WATER TREATMENT AT POWER PLANT

# Boiler Make-Up Water
## Product Recommendations

Boiler feedwater is generally the blend of returned steam condensate and fresh make-up water that is added to replace the volume escaping as steam or discharged as blowdown. Depending on technology preference, region, water source, and boiler type, a variety of technologies may be required to treat make-up water before it enters the steam loop. DuPont has the widest range of products available to pretreat (UF), demineralize (RO and IX), and polish (IX) make-up water to protect your equipment from scaling and corrosion.

### Membrane Technologies

| TECHNOLOGY | PRODUCT | APPLICATION | FEATURES AND RECOMMENDED USES |
|---|---|---|---|
| ULTRAFILTRATION MODULE AND SKID | IntegraFlux™ SFP-2880XP | Suspended Solids Removal | High-permeability and high-mechanical strength hollow fiber polyvinylidene fluoride (PVDF) membranes. The modules provide excellent performance, industry leading membrane area with low energy and chemical consumption. XP fiber provides up to 35% higher permeability than previous generation modules, improving operating efficiencies and productivity. |
| | Ultrafiltration SFP-2880 | | High-mechanical strength hollow fiber PVDF membranes. The modules provide excellent performance with industry-leading membrane area. |
| | IntegraPac™ IP-77XP | | The skids are pre-engineered, standardized, and ready to assemble. Comprising IntegraPac™ Modules (standard and XP fiber), auxiliary parts, and piping, the skids can significantly streamline design, assembly, and installation. Flexible sizing with 6 – 22 modules per skid. |
| | IntegraPac™ IP-77 | | |
| NANOFILTRATION ELEMENTS | FilmTec™ NF270-400/34 | Softening | A product suitable for removal of a high percentage of total organic carbon (TOC) and with medium- to high-salt passage and medium hardness passage at very low operating pressures. |
| | FilmTec™ NF90-400/34 | Softening/ Partial Demineralization | A product suitable for high hardness removal and partial monovalent ion passage at low operating pressures. |
| REVERSE OSMOSIS ELEMENTS | FilmTec™ Eco Pro-440 | Demineralization from Controlled Feedwater Source (Municipal/High Quality/2nd-pass RO) | State-of-the-art solution to deliver high salt rejection at low operating pressure, reducing CAPEX and OPEX. |
| | FilmTec™ BW30HR-440 | | Very high rejection proven at broad Total Dissolved Salts (TDS) range, coupled with reduced footprint installations. |
| | FilmTec™ BW30HRLE-440 | | Delivers low operating pressure coupled with a good permeate purity. |
| | FilmTec™ BW30-400 | | Established industry reference product providing consistent, high performance and long element life with decades of proven performance. |
| | FilmTec™ Fortilife™ CR100 | Demineralization from Challenging Feedwater Source (Surface Water/ Wastewater) | State-of-the-art solution to tackle tough fouling coupled with excellent salt rejection. |
| | FilmTec™ Eco Pro-400 | | State-of-the-art solution to deliver high salt rejection at low operating pressure, reducing CAPEX and OPEX. |
| | FilmTec™ BW30XFR-400/34 | | Established high fouling resistance and fouling removal efficiency coupled with very high rejection proven at broad TDS range. |
| | FilmTec™ BW30XFRLE-400/34 | | Improved fouling resistance as well as efficiency of element´s cleaning combined with low energy consumption and good water purity. |
| | FilmTec™ BW30-400/34 | | Consistent and reliable high operational performance coupled with increased productivity compared to BW30-365. |
| | FilmTec™ BW30-365 | | Established industry reference product providing consistent, high performance and long element life with decades of proven performance. |
| | FilmTec™ SW30XHR-440 | Seawater Desalination from Controlled Feedwater Source (Well, UF Pretreated) | Highest rejection seawater RO element enabling stringent water quality requirements. |
| | FilmTec™ SW30HRLE-440 | | High rejection at sustainable lower lifecycle cost for medium- and high-salinity feedwaters. |
| | FilmTec™ SW30XLE-440 | | Advanced combination of productivity and rejection resulting in a low energy seawater element, enabling lowest operation cost. |
| | FilmTec™ SW30ULE-440 | | An advanced combination of high productivity and high rejection for medium-salinity and medium-temperature feedwaters with extra-low energy consumption. |
| | FilmTec™ SW30XHR-400 | Seawater Desalination from Challenging Feedwater Source | Highest rejection seawater RO element enabling stringent water quality requirements. |
| | FilmTec™ SW30HRLE-400 | | High rejection at sustainable lower lifecycle cost for medium- and high-salinity feedwaters. |
| | FilmTec™ SW30HRLE-370/34 | | Durable, high-rejection, high-productivity seawater element, helping to support smooth operations and low cost of water. |
| | FilmTec™ SW30XLE-400 | | Advanced combination of productivity and rejection resulting in a low energy seawater element, enabling lowest operation cost. |
| | FilmTec™ SW30ULE-400 | | Medium-salinity and medium-temperature feedwaters provide an advanced combination of high productivity and high rejection through extra-low energy consumption. |

