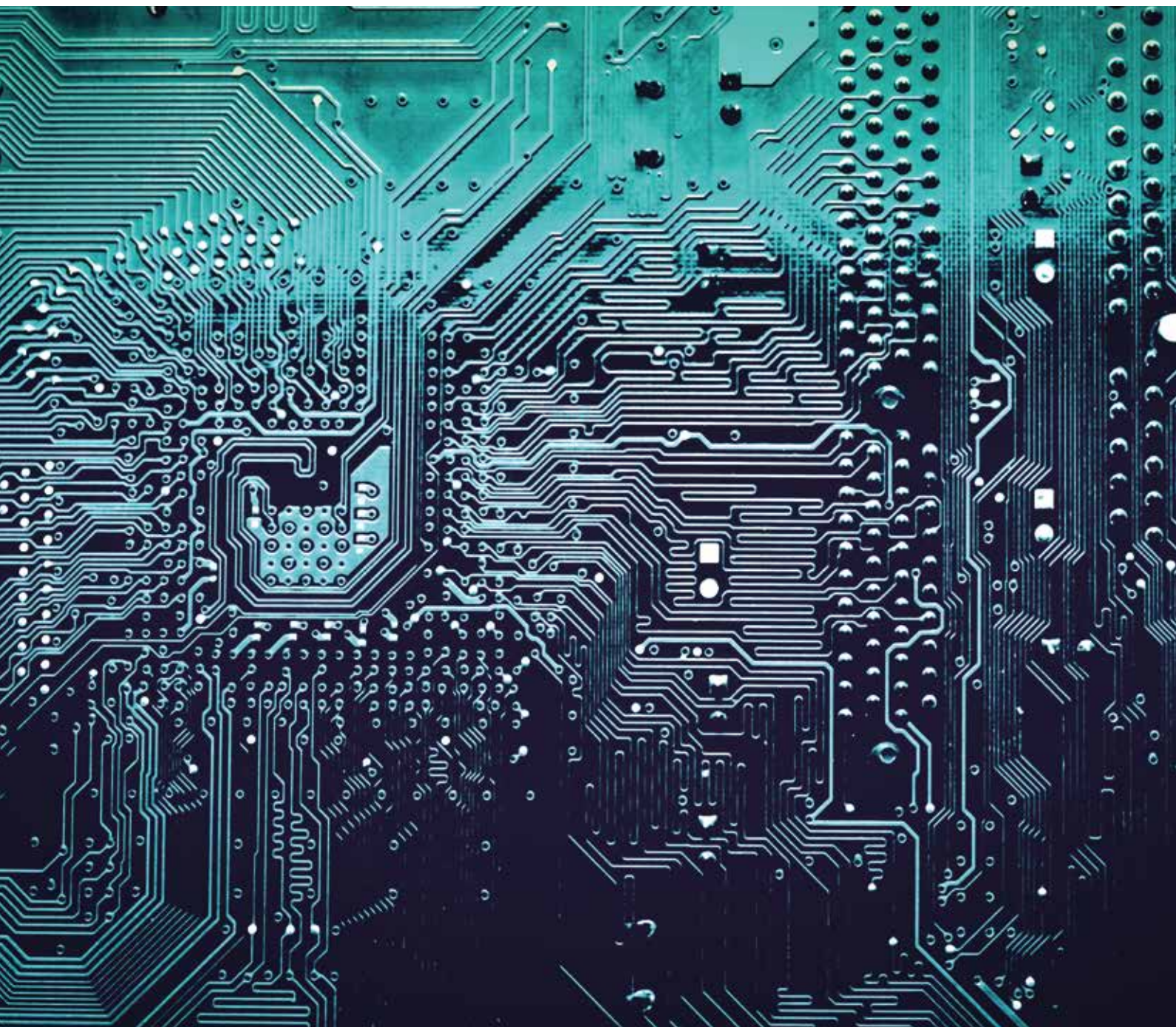


Enabling the high-demand production of today's most popular and advanced microelectronics technologies from water side



Multi-tech from DuPont enables reliable supply of ultrapure water, minimum liquid discharge, and maximum recovery of waste resource

The microelectronics industry counts on water as a key raw material in the fabrication of devices such as semiconductors, flat display panels, photovoltaics, and more. Ultrapure Water (UPW) is the primary cleaning solvent used to rinse away remnants during the production process.

