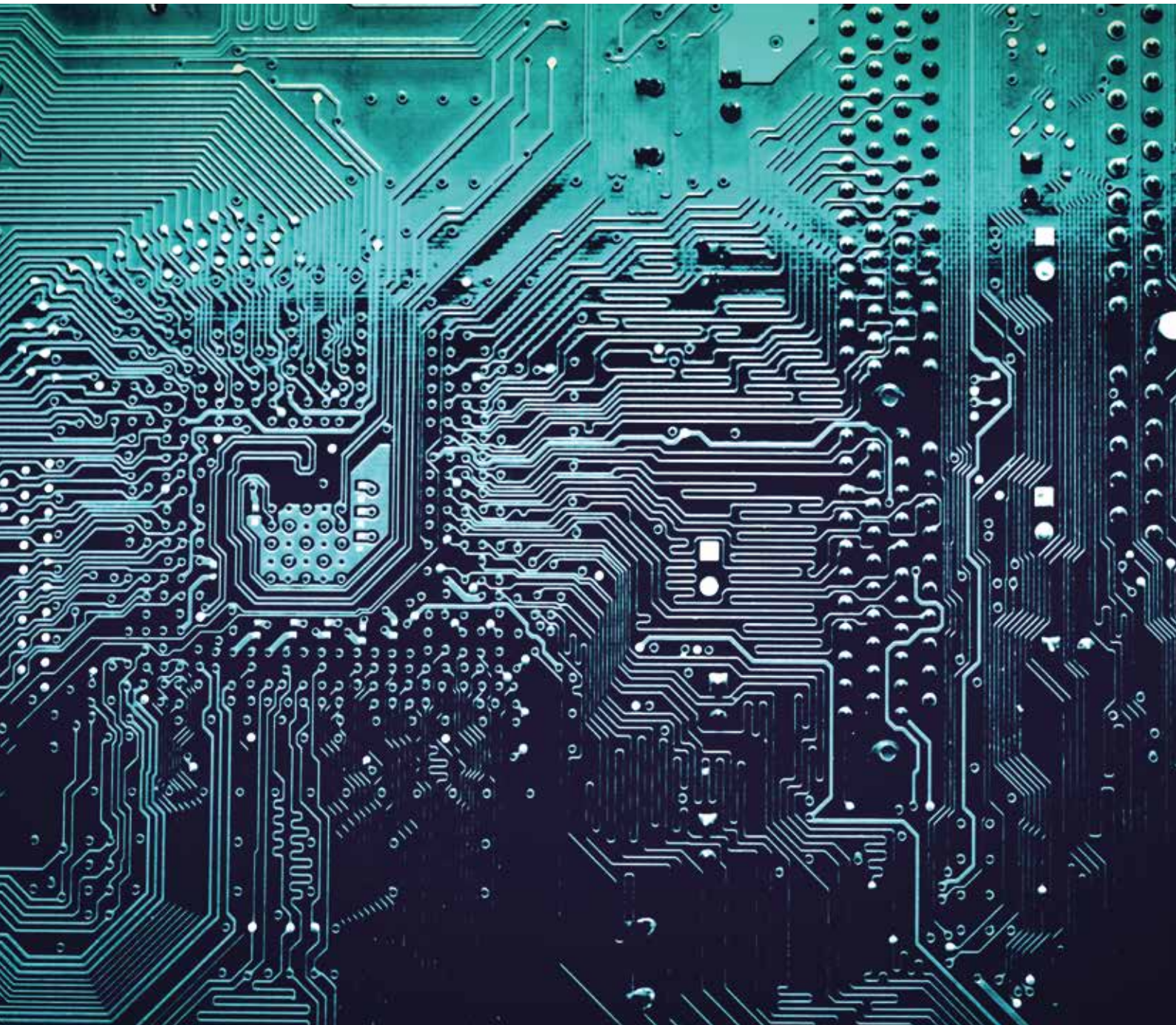
Water Solutions

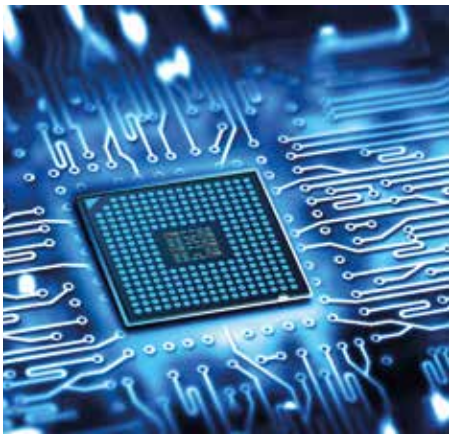
Enabling the high-demand production of today's most popular and advanced microelectronics technologies from water side



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.

