Ion Exchange and Adsorbent Solutions for the Nutrition Market

Food matters. DuPont makes it better.
Reliability, Value, and Innovation

DuPont is the largest manufacturer of ion exchange resins worldwide. Our comprehensive product line, technical expertise, and global reach allow for optimized performance of even the most complex manufacturing processes. With continuous investment in product innovation and manufacturing excellence, we have global expertise in serving the food processing industry.

DuPont consistently offers:
• **Reliability** – capital investment in worldwide production facilities to supply increasing global demand and offer leading quality, global service, and support.
• **Value** – products designed for applications that help lower operating costs and increase throughput, yield, and product quality.
• **Innovation** – R&D focused on delivering innovative products to maximize plant performance.
Sweeteners – pg 4-9
Corn and Starch
Deashing and Polishing
Chromatography
Decolorization
Enzymatic Immobilization
Beet Sugar
Softening
Chromatography
Cane Sugar
Decolorization

Beverages – pg 10-11
Citrus Debittering
Juice Deacidification
Juice Decolorization
Protein Haze Stabilization

Food Additives & Nutritionals – pg 12-13
L-Lysine
Citric and Lactic Acids
Plant Extracts and Polyphenols
Whey Deashing
Gelatin Deashing

DuPont Services and Research – pg 14-15
System Optimization Services™
DuPont Research & Development
Sweeteners
Corn & Starch Processing

The Value of Uninterrupted Production

With DuPont as your partner, you realize reliable production and benefit from our expertise.

You see DuPont’s value in consistent plant uptime and lower-than-typical operating costs. From standard resins with Gaussian particle size distribution to premium resins benefitting from uniform particle size technology, DuPont products and solutions have served plants worldwide reliably for decades.

DuPont’s value also comes in our expertise. Our deep history in the industry helps us understand your needs. We help you balance resin selection, system design, and plant operations to achieve optimal results. Altogether, DuPont helps you operate your plants with the highest return for your resin investment.

Deashing and Mixed Bed Polishing

AmberLite™ FP Ion Exchange Resins: An Excellent Choice for Corn and Starch Sweetener Deashing and Polishing

AmberLite™ FP Ion Exchange Resins lead the corn and starch sweetener industry in deashing and mixed bed polishing, removing unwanted ions and other contaminants from the syrup stream. DuPont offers a full line of cation and anion deashing products ranging from standard to premium offerings.

AmberLite™ FPC88 Strong Acid Cation (SAC) Resin and AmberLite™ FPA66 Weak Base Anion (WBA) Resin are an industry standard for deashing dextrose and fructose. AmberLite™ FPC88 UPS SAC Resin and AmberLite™ FPA77 UPS WBA Resin are premium products designed to deliver high ion exchange efficiencies and physical strength. Resin uniformity facilitates high throughput, economical regeneration, long life, and low operating costs.

AmberLite™ FP UPS resins are viewed as an industry standard as they help to achieve:
• Increased plant syrup capacity
• Less frequent regeneration, reducing chemical costs up to 25%
• Reduced sweetwater generation, reducing evaporation costs
• Reduced rinse requirements
• Reduced waste generation
• Packed bed and up-flow operations

Diagram 1: Typical High Fructose Corn Syrup Plant
AmberLite™ FP Mixed Bed Resins Help Improve Syrup Stability

Specifically designed for mixed bed polishing, AmberLite™ FPA22 Strong Base Anion (SBA) and AmberLite™ FPC88MB (Mixed Bed) Strong Acid Cation (SAC) Resins – are used near the end of the 55 High Fructose Corn Syrup process. Using a mixed bed avoids the large pH swings seen when separate columns are used. This minimizes impurities from degradation reactions that reduce syrup shelf life.

To provide a good balance between cationic and anionic sites, a typical mixed bed polisher consists of 60% (by volume) AmberLite™ FPA22 SBA resin and 40% AmberLite™ FPC88MB SAC resin. The AmberLite™ FPA22 SBA is paired to pick up both the acids produced by the cation, and weak acids in the product stream. AmberLite™ FPC88MB SAC is specially designed to distinctly separate from the anion resin during the regeneration procedure.

This resin pairing provides an easy-to-regenerate process and a clean finished product stream.