## Ion Exchange Technology

DuPont manufactures a wide array of premium ion exchange resins designed for the highest performance in the most sophisticated ion exchange systems including Amberpack™ and Upcore™ Packed and Layered Beds, and polishing mixed beds. All of these resins have a low uniformity coefficient and are sized for their promoted use. They have exceptional stability, capacity, and contaminant removal capability. The table below lists DuPont's premium ion exchange resins for Industrial Water Treatment along with their recommended uses. Use this table as a guideline to select the best ion exchange resins the industry has to offer.

| AmberLite™ RESIN PRODUCTS | APPLICATION | TYPE | PARTICLE SIZE DISTRIBUTION | MATRIX | COPOLYMER | SYSTEM DESIGN | | | | | FEATURES AND RECOMMENDED USES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO-CURRENT | COUNTER-CURRENT | LAYERED BEDS | PACKED BEDS | MIXED BEDS | |
| **HIGH PERFORMANCE RESINS** | | | | | | | | | | | |
| HPR1100 Na | Softening | SAC | UPS | G | S | ● | ● | | ● | | Softening resin with excellent physical stability and low rinse profile. |
| HPR1200 H | Demineralization Mixed Bed Polishing | SAC | UPS | G | S | ● | ● | | ● | ● | Designed to be the go-to, high-quality SAC resin. |
| HPR1200 Na | Softening | SAC | UPS | G | S | ● | ● | | ● | ○ | |
| HPR1300 H | Demineralization Mixed Bed Polishing | SAC | UPS | G | S | ● | ● | ● | ● | ● | High strength resin. Good for layered beds and mixed beds for polishing and pure water applications when very low sodium leakage and conductivity is a chief concern. |
| HPR1300 Na | Softening | SAC | UPS | G | S | ● | ● | ● | ● | ○ | |
| HPR650 H | Demineralization Mixed Bed Polishing | SAC | UPS | G | S | ● | ● | ● | ● | ● | High-solids SAC ideally suited for use in polishing mixed beds when highest resin purity and water quality are required. |
| HPR4200 Cl | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | ● | ● | ○ | Designed to be the go-to, high-quality SBA resin. Good balance of capacity, strength, and silica leakage. |
| HPR4200 OH | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | ● | ● | ● | |
| HPR4700 OH | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | | ● | ● | High-capacity, high-solids SBA resin with rapid kinetics. Excellent selectivity for silica makes it an ideal choice for post-RO mixed bed. |
| HPR4700 Cl | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | | ● | ○ | |
| HPR550 OH | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | | ● | ● | High-capacity, high-solids SBA resin with rapid kinetics designed specifically for use in polishing mixed beds when highest resin purity and water quality are required. Excellent selectivity for silica makes it an ideal choice for post-RO mixed bed. |
| HPR550 Cl | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | | ● | ○ | |
| HPR4580 Cl | Demineralization | SBA | Graded | G | A | ● | ● | ● | ● | | High operating capacity, good physical stability, and organic fouling-resistant acrylic SBA. |
| HPR4780 Cl | Demineralization | SBA | Graded | G | A | ● | ● | | ● | | Dual-flunctional (WBA+SBA) resin with extremely high operating capacity, efficiency, and organic fouling resistance. |
| HPR4800 Cl | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | | ● | ○ | High-quality SBA resin with excellent capacity and rinse characteristics. |
| HPR4800 OH | Demineralization Mixed Bed Polishing | SBA | UPS | G | S | ● | ● | | ● | ● | |
| HPR4811 Cl | Demineralization Scavenging | SBA | UPS | G | S | ● | ● | | ● | | High capacity gel SBA resin for use with high organic waters without the temperature limitations of acrylic resins. |
| HPR4100 Cl | Demineralization Dealkalization | SBA II | UPS | G | S | ● | ● | | ● | | The go-to, uniform, Type II SBA resin. |
| HPR6700 | Demineralization | WBA | Graded | G | A | ● | ● | | ● | | Very high-capacity WBA with exceptional physical stability and organic fouling resistance. |
| HPR7000 | Demineralization | WBA | Graded | G | A | ● | ● | | ● | | High-capacity WBA with exceptional physical stability, organic fouling resistance, and good rinse-down characteristics. |
| HPR2900 H | Demineralization | SAC | UPS | M | S | ● | ● | | ● | | High physical stability for harsh applications such as appreciable oxidative potential or high temperatures. |
| HPR2900 Na | Softening | SAC | UPS | M | S | ● | ● | | ● | | |

