

FilmTec™ Membranes and DuPont™ AmberLite™ Ion Exchange Resins for Dairy Applications

Get more from Milk. Get more from DuPont.



Experience Higher Operating Efficiency and Productivity

Milk is one of our most important forms of nutrition and a key source of many of the foods, beverages, and ingredients we consume. It is a complex mixture of fats (3.6%), proteins (3.3%), minerals (0.7%) and lactose (4.6%) suspended in water (87.8%).

The dairy market is a growth market driven by consumer trends and innovations in milk processing. Milk processing involves several separations, concentrations, and purifications requiring ultrafiltration, nanofiltration, reverse osmosis, and ion exchange resin purification steps.

DuPont, with over 40 years of experience in the dairy industry, provides full-fit sanitary spiral wound elements, FimTec™ Hypershell™ rigid outer shell technology, ion exchange resins, and continuing innovation in quality and design to help you process milk into the essential foods and ingredients we use every day.

DuPont's comprehensive product line, technical expertise, manufacturing excellence, continuous innovation and global reach provide you with solutions to solve your application and process challenges and enable economical, high-performance, enduring operations.

This brochure covers processing solutions offered by DuPont for the dairy industry. Learn how DuPont can help you meet your processing and quality needs with quality membrane elements and ion exchange resins.

DuPont Reverse Osmosis and Nanofiltration Membrane Portfolio for Dairy

Dewatering	
- milk/whey/UF permeate Concentration	reverse osmosis (RO)
Dewatering & Desalting	
- lactose/whey Separation	nanofiltration (NF)
Downstream Polishing	
- water recovery	FilmTec™ RO-390
Hot Water Sanitization	
- NO chemical sanitizers	FilmTec™ HSRO-390

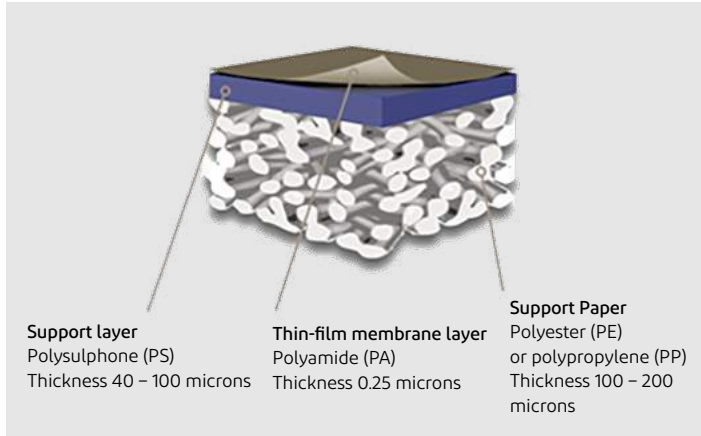
DuPont Ion Exchange Resins Portfolio for Dairy

Demineralization	DuPont™ AmberLite™
Decationization	strong acid cation
Deashing	weak acid cation
- whey/lactose Purification	weak base anion
Chromatographic Separation	FilmTec™ AmberLite™
- lactose Derivatives	FilmTec™ AmberLite™ CR99
	FilmTec™ AmberLite™ CR1360



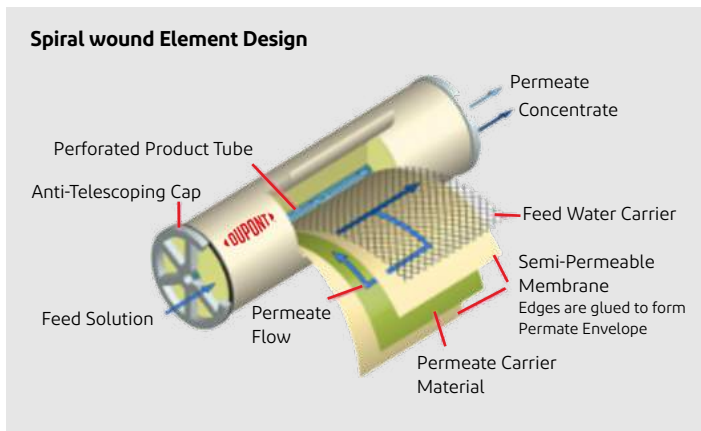
What is Membrane Filtration?