Deashing and Polishing Product Pairs for Extended Syrup Run Times

Although performance-grade AmberLite™ FP Ion Exchange Resins will deliver high product quality, premium-grade AmberLite™ FP UPS Ion Exchange Resins help decrease operating costs and improve plant capacity. Premium resins extend syrup run times up to 25%, reducing downtime and the chemicals spent on regeneration. A simple change to premium AmberLite™ FP UPS resins can postpone or eliminate the need for capital expansion.

<table>
<thead>
<tr>
<th>Syrup Run Time</th>
<th>Strong Acid Cation (SAC) Resins</th>
<th>Anion Resins</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEASHING Base Performance</td>
<td>AmberLite™ FPC88</td>
<td>AmberLite™ FPA66</td>
</tr>
<tr>
<td>Enhanced ~10% Increase</td>
<td>AmberLite™ FPC88 UPS</td>
<td>AmberLite™ FPA66 UPS</td>
</tr>
<tr>
<td>Premium ~25% Increase</td>
<td>AmberLite™ FPC88 UPS</td>
<td>AmberLite™ FPA77 UPS</td>
</tr>
<tr>
<td>POLISHING Base Performance</td>
<td>AmberLite™ FPC88MB</td>
<td>AmberLite™ FPA22</td>
</tr>
<tr>
<td>Enhanced ~10% Increase</td>
<td>AmberLite™ FPC88 UPS</td>
<td>AmberLite™ FPA22 UPS</td>
</tr>
</tbody>
</table>

Corn and Starch Sweetener Deashing Product Guide

<table>
<thead>
<tr>
<th>Process and Resin Type</th>
<th>Resins</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deashing Cation (SAC)</td>
<td>AmberLite™ FPC88 Na</td>
<td>Sodium-form – Produces low-conductivity syrup products; most stable resin form for resin inventory safety stock</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPC88 H</td>
<td>Hydrogen-form – Produces low-conductivity syrup products</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPC88 UPS Na</td>
<td>Sodium-form – Offers reduced sweetwater and rinse requirements; most stable resin form for resin inventory safety stock</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPC88 UPS H</td>
<td>Hydrogen-form – Offers reduced sweetwater and rinse requirements</td>
</tr>
<tr>
<td>Deashing Anion (WBA)</td>
<td>AmberLite™ FPA66</td>
<td>Produces low-conductivity syrup products</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPA66 UPS</td>
<td>Increased syrup throughput using a uniform size product</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPA77 UPS</td>
<td>Lowest processing cost using highest capacity, uniform size product</td>
</tr>
</tbody>
</table>

Corn and Starch Sweetener Polishing Product Guide

<table>
<thead>
<tr>
<th>Process</th>
<th>Resins</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polishing Mixed Beds</td>
<td>AmberLite™ FPC88MB H SAC paired with AmberLite™ FPA22 OH SBA</td>
<td>Syrup products with maximum shelf stability; both resins in their regenerated ionic form</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPC88MB Na paired with AmberLite™ FPA22 Cl</td>
<td>Syrup products with maximum shelf stability; most stable resin forms for resin inventory safety stock (Na- and Cl-forms, respectively)</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPC88 UPS H paired with AmberLite™ FPA22 UPS OH</td>
<td>Syrup products with maximum shelf stability; efficient mixed bed utilization; both resins in their regenerated ionic form</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPC88 UPS Na paired with AmberLite™ FPA22 UPS Cl</td>
<td>Syrup products with maximum shelf stability; efficient mixed bed utilization; most stable resin forms for resin inventory safety stock (Na- and Cl-forms, respectively)</td>
</tr>
</tbody>
</table>
Sweeteners
Corn & Starch Processing

Chromatography
DuPont Helps Make Corn and Starch Sweetener Separations Better

AmberLite™ CR99 Chromatographic Separation Resins help deliver fast, sharp, and economical chromatographic separations.

One of the most critical factors in chromatographic separation is the uniformity of the separation beads. Bead uniformity affects both the degree of sweetener separation achieved and the pressure on the chromatography columns. Resins with a wide particle size distribution demonstrate a high system pressure drop, which lowers productivity. Additionally, the wide particle size distribution beads produce more dilute product streams due to poor separation (wide and less distinct separation bands). Wide particle size beds require additional elution water and, as all of this water must ultimately be removed, places a higher demand and expense on the already expensive evaporation process.

