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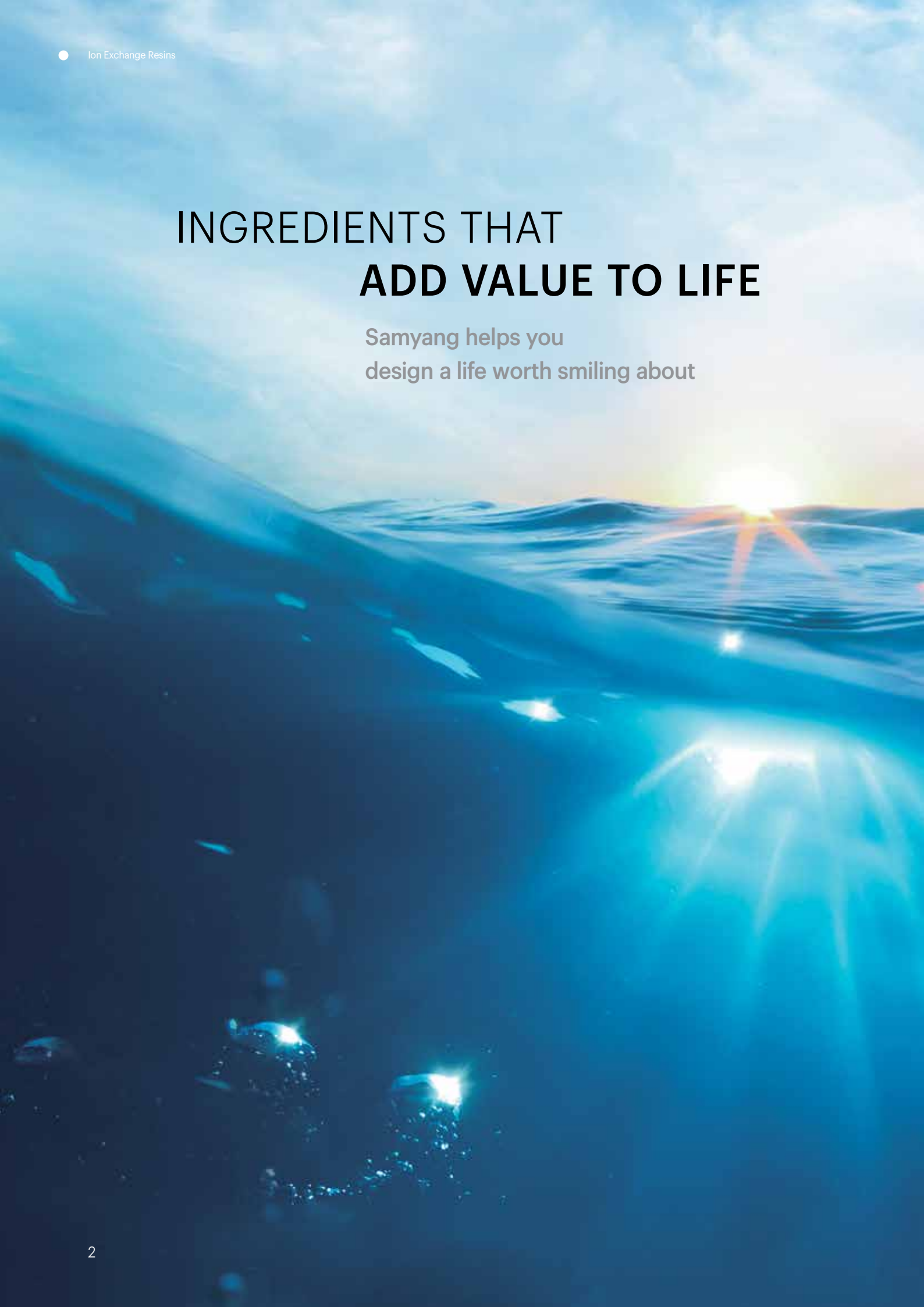
SAMYANG CORPORATION

TRILITE
삼양 트리라이트

Ion Exchange Resin

samyang



INGREDIENTS THAT
ADD VALUE TO LIFE

Samyang helps you
design a life worth smiling about

"Adding quality to your life"-this is what we are called to do in a way as natural as breathing.
Over the last 100 years, Samyang has been working to make our
life more abundant and convenient thus improving the standard of living.
Guided by bot traditional values and the growth mindset,
Samyang is now preparing for another great 100 years.
Samyang aims to grow into a global company by strengthening the core business
that involves several interrelated sectors spanning chemicals, food, biopharmaceuticals and packaging,
and advancement of our business structure. Dedicated to creating a more abundant and convenient lifestyle,
Samyang is looking forward to the next 100 years of even greater achievements.

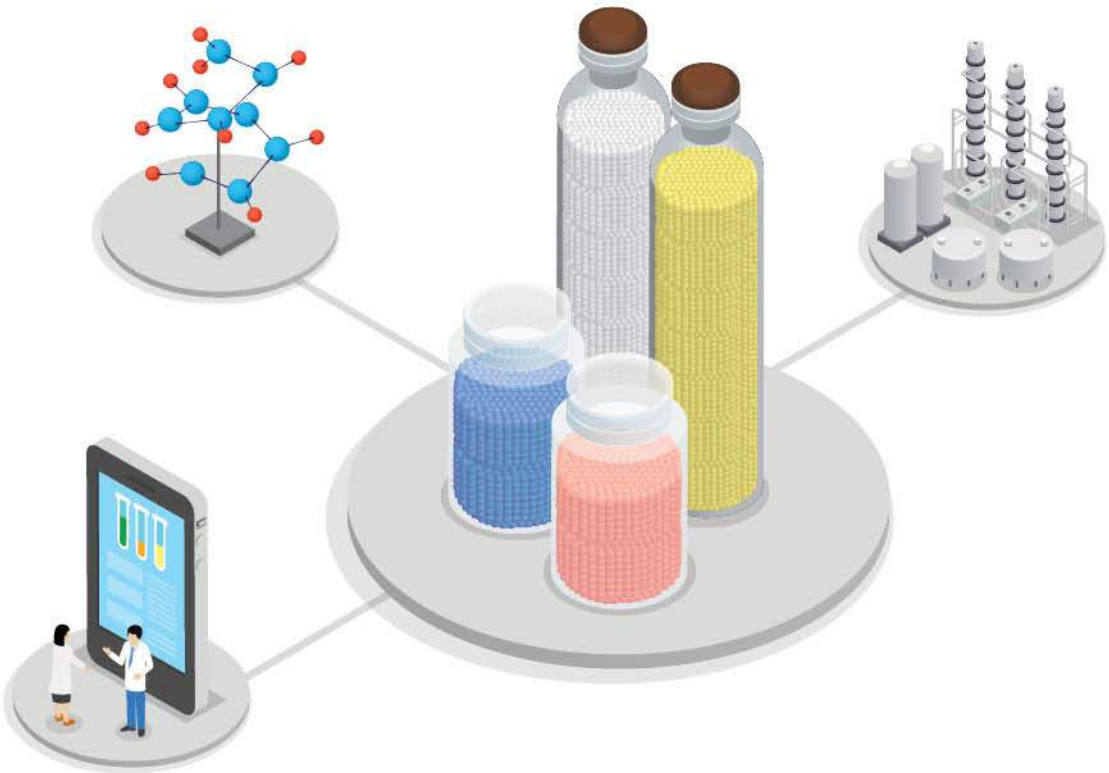
SPECIALTY CHEMICAL ION EXCHANGE RESIN BUSINESS

Samyang Corporation is the history of Ion Exchange Resins in Korea.

In 1976, Samyang Corporation successfully initiated localized production of IER in South Korea by technical cooperation with Mitsubishi Chemical Corporation, Japan.

In 2011, with successful development of UPW(Ultrapure water) grade resins, we are contributing to enhancing national competitiveness in the semiconductor and the display industries.

In 2016, Asia's largest UPS (Uniform Particle Sized) Specialized IER (Ion exchange resin) plant; Samyang Fine Technology Corporation was founded. Premium grade TRILITE ion exchange resins are being supplied to the wide range of reputable global customers in Power plants, Electronics, Food ingredient industries.



Samyang at a glance

Samyang is dedicated to creating a healthy and abundant future for all humanity

Since our founding in 1924 by Kim Yeon-su, also known under the pseudonym Sudang, Samyang Group has entered into the markets of sugar manufacturing, integrated synthetic fiber and flour milling based on upright, trustworthy management and greatly contributed to both increasing the country's living standards through the provision of essentials and the development of the national economy.

Upon entering the 21st century, Samyang Group defined its vision of becoming a company creating an abundant and convenient living, empowered by our core businesses of chemicals, food, biopharmaceuticals and packaging.

Having utilized our competitive edge, especially in these sectors, we have dedicated ourselves to the pursuit of change and innovation in order to become an R&D-based global company offering specialized products and services while exploring new business growth engines.

In November 2011, Samyang Group was launched as a holding company to set apart the manufacturing and investment businesses to essentially promote corporate governance transparency and increase our brand name value. Samyang Holdings Corporation has various subsidiaries that operate main businesses, including Samyang Corporation, Samyang Biopharmaceuticals Corporation and Samyang Packaging Corporation, and currently practices expedient decision-making and responsibility in management tailored to the traits of each business sector.

samyang

1931, Renamed 'Samyang Corporation'
Founded 'Samsu Company'
1924

1955
Enter into Food business
Completion of Ulsan sugar Refining Plant

Completion of Jeonju polyester plant
Enter into Chemical business
1969

1976
Enter into ion exchange resin business
Established Ulsan plant

First production of PET bottle in Korea
Enter into Packaging business
1979

1996
Enter into Pharmaceutical business
Completion of Daedeok Pharmaceutical plant

Established Samyang Holdings, Samyang Corporation, Samyang Biopharmaceuticals Corporation
Shifted to holding company
2011

2014
Production UPS resin
Established Samyang Fine Technology.




TRILITE At a glance

1 First & Only

TRILITE 삼양 트리라이트 Ion Exchange Resin

Only manufacturer of ion exchange resin in Korea

+2 Factories

Own factories in Ulsan and Gunsan, Other OEM factories

+200 Products

More than 200 products in Power, UPW, Foods, Catalysts

+400 Partners

Together with 400 partners around the world

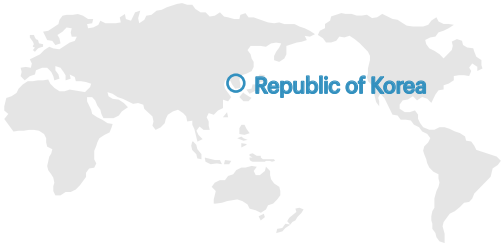
+50 Sales networks

Exporting to more than 50 countries around the world

1.1↓ Uniformity coefficient

Premium UPS Resins with Uniformity coefficient less than 1.1

Locations (HQ, Plant, Tech-center)



Seoul (Headquarter)

- **Technical sales force in 3 fields**
  - Demineralization/ Ultrapure water, Condensate polishing/ Catalyst
  - Starch sugar /Nuceotide/ Amino acids/Pharmaceutical
  - Wastewater / Chelating resin/ Purification
- **One Stop Service**
  - Analysis of IER
  - Facility diagnosis
  - System design support
  - Technical seminar
  - Trouble shooting

Daejeon (Technical Center)

- **Analysis of IER**
- **Recipe improvement of IER**
- **New product development**
  - Tailored / Specialty resins
- **Application process developemnt**
  - Pilot test
  - Engineering data gathering
  - Process proposal

Gunsan (UPS Resin Plant)

- Uniform particle sized resins
- **Samyang Fine Technology (Since 2016)**
- **Joint venture with Mitsubishi Chemicals**
- **Largest manufacturing capacity for UPS resins in Asia**
- **Product line**
  - Uniform particle sized resins
  - Ultrapure water grade(OLED, LCD)
  - Chromatography resins

Ulsan (UPW/Tailored/Specialty Resin Plant)

- **Samyang Ulsan Factory (Since 1976)**
- **Specialized production of Tailored resins**
- **Product line**
  - Ultrapure water grade(Semiconductor)
  - Tailored resin (Starch sugar, Nucleotide, Catalyst)
  - Specialty resins (Chelating resins, Synthetic adsorbents)

Samyang Fine Technology

Samyang Fine Technology is a joint venture between Samyang Corporation and Mitsubishi Chemical Corporation. It is the unique production unit for the uniform particle size ion exchange resin, located in Gunsan, South Korea. It boasts the latest facilities and the largest production scale for UPS resin production in Asia.

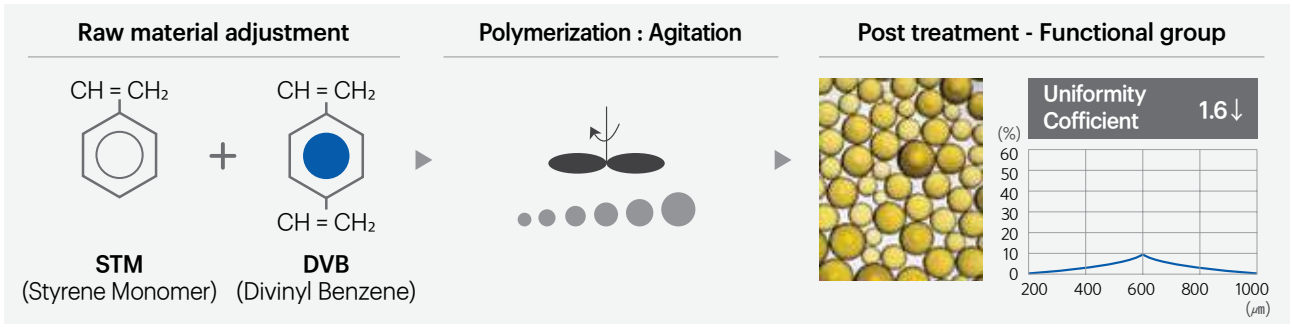
History	
2016. 04	Completion ceremony
2015. 12	Commercial operation
2014. 01	Establishment
2013. 07	Joint venture agreement

Cutting-edge Technology Droplet Generator

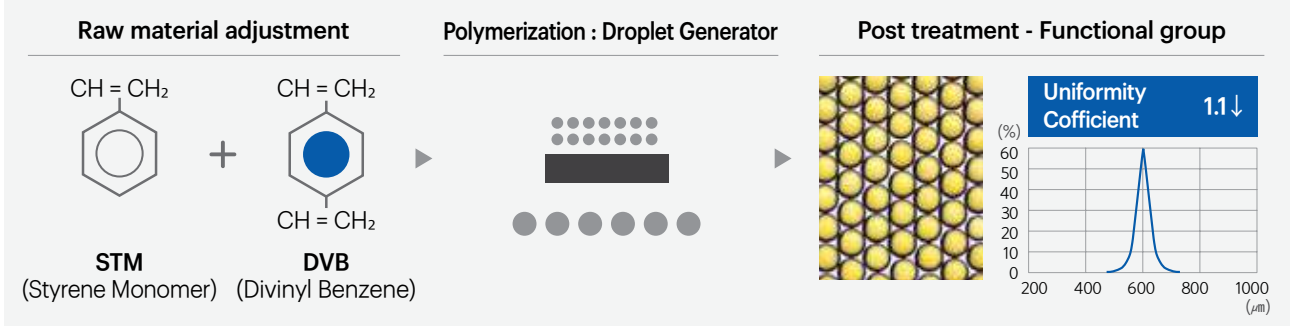
Next generation Ion Exchange Resins

TRILITE UPS resin has adopted state-of-the-art Droplet generating technology for polymerization, differentiated from the prevailing mechanical sieving of polymers and conventional polymerization technology. Premium grade TRILITE Ion Exchange Resins are manufactured from the newest UPS IER plant in the world. TRILITE satisfies high quality standards; Uniformity coefficient of TRILITE is under 1.1 with high mechanical and chemical stability.

Conventional Technology



UPS(Uniform Particle Sized Technology)

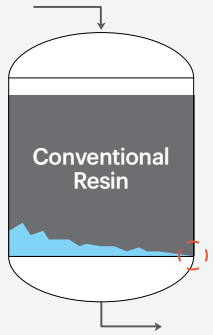


Next Generation IER - High Performance Low Cost

Uniformity of IER enlarges its Performance

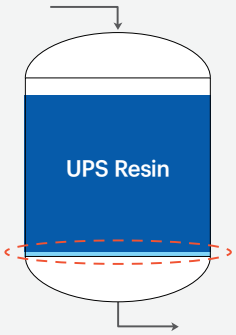
TRILITE UPS resins are renowned in the industry for the consistency of uniformity coefficient, which elevates the performance of the systems. TRILITE UPS resins are manufactured under strict quality control to ensure the optimized size of the resins, enabling extremely even reactions. UPS resins give an extremely even exhaustion front of resins in the vessel, hence the operating capacity is enhanced. Also, it has outstanding mechanical and chemical stability, leading to a remarkably low crush rate even after long-term use.