Membranes are a thin, semi-permeable barrier that allows water and smaller compounds or particles to pass through while restricting the passage of larger compounds.



Schematic cross-section of a thin-film membrane used in reverse osmosis

Membranes are wound into spiral elements with different spacers, membrane types, lengths and diameters. This configuration offers high membrane surface area in a small footprint that is operationally robust and helps minimize capital and operating costs.



RO ↓ In reverse osmosis (RO), pressure pushes water through the semi-permeable membrane, concentrating the feed.

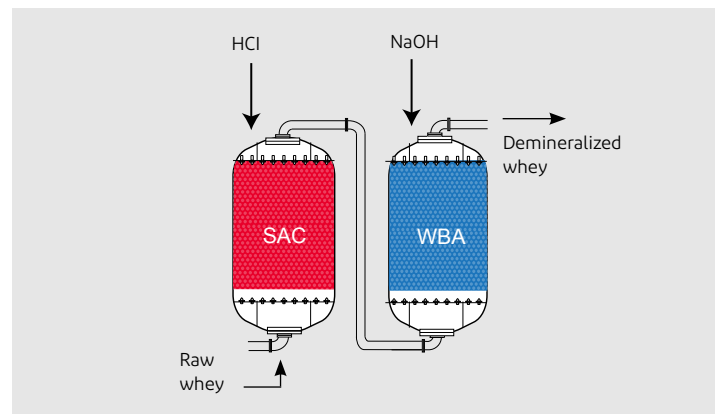
NF ↓ In nanofiltration (NF), smaller molecular weight compounds can pass through while larger and charged species are rejected.

How does Ion Exchange Resin Work?

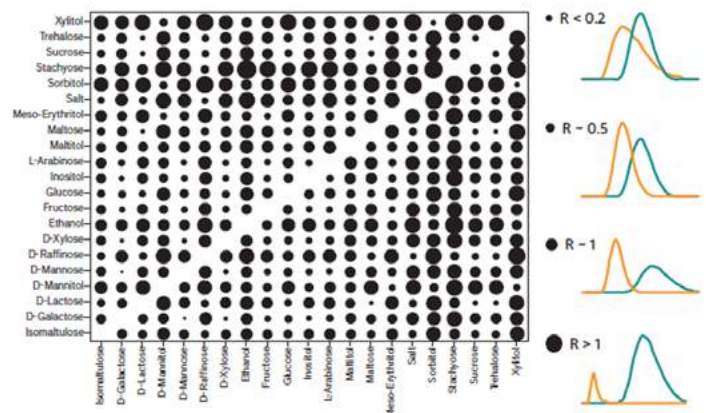
Ion exchange resins (IX) are functionalized polymer beads that can demineralize feeds or serve as a stationary media to chromatographically separate compounds from one another.



Near-complete demineralization of whey and lactose is achieved using ion exchange technology. The feed enters a strong acid cation resin followed by a weak basic anion exchanger to remove inorganic salts. The columns are regenerated with HCl and NaOH, respectively.



In chromatography, resin stationary phase can separate a wide range of carbohydrates by affinity or size exclusion in simulated moving beds.



Solutions for the Dairy Industry

DuPont offers complete suite of technical solutions for dairy processing. DuPont experts specialize not only in membrane and ion exchange technology, but also in how to combine these technologies together to achieve your process needs.



Key applications for RO/NF membrane filtration

- Dewatering and concentration of valuable products to reduce volume, saving on transport and storage costs.
- Removal of salts to enhance nutritional value.
- Concentration of streams to reduce evaporator loads and energy costs for powdered product production.
- Purification to reduce waste water and COD to meet local discharge regulations.



Key applications for ion exchange resin demineralization

- Near-complete demineralization of milk and whey streams (down to $\mu\text{S}/\text{cm}$ level).
- High-level purifications for infant formula.
- Softening of dairy feeds to avoid downstream precipitation in membrane and evaporator operations. (CaPO₄ hardness removal)



Key applications for Chromatographic separation

- Separation of lactose from milk enabling lactose-free milk and recovery of lactose as a separate product stream.
- Purification and recovery of lactose derivatives:
 - Galactooligosaccharides (GOS)
 - Tagatose
 - Lactulose

RO/NF/Evap Polishing

Water recovery and effluent control with an additional RO treatment.