AmberLite™ CR99 resins help eliminate these problems. The resin beads’ uniform size and structure, as well as their smooth surface, more effectively produce enriched fructose.

The graph illustrates the sharp separation achieved with AmberLite™ CR99 in a small-scale laboratory column.

Corn and Starch Sweetener Chromatography

AmberLite™ CR99 Chromatographic Separation Resins are available with uniform bead size ranging from 220 – 350 µm to suit your specific operational goals for an extensive variety of applications, as summarized in the related tables.

<table>
<thead>
<tr>
<th>Chromatographic Separation Resin Size (µm)</th>
<th>Best For</th>
<th>Chromatographic Separation Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td>Low pressure drop</td>
<td>AmberLite™ CR99 K/350, K/320, or K/310</td>
</tr>
<tr>
<td>320</td>
<td>Standard performance</td>
<td>AmberLite™ CR99 K/320, K/310, or K/280</td>
</tr>
<tr>
<td>310</td>
<td>Reduced operating costs</td>
<td>AmberLite™ CR99 Ca/320, Ca/310, or Ca/280</td>
</tr>
<tr>
<td>280</td>
<td>Difficult separations, reduced separator water usage</td>
<td>AmberLite™ CR99 Ca/310 or Ca/280</td>
</tr>
<tr>
<td>220</td>
<td>Exceptional performance in shallow-bed separators, operating cost reduction</td>
<td>AmberLite™ CR99 Ca/220 or K/220</td>
</tr>
</tbody>
</table>
Sweetener Processing Product Suite/Applications

**Decolorization**
DuPont Adsorbent Resins Facilitate Syrup Quality by Removing Impurities

AmberLite™ SD-2 Adsorbent Resin helps deliver decolorization and extend product shelf life by removing unwanted flavors and aromas, as well as color precursors, such as 5-(Hydroxymethyl)furfural (HMF).

AmberLite™ SD-2 is used alone or in combination with activated carbon. The adsorbent can help correct for color spikes in the syrup stream, such as those caused by a process upset or shutdown.

**Sweetener Decolorization**

<table>
<thead>
<tr>
<th>Process</th>
<th>Adsorbents</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decolorization</td>
<td>AmberLite™ SD-2</td>
<td>Efficient color and HMF removal</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ XAD™761</td>
<td>Syrup storage stability</td>
</tr>
</tbody>
</table>

**Enzymatic Immobilization**
AmberLite™ FP Ion Exchange Resins Offer Simpler Operation, Excellent Downstream Processing

The two primary applications of enzymes to starch-based sweeteners are converting starch to glucose (also known as dextrose) with alpha- and beta-amylase and converting glucose to fructose with glucose isomerase. The enzymes can be immobilized on phenolic-based media and applied in packed bed columns for a continuous, heterogeneous catalytic process.

AmberLite™ FP Ion Exchange Resins offer effective enzymatic transformation to provide:
- Simpler operation and downstream processing
- Increased enzyme stability and lower enzyme use
- Higher and more consistent activity
- Lower costs for raw materials and operation

**Enzyme Immobilization**

<table>
<thead>
<tr>
<th>Enzyme Immobilization</th>
<th>Weak Base Anion Resins</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-amylase, β-galactosidase, glucoseoxidase</td>
<td>AmberLite™ FPA51</td>
<td>Activity-optimized for smaller enzymes</td>
</tr>
<tr>
<td>Maltose phosphorylase, trehalose phosphorylase</td>
<td>AmberLite™ FPA54</td>
<td>Unique, highly porous</td>
</tr>
<tr>
<td>Glucose isomerase</td>
<td>Duolite™ A568</td>
<td>Large pores facilitate high enzyme activity</td>
</tr>
</tbody>
</table>
Sweeteners
Beet Sugar Softening and Chromatography

Increase White Sugar Production with DuPont Ion Exchange Softening and Chromatography Resins

Sugar beets are an important source of sucrose (saccharose). Diagram 3 illustrates the key steps involved in refining beets to recover sugar. Critical unit operations using ion exchange resins include softening (decalcification) and chromatography.