Today's integrated circuits are so complex that even the smallest contaminant can prevent a circuit from functioning properly. Meanwhile, stricter discharge standards and sustainable development concepts have been driving end users to reclaim more wastewater and waste resource to reach the minimum liquid discharge and even zero liquid discharge.

Semiconductor



Flat display panel



Solar PV panel

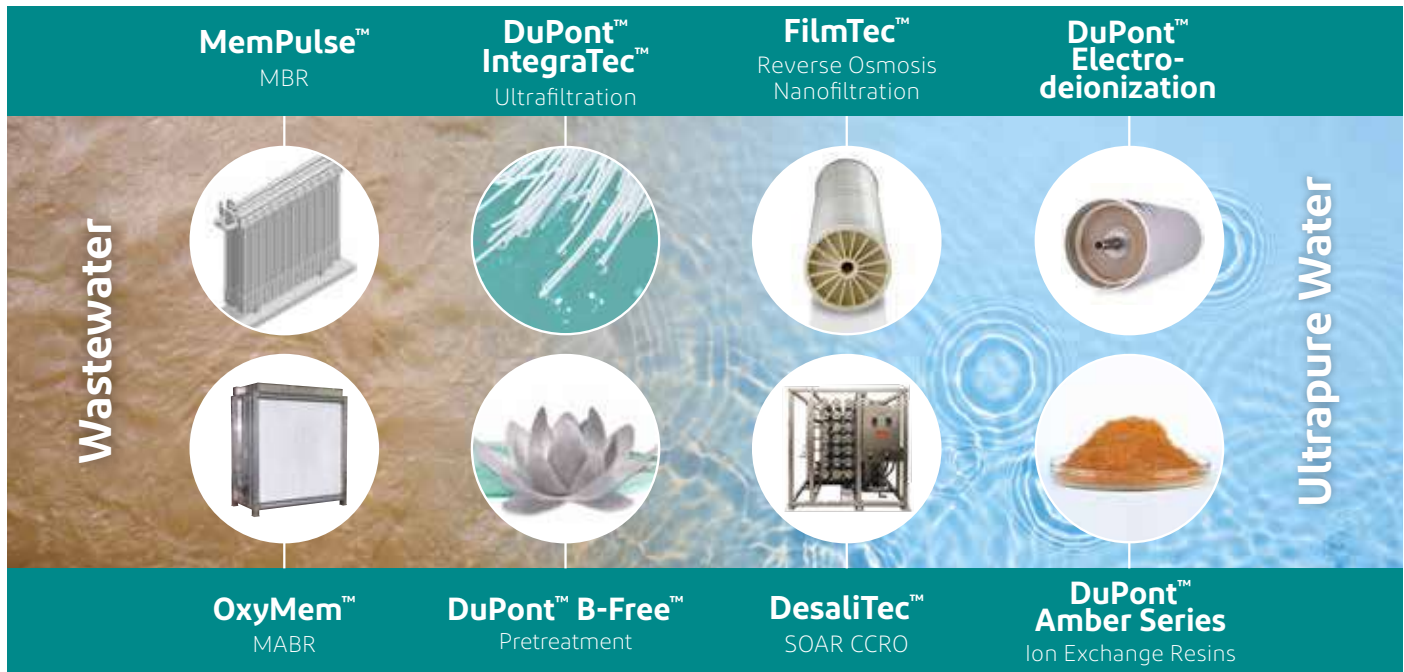


For years, DuPont Water Solutions has been meeting the needs of end users, original equipment manufacturers (OEMs), and service companies around the world. Our experience and multi-tech solutions make us the perfect partner for production of UPW, wastewater treatment and reuse, waste resource recovery through cutting edge Ultrafiltration (UF), Membrane Bioreactors (MBR) & Membrane Aerated Biofilm Reactor (MABR), Reverse Osmosis (RO) & Closed Circuit Reverse Osmosis (CCRO), and Ion Exchange Resin (IER) technologies.