Challenge

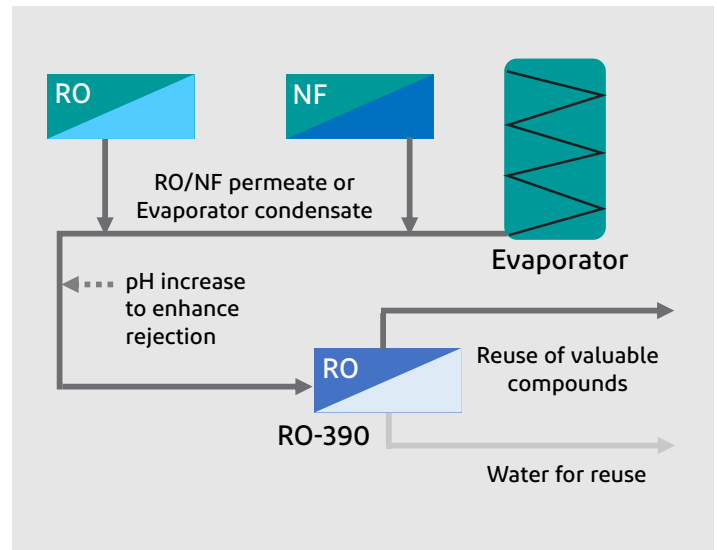
- In the dairy industry, significant amounts of water are removed by membrane or evaporation processes. This water usually contains trace organics like acids, amino acids, and lactose. The COD/BOD in some cases presents regulatory challenges for wastewater disposal.

Solution

- By using FimTec™ RO-390 to treat RO/NF permeate and evaporator condensate from milk/whey concentration, the BOD/COD can be substantially reduced (typically < 25 ppm). This process is referred to as polishing and the resulting permeate from this stage can be disposed or reused

Key benefits

- High rejection of organics
- Water is recovered and reused, reducing plant operating costs.
- Water is reused as process, rinse water, CIP, boiler feed or diafiltration water, increasing plant sustainability
- Recycling water avoids new water supply and saves on water pre-treatment costs



Chromatography Separation

Lactose Derivatives

Lactose can be transformed into other high value products (sugars and polyols)

Challenge

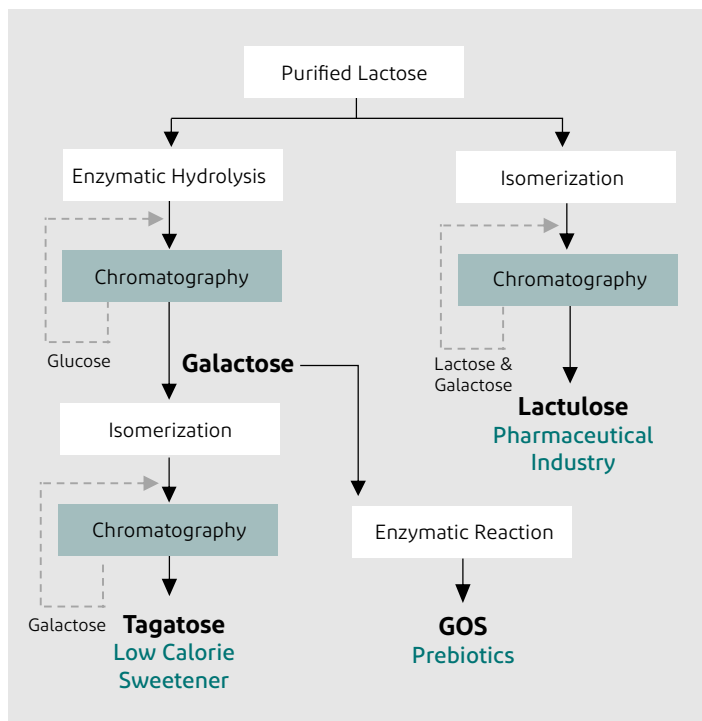
Lactose can be enzymatically and chemically transformed into galactose, tagatose, and other valuable carbohydrates, but the resulting mix of products needs to be separated from one another.

