Prime RO Webpage





DesaliTec™ SOAR CCRO





DuPont™ IntegraTec™ Ultrafiltration Capabilities



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