DuPont Water Solutions Portfolio

The broadest in the industry



Expertise Beyond the Product



Design Software

- The industry's first fully integrated modeling software program to integrate our leading technologies – UF, RO, CCRO, IX



Online Normalization Tool

- FT-Norm PRO – makes the normalization process simple to accomplish but robust enough to allow for effective monitoring of UF and RO systems



Webinars

- Water Education Resource
- Provides insight on Application, Technology and Design Best Practices
- 30+ Webinars Available Online



Value Calculators

- Cost Savings Calculator
- DuPont™ B-Free™ Calculator
- Resin Replacement Calculator
- Sustainability Calculator



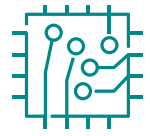
R&D Capabilities

- 4 world-class R&D centers
- Real world testing conditions
- Industrial scale assets
- Best-in-class analytical lab
- Cooperation with key institutions
- Product and application experts
- Customer collaboration projects



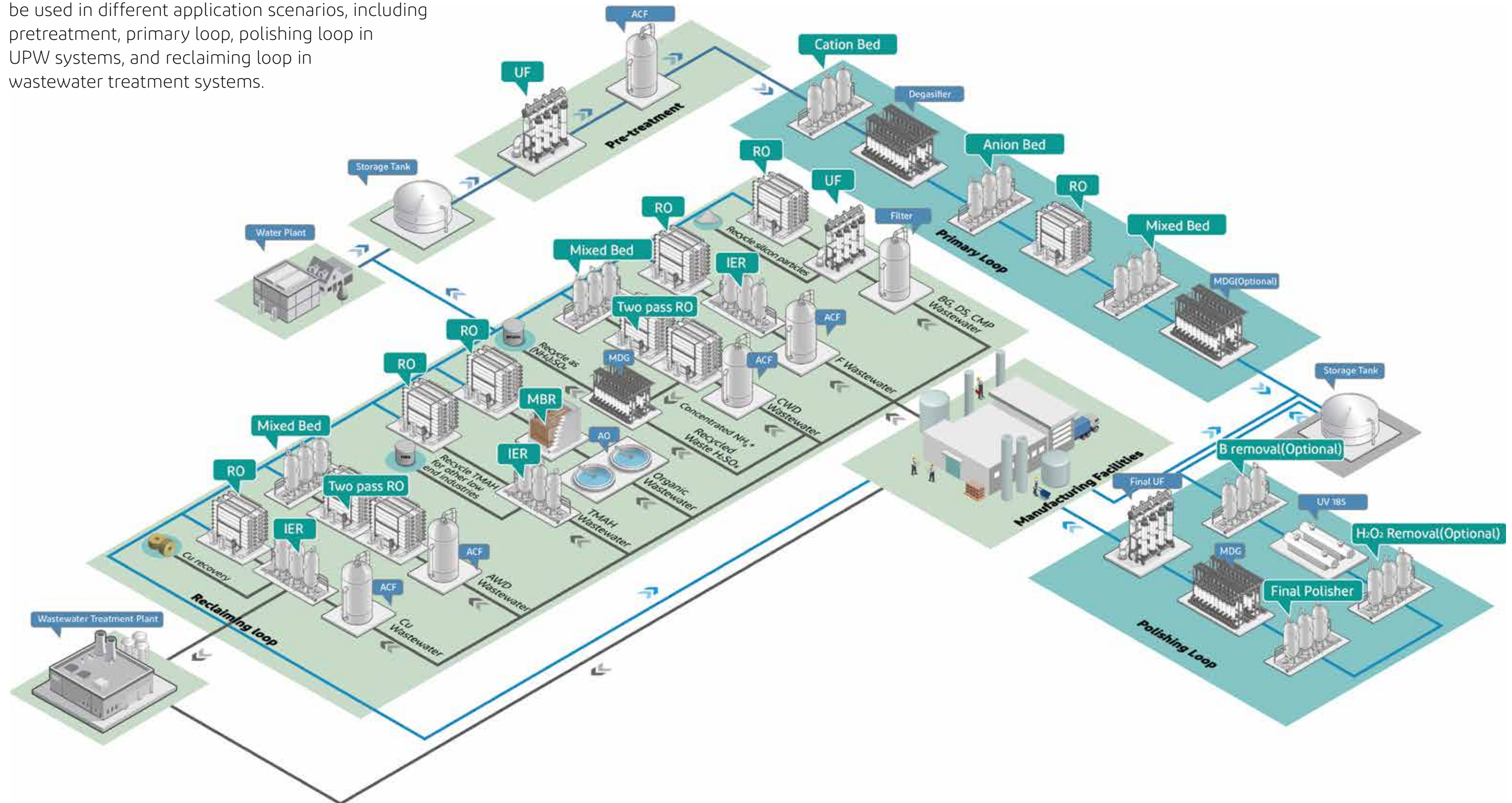
System Optimization Services

- Testing, evaluation, and troubleshooting of IX, RO, NF and UF systems, water analysis
- Suggest corrective actions to enhance system performance
- DuPont™ FilmTec™ Fortilife™ DIRECTOR™, the biofilm quantification method