Comparison of UPS resin and conventional resin



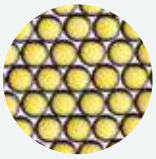
Conventional resin

- Conventional resin gives diffused exhaustion front
  → Inefficient use of exchange capacity

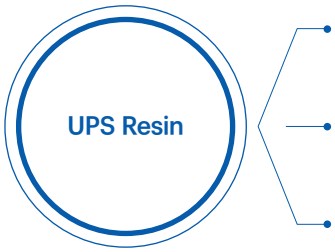


UPS resin

- UPS resin gives an extremely even exhaustion front
  → Efficient use of exchange capacity



Advantages of using UPS resin

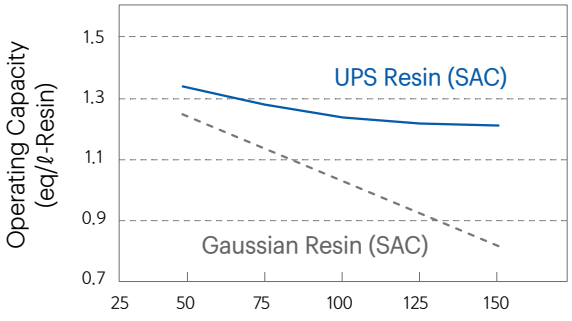


Improved kinetics and fast reaction speed, excellent physical & chemical strength

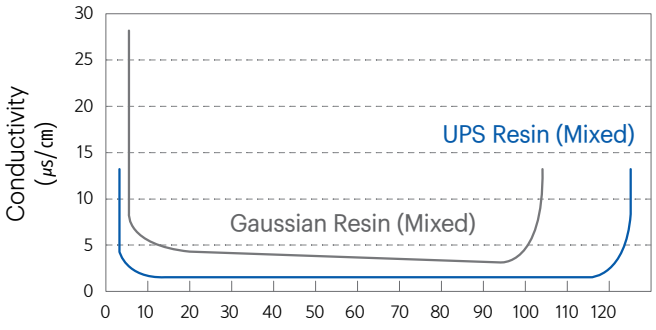
Higher operating capacity, reduction of rinse volume, longer life time of ion exchange resins

Lower running cost and capital expenditure

High operating exchange capacity and treated water quality of UPS resin



Specific Flow Rate (SV)



Service Volume (Bed Volume)

Classification of Ion Exchange Resin

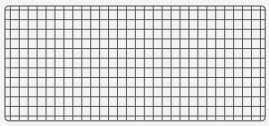
Particle distribution, size, uniformity coefficient

• Gaussian (0.3 ~ 1.2mm)	• Gaussian L-type (L) (0.425 ~ 1.2mm)	• UPS (0.5 ~ 0.6mm)	• Chromatography (0.2 ~ 0.3mm)
			

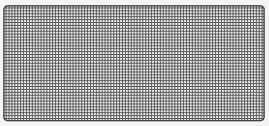
※ UPS : Uniform Particle Sized

Crosslinkage

• **Low crosslinkage**

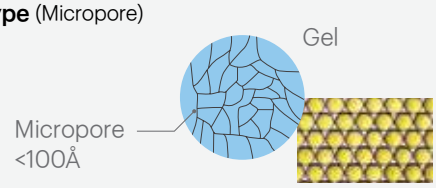


• **High crosslinkage**

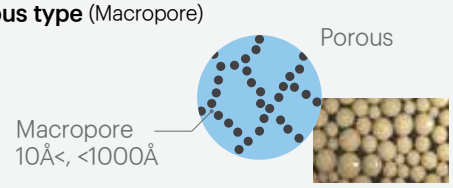


Porosity

• **Gel type** (Micropore)



• **Porous type** (Macropore)



Functional group

Cation	Anion	Specialty	Inert
SAC Strongly acidic cation **WAC** Weakly acidic cation	**SBA** Strongly basic anion **WBA** Weakly basic anion	Chelating resins Synthetic adsorbents	For packed bed system For mixed bed polisher

Post-treatment / Tailored resin

UPW	**Pre-mixed Dry**	**Catalyst**	**Nucleic acid Lysine Starch Sugar, etc**

Product List

Water treatment

Water treatment systems (softening, demineralization) are designed considering the different types of ion exchange resins, service/regeneration direction of a solution, and various combinations of IER towers. An appropriate system is recommended under the conditions of raw water and required water quality. TRILITE ion exchange resin line-up consists of the most efficient line-ups for various types of softening and demineralization of water. It results in cost-effective, high performance of water treatment with remarkably high operating capacity and high mechanical and chemical stability.

Particle Size, Distribution, Uniformity Coefficient

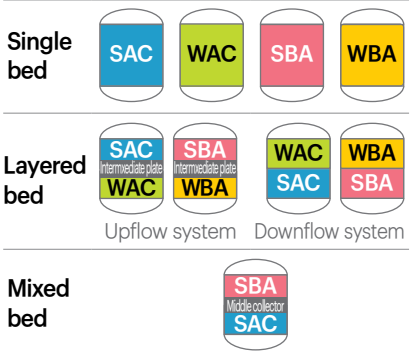
- **Gaussian**
  - Particle Size : 0.3 ~ 1.2mm
  - Uniformity Coefficient : 1.6 ↓

- **Gaussian L-type** (L)
  - Particle Size : 0.425 ~ 1.2mm
  - Uniformity Coefficient : 1.4 ↓

- **UPS**※
  - Particle Size : 0.5 ~ 0.7mm
  - Uniformity Coefficient : 1.1 ↓

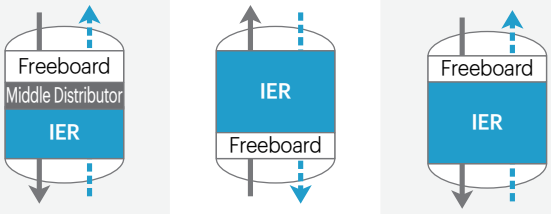
※ UPS : Uniform Particle Sized

Classification by IER layer



※ SAC : Strongly Acidic Cation Resin
WAC : Weakly Acidic Cation Resin
SBA : Strongly Basic Anion Resin
WBA : Weakly Basic Anion Resin

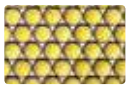
Classification by regeneration system

Co-current Regeneration system	Counter-current regeneration system	
	Water Blocking system	Packed bed
		Up-flow system / Down-flow system
Service Regeneration		
Gaussian	Gaussian or L-type	UPS

※ IER : Ion Exchange Resin

TRILITE Water treatment product lines

Product line	Origin	U.C (Uniformity coefficient)	Grade	Remarks
Premium	Samyang Fine Technolgoy	1.1↓	• **Power plant** - Nuclear grade - Condensate polishing	Premium grades produced in UPS resin specialized factory, extremely even uniformity, impurities minimized resins. High performance for premium water treatment.
	Samyang Corp Ulsan plant		• **Ultrapure water** - Make-up & final polisher in semiconductor and OLED/ LCD, etc	
Performance	Samyang Fine Technolgoy	1.1↓	• **Power plant** - Condensate polishing - Pretreatment Make-up	Produced in UPS resin specialized factory, extremely even uniformity and excellent physical, chemical strengths. High performance and long-term use
			• **Large-scaled industrial water treatment** - Petrochemicals, foods, electronics, etc	
Basic	OEM	1.1↓ ~ 1.6↓	• **General water treatment** - Softening (industrial, domestics, foods) - Demineralization	Produced under Samyang's strict quality control and technical guidance. Highly reliable quality and economical results.

	Type	Strongly acidic cation resins (SAC)			Strongly basic anion resins (SBA)			
		Grade	TEC (eq/ℓ)	Particle Distribution	Type	Grade	TEC (eq/ℓ)	Particle Distribution
Premium	UPS Gel	MC-10S	2.2↑	0.60~0.70㎜		MA-10S	1.35↑	0.50~0.60㎜
		MC-10SH	2.0↑	0.61~0.71㎜		MA-10SOH	1.1↑	0.54~0.64㎜
Performance		MC-08	2.0↑	0.55~0.65㎜	Type1	MA-12	1.3↑	0.53~0.63㎜
		MC-08H	1.8↑	0.57~0.67㎜		MA-12OH	1.1↑	0.57~0.67㎜
		MC-10	2.2↑	0.60~0.70㎜		MA-10	1.35↑	0.50~0.60㎜
		MC-10H	2.0↑	0.61~0.71㎜		MA-10OH	1.1↑	0.54~0.64㎜
		MC-14M	2.5↑	0.50~0.60㎜		MA-15	1.4↑	0.55~0.65㎜
		MC-14MH	2.4↑			MA-15OH	1.2↑	0.58~0.68㎜
					Type2	MA-20	1.3↑	0.53~0.63㎜
Basic		UKC-08	2.0↑	0.55~0.65㎜	Type1	UKA-12	1.3↑	0.55~0.65㎜
		UKC-10	2.2↑	0.60~0.70㎜				
		UKC-12	2.3↑	0.60~0.70㎜				
	Gaussian Gel	SCR-B(L)	2.0↑	0.3~1.2㎜ (L-type) 0.425~1.2㎜	Type1	SAR10(MB)	1.3↑	0.3~1.2㎜ (L-type) 0.425~1.2㎜ (MB) for mixed bed
						SAR12	1.3↑	
					Type2	SAR20(MB)	1.3↑	
		KC-07	1.9↑	0.3~1.2㎜	Type1	KA-10(MB)	1.3↑	0.3~1.2㎜ (MB) for mixed bed
		KH-70	1.9↑			KA-12	1.3↑	
		KC-08	2.0↑		Type2	KA-20(MB)	1.3↑	
		KH-80	2.0↑					
	Functional group	(Polystyrene+DVB) + Sulfonate			(Polystyrene+DVB) + Type1 : TMA, trimethylamine, Type2 : DMEA, dimethylethanolamine			

	Type	Weakly acidic cation resins (WAC)			Weakly basic anion resins (WBA)			
Premium					UPS Porous	AW90	1.6↑	0.50~0.60㎜
Performance	Gaussian Porous	WCA10L	4.2↑	0.425~1.2㎜		AW80	1.5↑	0.40~0.60㎜
Basic					Gaussian Porous	AW30	1.5↑	0.425~1.2㎜
	Functional group	(Polystyrene+DVB) + Carboxylic Acid			(Polystyrene+DVB) + Tertiary Amine			

Softening

Softening		Product Line	SAC	SBA	WAC	WBA
Softening (Industrial grade)	SAC →	Performance	MC-08 MC-10			
		Basic	UKC-08, UKC-10 UKC-12, SCR-B KC-07, KC-08			
Softening (Food grade)	SAC →	Basic	KH-70 KH-80			

Hardness components (calcium, magnesium, etc.) in raw water form scale and cause problems in water treatment systems. The softening facility produces soft water by removing hardness components from raw water with cation exchange resins.
In general, strongly acidic cation exchange resins are used in the water softening, and purified salts are used as regenerant. When the hardness component is highly concentrated in raw water, it is treated with weakly acidic cation resins.

Sodium hypochlorite (NaClO), Free chlorine (Cl_2), Ozone (O_3)

When used with oxidizing agents or sterilizer(sodium hypochlorite and free chlorine), it is recommended to use strong acid cation exchange resin with excellent oxidation resistance.

Selection		ClO_2 Concentration	Cl_2 or O_3 Concentration
Performance	MC-08	0.1ppm↓	0.2ppm↓
Basic	UKC-08, SCR-B KC-07, KC-08		
Performance	MC-10	0.15ppm↓	0.3ppm↓
Basic	UKC-10		
Basic	UKC-12	0.2ppm↓	0.4ppm↓

Food grade softening

For the food grade softening application, such as a food processing companies, it is necessary to use an appropriate food grade ion exchange resins.

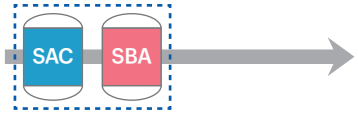
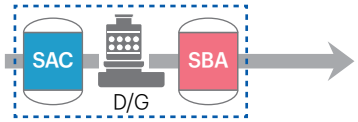
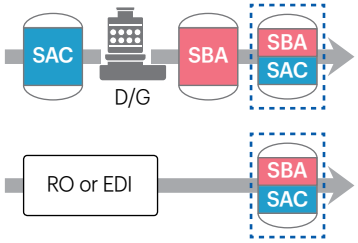
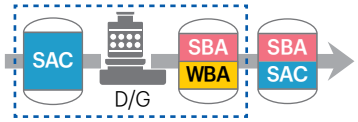
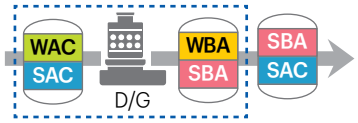
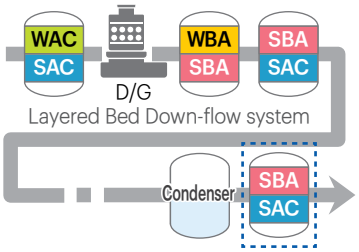
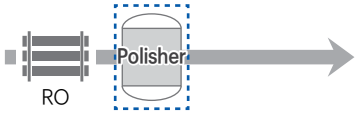
KH-80 SCR-B

• NSF test method

Put 50㎖ ion exchange resins into 100 ㎖ at 70℃, and measure APHA(unit of chromaticity) with a Visible Spectrophotometer.

TRILITE	Grade	Spec.	Day 1	Day 2	Day 3	Day 4	Day 7
KH-80	**Food**	**< 20**	**12**	**13**	**13**	**13**	**14**
SCR-B	Tech	-	145	149	153	160	183

Demineralization

Demineralization system		Treated water quality	Product Line	SAC	SBA	WAC	WBA
2B2T (2Bed 2Tower) Cation Exchanger + Anion Exchanger		1~2㎲/㎝↓ SiO_2 20~100ppb↓	Performance	MC-08 MC-10	MA-12 MA-20		
2B3T Cation Exchanger + Degasifier + Anion Exchanger			Basic	SCR-B UKC-08 UKC-10 KC-08	SAR10 SAR20 UKA-12 KA-12 KA-20		
Working MB (Mixed Bed)		1㎲/㎝↓ SiO_2 100ppb↓	Performance	MC-08	MA-20		
			Basic	SCR-B	SAR20MB		
2B2T or 2B3T or RO or EDI + **MBP** (Mixed Bed Polisher)		0.1㎲/㎝↓ SiO_2 5~10ppb↓	Premium	MC-10S	MA-10S		
			Performance	MC-08 MC-10	MA-10		
			Basic	SCR-B	SAR10MB KA-10MB		
3B3T +MBP	 Layered bed Up-flow system	10~17 ㏁·cm↑ SiO_2 5~10ppb↓	Performance	MC-08 MC-10	MA-12 MA-10		AW90 AW80
			Basic	SCR-B UKC-08 UKC-10	SAR10MB UKA-12		AW30
4B3T +MBP	 Layered bed Up-flow system	10~17 ㏁·cm↑ SiO_2 5~10ppb↓	Performance	MC-08 MC-10	KA18LB	WCA10L	AW90 AW80
			Basic	SCR-B UKC-08 UKC-10			AW30
4B3T +MBP **+CPP** (Condensate Polisher)		0.1㎲/㎝↓ SiO_2 10ppb↓	Premium	MC-10SH	MA-10SOH		
			Performance	MC-10H	MA-10OH MA-15OH		
RO (Reverse Osmosis) + **Polisher** (Polishing Resin)	 Non-regenerable	15~18 ㏁·cm↑ SiO_2 5~10ppb↓	Premium	UPRM100U, UPRM200U, UPRM300U			
		10~17 ㏁·cm↑ SiO_2 10ppb↓	Performance	SM210, SM300			
			Basic	SM200			

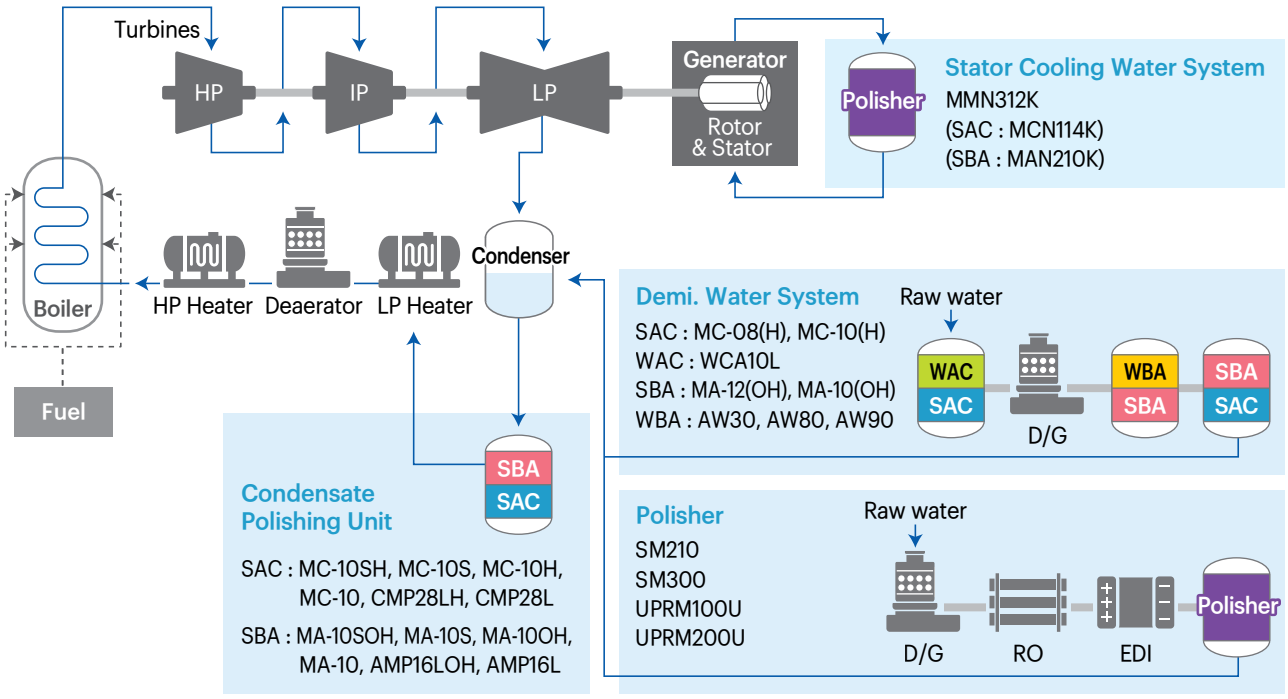
※ Anti-clumping treatment is applied to all anion exchange resins for the mixed bed system application.