Semiconductor

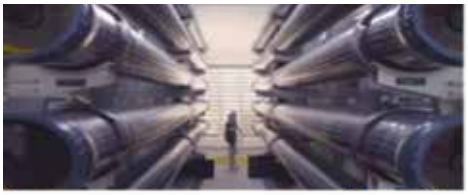


Flat display panel

Solar PV panel

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.

Reverse Osmosis



Ion Exchange Resins

Ultra Filtration

Closed Circuit Reverse Osmosis

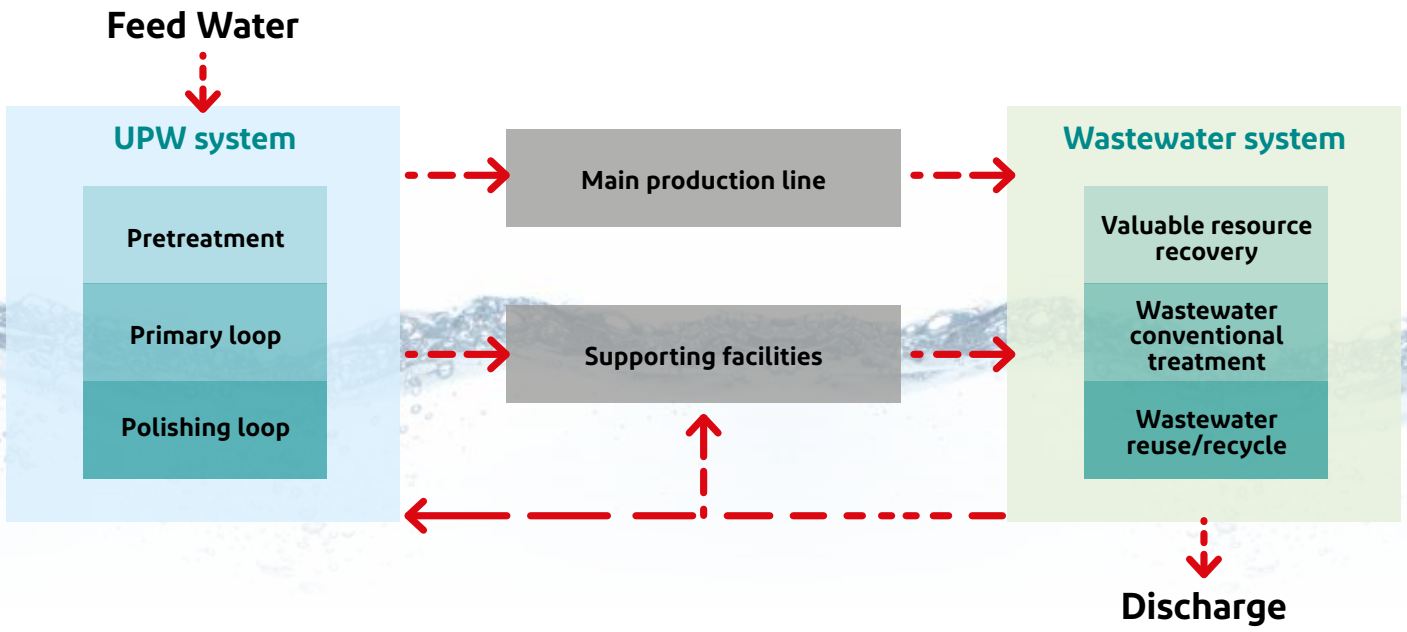
Membrane Bioreactor

Membrane Aerated Biofilm Reactor

Membrane Digasification

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), membrane degasification (MDG), reverse osmosis (RO) & Closed Circuit Reverse Osmosis (CCRO), and ion exchange resin (IER) technologies.

Water treatment systems in microelectronics industries



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 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. Now, DuPont has the enhanced capacity on UF with widest range of UF products from inside-out to outside-in, PES to PVDF, and pressured UF to submerged UF.

IntegraFlux™ XP PVDF UF and dizzer® Multibore® 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
IntegraFlux™ SFP-2880XP	PVDF UF	dizzer® XL 0.9 MB 80 W	PES UF
IntegraPac™ IPD-77XP Skid	PVDF UF	T-Rack® skid	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 on the right:

Product Name	Category
AmberLite™ HPR1200 Na	SAC
AmberLite™ HPR1300 Na	SAC
AmberLite™ HPR8300 H	WAC
AmberLite™ MAC-3 H	WAC