Solution

Chromatographic enrichment is the preferred technology for this purification

Key benefits

Purified lactose is converted into several value-added carbohydrates for food and pharmaceutical uses.



Lactose Mother Liquor Demin

Chromatography can recover lactose from crystallization mother liquors to improve yield.

Challenge

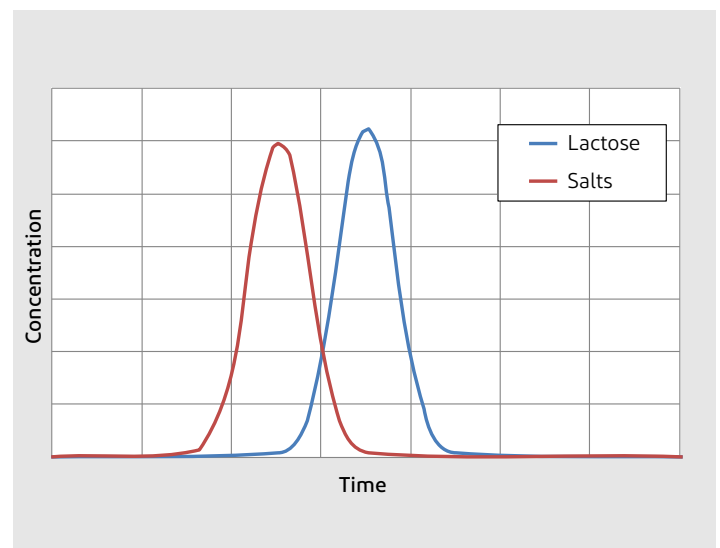
Lactose is produced by crystallization, but yield is suboptimal due to lactose lost in the mother liquor. The mother liquor is too salty to use and must be disposed of.

Solution

Chromatography using DuPont™ AmberLite™ CR99 Na/310 or AmberLite™ CR99 Na/320 enables the separation and recovery of lactose from salt, enabling the recycle of lactose back to the crystallizer to improve overall process yield.

Key benefits

Process is green using only water and reducing mother liquor waste. Salts can be recovered and reused as well.



DuPont Product Portfolio

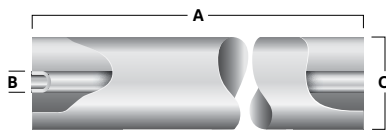
DuPont offers membranes, ion exchange resins, and chromatographic media to tackle your dairy processing needs head-on.

RO/NF Membrane Portfolio

- Sanitary full fit design that eliminates stagnant areas.
- Sanitizable with peracetic acid or hydrogen peroxide up to 1,000 ppm at 25°C for 20 minutes recirculation (one-twice a week).
- Heat Sanitizable products (HSRO) are sanitized by heating up to 85°C, eliminating the need for chemicals.
- Elements are designed to fit schedule 40, 8-inch stainless pipe (nominal 7.98-inch ID).
- Maximum element dP is 0.9 bar and maximum entire vessel dP is 4.1 bar.
- Maximum element recirculation cross-flow is: 18.2 m³/h (80 gpm) for 8 inch and 6.8 m³/h (30 gpm) for 4 inch elements.

Short Name	Name	Feed Spacer (mi)	Outer Wrap	ATDs included	Rating max	Cleaning limits
NF245	FilmTec™ Hypershell™ NF245-8038-FF	33	Hypershell™	No	50°C/54.8bar	pH 1.8-11 at 50°C
	FilmTec™ Hypershell™ NF245-8038/48-FF	48	Hypershell™	No		
	FilmTec™ Hypershell™ NF245-390-FF	27	Hypershell™	Yes		
	FilmTec™ NF245-3838/30-FF	30	Mesh Wrap	No		
	FilmTec™ Hypershell™ NF245-3838/48-FF	48	Hypershell™	No		
	FilmTec™ NF245-3840/30-FF	30	Mesh Wrap	No		
NF	FilmTec™ Hypershell™ NF-8038-FF	33	Hypershell™	No		
	FilmTec™ Hypershell™ NF-390-FF	27	Hypershell™	Yes		
	FilmTec™ NF-3838/30-FF	30	Mesh Wrap	No		
	FilmTec™ NF-3840/30-FF	30	Mesh Wrap	No		
RO	FilmTec™ Hypershell™ RO-8038	33	Hypershell™	No		
	FilmTec™ Hypershell™ RO-8038/48	48	Hypershell™	No		
	FilmTec™ Hypershell™ RO-390-FF	27	Hypershell™	Yes		
	FilmTec™ RO-3838 / 30-FF	30	Mesh Wrap	No		
	FilmTec™ RO-3840 / 30-FF	30	Mesh Wrap	No		
HSRO	FilmTec™ HSRO-390	30	Hypershell™	Yes	45°C/41bar	pH 1-12 at 45°C
	FilmTec™ HSRO-390-FF	30	Mesh Wrap	Yes		
	FilmTec™ HSRO-4040-FF	30	Mesh Wrap	Yes		