※ The data for treated water quality is for reference.

Power Plant - Thermal

In thermal power plants, ion exchange resins are applied to demineralization, cooling water, and condensate polishing application. For demineralization, there are various combinations of ion exchange resins and equipments. The resins for Condensate polishing require high operating capacity, heat resistance, and strong mechanical/chemical strengths to remove impurities from the steams. TRILITE ion exchange resin has various reputable references to domestic and overseas thermal power plants and contributes to the competitive power supply to customers through stable quality control and technical support.

Typical power plant steam turbine loop and IER selection



Excellent hydraulics, physical chemical stability, excellent separability of cation and anion resin contribute to stable operation of power plants

• Condensate polishing resins

	SAC				SBA			
	Type	Grade name	TEC (eq/ℓ)	Particle distri-bution	Type	Grade name	TEC (eq/ℓ)	Particle distri-bution
Gaussian	Porous	CMP28L	2.05↑	0.425 ~1.2㎜	Porous type1	AMP16L	1.2↑	0.425 ~1.2㎜
		CMP28LH	2.0↑			AMP16LOH	0.8↑	
UPS	Gel	MC-10	2.2↑	0.60 ~0.70㎜	Gel type1	MA-10	1.35↑	0.50 ~0.60㎜
		MC-10H	2.0↑	0.61 ~0.71㎜		MA-10OH	1.1↑	0.54 ~0.64㎜
		MC-10SH	2.0↑	0.61 ~0.71㎜		MA-10SOH	1.1↑	0.54 ~0.64㎜
		MC-14	2.5↑	0.60 ~0.70㎜		MA-15	1.4↑	0.55 ~0.65㎜
		MC-14H	2.4↑			MA-15OH	1.2↑	0.58 ~0.68㎜

• Post RO or EDI

UPS	UPRM100U Mixed Resin ratio = 1 : 1 as same equivalent
Gaussian	SM210, SM300 Mixed Resin ratio = 1 : 1 as same equivalent

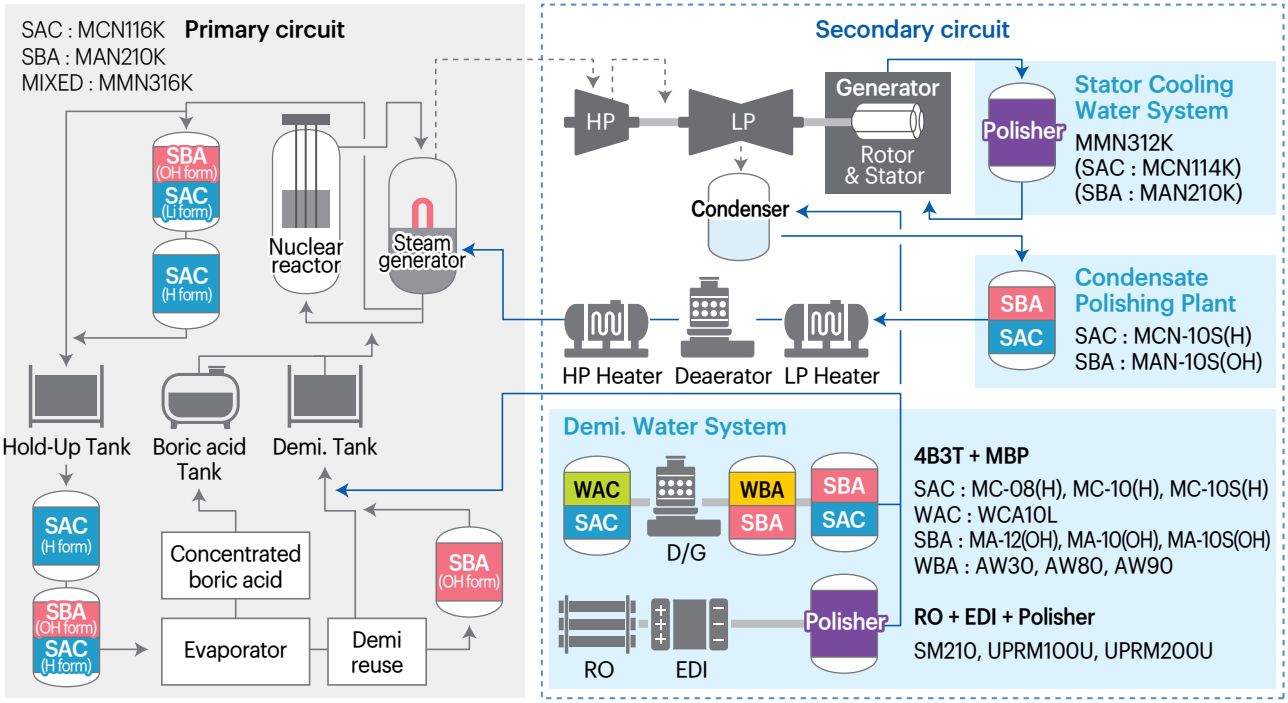
• For Stator Cooling Water System

UPS	MMN312K Mixed Resin ratio = 1 : 1 as same equivalent

Power Plants - Nuclear

In nuclear power plants, ion exchange resins are used in processes such as make-up, condensate polishing, and primary circuit. Generally, pressurized water reactor (PWR) nuclear power plant water treatment flow consists of a primary make-up system and a secondary system including condensate polishing. For the primary circuits, high-crosslinkage resins are used against the radiation exposure, and the content of impurities must be low and physical, chemical strength must be excellent. TRILITE ion exchange resin has various reputable supply references to global nuclear power plants and contributes to the competitive power supply of customers with stable quality control and timely delivery.

Typical PWR water treatment system and IER selection



High exchange capacity, extremely low TOC leakage and produce high purity water
Excellent H/OH conversion rate and low metal traces contribute to the stable operation of power plants

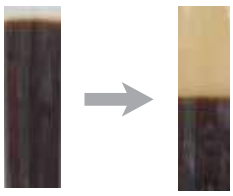
• Primary circuit for nuclear power plant

	Strongly acidic cation resin (SAC)				Strongly basic anion resin (SBA)			
	Type	Grade	TEC (eq/ℓ)	Particle distribution	Type	Grade	TEC (eq/ℓ)	Particle distribution
UPS	Gel	MCN116K	2.4↑	0.55~0.70㎜	Gel type1	MAN210K	1.2↑	0.55~0.70㎜
	MMN316K / Mixed Resin ratio = 1 : 1 as same equivalent (MCN116K : MAN210K)							

Advantages of TRILITE condensate polishing (CPP) resins

- **Applicable to High temp., pressure operating conditions.**
- **Control over trace impurities**
- **Stable operation and long-term use**

- Excellent physical chemical strength → low resin shredding and loss
- High exchange capacity → high purity and low trace impurities
- Even uniformity → low pressure drop and fast service
- Excellent separability → increased regeneration efficiency



Mixed — After backwashing

Performance

UPS Strongly Acidic Cation(SAC) Resins

Grade	MC-04	MC-04H	MC-08	MC-08H	MC-10	MC-10H	MC-14M	MC-14MH
Matrix	Polystyrene+DVB							
Type	Gel							
Functional group	Sulfonic acid							
Ionic form	Na^+	H^+	Na^+	H^+	Na^+	H^+	Na^+	H^+
Specific gravity	1.16	1.13	1.28	1.2	1.32	1.22	1.36	1.32
Shipping weight (g/ℓ)	790	750	845	800	850	805	865	815
Moisture retention (%)	57~67	65~70	43~49	50~56	38~44	45~51	31~37	37~43
Total capacity (eq/ℓ)	1.3↑	1.2↑	2.0↑	1.8↑	2.2↑	2.0↑	2.5↑	2.4↑
Uniformity coefficient	1.1↓							
Average diameter (㎛)	500±50	500±30	600±50	620±50	650±50	660±50	540±50	550±50
Operating temp. (℃)	120↓							
Operating pH range	0~14							
Swelling rate ($Na^+ \rightarrow H^+$)	9%	9%	9%	9%	8%	8%	7%	7%
Remarks	High crosslinkage resin features the high resistance against oxidizing agents, high exchange rate per apparent volume and less swelling rate. However, it adversely has less exchange rate for large molecules, less regeneration efficiency and vulnerable to organic fouling. Low crosslinkage resin features higher regeneration efficiency, high resistance against organic fouling and fast reaction rate. However, it adversely has low exchange capacity and vulnerable to oxidizing agents.							

※ The data for Specific gravity/ Shipping weight/ Swelling rate is for reference.

Applications

TRILITE MC-04(H)

TRILITE MC-04(H) is a low crosslinkage UPS SAC resin which features fast exchange reaction. It is widely applied to various chemical reactions such as catalytic application (Bisphenol-A, etc), separation and refining of nucleic acid and amino acid, etc.

TRILITE MC-08(H)

TRILITE MC-08(H) is a standard crosslinkage UPS SAC resin. With its excellent regeneration efficiency and less rinse volume consumption, high purity water can be produced economically. It has outstanding mechanical and chemical stability, leading to low crush rate even after long-term use. It is widely used for softening, demineralization and other applications such as lysine, sugar and catalyst reaction.

TRILITE MC-10(H)

TRILITE MC-10(H) is a high crosslinkage UPS SAC resin which features outstanding mechanical and chemical stability. It is widely used for premium water treatments such as condensate polishing and pretreatment for ultrapure water.

TRILITE MC-14M(H)

MC-14M(H) is a very high crosslinkage UPS SAC resin. It has outstanding mechanical and chemical stability. It is widely used for premium application where extremely high exchange capacity is required such as Primary circuit in nuclear power plants and etc.

Performance

UPS Strongly Basic Anion(SBA) Resins

Grade	MA-12	MA-12OH	MA-10	MA-10OH	MA-15	MA-15OH	MA-20
Matrix	Polystyrene + DVB						
Type	Gel						
Functional group	Type 1 (Trimethylammonium)						Type 2 (Dimethylethanol-ammonium)
Ionic form	Cl^-	OH^-	Cl^-	OH^-	Cl^-	OH^-	Cl^-
Specific gravity	1.08	1.07	1.08	1.07	1.08	1.08	1.11
Shipping weight (g/ℓ)	670	660	675	665	705	670	700
Moisture retention (%)	49~55	62~70	43~49	59~65	39~45	54~62	45~51
Total capacity (eq/ℓ)	1.3↑	1.0↑	1.35↑	1.1↑	1.4↑	1.2↑	1.3↑
Uniformity coefficient	1.1↓						
Average diameter (㎛)	580±50	620±50	550±50	590±50	600±50	630±50	590±50
Operating temp. (℃)	80↓	60↓	80↓	60↓	90↓	70↓	40↓ (OH type) 60↓ (Cl type)
Operating pH range	0~14						
Swelling rate ($Cl^- \rightarrow OH^-$)	24%	24%	23%	23%	22%	22%	14%

※ The data for Specific gravity/ Shipping weight/ Swelling rate is for reference.

Applications

TRILITE MA-12(OH)

TRILITE MA-12(OH) is an UPS SBA resin (Gel Type 1) with TMA as functional group. It is supplied either in Cl or OH forms. It features higher SiO_2 removal and less ion leakage. With the fast reaction rate, it is widely used for various applications such as MBP(Mixed bed polisher) in demineralization, UPW and noble metal recovery.

TRILITE MA-10(OH)

TRILITE MA-10(OH) is a high crosslinkage UPS SBA resin (Gel Type 1) with TMA as functional group. It features outstanding mechanical and chemical stability, SiO_2 removal and less ion leakage. It is widely applied to Condensate polishing.

TRILITE MA-15(OH)

TRILITE MA-15(OH) is a very high crosslinkage UPS SBA exchange resin (Gel Type 1) with TMA as functional group. It features outstanding mechanical and chemical stability. It is widely applied to premium water treatment applications such as Anion exchanger for UPW and Condensate polishing.

TRILITE MA-20

TRILITE MA-20 is an UPS SBA resin (Gel Type 2) with DMEA as functional group. It features very high regeneration efficiency and operating capacity. It shows outstanding performance when used in packed bed system and pre-treatment single bed for demineralization.

Basic

Gaussian/UPS Strongly Acidic Cation(SAC) Resins

Application	Industrial softening and demineralization						Food grade	
Grade	**KC-07**	**KC-08**	**SCR-B**	**UKC-08**	**UKC-10**	**UKC-12**	**KH-70**	**KH-80**
Matrix	Polystyrene+DVB							
Type	Gel							
Functional group	Sulfonic acid							
Ionic form	Na^+							
Specific gravity	1.25	1.25	1.29	1.28	1.31	1.34	1.27	1.29
Shipping weight (g/ℓ)	800		830	840	850	860	820	830
Moisture retention (%)	45~50	43~50		42~47	41~45	39~44	45~52	43~50
Total capacity (eq/ℓ)	1.9↑	2.0↑		2.0↑	2.2↑	2.3↑	1.9↑	2.0↑
Effective Size (㎛)	400↑			UPS			400↑	
Uniformity coefficient	1.6↓			1.1↓			1.6↓	
Particle size (㎛)	300~1,200			600 ±50	650 ±50	650 ±50	300~1,200	
Operating temp. (℃)	120↓							
Operating pH range	0~14							
Swelling rate ($Na^+ \rightarrow H^+$)	9%	8%	8%	9%	8%	7%	9%	8%

※ The data for Specific gravity/ Shipping weight/ Swelling rate is for reference.

Applications

TRILITE KC-07

It is widely used for industrial softening with the cost advantage.

TRILITE KC-08

It is a standard crosslinkage Gaussian SAC resin with the cost advantage which is widely used for industrial softening.

TRILITE SCR-B

It is a standard crosslinkage Gaussian SAC resin. It is widely applied to water treatments like softening and demineralization and other applications such as refining of sugar/starch sugar, amino acids separation, dehydration of organic solvents and catalyst for various chemical reactions.

TRILITE UKC-08

It is a standard crosslinkage UPS SAC resin and widely used for industrial softening and demineralization.

TRILITE UKC-10, TRILITE UKC-12

These are high crosslinkage UPS SAC resins which are widely used for TRILITE UKC-12 industrial softening and demineralization.

TRILITE KH-70, TRILITE KH-80

These are the premium grade resins for domestic appliances and food processing softening applications. Special post treatments reduce the colorants leakage and the bad ordor at the initial stage of usage.

Basic

Gaussian/UPS Strongly Basic Anion(SBA) Resins

Grade	KA-10(MB)	SAR10(MB)	KA-12	SAR12	UKA-12	KA-20(MB)	SAR20(MB)
Matrix	Polystyrene+DVB					Polystyrene+DVB	
Type	Gel						
Functional group	Type 1 (Trimethylammonium)					Type 2 (Dimethylethanolammonium)	
Ionic form	Cl^-						
Specific gravity	1.11	1.11	1.08	1.07	1.08	1.13	1.13
Shipping weight (g/ℓ)	670	685	685	680	670	720	700
Moisture retention (%)	42~48	43~48	50~60	48~55	49~55	39~44	39~44
Total capacity (eq/ℓ)	1.35↑	1.3↑	1.2↑	1.3↑	1.3↑	1.3↑	1.3↑
Effective Size (㎛)	400↑				UPS	400↑	
Uniformity coefficient	1.6↓				1.1↓	1.6↓	
Particle size (㎛)	300~1,200				580±50	300~1,200	
Operating temp. (℃)	60↓ (OH type) 80↓ (Cl type)					40↓ (OH type) 60↓ (Cl type)	
Operating pH range	0~14						
Swelling rate ($Cl^- \rightarrow OH^-$)	24%					15%	12%

※ The data for Specific gravity/ Shipping weight/ Swelling rate is for reference.