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

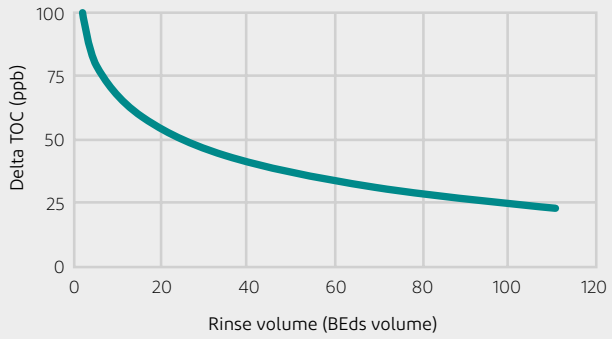
Demineralization with IER

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
AmberLite™ HPR8300 H	WAC	AmberTec™ UP9700/9600	UP Grade WBA
AmberLite™ MAC-3 H	WAC	AmberLite™ HPR9500	WBA
AmberLite™ HPR1200 H	SAC	AmberLite™ HPR4200 OH	SBA
AmberLite™ HPR1100 H	SAC	AmberLite™ HPR4800 OH	SBA

The innovative UP grade WBA 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

Demin systems with IER

IX Train

CO_2 removal with MDG

MDG is a more efficient way to remove gas from water compared with a traditional degassing tower. DuPont Ligasep™ modules have higher removal rate on CO_2, smaller footprint, and higher cleanliness. It can be used between cation and anion bed, before the working mixed bed or EDI.

Product Name	Category	Product Name	Category
Ligasep™ LDM-040-HS	MDG	Ligasep™ LDM-120-HS	MDG

Reverse osmosis

DuPont FilmTec™ is the inventor of thin film composite reverse osmosis (RO) element, which is at the core of modern RO technology. FilmTec™ RO is famous for its reliable performance, which creates lower cost for the whole lifecycle. RO is used to remove TDS and organic matters. DuPont developed tailored semiconductor grade (SG) RO with higher rejection of lower molecular organics and accelerated total organic carbon (TOC) rinse down. DuPont's ECO series RO products have leading performance with lower energy consumption and high quality permeate water. Fortilife™ CR100 is the best choice for challenging feed water with high potential for biofouling. FilmTec™ BW30HR-440(i) is suitable for the needs of higher salt rejection.

Product Name	Category	Product Name	Category
FilmTec™ SG30LE-440i	SG Grade RO	FilmTec™ ECO PRO-440(i)	Low Energy RO
FilmTec™ SG30-400/34i	SG Grade RO	FilmTec™ ECO PLATINUM-440(i)	Low Energy RO
FilmTec™ Fortilife™ CR100	Antifouling RO	FilmTec™ BW30HR-440(i)	High Rejection RO

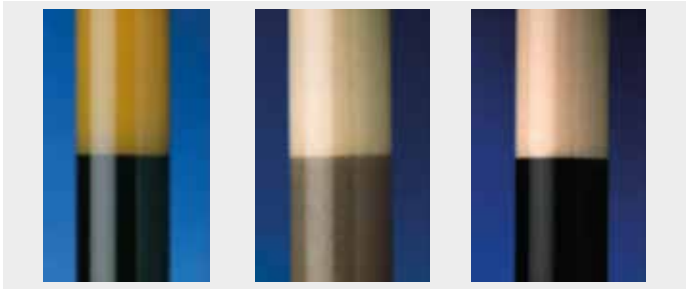
Typical organic removal rejection of SG grade RO

Organic compound	MW	Rejection (%) SG30-400/341[1]	Rejection (%) SG30LE-440i[2]
Methanol	32	14	13
Ethanol	46	50	40
Acetone	58	68	48
Isopropanol	60	95	92

Test conditions:
1) Feed concentration 10ppm, 214 psi (1.47 MPa), 25°C, pH7 and 15% recovery.
2) Feed concentration 10ppm, 107 psi (0.47 MPa), 25°C, pH7 and 15% recovery.

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
AmberTec™ UP1400 H	UP Grade SAC	AmberTec™ UP4000 OH	UP Grade SBA
AmberTec™ UP650 H	UP Grade SAC	AmberTec™ UP550 OH	UP Grade SBA
AmberTec™ UP252 H	UP Grade SAC	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.

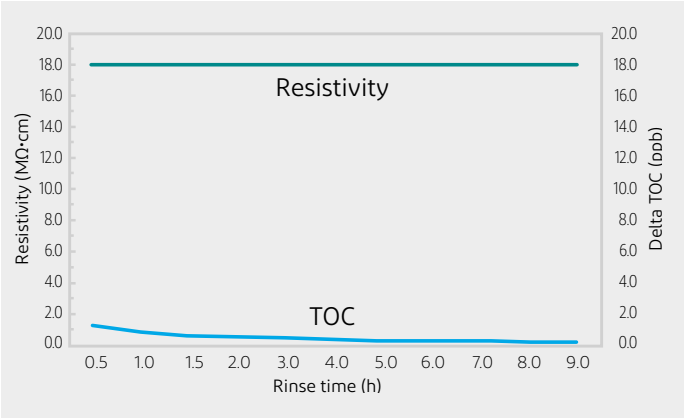
Final polishing mixed bed IER

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

Industry	Key Products
Photovoltaics	AmberTec™ MR-3 LC H/OH AmberTec™ UP6150 H/OH
Display Panels	AmberTec™ UP6150 H/OH AmberTec™ MR-300 UPW H/OH*
Semiconductor	AmberTec™ MR-450 UPW H/OH AmberTec™ UP6040 H/OH AmberTec™ UP6060 H/OH

* The product could be used in some semiconductor applications. Please consult local DuPont technical representatives if you need more information.