Key: SBA = Strong Base Anion WBA = Weak Base Anion SAC = Strong Acid Cation

G = Gel resins M = Macro resins PE = Polyethylene PP = Polypropylene S = Styrenic A = Acrylic

● = Recommended ○ = Alternative



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| AmberLite™ RESIN PRODUCTS | APPLICATION | TYPE | PARTICLE SIZE DISTRIBUTION | MATRIX | COPOLYMER | SYSTEM DESIGN | | | | | FEATURES AND RECOMMENDED USES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO-CURRENT | COUNTER-CURRENT | LAYERED BEDS | PACKED BEDS | MIXED BEDS | |
| **HIGH PERFORMANCE RESINS** | | | | | | | | | | | |
| HPR8300 H | Softening Dealkalization Demineralization | WAC | Graded | M | A | ● | ● | ● | ● | | High-capacity dealkalization and softening resin with demonstrated improved operating capacity versus other WACs, available in both H- and Na-form operation. |
| HPR8400 H | Softening Dealkalization Demineralization | WAC | Graded | M | A | ● | ● | | ● | | High-capacity dealkalization and softening resin allowing low pressure drop in high-velocity operations. |
| HPR9200 Cl | Demineralization Mixed Bed Polishing | SBA | UPS | M | S | ● | ● | | ● | ○ | Exceptional physical stability, resistance to osmotic shock, and well-suited for use in demineralization of high-organic waters. |
| HPR9100 Cl | Demineralization | SBA II | UPS | M | S | ● | ● | ○ | ● | | High resistance to organic fouling and physical stresses with improved operating capacity compared to Type I macro SBA and increased resin lifetime in operation compared to a gel Type II resin. |
| HPR9500 | Demineralization | WBA | UPS | M | S | ● | ● | ● | ● | | Displays excellent thermal stability, 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 an OH-form strong base anion in layered bed systems. |
| HPR9600 | Demineralization | WBA | UPS | M | S | ● | ● | ● | ● | | Combines excellent physical and thermal stability, good organic fouling resistance, and high kinetics, yielding good operating capacity even in low-temperature operations. |
| HPR9700 | Demineralization | WBA | Graded | M | S | ● | ● | | ● | | Combines excellent physical and thermal stability, good organic fouling resistance, and allows low pressure drop in high-velocity operations. |
| HPR2800 H | Demineralization Mixed Bed Polishing | SAC | UPS | M | S | ● | ● | ● | ● | ● | High physical stability for harsh applications such as demineralization systems involving appreciable oxidative potential or high temperatures. Allows low pressure drop in high-velocity operations and optimized for separability in mixed beds. |
| HPR9000 OH | Demineralization Mixed Bed Polishing | SBA | UPS | M | S | ● | ● | | ● | ● | Specifically designed for use in regenerable mixed beds when highest resin purity and water quality are required. Exceptional resistance to surface fouling as well as physical, osmotic, and oxidative stresses, which allows increased resin lifetime in operation. |
| HPR9000 $SO_4$ | Demineralization Mixed Bed Polishing | SBA | UPS | M | S | ● | ● | | ● | ● | |
| 14i | Demineralization | Inert | Gaussian | – | PP* | | ○ | ○ | ● | | Floating inert resin specifically designed for use as an upper layer in down-flow regenerated ion exchange systems, such as floating beds. |
| 62i | Softening Demineralization | Inert | Gaussian | – | PE* | | ○ | ○ | ● | | Floating inert resin with properties specifically designed for use as an upper layer in up-flow regenerated ion exchange systems, such as Upcore™ Packed Bed Systems. |
| 600i | Mixed Bed Polishing | Inert | UPS | G | A | | | | | ○ | Non-functionalized bead designed to create an inert zone between the functional resins in mixed beds. |
| SCAV1 | Scavenging | | Gaussian | G | A | ● | | | | | Removal of hydrophobic and hydrophilic NOM species for high free mineral acidity (FMA) waters at acidic pH. Best used with waters with medium- to high-TDS when the ratio of TOC to sulfate (ppm C / meq $SO_4$) is less than 3. |
| SCAV2 | Scavenging | | Gaussian | G | A | ● | | | | | Removal of high-load hydrophilic and hydrophobic NOM for low free mineral acidity waters at acidic pH. Best used with waters with low- to medium-TDS when the ratio of TOC to sulfate (ppm C / meq $SO_4$) is greater than 3. |
| SCAV3 Cl | Scavenging Demineralization | | Gaussian | M | S | ● | | | | | 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. |
| SCAV4 Cl | Scavenging Demineralization | | Gaussian | M | A | ● | | | | | 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. It is the go-to organic scavenger for the bulk removal of NOM, and especially useful as RO pretreatment. |