Applications

TRILITE SAR10(MB), TRILITE KA-10(MB)

These are the high crosslinkage Gaussian SBA resin (Gel type 1) with higher SiO_2 removal and less ion leakage. It is widely used for Anion exchanger and MBP for demineralization, and also catalyst application and recovery of noble metals such as gold.

TRILITE SAR12, TRILITE KA-12

These resins features high SiO_2 removal and low ionic leakage and widely used for anion exchanger for demineralization system.

TRILITE UKA-12

It is a UPS SBA resin which is widely used for anion exchanger for demineralization system.

TRILITE SAR20(MB), TRILITE KA-20(MB)

These are the Gaussian SBA resin (Gel type 2), and features high regeneration efficiency and operating capacity. It is most widely used for water treatment, noble metal recovery and other refining applications.

Performance | Basic

Weakly Acidic Cation(WAC) / Weakly Basic Anion(WBA) Exchange Resins

Type	Weakly Acidic Cation Exchange Resins	Weakly Basic Anion Exchange Resins				
Grade	**WCA10L**	**AW20**	**AW30**	**AW30C**	**AW80**	**AW90**
Matrix	Polyacrylate+DVB	Polystyrene+DVB				
Functional group	COOH (Carboxylic acid)	Secondary amine	Tertiary amine			
Ionic form	H^+	Free Base				
Specific gravity	1.19	1.07	1.05	1.05	1.04	1.04
Shipping weight (g/ℓ)	720	650	700	700	670	640
Moisture retention (%)	45~50	39~45	48~58	55~65	55~60	40~50
Total capacity (eq/ℓ)	4.5↑	2.5↑	1.5↑	1.6↑	1.6↑	1.6↑
Effective Size (㎛)	500↑	400↑	400↑	400↑	UPS	UPS
Uniformity coefficient	1.6↓	1.6↓	1.6↓	1.6↓	1.2↓	1.1↓
Particle size (㎛)	425~1,200	300~1,200	425~1,200	300~1,200	400~600	550±50
Operating temp. (℃)	120↓	100↓	60↓	100↓	60↓	60↓
Operating pH range	4~14	0~9	0~9	0~9	0~9	0~9
Swelling rate ($Na^+ \rightarrow H^+$, FB → Cl^-)	60%	30%	20%	20%	23%	20%

※ The data for Specific gravity/ Shipping weight/ Swelling rate is for reference.

Applications

TRILITE WCA10L

It is a Gaussian WAC resin. With excellent ion exchange capacity, high purity water can be produced economically. It features high mechanical and chemical stability leading to low crush rate after long term use. It has high exchange capacity and regeneration efficiency. It is widely applied in layered bed of water treatment systems combined with SAC resins, and also used for Electrodeposition of paints, etc.

TRILITE AW20

It doesn't have natural salt splitting capacity but high exchange capacity and regeneration efficiency. It is widely used for refining of organic solvents with excellent chemical stability, heat resisting capacity and mechanical strength against attrition loss.

TRILITE AW30

It features outstanding chemical stability, high resistance against organic fouling and superior decolorization capacity. It is widely used for general water treatment and starch sugar refining.

TRILITE AW30C

It feaures excellent chemical stability, heat resistance, mechanical strength and large WBA ratio. It is widely used for starch sugar refining.

TRILITE AW80

It is an UPS WBA resin and features excellent chemical stability and heat resistance. It is widely used for layered bed water treatment system combined with SBA resins.

TRILITE AW90

It is an UPS resin with high chemical stability, high resistance against organic fouling and superior depolarization capacity. It is widely used for starch refining and Layered bed water treatment system combined with SBA resins.

Premium Performance

Condensate Polishing & Stator Cooling Water

	Condensate Polishing				Stator Cooling Water		
Grade	**MC-10SH**	**CMP28LH**	**MA-10SOH**	**AMP16LOH**	**MCN114K**	**MAN210K**	**MMN312K**
Matrix	Polystyrene+DVB						
Type	Gel	Porous	Gel	Porous	Gel		
Functional group	Sulfonic acid		Type 1 (Trimethylammonium)		Sulfonic acid	Type 1 (Trimethyl-ammonium)	MCN114K + MAN210K
Ionic form	H^+	H^+	OH^-	OH^-	H^+	OH^-	
Total capacity (eq/ℓ)	2.0↑	2.0↑	1.1↑	0.8↑	2.0↑	1.2↑	
Moisture retention (%)	45~51	42~48	59~65	60~68	45~51	54~60	
Shipping weight (g/ℓ)	805	780	665	650	805	705	
Uniformity coefficient	1.1↓	1.4↓	1.1↓	1.4↓	1.1↓	1.1↓	
Particle size (㎛)	660±50	425~1,200	590±50	425~1,200	660±50	630±50	
Effective size	UPS	400↑	UPS	400↑	UPS	UPS	
ΔTOC (ppb)	-	-	-	-	10↓	10↓	10↓
Operating temp. (℃)	120↓	120↓	60↓	70↓	120↓	60↓	60↓
Operating pH range	0~14						

※ The data for Specific gravity/ Shipping weight/ Swelling rate is for reference.

Applications

TRILITE MC-10SH

It is a high crosslinkage UPS SAC resin which features outstanding mechanical and chemical stability. It is widely used for premium water treatments such as condensate polishing.

TRILITE CMP28LH

It is a very high crosslinkage Gaussian SAC resin, which features excellent stability against oxidizing agents. It is widely used for water treatment, metal removals and condensate polishing.

TRILITE MA-10SOH

It is a high crosslinkage UPS SBA resin (Gel Type 1) with TMA as a functional group. It features outstanding mechanical and chemical stability, SiO_2 removal and less ion leakage. It is widely applied to Condensate polishing.

TRILITE AMP16LOH

It is a high crosslinkage resin, which features outstanding SiO_2 removal capacity and less ion leakage. It is widely used for water treatment containing large amount of organic contents MBP application and the condensate polishing.

TRILITE MCN114K

It is a high crosslinkage UPS SAC resin and features excellent mechanical and chemical stability, and low crush rate after long term use. It is widely used for premium water treatment such as nuclear power plant and stator cooling system.

TRILITE MAN210K

It is a high crosslinkage UPS SBA resin and features excellent mechanical and chemical stability, and low crush rate after long term use. It is widely used for premium water treatment such as nuclear power plant and stator cooling system.

TRILITE MMN312K

It is a mixed resin of MCN114K and MAN210K by 1:1 exchange capacity ratio, and widely used for premium water treatment, such as nuclear power plant and stator cooling system.

Premium

Nuclear grade Ion Exchange Resins

	Primary Circuit			Secondary Circuit	
Grade	**MCN116K**	**MAN210K**	**MMN316K**	**MCN-10SH**	**MAN-10SOH**
Matrix	Polystyrene+DVB				
Functional group	Sulfonic acid	Type 1 (Trimethyl-ammonium)	MCN116K + MAN210K	Sulfonic acid	Type 1 (Trimethyl-ammonium)
Ionic form	H^+	OH^-		H^+	OH^-
Total capacity (eq/ℓ)	2.4↑	1.2↑		2.0↑	1.2↑
Shipping weight (g/ℓ)	810	660		805	665
Moisture retention (%)	36~43	54~60		45~51	59~65
Uniformity coefficient	1.1↓			1.1↓	
Average diameter (㎛)	550±50	630±50		660±50	590±50
Operating temp. (℃)	120↓	60↓		120↓	60↓
Operating pH range	0~14			0~14	

※ The data for Shipping weight is for reference.

Applications

TRILITE MCN116K

It is a high crosslinkage UPS SAC resin which features excellent mechanical and chemical stability, and low crush rate after long term use. It is widely used for premium water treatment such as primary circuit for nuclear power plant.

TRILITE MAN210K

It is a high crosslinkage UPS SBA resin (Gel type 1) which features excellent mechanical/ chemical stability and low crush rate after long term use. It is widely used for premium water treatment such as nuclear power plant, and under the standard operating conditions, it maintains less than △TOC 10ppb of outlet water quality.

TRILITE MMN316K

TRILITE MMN316K is a mixed resin of MCN116K and MAN210K by 1:1 exchange capacity ratio.It is widely used for premium water treatment such as nuclear power plant.

TRILITE MCN-10SH

It is a high crosslinkage UPS SAC resin which features outstanding heat resistance and chemical stability. It is widely used for premium water treatments such as secondary circuit condensate polishing of nuclear power plant.

TRILITE MAN-10SOH

It is a high crosslinkage UPS SBA resin which features outstanding heat resistance and chemical stability. It is widely used for premium water treatments such as secondary circuit condensate polishing of nuclear power plant.

Catalyst

Ion exchange resins are used as a catalyst for various chemical reactions and convert the Batch operation into the Continuous operation.

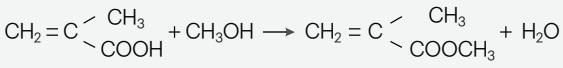
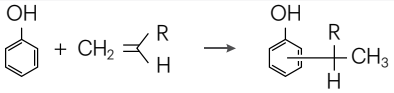
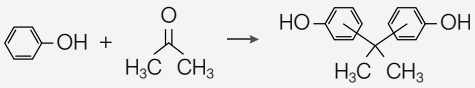
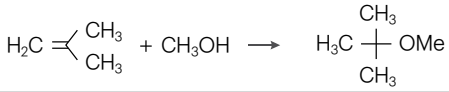
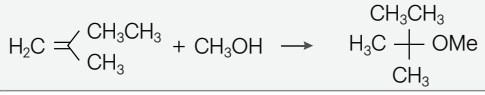
The followings are the advantages of IERs used in the catalyst applications :

① Easily separable from the reaction system and cost-effective with the continuous reaction in the column reactor.
② Unnecessary for regeneration or re-concentration, high reaction selectivity and fewer byproducts produced.
③ Easy to be selected with low corrosive to the system.

Also, caution must be taken that it features less heat stability compared to the inorganic catalyst and slow reaction rate for macromolecules reactions.

TRILITE catalyst resin optimizes the catalytic reactions with the improved porosity and excellent ionic conversion rate of resins. It shows a fast reaction rate with maximized surface area and remarkable internal diffusion speed, resulting in efficient reactions even in the non-polar solvent. Also, it has outstanding mechanical and chemical stability and excellent elasticity of polymers. Hence, the superior durability of resins can be achieved even under the rapid volume changes and results in a longer lifetime.

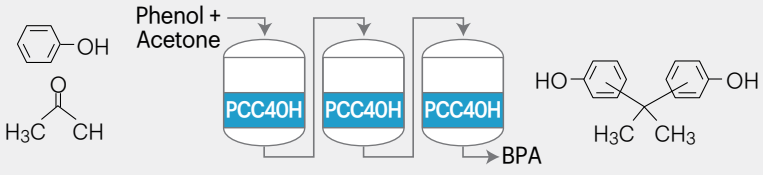
• Catalyst applications and selection of catalyst resins

Applications	Reaction Mechanism	Recommendation	Equivalent
Hydrolysis of methyl acetate		CMP08LH	DIAION PK208LH
Esterification reaction		PCC40H, MC-08H, CMP08LH, SPC160H, SPC180H, SPC400LH	
Synthesis of MMA (methyl methacrylate)		SPC180H	
Alkylation of phenol		SPC260H, SPC320H	Amberlyst 15Wet
Synthesis of Bisphenol A		PCC40H, PCC30H	DIAION SK104H Lewatit K1131S
Methyl tertiary butyl ether(MTBE)		SPC260H, SPC280H	Amberlyst 35Wet
t-amyl methyl ether(TAME)		SPC160H, SPC180H	Lewatit K2621

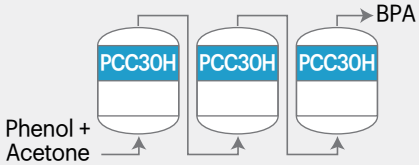
• Bisphenol-A(BPA) Catalyst

Bisphenol-A(BPA) is used as a raw material for manufacturing various plastics such as polycarbonate or epoxy resin, and high purity Bisphenol-A can be produced by using an ion exchange resin as a catalyst in a mixture of phenol and acetone.

Idemitsu process



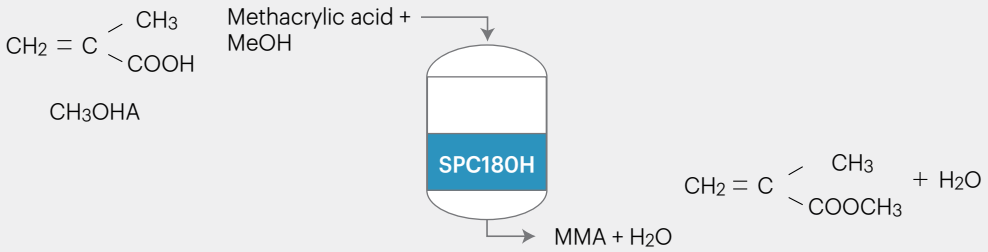
Badger process



• MMA (Methylmethacrylic acid) Catalyst

MMA (Methylmethacrylic acid) is used as a raw material for acrylic resins, paints, and adhesives due to its excellent transparency and durability against temperature. MMA and can be produced by using an ion exchange resin as a catalyst in a mixture of methacrylic acid and methanol.

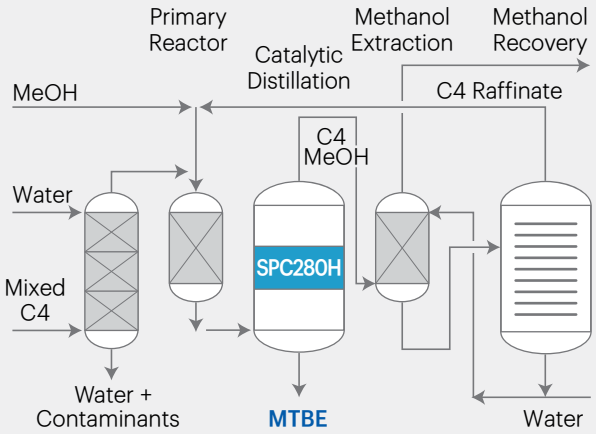
Nippon Shokubai process



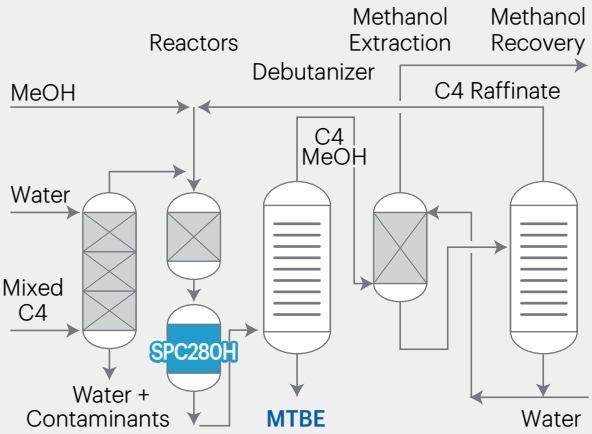
• MTBE (Methyl tertiary butyl ether) Catalyst

MTBE (Methyl tertiary butyl ether) is an ether compound containing oxygen in its molecular structure and is widely used as an octane enhancer in gasoline. Cracking MTBE can produce high-purity isobutene, which is a raw material of MMA.
Isobutene and methanol can be produced by selective catalyzing the reaction with an ion exchange resin.

CDTECH process : Catalytic distillation process

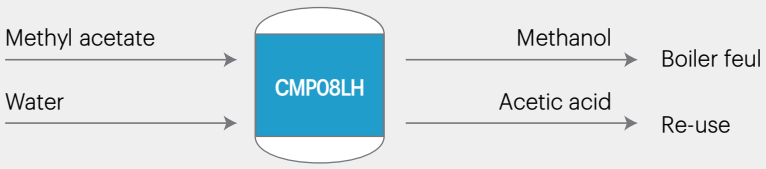


Samprogetti process : Fixed bed process



• MA (Methyl acetate) Hydrolysis Catalyst

When producing terephthalic acid (TPA), a raw material for polyester fiber, methyl acetate is produced as a by-product.
It is converted to acetic acid and methanol by the MA hydrolysis process, and acetic acid is reused in the process, and methanol is used as boiler fuel.