The sugar syrup stream contains salts and color. These contaminants are molassogenic, which causes valuable sugar to remain in the remaining liquor (molasses) after crystallization. To extract more of the high-value sugar, the molasses is fed to desugarization chromatographic beds. AmberLite® CR99 K Chromatographic Separation Resins, in potassium-form, help separate sugar from salts and color. A purified sugar stream is recovered and recycled back to crystallization, facilitating an increased overall sugar yield. In some plants, valuable betaine is also recovered by chromatography. The salts and color are routed to other byproducts, such as animal feed products.

Decalcification upstream of the chromatography step helps AmberLite™ CR99 K resins remain in the potassium-form. If calcium is not removed, the chromatography resin would convert to calcium-form, which would significantly reduce separation performance. Decalcification of the process stream with a cation resin listed in the table below helps reduce evaporation scaling, which helps increase efficiency and helps reduce downtime.

Processors rely on DuPont ion exchange technologies for critical decalcification processes and chromatographic recovery of sugar and betaine from beet molasses.

Beet Sugar Decalcification

<table>
<thead>
<tr>
<th>Processes</th>
<th>Strong Acid Cation Resins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin Juice, NRS Process, Gryllus, Quentin Process, and Decalcification</td>
<td>AmberLite™ FPC14 Na, AmberLite™ FPC22 Na, AmberLite™ FPC16 UPS Na, AmberLite™ FPC88 Na, AmberLite™ MAC-3 H Weak Acid Cation Resin</td>
</tr>
</tbody>
</table>

Beet Molasses Desugarization/Chromatography

<table>
<thead>
<tr>
<th>Process</th>
<th>Chromatographic Separation Resins</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desugarization/Chromatography</td>
<td>AmberLite™ CR99 K/310</td>
<td>Low water consumption reduces evaporator cost</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ CR99 K/320</td>
<td>Low-pressure design for deep beds</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ CR99 K/350</td>
<td>Low-pressure design for deep beds and high viscosity</td>
</tr>
</tbody>
</table>
Sweeteners

Cane Sugar Decolorization

DuPont Ion Exchange Resins Help Maximize Cane Sugar Decolorization

AmberLite™ Ion Exchange Resins have proven to be an excellent choice for cane sugar decolorization.

Unlike with beet sugar, the sucrose in sugar cane cannot be extracted by diffusion alone. The cell walls of sugar cane must be broken, which is accomplished by crushing the sugar cane in large mechanical rollers. This processing introduces color impurities into the raw sugar. Cane-based color has a tendency to be incorporated into sugar crystals during crystallization. Therefore, as shown in Diagram 4, additional decolorization is required before cane sugar crystallization.

### Cane Sugar Decolorization

<table>
<thead>
<tr>
<th>Resin Type</th>
<th>Strong Base Anion Resins</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic Matrix</td>
<td>AmberLite™ FPA98 Cl</td>
<td>High-color syrups and regeneration efficiency</td>
</tr>
<tr>
<td>Styrenic Matrix</td>
<td>AmberLite™ FPA900UPS Cl</td>
<td>Uniform size for increased efficiency</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPA90RF Cl</td>
<td>Size-graded for packed beds</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPA90 Cl</td>
<td>Highest degree of decolorization</td>
</tr>
</tbody>
</table>

### Liquid Sugar Purification

<table>
<thead>
<tr>
<th>Resin Type</th>
<th>Resin</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong Base Anion</td>
<td>AmberLite™ FPA42 Cl</td>
<td>High color capacity for high throughput</td>
</tr>
<tr>
<td>Weak Acid Cation</td>
<td>AmberLite™ MAC-3 H</td>
<td>Paired with AmberLite™ FPA42 Cl – adds deashing to color removal</td>
</tr>
</tbody>
</table>
DuPont Satisfies the Beverage Industry’s Thirst for Innovation

The global marketplace for beverages is large, diverse, and dependent on consumer perceptions of quality and value. Consumers demand both quality and consistency in their beverage choices, including product clarity, taste, and nutritional value. AmberLite™ Ion Exchange Resins and Polymeric Adsorbents help beverage companies worldwide deliver on those demands.

Citrus Debittering

Citrus juices have natural bitter components, such as limonin and naringin. Removal of these bitter molecules is important for taste and shelf-life stability. As shown in Diagram 5, citrus processors use AmberLite™ FPX66 Polymeric Adsorbent to help debitter juice by removing these components through hydrophobic interaction. Ultrafiltration diverts the citrus pulp around the resin. Regeneration with hot dilute caustic removes the limonin and prepares the resin for reuse.