AmberTec™ UP6060 Rinse down performance



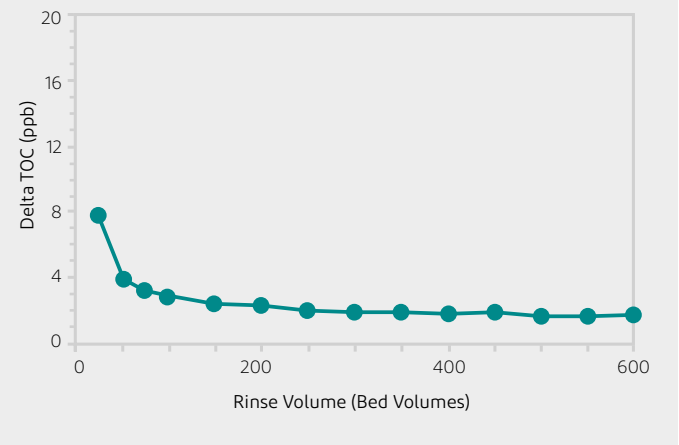
AmberTec™ UP6060 is a new generation final polishing mixed bed to meet the requirement for highest purity for the most advanced technology or stable performance in semiconductor industry. It has extraordinary lower ΔTOC with less than 1ppb after 2-hour UPW rinse. It also enables metal level at point 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) 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 AmberTec™ UP4000), 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 name	Category
AmberTec™ UP7530	UP Grade BSR

AmberTec™ UP7530 Rinse down performance



O_2 removal with MDG

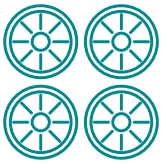
For oxygen removal in UPW water, MDG is widely used. The unique skinned semi-dense and genuine gas permeable membrane in DuPont Ligasep™ simplifies the system design and allows for better performance with less or no nitrogen supply in oxygen removal systems.

Product name	Category
Ligasep™ LDM-040-LS	MDG
Ligasep™ LDM-120-LS	MDG

Wastewater treatment – Maximizing the value of wastewater

A large amount of water is consumed in the microelectronic industry. To save water and achieve sustainable business development, the industry has been keen to reclaim wastewater generated from various manufacturing processes.

Depending on the origin of wastewater composition and concentrations, suitable products and treatment processes can vary greatly. Different technologies and products from DuPont are being used to reclaim the wastewater or valuable matters in wastewater.



Reverse osmosis (RO)

RO has been extensively utilized to reduce impurities prior to recycling back to the feed water of UPW or for reuse as utility water. Based on the feed water characteristics and customer needs, different RO products from DuPont FilmTec™ can be used.

- FilmTec™ ECO series RO elements are suitable for wastewater with lower fouling potential and lowest operational cost.
- FilmTec™ Fortilife™ CR series RO elements are suitable for wastewater with higher fouling potential and required higher permeate quality.
- FilmTec™ Fortilife™ XC series RO elements are for high recovery reclaim and reuse RO systems intended to treat the RO brine up to a TDS concentration of 70,000 – 80,000 ppm. These elements are intended for high fouling high salinity processes where reliability and cleaning frequency are high priorities.
- DuPont's patented CCRO solution brings the industry a step change in filtration performance which provides high recovery (typically 90 – 98%) for performance, cost, and remote/maintenance free operations.

Ion exchange resin, UF, MBR and MDG

Ion exchange resins, ultrafiltration, and membrane degasification technologies are also adopted to reuse water and/or recycle resources from wastewater. The following are some examples:

- Separation of Copper from wastewater with chelating resin AmberSep™ IRC748 and AmberSep™ M4195
- Separation of Tetra-methyl ammonium hydroxide (TMAH) from wastewater with high performance weak acid cation (WAC) resins, such as AmberLite™ HPR8400 and HPR8300.
- Separation of fine particles from dicing saw (DS), back grinding (BG), and chemical mechanical polishing (CMP) wastewater with UF products from DuPont. DuPont IntegraFlux™ and dizzer® XL UF modules with high physical strength fibers are best choices for those high SS wastewater treatment.
- Enhance organic wastewater reuse by membrane bioreactor (MBR) from DuPont MEMCOR®.
- Remove ammonia from caustic wastewater by DuPont Ligasep™ membrane degasification modules.

Picture credits: istock, DuPont

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