Strongly Acidic Cation Resins for Catalyst

Grade	MC-04H	PCC30H	PCC40H	SPC260H	SPC280H
Matrix	Polystyrene+DVB				
Type	Gel			Porous	
Functional group	Sulfonic acid				
Ionic form	H^+ (H Conversion rate 99.9%↑)				
Shipping weight (g/ℓ)	750	700	780	800	800
Moisture retention (%)	65~70	60~70	57~67	50~58	50~58
Total capacity (eq/kg)	5.1↑	4.5↑	4.5↑	4.7↑	5.2↑
Total capacity (eq/ℓ)	1.20↑	1.2↑	1.2↑	1.75↑	1.9↑
Effective Size (㎛)	UPS	780↑	400↑		
Uniformity coefficient	1.1↓	1.6↓			
Particle size (㎛)	500±30	700~1450	300~1200		
Operating temp. (℃)	120↓	120↓	120↓	120↓	120↓
Operating pH range	0~14	0~14	0~14	0~14	0~14

※ The data for Shipping weight is for reference.

Applications

TRILITE MC-04H

It is a low crosslinkage UPS SAC resin and features a fast exchange reaction. It is widely applied to various chemical reactions such as catalytic application, separation and refining of nucleic acid and amino acid, etc.

TRILITE PCC30H, TRILITE PCC40H

These are low crosslinkage SAC resin with high reaction rate and mechanical and chemical stability and widely used as a catalyst for Bisphenol-A.

TRILITE SPC260H

It is a porous type SAC resin with high exchange capacity and good resistance against attrition loss. It is widely used for etherification catalysts such as MTBE, synthesis of sec-butylacetate and phenol purification.

TRILITE SPC280H

It features an enhanced exchange capacity (approximately 10%) compared to SPC260H, which can expect better performance for esterification catalyst.

Strongly Acidic Cation Resins for Catalyst

Grade	CMP08H	CMP28H	SPC400H	SPC160H	SPC180H	SPC320H
Matrix	Polystyrene+DVB					
Type	Porous					
Functional group	Sulfonic acid					
Ionic form	H^+					
Shipping weight (g/ℓ)	720	780	690	740	750	780
Moisture retention (%)	65~71	42~48	65~75	54~60	53~60	42~48
Total capacity (eq/kg)	4.9↑	4.0↑	4.9↑	4.5↑	4.5↑	4.5↑
Total capacity (eq/ℓ)	1.1↑	1.9↑	1.0↑	1.5↑	1.5↑	1.9↑
Effective Size (㎛)	400↑					
Uniformity coefficient	1.6↓					
Particle size (㎛)	General type : 300~1,200, L-type : 425~1,200, XL-type : 700~1,200					
Operating temp. (℃)	120↓					
Operating pH range	0~14					

※ The data for Shipping weight is for reference.

Applications

TRILITE CMP08H

It is a low crosslinkage SAC resin and is widely used for MA hydrolysis catalyst for PTA/PIA manufacturing process and special refining process such as acid catalyst, an organic chemical reaction.

TRILITE CMP28H

It is a very high crosslinkage porous type SAC resin, which features excellent mechanical and chemical stabilities. It can be highly effective for organic chemical reactions of highly concentrated solutions and the removal of impurities. It is widely used for special applications such as THF(tetrahydrofuran) refining.

TRILITE SPC400H

It is a low crosslinkage SAC resin, which features an excellent diffusion rate and conversion rate. It is widely used for Acrylic Acid(AA, Ethyl Hexylacrylate(EHA) reaction catalyst by Alkylation.

TRILITE SPC160H

It features a very high whole bead count, high uniformity, excellent mechanical and chemical stability. It is widely used for special applications such as etherification of Tetrahydrofuran(THF) and BDO/THF refining.

TRILITE SPC180H

It features stronger mechanical strength, larger surface area, and porosity than conventional catalyst resins. Its high diffusion rate into the inside of resins leads to high reaction performance. It is used for water treatment and catalyst applications such as alkylation and etherification, e.g. 1,4-BDO, MMA.

TRILITE SPC320H

It features excellent exchange capacity, large specific surface area, and high porosity. It features excellent adsorption and recovery capacity to metal ions such as Cu, V_2O_5, etc. It is widely used for Phenol purification and H_2O_2 refining.

Ultrapure water

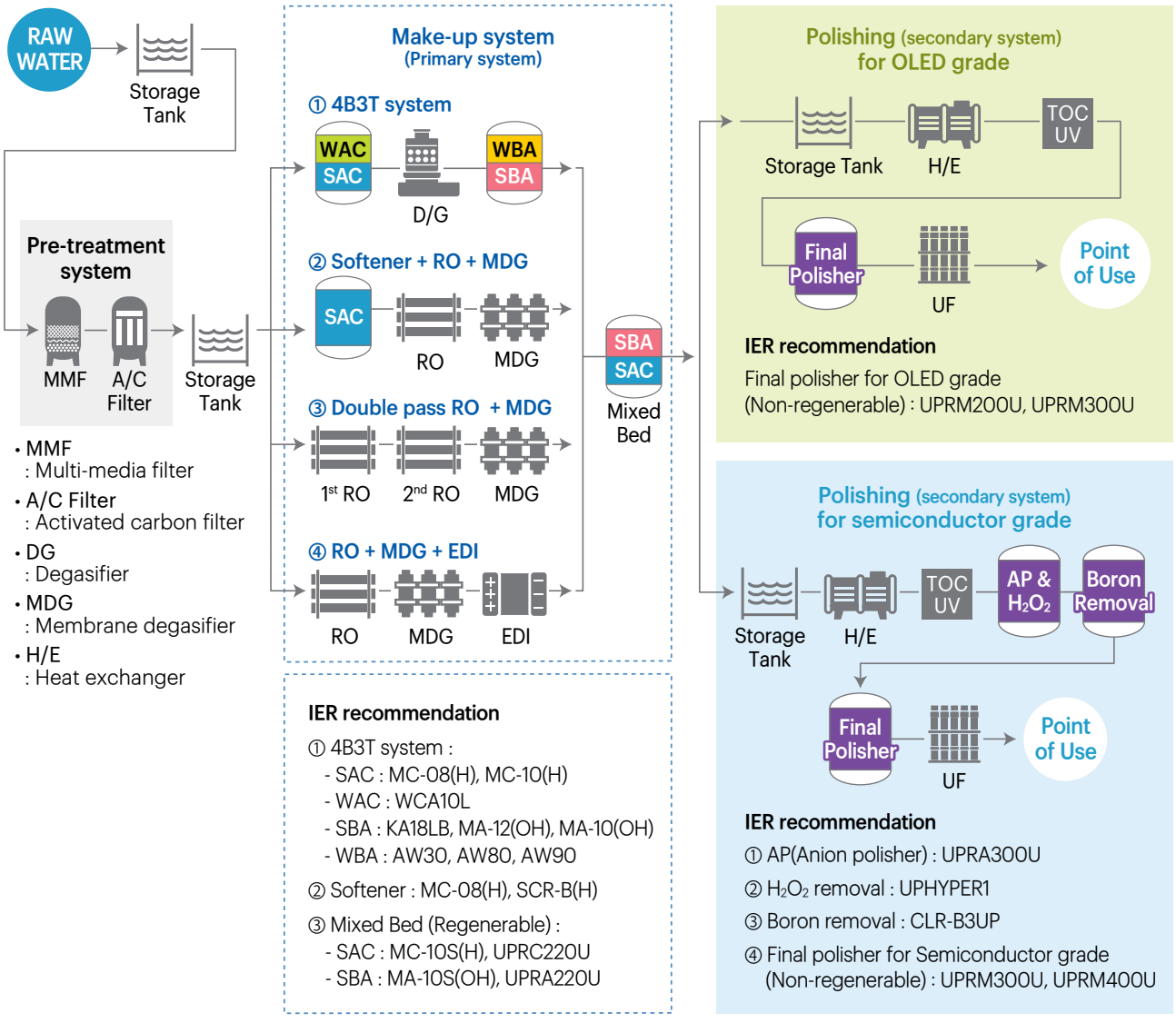
UPW (Ultrapure water) refers to extremely pure water from which ionic/nonionic impurities have been removed through various water treatment processes. With the development of electronic industries(semiconductor and display), the requirements of the 'Cleaning process' became more precise and the quality of ultrapure water required is also becoming more stringent.

An ultrapure water production process is generally composed of a pre-treatment system, Make-up system (Primary system), and Polishing system (Secondary system). TRILITE UPW resins are specially manufactured under stringent quality control and state-of-the-art technology.

Advantage of TRILITE UPW resins

① Extremely even uniformity coefficient(less than 1.1) enables the excellent operating capacity under a fast service rate.
② The excellent conversion rate of resins to minimize ionic leakages(H^+, OH^-)
③ Strict control over TOC(Total Organic Carbon) and trace metal ions.

Typical UPW process and IER recommendation



TRILITE UPW resins are supplied to reputable ultrapure water systems from LCD(Samsung Display, LG Display, etc.) to semiconductor(Samsung Electronics, SK Hynix, etc.) and contributing to competitive edge of customers with stable quality control and on-time delivery.
TRILITE UPW resins are recommended according to required treated water quality and the features are as follows.

Grade Series	UPW Cation resins				UPW Anion resins				
	Type	Grade	TEC (eq/ℓ)	H^+ (%)	Type	Grade	TEC (eq/ℓ)	OH^- (%)	Cl^- (%)
UPR100 Series	Gel	UPRC100U	1.9↑	99.0↑	Gel type1	UPRA100U	1.0↑	95.0↑	1.0↓
		UPRC120U	2.0↑			UPRA120U	1.1↑		
UPR200 Series		UPRC200U	1.9↑	99.9↑		UPRA200U	1.0↑	95.0↑	1.0↓
		UPRC220U	2.0↑			UPRA220U	1.1↑		
UPR300 Series		UPRC300U	1.9↑	99.9↑		UPRA300U	1.0↑	97.0↑	0.1↓
		UPRC320U	2.0↑			UPRA320U	1.1↑		

※ Feed water
- UPR100 Series : Conductivity 10㎲/㎝ RO outlet, SV36
- UPR200, 300 Series : Resistivity >17.5 ㏁.㎝, TOC <2ppb, SV30

The mixed resin for the final polisher is a key element determining the final quality of ultrapure water. Samyang offers various products depending on the required treated water quality, and the guaranteed outlet condition and features of treated water are as follows.

Grade Series	Grade series	Cation Conversion	Anion Conversion		Outlet condition	Features and applciation
		H^+ (%)	OH^- (%)	Cl^- (%)		
UPR100 Series	UPRM100U	99.0↑	95.0↑	1.0↓	Guarantee) Resistivity > 17.0 ㏁·cm Actual) Resistivity > 18.0 ㏁·cm	Very high resistivity UPW General electronics grade make-up and final polisher
UPR200 Series	UPRM200U	99.9↑	95.0↑	1.0↓	Resistivity > 18.1 ㏁·cm(in 30 min) △TOC < 5 ppb (in 120min)	Very high resistivity, low △TOC UPW, LCD/OLED grade make-up and final polisher
UPR300 Series	UPRM300U	99.9↑	97.0↑	0.1↓	Resistivity > 18.2 ㏁·cm(in 30 min) △TOC < 1 ppb (in 180min)	Very high resistivity, low △TOC UPW, Semiconductor grade final polisher
UPR400 Series	UPRM400U	99.9↑	97.0↑	0.1↓	Resistivity > 18.2 ㏁·cm(in 30 min) △TOC < 1 ppb (in 180min) Metal impurity (ppm, as Dry Base) Na<1, Fe<1, Zn<0.5,Al<0.5, Cu<0.5	Very high resistivity, very low △TOC, very low Metal ion leakage UPW, Semiconductor grade final polisher

※ Feed water
- UPR100 Series : Conductivity 10㎲/㎝ RO outlet, SV36
- UPR200, 300, 400 Series : Resistivity >17.5 ㏁·㎝, TOC <2ppb, SV30

Samyang offers customized UPW resins to meets the various quality requirement of treated water.

Ultrapure water for primary system UPR100 Series

Grade		UPRC100U	UPRA100U	UPRC120U	UPRA120U
Matrix		UPS SAC Gel type	UPS SBA Gel type1	UPS SAC Gel type	UPS SBA Gel type1
		Standard Crosslinkage		High Crosslinkage	
Ionic form		H^+	OH^-	H^+	OH^-
Total capacity (eq/ℓ)		1.9↑	1.0↑	2.0↑	1.1↑
Moisture retention (%)		50~56	62~70	45~51	59~65
Average diameter (㎛)		620±50	620±50	660±50	590±50
Uniformity coefficient		1.1↓	1.1↓	1.1↓	1.1↓
Ionic conversion rate	H^+ (%)	99.0↑	-	99.0↑	-
	OH^- (%)	-	95.0↑	-	95.0↑
	Cl^- (%)	-	1.0↓	-	1.0↓
		↓	↓	↓	↓
		Mixed ratio : 1:1 (Capacity ratio)		Mixed ratio : 1:1 (Capacity ratio)	
		↓		↓	
Grade		UPRM100U		UPRM120U	
Type		Mixed resin			
Outlet condition 1		Guarantee) Resistivity > 17.0 ㏁·cm (in 10min.) Actual) Resistivity > 18.0 ㏁·cm (in 10min.)			
		Feed water : Conductivity 10㎲/㎝ RO outlet, SV36			
Outlet condition 2		Guarantee) Resistivity > 18.0 ㏁·cm (in 30min.)			
		Feed water : Resistivity > 17.5 ㏁·cm, SV30			

Ultrapure water for secondary system UPR200 Series

Grade		UPRC200U	UPRA200U	UPRC220U	UPRA220U
Matrix		UPS SAC Gel type	UPS SBA Gel type1	UPS SAC Gel type	UPS SBA Gel type1
		Standard Crosslinkage		High Crosslinkage	
Ionic form		H^+	OH^-	H^+	OH^-
Total capacity (eq/ℓ)		1.9↑	1.0↑	2.0↑	1.1↑
Moisture retention (%)		50~56	62~70	45~51	59~65
Average diameter (㎛)		620±50	620±50	660±50	590±50
Uniformity coefficient		1.1↓	1.1↓	1.1↓	1.1↓
Ionic conversion rate	H^+ (%)	99.9↑	-	99.9↑	-
	OH^- (%)	-	95.0↑	-	95.0↑
	Cl^- (%)	-	1.0↓	-	1.0↓
		↓	↓	↓	↓
		Mixed ratio : 1:1 (Capacity ratio)		Mixed ratio : 1:1 (Capacity ratio)	
		↓		↓	
Grade		UPRM200U		UPRM220U	
Type		Mixed resin			
Outlet condition		Resistivity > 18.1 ㏁·cm (in 30min.) △TOC < 5ppb (in 120min.)		Resistivity > 18.1 ㏁·cm (in 30min.) △TOC < 5ppb (in 120min.)	
		Feed water : Resistivity > 17.5 ㏁·cm, TOC < 2ppb, SV30			

Ultrapure water for final polishing UPR300 Series

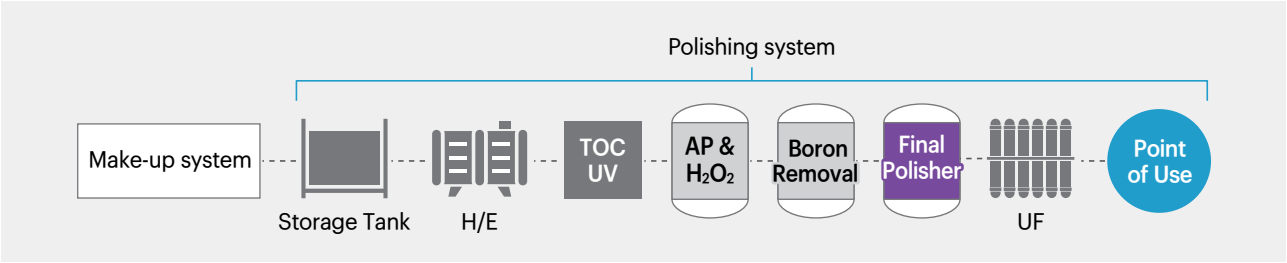
Grade		UPRC300U	UPRA300U	UPRC320U	UPRA320U
Matrix		UPS SAC Gel type	UPS SBA Gel type1	UPS SAC Gel type	UPS SBA Gel type1
		Standard Crosslinkage		High Crosslinkage	
Ionic form		H^+	OH^-	H^+	OH^-
Total capacity (eq/ℓ)		1.9↑	1.0↑	2.0↑	1.1↑
Moisture retention (%)		50~56	62~70	45~51	59~65
Average diameter (㎛)		620±50	620±50	660±50	590±50
Uniformity coefficient		1.1↓	1.1↓	1.1↓	1.1↓
Ionic conversion rate	H^+ (%)	99.9↑	-	99.9↑	-
	OH^- (%)	-	97.0↑	-	97.0↑
	Cl^- (%)	-	0.1↓	-	0.1↓
		↓	↓	↓	↓
		Mixed ratio : 1:1 (Capacity ratio)		Mixed ratio : 1:1 (Capacity ratio)	
		↓		↓	
Grade		UPRM300U		UPRM320U	
Type		Mixed resin			
Outlet condition		Resistivity > 18.2 MΩ·cm (in 30min.) △TOC < 1ppb (in 180min.)		Resistivity > 18.2 MΩ·cm (in 30min.) △TOC < 1ppb (in 180min.)	
		Feed water : Resistivity > 17.5 MΩ·cm, TOC < 2ppb, SV30			