Juice Deacidification

Fruit juices, especially citrus juices, are naturally acidic, and excessive acidity can present taste and tolerance issues for consumers. Using ion exchange resins from DuPont, processors deacidify fruit juices while still maintaining Federal Standards of Identity. The most common approach for citrus juice deacidification is shown in Diagram 6. Pulp is separated from the juice using either a centrifuge or ultrafiltration. The juice then contacts a weak base anion exchange resin in a packed bed column. The pulp is returned to the juice prior to packaging or evaporation.

For other fruit juices, a pectin removal process may replace the pulp centrifuge or UF system. Because of the high osmotic forces put upon the ion exchange resin in this application, the resin must have high osmotic stability and acid capacity – exactly the characteristics of AmberLite™ Ion Exchange Resins.
Juice Decolorization

Color removal in fruit juice is usually part of a longer process to make a neutral base for converting the juice to a designed beverage, or to create juice for canning or blending as a supplemental natural sugar source.

Browning and color stability are the primary concerns when decolorizing a primary juice. Oxidized amino acids, polyphenols, and color precursors in the juice contribute to color formation. But these compounds can be successfully removed without significantly altering other juice properties using AmberLite™ FPX66 Polymeric Adsorbent. This process facilitates a clean and economical alternative to using powdered activated carbon.

Protein Haze Stabilization

Haze can form in some beverages after packaging, which can have a negative impact on consumer preference. This occurs with beers, wines, and some fruit juices. This haze is typically formed by the interaction of proteins and polyphenols in the beverage. Removing the proteins will improve the haze stability of the beverage.

AmberLite™ FPX62 Polymeric Adsorbent helps remove haze-forming proteins from fruit/vegetable juices and syrups, beers, and wines. AmberLite™ FPX62 also helps beer to retain desirable head-forming proteins without the handling, yield, and waste issues encountered when using bentonite clay for this same purpose.

Beverages

<table>
<thead>
<tr>
<th>Process</th>
<th>Products</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citrus Debittering</td>
<td>AmberLite™ FPX66 Polymeric Adsorbent</td>
<td>Selective removal of limonin and naringin with large active surface area</td>
</tr>
<tr>
<td>Juice Deacidification</td>
<td>AmberLite™ FPA66 WBA Resin</td>
<td>Removal of citric and other acids</td>
</tr>
<tr>
<td>Juice Decolorization</td>
<td>AmberLite™ FPX66 Polymeric Adsorbent</td>
<td>High active surface area with large pores</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ SD-2 Polymeric Adsorbent</td>
<td>High active surface area with a range of pore sizes</td>
</tr>
<tr>
<td>Fruit Juice Deashing</td>
<td>AmberLite™ FPC88 UPS SAC Resin paired with</td>
<td>Low-conductivity decolorized products</td>
</tr>
<tr>
<td></td>
<td>AmberLite™ FPA66 UPS WBA Resin</td>
<td></td>
</tr>
<tr>
<td>Protein Haze Stabilization</td>
<td>AmberLite™ FPX62 Polymeric Adsorbent</td>
<td>Protein removal with minimal removal of flavor and color</td>
</tr>
</tbody>
</table>
Sweetener Processing Product Suite/Applications

Food Additives & Nutritionals

DuPont Adsorbents and Ion Exchange Resins Extract Value

Nutritionals are components or derivatives of food products that have health benefits and/or commercial value and include valuable nutrients such as amino acids, polyphenols, and organic acids. These products are often extracted from substances such as green tea or fruits, or generated by fermentation.

In all cases, these products must first be separated from a solution and purified, which is precisely where adsorbents and ion exchange resins from DuPont shine.

L-Lysine

L-lysine is an essential amino acid and is commercially important as a nutritional supplement to animal feeds. It is produced via fermentation and recovered using a strong acid cation resin. DuPont offers a wide range of strong acid cation exchange resins specifically designed for the recovery and purification of L-lysine. Resin selection will depend on local operating conditions.