Model 8038 or 3838

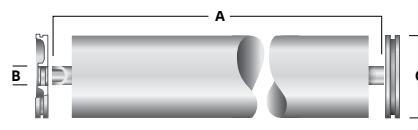


Model 8038



- Trimmed leaves (tails)
- For applications where concentrate and/or permeate is the product
- PWT cut flush with element
- ATD's not included

Model 390



Model 390



- Leaves (tails) untrimmed
- For applications where permeate is the product (mainly polishing)
- PWT extends 1"
- ATD's included

Ion Exchange Resin Portfolio

- Achieve high level of decationization/demineralization/deashing with DuPont™ AmberLite™ strong acid cation (SAC), weak acid cation (WAC), and weak base anion (WBA) resins. DuPont™ AmberLite™ FPA661 used for Specialty Protein and Deashing.
- Reverse Flow Regeneration is the preferred method of employing ion exchange for whey demineralization, reverse flow is especially effective adding efficiencies to the cation resin step.
- Gelular matrix resins are used to minimize protein fouling and prolong resin life.

Name	Type	Resin Type	Functional Group
AmberLite™ FPC16UPS	Strong Acid Cation	Styrenic	Sulfonic acid
AmberLite™ FPC1110 Na	Strong Acid Cation	Styrenic	Sulfonic acid
AmberLite™ FPC336 H	Weak Acid Cation	Polyacrylic	Carboxylic acid
AmberLite™ MAC-3	Weak Acid Cation	Polyacrylic	Carboxylic acid
AmberLite™ FPA55	Weak Base Anion	Acrylic	Tertiary amine
AmberLite™ FPA661	Weak Base Anion	Styrenic	Tertiary amine

Operation	SAC	WAC	WBA
Service Rate (BV/h)	4 - 10	4 - 10	4 - 10
Service Temp (°C)	5 -15	5 -15	5 -15
Regenerant	HCl	HCl	NaOH
Regeneration Dose Reverse Flow Regen (g/l)	80 - 100	156*	80 - 100
Regeneration Dose Co-Flow Regen (g/l)	55 - 65	156*	60 - 70
Regeneration Rate (BV/h)	2	2	2
Regeneration Temp (°C)	20	20	20

*Regenerant level, 100% basis

Chromatographic Resin Portfolio

DuPont offers several chromatographic resin media for purification of lactose and lactose derivatives. These resins are designed to be used in simulated moving beds (SMB) and separate carbohydrates and salts by one of three mechanisms:

- Ion-Exclusion: Neutral carbohydrates are separated from charged salts
- Size-Exclusion: Carbohydrates are separated from one another based on molecular size
- Affinity: Carbohydrates are separated from one another based on affinity to a calcium ligand

DuPont™ AmberLite™ CR chromatographic resins have several key features to ensure you get the highest performance and purity:

- Uniform particle size to ensure sharp, more uniform chromatographic separations
- Small particle size for fast separation kinetics and increased surface area between resin and feed to promote chromatographic separation
- Optimized microporosity for enhanced size- and affinity-based separations

Name	Ionic Group	Separation Mechanism	Applications
AmberLite™ CR99 Na/320	Sodium	Ion-Exclusion Size-Exclusion	Lactose/Salt Separation Lactose/Monosaccharide Separations
AmberLite™ CR99 Na/310	Sodium	Ion-Exclusion Size-Exclusion	Lactose/Salt Separation (high purity) Lactose/Monosaccharide Separations (high)
AmberLite™ CR1360 Na	Sodium	Size-Exclusion	Galactooligosaccharde (GOS) Purification
AmberLite™ CR99 Ca/310	Calcium	Affinity Affinity Affinity	Galactose/Glucose Chromatography Galactose/Tagatose Chromatography Lactose/Lactulose Chromatography
AmberLite™ CR1360 Ca	Calcium	Acrylic	Galactooligosaccharde (GOS) Purification