Ultrapure water for final polishing with minimized metal ion leakage UPR400 Series

Grade		UPRC400U	UPRA400U	UPRC420U	UPRA420U
Matrix		UPS SAC Gel type	UPS SBA Gel type1	UPS SAC Gel type	UPS SBA Gel type1
		Standard Crosslinkage		High Crosslinkage	
Ionic form		H^+	OH^-	H^+	OH^-
Total capacity (eq/ℓ)		1.9↑	1.0↑	2.0↑	1.1↑
Moisture retention (%)		50~56	62~70	45~51	59~65
Average diameter (㎛)		620±50	620±50	660±50	590±50
Uniformity coefficient		1.1↓	1.1↓	1.1↓	1.1↓
Ionic conversion rate	H^+ (%)	99.9↑	-	99.9↑	-
	OH^- (%)	-	97.0↑	-	97.0↑
	Cl^- (%)	-	0.1↓	-	0.1↓
		↓	↓	↓	↓
		Mixed ratio : 1:1 (Capacity ratio)		Mixed ratio : 1:1 (Capacity ratio)	
		↓		↓	
Grade		UPRM400U		UPRM420U	
Type		Mixed resin			
Outlet condition		Resistivity > 18.2 MΩ·cm (in 30min.) △TOC < 1ppb (in 180min.) Metal Leakage* < 0.1ppt Ion Leakage** < 1ppt			
		Feed water : Resistivity > 17.5 MΩ·cm, TOC < 2ppb, SV30			

* Li, Na, Mg, Al, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Sr, Ba, Pb
** F^-, Cl^-, NO_2^-, Br^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, NH_4^+

TRILITE Semiconductor grade Final Polisher resins

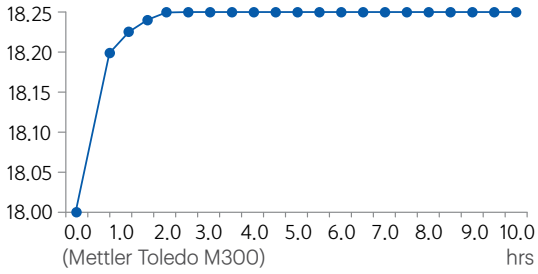


Final treated water quality is determined by semiconductor grade final polisher ion exchange resins, which feature extremely high resistivity, extremely low ion leakage.

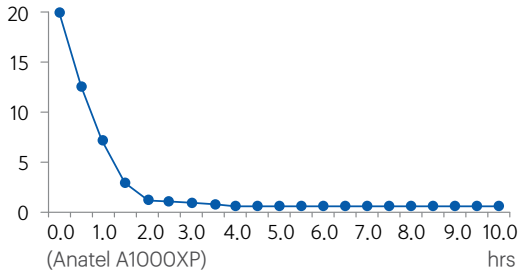
① Minimized TOC leakage : < 1ppb
② Extremely high conversion rate : H^+ > 99.9%, OH^- > 97%
③ Short rinse-up time and high kinetic performance

TRILITE UPRM300U, UPRM400U are the semiconductor grade final polisher ion exchange resins, satisfying the above criteria, qualified in the Samsung Electronics quality test.

① Resistivity (MΩ·cm)



② TOC (ppb)



TRILITE UPRM400U is a specially developed premium grade with minimized metal ion leakage.

• Final polisher grade specification (Company "S" in Korea)

Criteria	Spec	UPRM300U	UPRM400U
Resistivity*	> 18.2 MΩ·cm	O (in 30min)	O (in 30min)
ΔTOC*	< 1 ppb	O (in 180min)	O (in 180min)
Boron	< 1 ppt	O	O
Metal**	< 0.1 ppt	△	O
Ion***	< 1 ppt	△	O

* Feed water : Resistivity >17.5 MΩ·cm, TOC < 2ppb, SV30
** Li, Na, Mg, Al, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Sr, Ba, Pb
*** F^-, Cl^-, NO_2, Br^-, NO_3, SO_4, PO_4, NH_4

• Company "S" Metal ion leakage analysis result

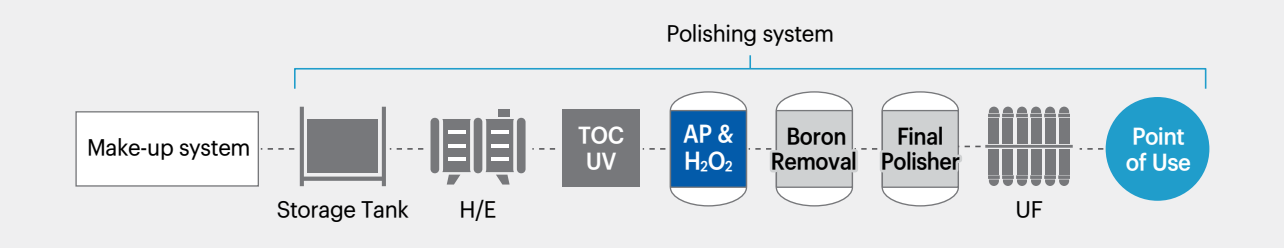
Li	Na	Mg	Al	K	Ca	Cr	Mn
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fe	**Co**	**Ni**	**Cu**	**Zn**	**Ba**	**Pb**	**Sr**
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

F^-	Cl^-	NO_2^-	Br^-	NO_3^-	SO_4^{2-}	PO_4^{3-}	NH_4^+
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

• Compnay "O" (Japan) Metal ion leakage analysis result

Li	Na	Mg	Al	K	Ca	Ti	Cr	Mn
<0.005	0.020	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005
Fe	**Co**	**Ni**	**Cu**	**Zn**	**As**	**Cd**	**Ba**	**Pb**
<0.005	<0.005	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

TRILITE H_2O_2 Removal resin

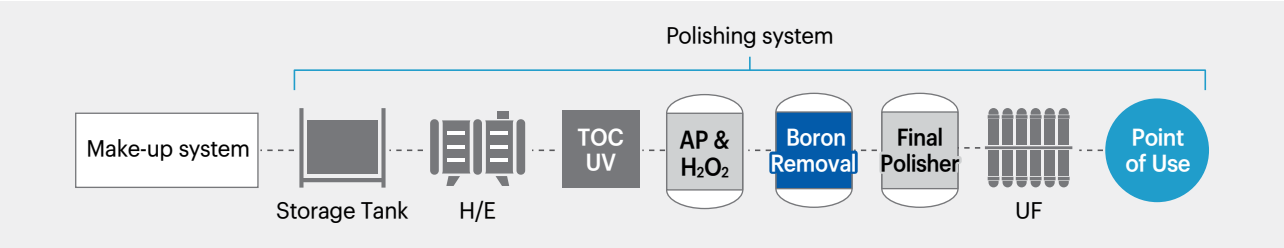


TOC UV decomposes TOC components in water using 185nm UV, which features strong molecular bond breaking power. It generates highly reactive Hydroxyl radicals, breaks the binding ring of TOC components, decomposes them into H_2O and CO_2, and the generated CO_2 is removed from the later AP (Anion polisher). At this point, ion exchange resin with very low TOC leakage (△TOC<1ppb) should be selected. TOC-UV also generates hydrogen peroxide (H_2O_2) of about 30ppb or less by reacting with H_2O by hydroxyl radicals. The generated H_2O_2 deteriorates the post-AP process, causing performance degradation, and causes a problem in the process, and causing wafer defects.
H_2O_2 removal resin TRILITE UPHYPER1 extends the stability and life of the Polishing system by removing H_2O_2 and anions generated by TOC UV treatment. TRILITE UPHYPER1 has been supplied to Samsung Electronics and ultra-pure water facilities at various sites, proving its excellent performance.

Anion Polishing Resin	$CH_2N(CH_3)_3^+OH^-$ $CH_2N(CH_3)_3^+OH^-$ + H_2O_2 → + OH^- $CH_2N(CH_3)_3$ + H_2O + $1/2O_2$	Slow H_2O_2 removal rate and generating O_2 deteriorates life cycle (resin degradation and high TOC)
UPHYPER1	$CH_2N(CH_3)_3^+$ SO_3^{2-} $CH_2N(CH_3)_3^+$ $CH_2N(CH_3)_3^+OH^-$ + H_2O_2 → $CH_2N(CH_3)_3^+$ $CH_2N(CH_3)_3^+$ SO_4^{2-} + H_2O	Fast H_2O_2 removal rate and removes anions and CO_2

	Grade	Inlet Condition	Outlet condition
H_2O_2 removal	UPHYPER1	Resistivity >18.2 MΩ·cm TOC < 1 ppb SV=10	Resistivity > 18.2 MΩ·cm (in 24 hr) △TOC < 1.0 ppb (in 24 hr) H_2O_2 removal > 16g H_2O_2/ℓ-Resin

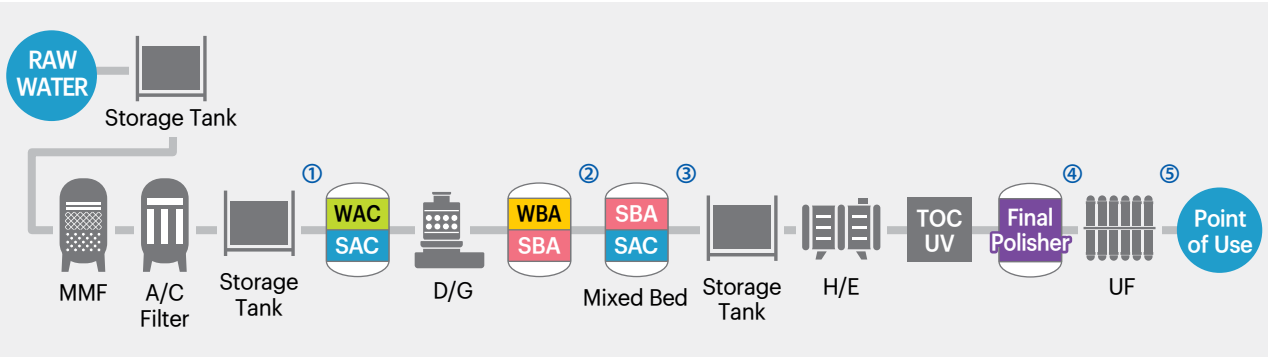
TRILITE UPW grade boron removal resin



Boron(B) has very weak selectivity with ion exchange resins in water and is eluted first because of its weak affinity, reducing the stability and life of the polishing system. Boron is used as a dopant in semiconductor production, and since unintended inflow of boron affects semiconductor performance, boron must be managed very strictly as less than 1 ppt in the semiconductor manufacturing process to realize stable operation.
TRILITE CLR-B3UP, UPW grade ion exchange resin uses N-methylglucamine as functional group and is optimized for minimum TOC leakage.

	Grade	Functional group	Total Capacity	Inlet Condition	Outlet condition
Boron Polisher	CLR-B3UP	N-methylglucamine	TEC (eq/L) : 0.9↑ Boron (eq/L) : 0.4↑	Resistivity > 17.5 MΩ·cm TOC < 2ppb, V=30	Resistivity > 17.0 MΩ·cm (in 48 hr) △TOC < 5.0ppb (in 48 hr)

Latest OLED Grade UPW production system



Criteria	Unit	① Cation Exchanger Inlet	② Anion Exchanger Outlet	③ Mixed Bed Outlet	④ Final Polisher Outlet	⑤ UF Outlet
Conductivity	μS/cm	200 ~ 400	≤ 10	-	-	-
Resistivity	MΩ·cm	-	-	≥ 10 ~ 15	≥ 18	≥ 18
TOC	ppb	500 ~ 1000	-	≤ 40	≤ 30	≤ 30
SiO_2	ppb	< 11,000	≤ 20 ~30	≤ 5	≤ 5	≤ 5
Particle	EA/mℓ, at ≥ 0.1㎛	-	-	-	-	≤ 10
Recommendation		**SAC** - MC-08(H) - MC-10(H) **WAC** - WCA-10L	**SBA** - MA-12(OH) - MA-10(OH) **WBA** - AW80 - AW90	**SAC** - MC-10S(H) - UPRC220U **SBA** - MA-10S(OH) - UPRA220U	**UPRM200U**	-

• Ultrapure water systems

Chromatography

TRILITE MCK Series is the chromatographic separation resin with a uniform particle size distribution of fine particles. Useful substances can be separated such high purity sugar separation such as Fructose/Glucose separation and recovery of sugar from molasses and various applications such as acid recovery, etc.

① Ligand exchange chromatography : Separation using the interaction of specificity of several components.
Example) Fructose/Glucose separation using MCK-55 (Ca-form)
② Size exclusion chromatography : Separation according to the size of the molecular weight
Example) Separation of oligosaccharides using MCK-30 (Na-form)
③ Ion exclusion chromatography : Separation through repulsion between ions of the same sign
Example) Sucrose collection from molasses using MCK-22M (K-form)

TRILITE offers have various products such as strong acid cation exchange resin Gel type, strong basic anion exchange resin Gel type 1 and 2, and the major applications are as follows.

Type		Ionic form	Grades	Applications
UPS SAC Gel		Na	MCK-30	Glucose/Oligosaccharide separation, Maltose/Oligosaccharide separation
		K	MCK-22M	Sucrose collection from Molasses
		Ca	MCK-55	Fructose/Glucose separation, Fructose/Allulose separation, Fructose/Galactose separation
UPS SBA Gel	Type 1	Cl	MA-13J	Bio diesel purification process
	Type 2	Cl	MA-23F	Acid purification

TRILITE MCK Series recommendation - separation capabilities by particle size and crosslinkages

Ion exchange resins for chromatographic separation achieve optimum separation capacity according to particle size uniformity, size adjustment, and crosslinkage. TRILITE MCK series is produced with a very high level of uniformity (less than 1.1), various particle sizes and ionic types, and has excellent physical and chemical properties through strict quality control, and a variety of products are manufactured such as follows.

The smaller the particle size, the better the separation but the greater the pressure drop.

The lower the degree of crosslinkage, the better the separation but more the crush rate

Cross-linkage	Ionic form	Average particle size			
		210~220㎛	283~295㎛	305~328㎛	340~350㎛
		●	●	●	●
5%	K			MCK-22M (305㎛)	MCK-22K (346㎛)
6%	Na	MCK-30 (220㎛)	MCK-30J (295㎛)	MCK-30L (328㎛)	MCK-30K (350㎛)
	K	MCK-32 (213㎛)	MCK-32J (288㎛)	MCK-32L (320㎛)	MCK-32K (345㎛)
	Ca	MCK-35 (210㎛)	MCK-35J (283㎛)	MCK-35M (305㎛) MCK-35L (315㎛)	MCK-35K (340㎛)
8%	Na	MCK-50 (215㎛)			
	K	MCK-52 (215㎛)			
	Ca	MCK-55 (210㎛)			

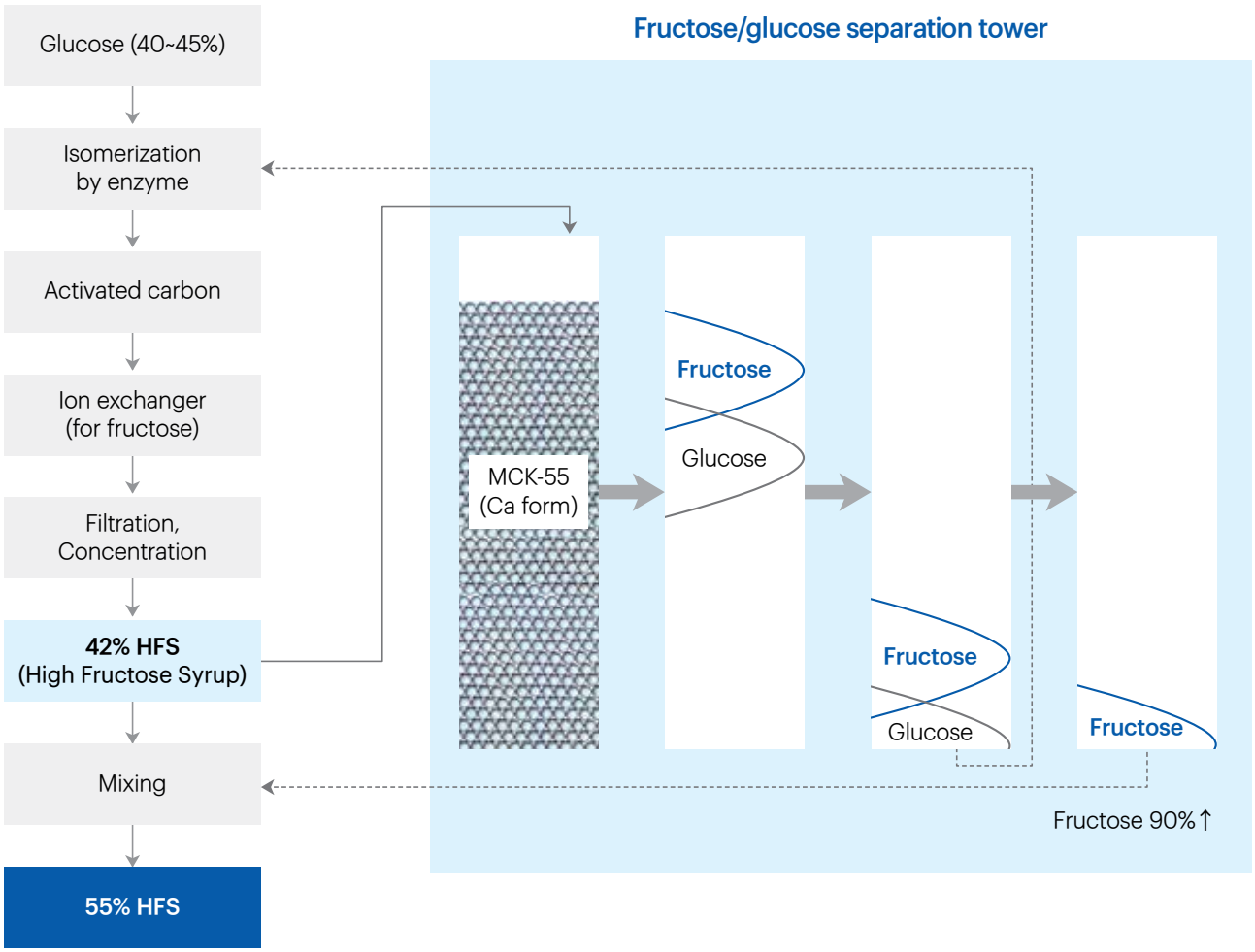
※ The data for particle size and crosslinkage is for reference.