L-Lysine

Citric and Lactic Acids

Citric and lactic acids are large-volume, commercially important organic acids used primarily in the food and beverage industry as acidulents and preservatives. Citric acid is well-known as the source of the tart flavor in fruit juices. Lactic acid is used in many food applications including bakery, meat and dairy products, beverages, salads, and dressings.

DuPont provides a full range of ion exchange products for manufacturing citric and lactic acids. Typical ion exchange processes include a strong acid cation exchange resin and a weak base anion exchange resin. Organic acids cause ion exchange resins to experience extreme swings in volume (swelling). For this reason, only the most physically stable ion exchange resins, such as those available from DuPont, can be used to recover and purify organic acids.

One acid-refining technique, shown in Diagram 7, uses a precipitation process with lime to produce calcium citrate and calcium lactate solids. This is then contacted with sulfuric acid to produce a partially purified soluble organic acid and a large mass of calcium sulfate byproduct. These processes produce streams that require demineralization using DuPont ion exchange products.

Organic Acid Purification

<table>
<thead>
<tr>
<th>Application</th>
<th>Resin</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citric and Lactic Acid Deashing</td>
<td>AmberLite® FPC23 UPS H</td>
<td>Lower processing cost using highest capacity, uniform size product</td>
</tr>
<tr>
<td></td>
<td>AmberLite® FPC88 UPS H</td>
<td>Offers reduced sourwater and rinse requirements</td>
</tr>
<tr>
<td></td>
<td>AmberLite® FPC88 H</td>
<td>Reliable performance</td>
</tr>
<tr>
<td></td>
<td>AmberLite® FPA53</td>
<td>Durable in citric or lactic acid feeds and paired with a SAC resin</td>
</tr>
<tr>
<td></td>
<td>AmberLite® FPA55</td>
<td></td>
</tr>
<tr>
<td>Lysine Recovery</td>
<td>AmberLite® FPC11 Na</td>
<td>Resists breakage under high-loading stress</td>
</tr>
<tr>
<td></td>
<td>AmberLite® FPC16 UPS Na</td>
<td></td>
</tr>
<tr>
<td>Chromatographic Separation</td>
<td>AmberLite® CR5550</td>
<td>Excellent chromatographic resolution, eliminating the citric acid precipitation step</td>
</tr>
</tbody>
</table>
Plant Extracts and Polyphenols

Polyphenols are compounds found in natural foods that provide color and flavor and are highly valued for their antioxidant and health properties. These can be derived from many different sources including plants (cocoa, green tea, pine bark), fruits (red berries, pineapple, orange juice, grapes skins, and seeds), molasses, and oils.

Many nutrition companies use AmberLite™ FPX66 or AmberLite™ XAD™7HP Polymeric Adsorbents to help remove, recover, and purify a variety of polyphenols for commercial use. Once recovered, polyphenols can be added to foods and beverages.

Whey Deashing

Milk is one of the most important forms of nutrition. It is a complex mixture of fats, proteins (caseins), minerals, enzymes, and carbohydrates (lactose). These components can be separated through the use of membrane processes to form cheeses, cultured milk products, and whey proteins.

DuPont resins help milk processors produce high-quality demineralized whey. The highest levels of whey demineralization are achieved with a two-bed ion exchange system, using strong acid cation and weak base anion exchange resins.

Gelatin Deashing

Gelatin, made by hydrolyzing collagen and used in a variety of food and pharmaceutical products, has strict quality requirements. The resulting solution contains a high molecular weight protein and a considerable amount of mineral content (ash). DuPont ion exchange resins help remove this mineral content and ensure that the gelatin meets customer specifications and application requirements.

Food Additives & Nutritional Products

<table>
<thead>
<tr>
<th>Nutritional</th>
<th>Products</th>
<th>Best For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphenols</td>
<td>AmberLite™ FPX66 Polymeric Adsorbent</td>
<td>High extraction capacity and solvent recovery</td>
</tr>
<tr>
<td>Whey, Gelatin, and Glycerin Deashing</td>
<td>AmberLite™ FPC88 UPS H SAC Resin paired with AmberLite™ FPA66 UPS WBA Resin</td>
<td>Deashing and decolorizing</td>
</tr>
<tr>
<td>Dairy Concentration and Desalting</td>
<td>FilmTec™ Hypershell™ Elements</td>
<td>Effective dewatering or product concentration</td>
</tr>
</tbody>
</table>
DuPont Expertise
A Key Ingredient in Food and Beverage Processing

DuPont System Optimization Services℠ (SOS)

Working with DuPont is easy and convenient. Whenever you choose DuPont resins, you get expert support from DuPont ion exchange technical service and development teams.