DuPont Multi-tech Solutions for Microelectronics

Multi-tech solutions from DuPont Water Solutions can be used in different application scenarios, including pretreatment, primary loop, polishing loop in UPW systems, and reclaiming loop in wastewater treatment systems.



UPW pretreatment – Protection of the entire purification line

The removal of hardness or large particles, such as suspended solids and colloids, prior to primary lines are key steps to guarantee the best performance of downstream demineralization treatments.

Ultrafiltration

Compared with multimedia filter (MMF), DuPont™ IntegraTec™ Ultrafiltration (UF) technologies as absolute barriers have proven their excellent performance in reduction of suspended solids, colloids, and algae to better protect the downstream RO system with improved stability and productivity. DuPont enhanced capacity on UF with wide range of UF products from inside-out to outside-in, PES to PVDF, and pressured UF to submerged UF.

DuPont™ IntegraTec™ XP PVDF UF and DuPont™ IntegraTec™ PES UF are very suitable for the pretreatment in UPW systems thanks to the higher stability, higher permeability, and less chemical consumption.

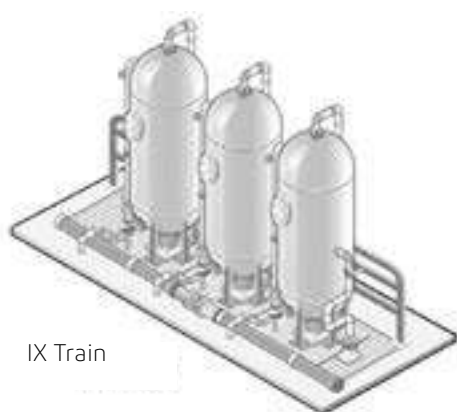


Product Name	Category	Product Name	Category
DuPont™ IntegraTec™ XP 77 IP IG	PVDF UF	DuPont™ IntegraTec™ MB PRO 95 TR	PES UF
DuPont™ IntegraTec™ XP 51 IP IG	PVDF UF	DuPont™ IntegraTec™ MB 80 TR	PES UF
		DuPont™ IntegraTec™ MB 60 TR-S	PES UF

Softening with Ion Exchange Resin

DuPont's softening Ion Exchange Resins (IER) remove the hardness traces to protect and increase the recovery of RO units. DuPont has both strong acid cation (SAC) and weak acid cation (WAC) softening IERs well known for High performance with proven track record. The popular products from DuPont are as below:

Product Name	Category
DuPont™ AmberLite™ HPR1200 Na	SAC
DuPont™ AmberLite™ HPR1210 Na	SAC
DuPont™ AmberLite™ HPR1100 Na	SAC
DuPont™ AmberLite™ HPR8300 H	WAC
DuPont™ AmberLite™ MAC-3 H	WAC



IX Train

UPW primary loop – Removal of dissolved impurities to reach pre-UPW quality

Demineralization with IER

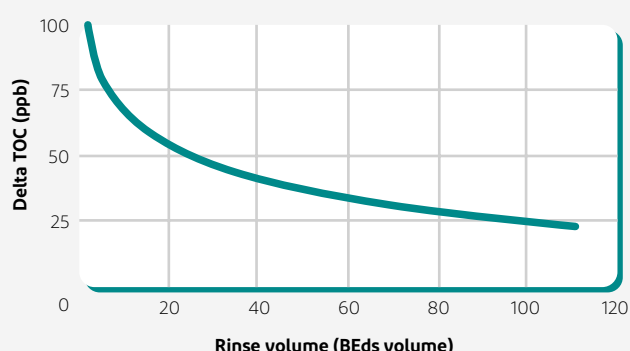
Demineralization with IER has been a very common technology in semiconductor plants since the 1970's. DuPont has selected and developed a special range of IERs from WAC & SAC to weak base anion (WBA) & strong base anion (SBA) enable immediate high-quality water in front of RO units. The popular products from DuPont are as below:



Product Name	Category	Product Name	Category
DuPont™ AmberLite™ HPR8300 H	WAC	DuPont™ AmberTec™ UP9700 or 9600	UP Grade WBA
DuPont™ AmberLite™ MAC-3 H	WAC	DuPont™ AmberLite™ HPR9500	WBA
DuPont™ AmberLite™ HPR1200 H or Na	SAC	DuPont™ AmberLite™ HPR4200 OH or Cl	SBA
DuPont™ AmberLite™ HPR1100 H or Na	SAC	DuPont™ AmberLite™ HPR4800 OH or Cl	SBA

The innovative UP grade WBA DuPont™ AmberTec™ UP9700 have lower TOC leachable to bring significant benefits with up to 97% reduction on rinse water consumption, wastewater discharge, labor and time saving, and no chemical regeneration needed at the start up stage.

UP Grade WBA UP9700 rinse performance



Benefits at start-up stage

97%
Rinse water savings

100%
Chemical savings

97%
Wastewater reduction

97%
Time & Labor savings

Reverse osmosis

DuPont™ FilmTec™ is the inventor of thin film composite reverse osmosis, which is the core of modern RO technology. DuPont™ FilmTec™ RO is famous for its consistent high quality and robustness, which creates lower cost for the entire lifecycle. DuPont can offer different RO products to meet the different needs on rejection, energy consumption, cleanliness, antifouling capability etc.

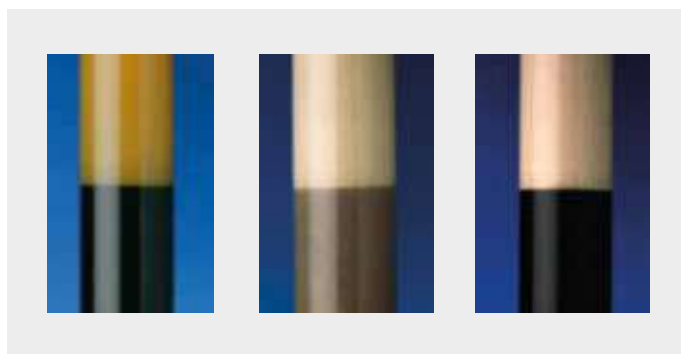


Typical organic removal rejection of SG grade RO

Product name	Key features
DuPont™ FilmTec™ SG30LE PRO-440	Semiconductor grade. High rejection on organics. Lower energy consumption, antifouling design with 28mil LDP spacer
DuPont™ FilmTec™ SG30-400/34i	Semiconductor grade. Higher rejection on organics, antifouling design with 34mil spacer.
DuPont™ FilmTec™ Eco PRO- 440(i)	Lower energy consumption, good salt rejection.
DuPont™ FilmTec™ Eco Platinum-440i	Lower energy consumption, good salt rejection, antifouling design with 28mil LDP spacer
DuPont™ FilmTec™ BW30XHR PRO-440	Extra high salt rejection. Excellent silica, boron, nitrate, TOC, and ammonium rejection
DuPont™ FilmTec™ Fortilife™ CR100	High salt and TOC rejection, anti-fouling module design, especial for anti-bio fouling

Working mixed bed with IER

Mixed bed demineralization creates pre-UPW quality immediately after RO units. DuPont™ AmberTec™ UP grade resins' efficiency and high-performance ratings have been acknowledged by the semiconductor industry for over 25 years. Those UP grade SAC & SBA in below table are specially designed to operate to the highest efficiency in regenerable mixed beds systems. Their state-of-art manufacturing processes make these resins also suitable for polishing mixed bed systems, without any regeneration at start-up.



Product Name	Category	Product Name	Category
DuPont™ AmberTec™ UP1400 H	UP Grade SAC	DuPont™ AmberTec™ UP4000 OH	UP Grade SBA
DuPont™ AmberTec™ UP650 H	UP Grade SAC	DuPont™ AmberTec™ UP550 OH	UP Grade SBA
DuPont™ AmberTec™ UP252 H	UP Grade SAC	DuPont™ AmberTec™ UP900 OH	UP Grade SBA

UPW polishing loop – Elimination of trace contaminants for highest UPW quality

Manufacturing processes in microelectronics have stringent requirements on UPW quality, including resistivity, trace metals, TOC, boron, dissolved oxygen, particles and more.