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* This is a polymer, not a copolymer.



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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO-CURRENT | COUNTER-CURRENT | LAYERED BEDS | PACKED BEDS | MIXED BEDS | |
| **GENERAL PURPOSE RESINS** | | | | | | | | | | | |
| IRC120 H | Demineralization | SAC | Gaussian | G | S | ● | | | | | General-purpose, durable resin offers a good balance of capacity and strength resulting in long lifetime for co-flow regenerated systems. |
| IRC120 Na | Softening | SAC | Gaussian | G | S | ● | | | | | |
| IRA402 Cl | Demineralization | SBA | Gaussian | G | S | ● | | | | | This industry-staple resin is designed to provide excellent balance of properties for capacity, strength, silica selectivity, and a long lifetime for co-flow regenerated systems. |
| IRA458 Cl | Demineralization | SBA | Gaussian | G | A | ● | | | | | Offers a good balance of high capacity and high strength for co-flow regenerated systems. |
| IRA410 Cl | Demineralization Dealkalization | SBA II | Gaussian | G | S | ● | | | | | General-purpose Type II SBA used for general demineralization where high operating capacity is needed. |
| IRA67 | Demineralization | WBA | Gaussian | G | A | ● | | | | | Very high capacity WBA with exceptional physical stability and organic fouling resistance. |
| IRC200 Na | Softening | SAC | Gaussian | M | S | ● | | | | | Highest physical stability for harsh applications such as hot process softeners, sodium-cycle or amine-cycle condensate treatment, and other systems involving appreciable oxidative potential or high temperatures. |
| IRC83 H | Softening Dealkalization Demineralization | WAC | Gaussian | M | A | ● | | | | | General-purpose, high-capacity dealkalization and softening resin with improved operating capacity demonstrated in high-TDS Na-form operation. |
| IRA900 Cl | Demineralization Scavenging | SBA | Gaussian | M | S | ● | | | | | Industry-staple macro SBA resin designed to provide a long lifetime for co-flow regenerated systems in variety of applications when resistance to organic fouling and physical stress is needed. |
| IRA910 Cl | Demineralization Dealkalization | SBA II | Gaussian | M | S | ● | | | | | High resistance to organic fouling and physical stresses with improved operating capacity compared to Type I macro SBA and increased resin lifetime in operation compared to a gel Type II resin. |
| IRA96 | Demineralization | WBA | Gaussian | M | S | ● | | | | | General-purpose WBA combining excellent physical and thermal stability, good organic fouling resistance. |

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