For more involved issues, DuPont offers a full range of System Optimization Services℠ (SOS) to help you achieve optimal performance from your resin, system, and plant operations. SOS Services℠ place our extensive knowledge and experience at your disposal. These services can complement your R&D innovation team, lighten the burden of your system start-up and staff training, and support the ongoing operation and maintenance of your system.

Request a Sample of DuPont Ion Exchange Products
Small orders of DuPont ion exchange resins, polymeric adsorbents, chelating resins, and copolymers can be ordered online through the Octochem website.
Innovation to Meet Future Customer Needs

The DuPont research and development process starts with you. By proactively communicating with our customers and listening to your unmet needs, we are able to work to develop products that lower your cost of production and deliver the most economical approach to new and/or difficult separations.

DuPont’s commitment to the food and beverage industries is demonstrated through our multiple research and product development centers around the world. These technology centers have delivered innovative new technologies. See below for a timeline of some of our most significant breakthroughs over the past 60+ years.

Regulatory Compliance

The resins here may be subject to food contact application restrictions in some countries. For country-specific food contact compliance statements, regulatory data sheets, and information on dietary rules, please contact the DuPont Contact Center.

DuPont has a fundamental concern for all who make, distribute, and use our products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with DuPont products – from initial concept and research to manufacturing, selling, using, disposing, and recycling each product.
Powering performance worldwide.

With a large global manufacturing footprint, strong R&D expertise and technical support services and systems, we supply high market volumes with high quality. DuPont partners with you, our customer, to understand unmet needs and develop tailored solutions.

### TECHNICAL SERVICE, RESEARCH & DEVELOPMENT
- Chauny, France
- Edina, MN, USA
- Huzhou, China
- Hyderabad, India
- KAUST Jeddah, KSA
- Midland, MI, USA
- Shanghai, China
- Singapore
- Tarragona, Spain*
- Wilmington, DE, USA

### COMMERCIAL OPERATIONS
- Astana, Kazakhstan
- Bangkok, Thailand
- Beijing, China
- Bogota, Colombia
- Buenos Aires, Argentina
- Budapest, Hungary
- Dubai, UAE
- Chengdu, China
- Delhi, India
- Edina, MN, USA
- Guangzhou, China
- HCM City, Vietnam
- Hong Kong, China
- Jakarta, Indonesia
- Johannesburg, South Africa
- Kuala Lumpur, Malaysia
- Madrid, Spain
- Manila, Philippine
- Melbourne, Australia
- Mexico City, Mexico
- Midland, MI, USA
- Moscow, Russia
- Mumbai, India
- Nairobi, Kenya
- Paris, France
- São Paulo, Brazil
- Seoul, Republic of Korea
- Pfaeffikon, Switzerland
- Shanghai, China
- Singapore
- Surabuya, Indonesia
- Taipei, Taiwan
- Tokyo, Japan
- Warsaw, Poland

### MANUFACTURING
- Chauny, France
- Edina, MN, USA
- Fombio, Italy
- Huzhou, China
- Jubail Industry City, Saudi Arabia
- Midland, MI, USA
- Qingpu, China
- Soma, Japan

* Global Water Technology Center

Have a question? Contact us at: dupont.com/water/contact-us

No freedom from infringement of any patent or trademark owned by DuPont or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer’s use and for ensuring that Customer’s workplace and disposal practices are in compliance with applicable laws and other government enactments. The product shown in this literature may not be available for sale and/or available in all geographies where DuPont is represented. The claims made may not have been approved for use in all countries. DuPont assumes no obligation or liability for the information in this document. References to “DuPont” or the “Company” mean the DuPont legal entity selling the products to Customer unless otherwise expressly noted. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

DuPont™, the DuPont Oval Logo, and all trademarks and service marks denoted with ™, SM or ® are owned by affiliates of DuPont de Nemours, Inc. unless otherwise noted. © 2020 DuPont.

DOWEX MONOSPHERE and DOWEX OPTIPORE are trademarks of The Dow Chemical Company used under license.