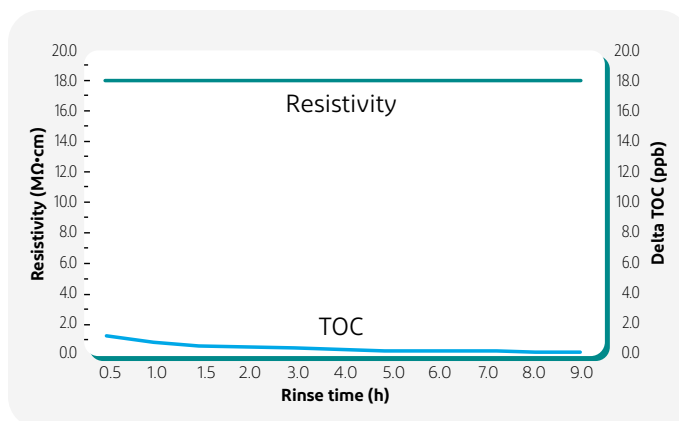
Final polishing mixed bed IER

To reach the higher requirement on resistivity, metal, and TOC, selecting a suitable final polishing mixed bed resin is very important. DuPont™ AmberTec™ final polishing mixed bed (MB) resins are widely recognized due to proven consistent and reliable performance with higher purity. In general, the below final polishing MB resins from DuPont can be selected based on the required UPW quality and practice

Target industry	Key Products
Solar PV panel	DuPont™ AmberTec™ MR-3 LC H/OH DuPont™ AmberTec™ UP6150 H/OH
Display panel	DuPont™ AmberTec™ UP6150 H/OH DuPont™ AmberTec™ MR-300 UPW H/OH* DuPont™ AmberTec™ MR-450 UPW H/OH*
Semiconductor	DuPont™ AmberTec™ UP6040 H/OH DuPont™ AmberTec™ UP6060 H/OH

* This product could be used in some low-end semiconductor market segments. Please consult local DuPont technical representatives if you need more information.

DuPont™ AmberTec™ UP6060 Rinse down performance



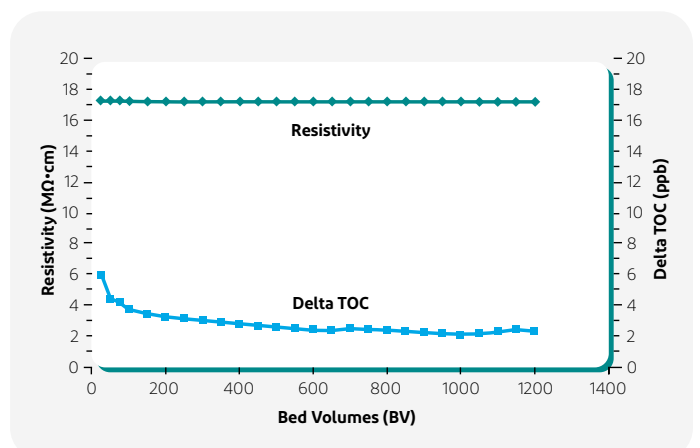
DuPont™ AmberTec™ UP6060 is a new generation final polishing mixed bed to meet the requirement for highest purity for the most advanced technology or stable performance in semiconductor industry. It has extraordinary lower ΔTOC with less than 1ppb after 2-hour UPW rinse. It also enables metal level at point of use reach lower than 0.1ppt.

Boron selective resin

Boron removal resin is needed when the boron concentration in feed water is high or manufacturing process has stringent requirements on boron. DuPont developed the tailored semiconductor grade boron selective resin (BSR) DuPont™ AmberTec™ UP7530 with lower TOC, higher working capacity, and uniform particle size, which can be used in UPW polishing loop. Compared to the current, widely used boron removal process with a semiconductor grade anion (like DuPont™ AmberTec™ UP4000), DuPont™ AmberTec™ UP7530 is expected to have much higher operating capacity which will enable the simplification of the boron removal system design and allow for more reliable performance.