Fructose / Glucose separation using ligand exchange chromatography

Isomerization of fructose by the use of enzyme glucose which features a higher sweetness (1.7 times of sugar). The starch sugar is proved to be economically efficient and is substitutable to the use of sugar. However, the enzyme reaction is reversible. The isomerization is limited up to 42% (equal to 90% of sugar sweetness) due to reaction equilibrium. Hence, it is required to increase the glucose percentage up to 55%, with the IER technology.

Ligand Exchange Chromatography is a principle of separation by using the affinity characteristics of various sugar components. During the passage of sugar components, the sugar components are dissolved in the moisture contained in the resin, and the dissolved sugar is the calcium ion of the resin. It interacts with and forms a ligand complex. At this time, since the fructose-calcium ion complex forms a stronger and longer interaction than the glucose-calcium ion complex, glucose is eluted first, followed by fructose.

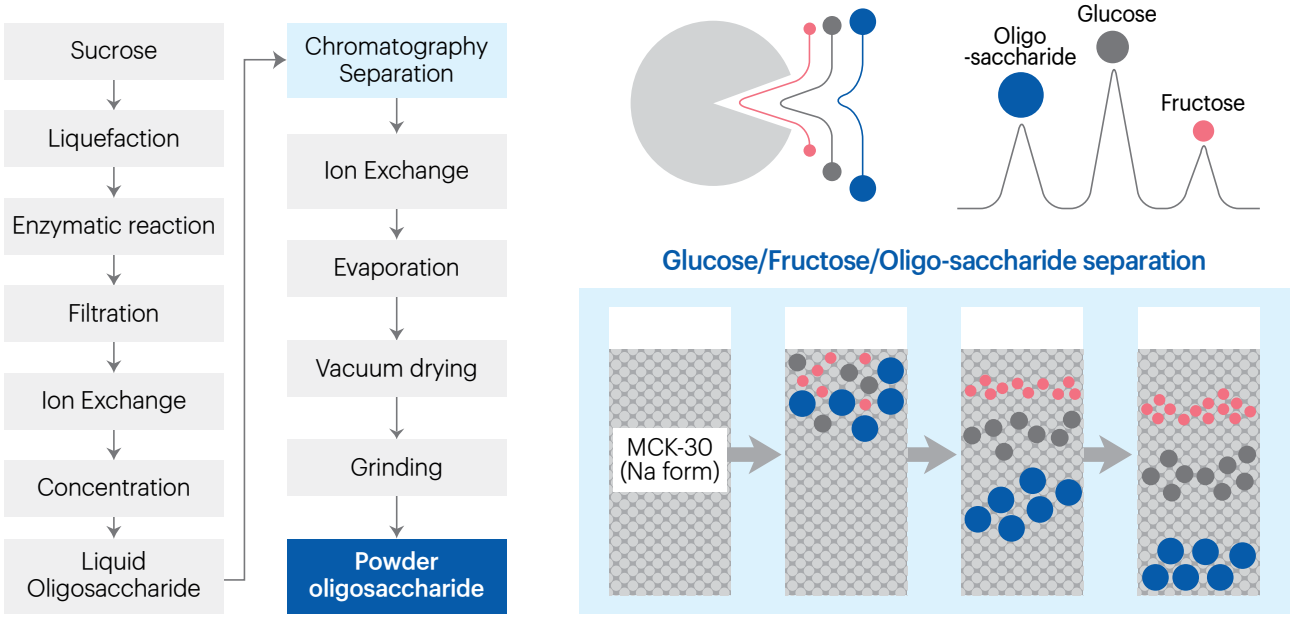
The below figure is a diagram when a general glucose and fructose mixed solution is treated from the top of a Ca-type cation exchange resin column. Fructose is recovered and supplied as a product, and glucose is introduced into the pre-process to react again with the isomerase.



Fructo-oligosaccharide separation using size exclusive chromatography

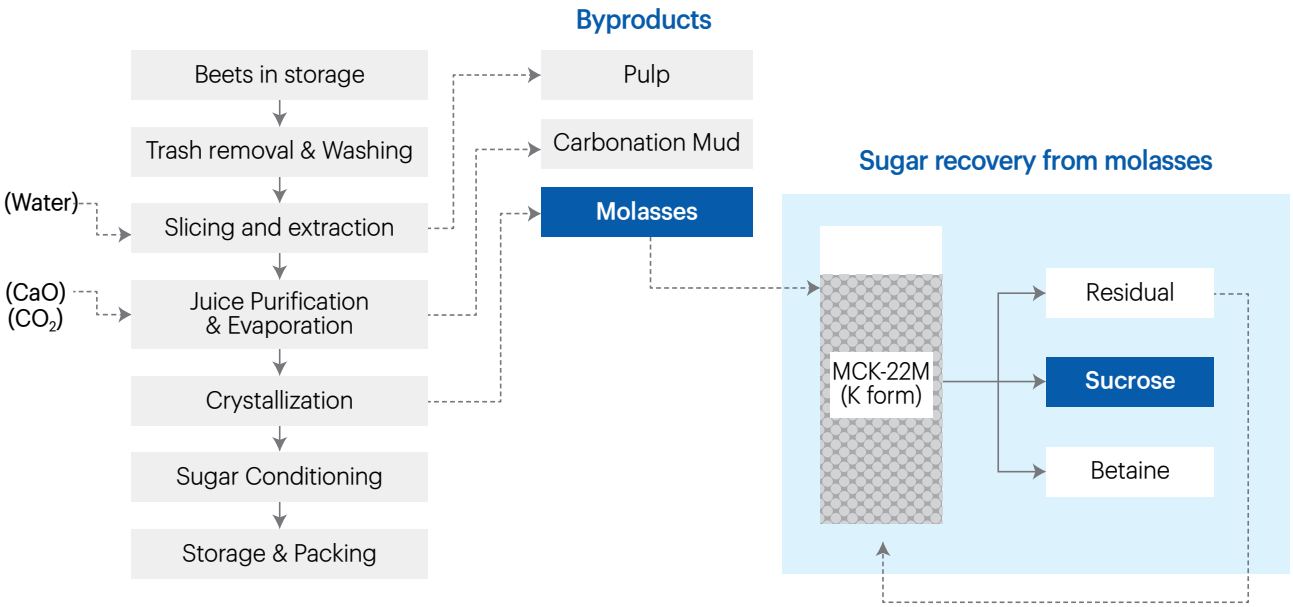
Oligosaccharides exist through condensation polymerization of monosaccharides such as glucose, fructose, and galactose, and are classified into disaccharides, trisaccharides, and polysaccharides according to the number of bonds. Due to the nature of condensation polymerization, there is a limited concentration of disaccharides and trisaccharides.

The concentration of fructo-oligosaccharides can be increased through size exclusion chromatography separation using Na type chromatography resin. This is a separating method according to the size of the molecular weight. There is no attraction between the stationary phase and the solute, and when the mobile phase simply passes through the porous fixed-phase resins, large molecules are excluded from the small molecules by passing only small molecules.



Sugar recovery from molasses using ion exclusion chromatography

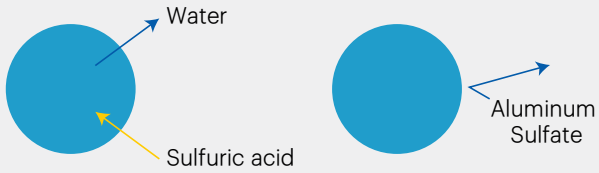
Molasses has been mainly fermented and used as feed for livestock. It contains about 50% or more of sucrose of molasses. By recovering it, the amount of sugar production can be increased by producing sucrose of 90 to 93% purity through ion exclusion chromatography separation process using K-type strong acid cationic resin.
Ion exclusion chromatography is the principle that electrolytes containing ions with the same sign as the charge of the ion exchanger are eluted before non-electrolytes by using the property of being excluded from each other by ions and repulsion.



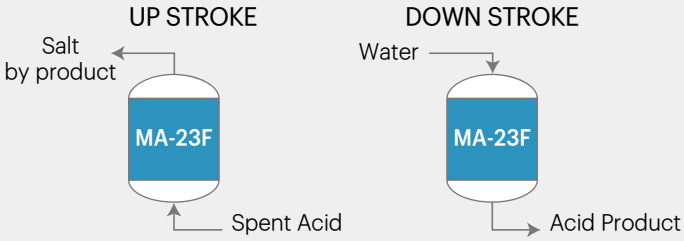
Acid purification

Acid purification process is based on the principle of acid retardation using anion chromatography resins. An example of a typical acid recovery process is that when aluminum products are electrolyzed in a sulfuric acid bath (anodic oxidation bath), aluminum is dissolved in the sulfuric acid bath and the solution in the sulfuric acid bath gradually deteriorates. When the concentration of aluminum reaches a certain level, it must be replaced with new sulfuric acid. At this time, neutralizing the used sulfuric acid or replacing the new sulfuric acid becomes a cost and environmental problem.

The acid recovery facility, APU (Acid purification unit), is composed of a filter that removes suspended matter, and a separation tower filled with a chromatography anion exchange resin, TRILITE MA-23F, which separates sulfuric acid and aluminum sulfate. It is based on the principle that when acid (Acid, sulfuric acid) and its salt (Salt, aluminum sulfate) pass through the ion exchange resin, the acid is adsorbed to the ion exchange resin, but the salt is separated.



When the ion exchange resin is rinsed with water, salts that are not adsorbed are washed away and the acid is adsorbed, so it is separated. The actual operation is divided into an up stroke and a downs stroke processes. During the up stroke process, the salt is excluded by the chromatography resin and discharged as a by-product as it precedes the acid. The purified acid can be desorbed and recovered during down stroke process.



In general, it realizes performance with an acid recovery rate of 70 to 95% or higher through the APU device, and although there is a difference according to the characteristics of each use, it is possible to remove 50 to 90% of metal components, and antimony(Sb) and bismuth (if pollutants such as Bi) are present, the removal efficiency drops to about 50%.

APU Performance	H_2SO_4 Product			Anodizing			HCl Product		
	H_2SO_4	Ni	Cu	HNO_3	HF	Metal	HCl	Co	Zn
	(g/ℓ)	(g/ℓ)	(g/ℓ)	(g/ℓ)	(g/ℓ)	(g/ℓ)	(eq/ℓ)	(g/ℓ)	(g/ℓ)
Feed	275	15	5	107	19.3	45	3.3	8.4	1.13
Product	240	3.75	1.25	104	18.5	12.6	3.2	7	0.03
Byproduct	35	11.25	3.75	0.3	0.3	30.4		1.4	1
Recovery	87%			97%			97%		
Removal		75%	75%	0.3%	1.6%	67.6%	-	16.7%	88.5%




MCK-22 Series (Chromatography cation resins)

Grade	MCK-22M	MCK-22K
Matrix	Polystyrene+DVB	
Functional group	Sulfonic acid	
Ionic form	K^+ (K Conversion rate 98%↑)	
Shipping weight (g/ℓ)	815	
Moisture retention (%)	47~52 (K type) 59~64(H type)	
Total capacity (eq/ℓ)	1.6↑	
Average diameter (㎛)	305±15	346±15
Uniformity coefficient	1.1↓	

MCK-30 Series (Chromatography cation resins)

Grade	MCK-30	MCK-30J	MCK-30L	MCK-30K
Matrix	Polystyrene+DVB			
Functional group	Sulfonic acid			
Ionic form	Na^+			
Shipping weight (g/ℓ)	830			
Moisture retention (%)	52~56			
Total capacity (eq/ℓ)	1.6↑			
Average diameter (㎛)	220±10	295±15	328±15	350±15
Uniformity coefficient	1.1↓			

MCK-32 Series (Chromatography cation resins)

Grade	MCK-32	MCK-32J	MCK-32L	MCK-32K
Matrix	Polystyrene+DVB			
Functional group	Sulfonic acid			
Ionic form	K^+ (K Conversion rate 98%↑)			
Shipping weight (g/ℓ)	840			
Moisture retention (%)	46~51			
Total capacity (eq/ℓ)	1.6↑			
Average diameter (㎛)	213±10	288±15	320±15	345±15
Uniformity coefficient	1.1↓			

※ The data for Shipping weight is for reference.

MCK-35 Series (Chromatography cation resins)

Grade	MCK-35	MCK-35J	MCK-35M	MCK-35L	MCK-35K
Matrix	Polystyrene+DVB				
Functional group	Sulfonic acid				
Ionic form	Ca^{2+} (Ca Conversion rate 98%↑)				
Shipping weight (g/ℓ)	840				
Moisture retention (%)	47~51				
Total capacity (eq/ℓ)	1.6↑				1.7↑
Average diameter (㎛)	220±10	283±10	305±10	315±10	340±10
Uniformity coefficient	1.1↓				

MCK-50 Series (Chromatography cation resins)

Grade	MCK-50	MCK-52	MCK-55
Matrix	Polystyrene+DVB		
Functional group	Sulfonic acid		
Ionic form	Na^{+}	K^{+}(K Conversion rate 98%↑)	Ca^{2+}(Ca Conversion rate 98%↑)
Shipping weight (g/ℓ)	855	865	
Moisture retention (%)	46~50	39~43	42~46
Total capacity (eq/ℓ)	1.9↑	2.0↑	
Average diameter (㎛)	215±10	215±10	
Uniformity coefficient	1.1↓		

Strongly Basic Anion Resins for Chromatography

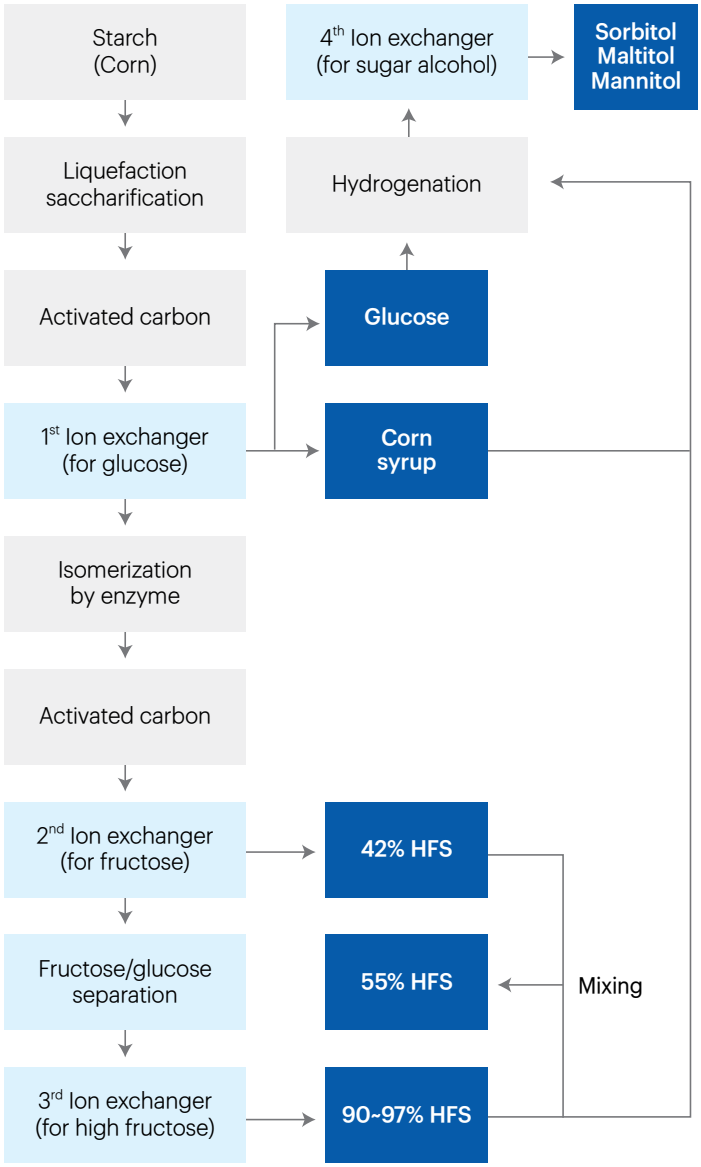
Grade	MA-13J	MA-13F	MA-23F
Matrix	Polystyrene+DVB		
Functional group	Type 1 (Trimethylammonium)		Type 2 (DMEA)
Ionic form	Cl^{-}		
Shipping weight (g/ℓ)	720		735
Moisture retention (%)	43~53	47~51	41~48
Total capacity (eq/ℓ)	1.35↑	1.4↑	1.3↑
Average diameter (㎛)	300±15	230±10	210±20
Uniformity coefficient	1.1↓		

※ The data for Shipping weight is for reference.