Values of FilmTec™ Hypershell™ Design

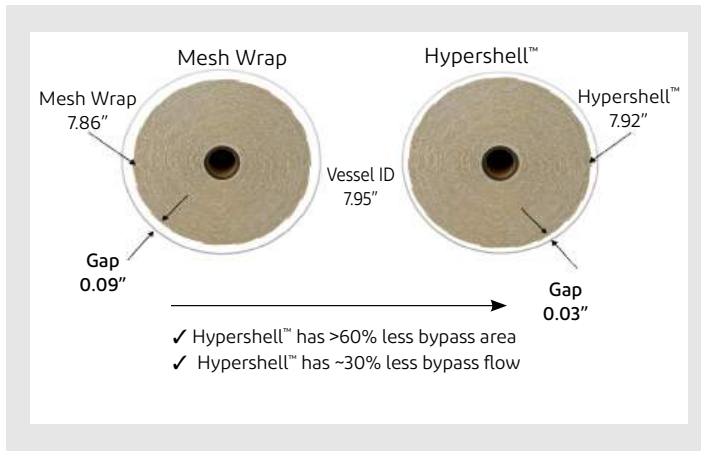
DuPont Premium Product

FilmTec™ Hypershell™ elements are sanitary design for use in Food and Dairy applications. The element product line combines three technologies: robust FilmTec™ membrane, precision automated rolling, and a machine polypropylene shell.

Improved Polypropylene solid inflexible shell with fixed outside diameter where shape does not deform in service



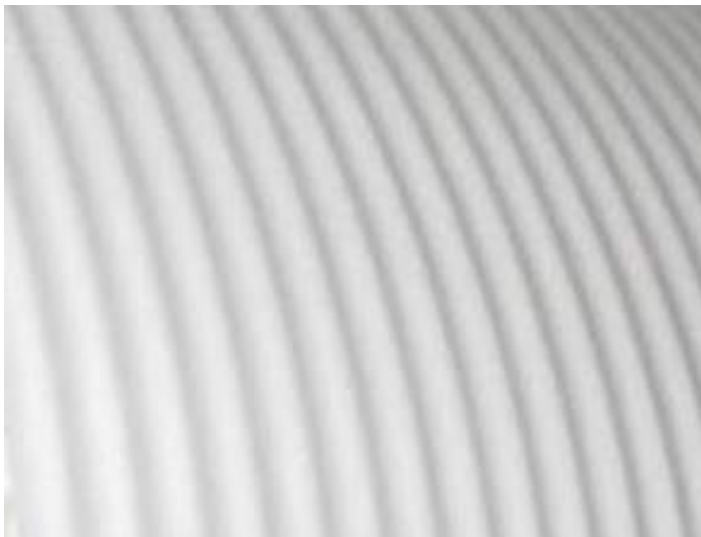
Less Bypass Area



Minimize Channeling

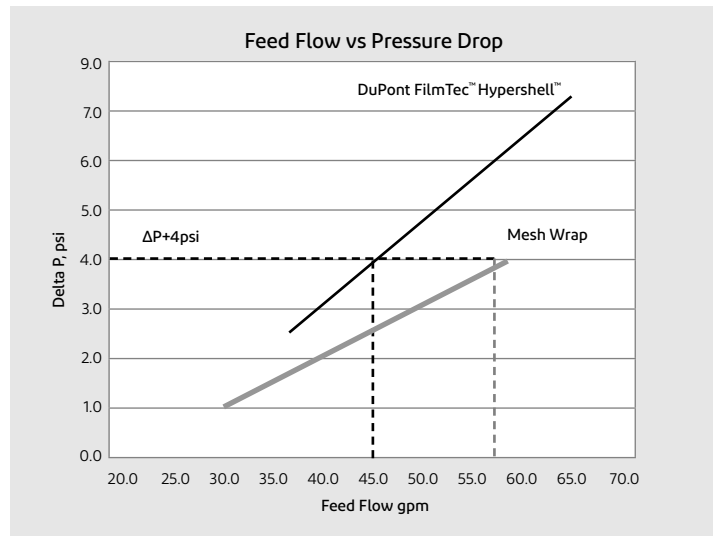


Safe and Easy Loading and Unloading



- The rugged shell also improved hydrodynamics through the element scroll.
- Reduction in premature elements failure