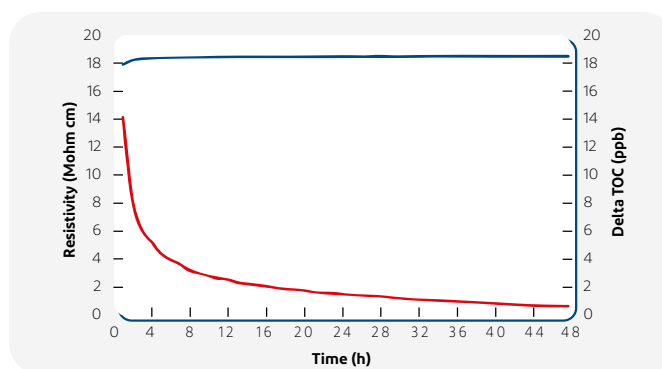
Product	DuPont™ AmberTec™ UP7530	DuPont™ AmberSep™ IRA743
Type	Semiconductor grade uniform	Industrial grade gaussian
Particle Diameter	490 – 590 μm	500–700 μm
Uniformity Coefficient	≤ 1.1	≤1.6
ΔTOC, 24 h	≤ 5ppb	NA
Resistivity, 24 h	≥ 15 MΩ·cm	NA

DuPont™ AmberTec™ UP7530 Rinse down performance



Hydrogen peroxide (H₂O₂) reduction resin

DuPont™ AmberTec™ UP4000Pd OH is a semiconductor-grade, uniform particle size, palladium-doped strong base anion exchange resin. It is specifically designed for the reduction of trace H₂O₂ which is generated as by-product by UV oxidation at polishing loop of ultrapure water (UPW) systems in semiconductor manufacturing plants. This resin provides exceptional high space velocity (SV) thanks to the rapid kinetics for reduction reaction. The high purity with lower TOC, metal and Cl⁻ enables the application in final polishing loop.



Wastewater treatment – Maximizing the value of wastewater

A large amount of water is consumed and discharged in the microelectronic industry. To save water and achieve sustainable growth, the industry has been eager to reclaim wastewater generated from various manufacturing processes. DuPont developed 3R (Recycle, Reuse, Reduce) wastewater treatment solutions to achieve the benefits below.

Benefits to customers



RECYCLE

Waste resources:
Cu/TMAH/NH₃



REUSE

Wastewater to
production facilities



REDUCE

Hazardous pollutants
discharged

The following are some examples for wastewater treatment in wafer fabrication plant with technologies from DuPont

BG (Back grinding) wastewater, DS (Dicing Saw) wastewater and CMP (Chemical Mechanical Polishing) wastewater

- DuPont™ IntegraTec™ XP PVDF and Multibore® PES 1.5mm UF have proven performance to reduce the fine silica particles in BG, DS and CMP wastewater.

CWD (Caustic Wastewater Drain), HFD (Diluted HF Drain) with NH₃/NH₄⁺

- DuPont™ FilmTec™ RO can be used to reduce the TDS and concentrate the NH₄⁺. DuPont™ FilmTec™ Eco PRO-440 and BW30XHR PRO-440 are good options.

AWD (Acid Wastewater Drain)

- DuPont™ FilmTec™ RO can be used to reduce the TDS after proper pretreatment. DuPont™ FilmTec™ Eco PRO-440 and BW30XHR PRO-440 are good options.

TMAH (Tetra-Methyl Ammonium Hydroxide) wastewater

- DuPont™ AmberLite™ high-capacity WAC resins have proven performance to recycle TMAH from wastewater.

Organic Wastewater

- DuPont™ MEMCOR® MBR can be used in organic wastewater biological treatment.
- DuPont™ FilmTec™ Fortilife™ CR100 and CR200 are suitable to reduce TDS and organics thanks to higher anti-fouling fouling capability.

Metal wastewater

- Chelating resin DuPont™ AmberSep™ IRC748 and DuPont™ AmberSep™ M4195 can separate Cu from wastewater.

Learn more about our products for different water treatment systems in microelectronics by visiting our product finder at our website [Solving Water Challenges \(dupont.com\)](https://www.dupont.com/solving-water-challenges)



Water Solutions

www.dupontwatersolutions.com

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