Energy Savings



- ✓ Up to 30% Energy Savings
- ✓ Up to 10% Greater Productivity

Regulatory Compliance

The products featured here may be subject to food contact application restrictions in some countries. Please note that the below is provided simply as information. Certificates of compliance can be obtained from our local DuPont team and these should be obtained on a routine bases as the legislation can and do change with time.

For country-specific food contact compliance statement, regulatory datasheet, and information on dietary rules, please contact us:

<https://www.dupont.com/water/contact-us.html>

FilmTec™ Dairy products

- Food and Drug Administration Department of Health and Human Services (USA)
 - FDA (21 CFR177.2550)
- The European Parliament and the Council of the European Union
 - Regulation (EC) 1935/2004
 - Regulation (EC) 10/2011
 - Regulation (EC) 2023/2006
- KIWA certificate of compliance
- IFANCA Halal Certificate
- Kosher compliance statement is available upon request
- Regulatory package, containing Allergen, BSE/TSE, GMO statements

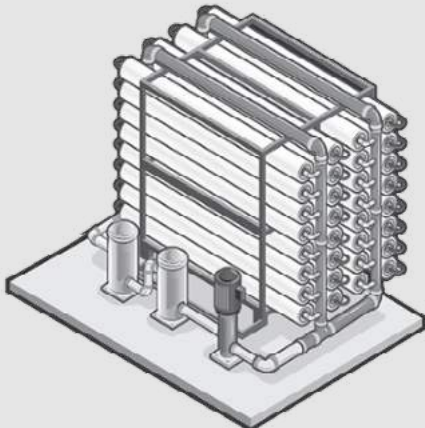
DuPont™ AmberLite™ Dairy products


The DuPont™ AmberLite™ FP product lines are being develop from resins which have been used successfully for many years in the Food processing market. In order to meet the growing expectations of the food industry, the products are manufactured in ISO 9001 certified manufacturing plant and evaluated to insure conformance with the applicable national and regional regulatory requirements.

- Food and Drug Administration Department of Health and Human Services (USA)
 - FDA (21 CFR173.25: Ion-exchange Resins)
 - FDA (21 CFR173.65: Copolymers of Divinylbenzene)
- Council of Europe Resolutions AP(2004)3 on ion exchange and adsorbent resins used in the processing of foodstuffs
- Halal certification of a select portfolio by IFANCA, HFCE or LPPOM-MUI
- Kosher certification by Ko-Kosher
- Regulatory package, containing Allergen, BSE/TSE, GMO statements


Technical Support

With DuPont's global reach, large R&D footprint, and unique Global Technology Center that applies science and innovation to meet customer needs, DuPont offers not only resins and membranes for the dairy industry but backs its innovative portfolio of technologies with world-class support to back you every step of the way.







Check Log Sheets




pH Dilemma




Probing




O-ring Lip-Seal




Power Breakdown




Pre-treatment




RO/NF element characterization



RO/NF cleaning optimization



RO, NF & UF Autopsies



Water & Membrane analysis

Advise on Process design & Cleaning strategies

Troubleshooting support

Membrane testing service & Suggest corrective actions

What We Offer

For more involved issues, DuPont offers a full range of System Optimization ServicesSM (SOS) to help you achieve optimal performance from your resin, system, and plant operations. SOS ServicesSM places 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, troubleshoot issues, and support the ongoing operation and maintenance of your system.

No fee associated

Visual inspection, Std. Test, Autopsy, Chemical degradation

ONLY DENIAL or ACCEPTANCE letter



Fee associated to the service

Several diagnostic tests are available to troubleshoot issues

A complete report is issued with further recommendation



Water Solutions

Have a question?

Contact us at:

dupont.com/water/contact-us

Resource: istock

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