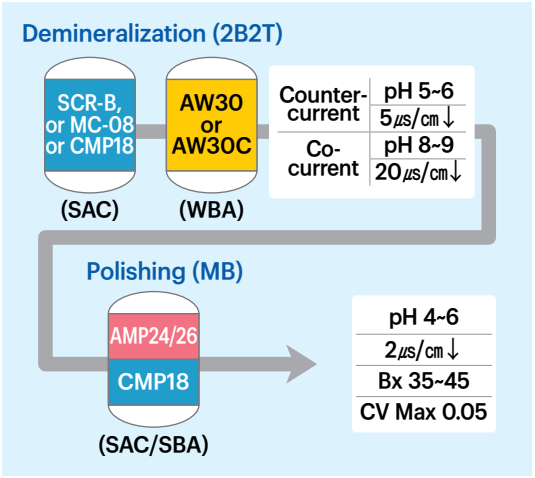
Food - Starch Sugar

Refining starch sugar and sugar alcohol are typical food applications of ion exchange resins. Organic matter content or viscosity of the stock solution is relatively highly concentrated and the adsorption capacity of specific substances has a profound effect on the yield. So, it is recommended to use optimized ion exchange resins for each process. Samyang Corporation is the only company in the world that produces ion exchange resins and starch sugars, and it produces and supplies optimized products based on the insights on starch sugar production, and continuously improves products through continuous technical discussions with customers.

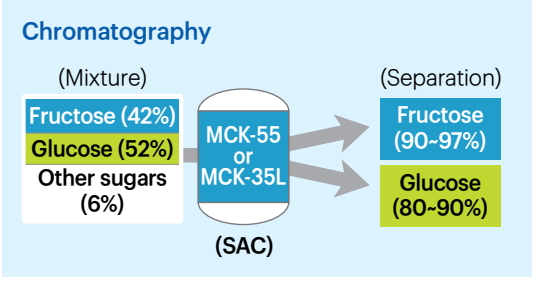
Typical starch sugar refining process and ion exchange resin recommendation



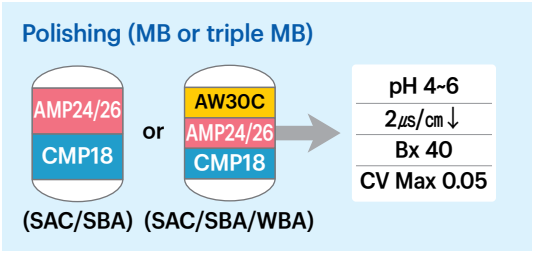
1st / 2nd / 4th Ion exchanger



F/G Separation



3rd Ion exchanger



For the starch sugar refining process, the reactivity is low because the viscosity of the treated liquid passing through the ion exchange resin is higher than that of general water treatment. Therefore, porous type resin, which has higher reactivity than gel type resin, is mainly used. TRILITE AW30C (WBA95% ↑) which has a high heat resistance and high weak base ratio, is recommended when the temperature of the treated solution is high (60℃) or isomerization is a concern when selecting a weak base anion resin. TRILITE MCK Series is most popularly used in the food industry and has superior uniformity and physicochemical strength compared to the copmpeting products, which is well received by customers.

Starch sugar refining resins

Type	SAC Gel		SAC Porous	SBA Porous		WBA Porous		
Grade	**SCR-B**	**MC-08**	**CMP18**	**AMP24**	**AMP26**	**AW30 (AW30M)**	**AW30C**	**AW90**
Matrix	Polystyrene+DVB							
Functional group	Sulfonic acid			Type 2 Quaternary amine		Tertiary amine		
Ionic form	Na^+			Cl^-		Free Base		
Specific gravity	1.29	1.28	1.3	1.09	1.11	1.05	1.05	1.04
Shipping weight (g/ℓ)	830	845	795	655	680	700	700	640
Moisture retention (%)	43~50	43~49	43~50	54~64	46~52	48~58	55~65	40~50
Total capacity (eq/ℓ)	2.0 ↑		1.8 ↑	1.0 ↑	1.2 ↑	1.6 ↑		
Effective Size (㎛)	400 ↑	UPS	400 ↑	400 ↑		400 ↑		UPS
Uniformity coefficient	1.6 ↓	1.1 ↓	1.6 ↓	1.6 ↓		1.6 ↓ (1.1 ↓)	1.6 ↓	1.1 ↓
Particle size (㎛)	300~1,200	600±50	300~1200	300~1200		425~710	300~1,200	550±50
Operating temp. (℃)	120 ↓	120 ↓	120(H^+), 140(Na^+)	70(OH^-), 90(Cl^-)		60 ↓	100	60 ↓
Operating pH range	0~14			0~14		0~9		
Swelling rate ($Na^+ \rightarrow H^+$, $Cl^- \rightarrow OH^-$, FB → Cl^-)	8%	9%	8%	14%		20%		

Applications

TRILITE SCR-B

High purity syrup can be produced economically.

TRILITE MC-08

With uniform particle size distribution, it is suitable for packed bed and up-flow system, and high operating efficiency can be expected.

TRILITE CMP18

It is a porous type SAC resin that features high performance for undiluted solutions with high viscosity. It is recommended for mixed bed polishers and expects long-term use due to high resistance to organic fouling.

TRILITE AMP24

It is a low crosslinkage porous type SBA resin. High performance can be expected for undiluted solutions with high viscosity. It is recommended for mixed bed polisher and expects long-term use due to high resistance to organic fouling.

TRILITE AMP26

It features a larger exchange capacity than that of AMP24. So when applied to a mixed bed polisher, a longer flow rate per cycle can be expected.

TRILITE AW30

It is widely used for the economic refining and decolorization of starch sugar. However, it should be used with caution in the process where the SBA (strong base) ratio is somewhat high and the isomerization reaction is concerned.

TRILITE AW30C

It features a high WBA ratio and excellent heat resistance which does not require the heat exchanger. It is widely used in processes where isomerization reactions such as high-purity glucose/fructose purification are concerned.

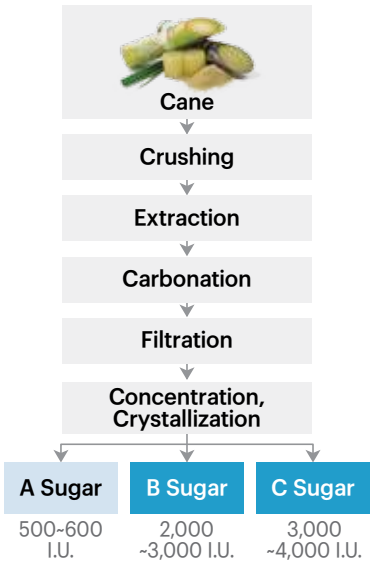
TRILITE AW30M, TRILITE AW90

With uniform particle size distribution, it is suitable for packed bed and up-flow system, and high operating efficiency can be expected.

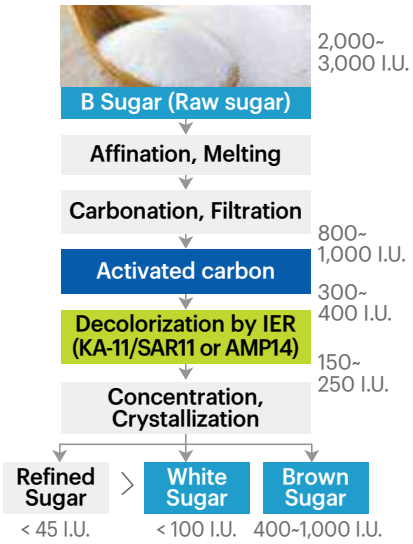
Food - Sugar

The general sugar (Cane sugar) production process can be classified into a process that first makes raw sugar and then uses it to make refined sugar. In general, ion exchange resins are not used when manufacturing raw sugar, whereas ion exchange resins are essential when manufacturing purified sugar. This is distinguished from the case of being used in combination with activated carbon and the two-step purification with only ion exchange resin without activated carbon. If activated carbon is not used, there may be pigment components that must be removed with ion exchange resin. With the use of TRILITE ASP10 in combination, it is expected a long service life due to increased bleaching ability and excellent organic pollution resistance.

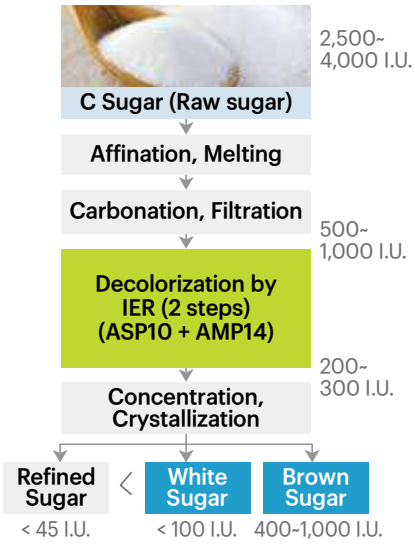
Cane sugar refining process



Sugar refining process with A/C



Sugar refining process without A/C



Type	SBA Gel Type 1		SBA Porous type 1	SBA Porous type
Grade	SAR11	KA-11	AMP14	ASP10
Matrix	Polystyrene+DVB			Polyacrylate+DVB
Functional group	Type 1 (Trimethylammonium)			Quaternary Ammonium
Ionic form	Cl^-			
Shipping weight (g/ℓ)	690	700	670	700
Moisture retention (%)	55~65		57~67	65~75
Total capacity (eq/ℓ)	0.90 ↑		1.00 ↑	0.90 ↑
Effective Size (㎛)	400 ↑			
Uniformity coefficient	1.6 ↓			
Particle size (㎛)	General type : 300~1200 L-type : 425~1200			425~1200
Operating temp. (℃)	60(OH^-), 80(Cl^-)		70(OH^-), 90(Cl^-)	40(OH^-), 80(Cl^-)
Operating pH range	0~14			
Swelling rate (Cl^- → OH^-)	35%		25%	25%

Applications

TRILITE SAR11, TRILITE KA-11

These are poly-styrenic gel type low crosslinkage resin recommended for economic decolorization of low color value (200~400 I.U.) syrup.

TRILITE AMP14

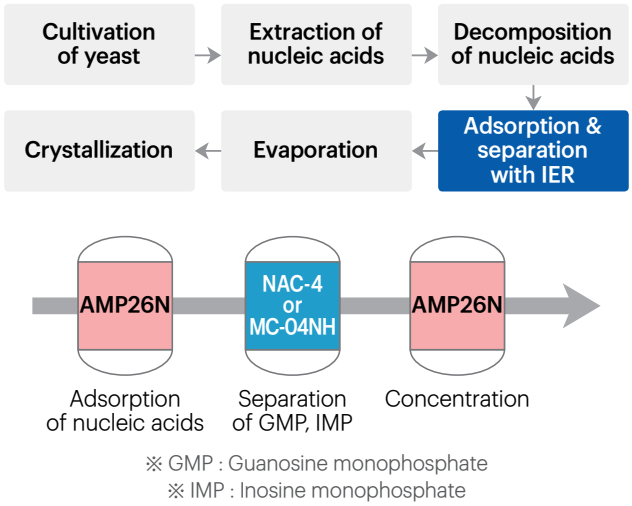
It is a styrenic porous type low cross linkage resin recommended for economic decolorization of mid color value (400~800 I.U.) syrup.

TRILITE ASP10

It is an acrylic porous type resin recommended for high color value (1,000 ~ 2,000 I.U.) syrup decolorization.

Food - Nucleotide / MSG / Amino acid (Lysine, Arginine)

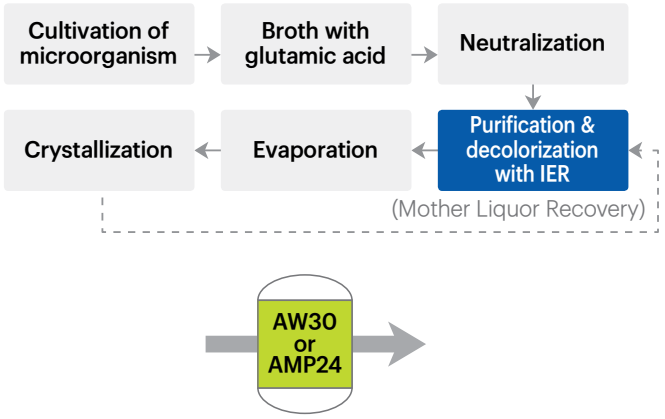
Nucleotide



※ GMP : Guanosine monophosphate
※ IMP : Inosine monophosphate

The nucleotide is used as a seasoning and raw material of seasonings, and TRILITE AMP26N and NAC-4 are optimized products for the adsorption, separation, and concentration of nucleic acid substances, with outstanding performance and long life cycle.

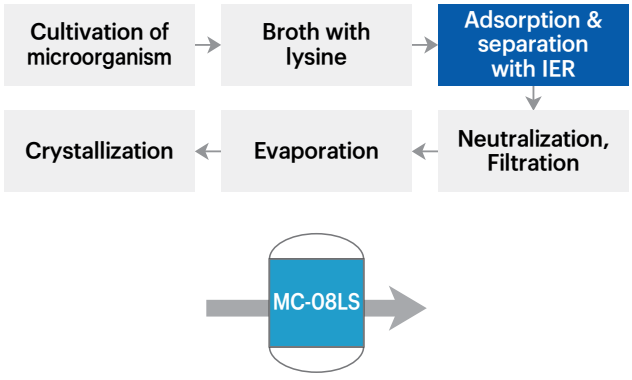
MSG



Purification/decolorization of MSG
※ MSG : Monosodium glutamate

MSG is another major seasoning and raw material of seasonings. Ion exchange resins are used in the process of purifying and decolorizing MSG produced through fermentation, and weak base or strong base anion resin is used depending on the operating conditions of the customers.

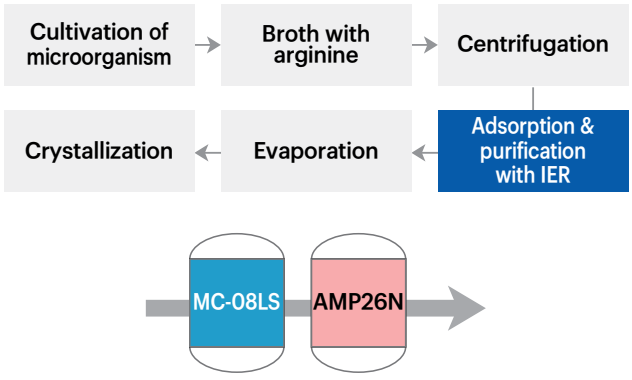
Lysine



Adsorption of lysine
※ Lysine : essential amino acid

Lysine, which is used as a feed nutrition additive, is an amino acid that is most actively commercialized, and TRILITE MC-08LS is a UPS resin developed specifically for lysine separation/ purification and has excellent adsorption capacity and physicochemical strength.

Arginine



Adsorption/purification of arginine
※ Arginine : semiessential amino acid

Arginine is a kind of natural amino acid that is widely used in medicines, foods, and other animal feeds. Fermentation broth passes through a strong acid cation resin, adsorbs arginine, and is then purified with a strong base anion resin and manufactured through a decolonization process.

Nucleotide / MSG / Amino acid (Lysine, Arginine) refining resins

Type	SAC Gel	UPS SAC Gel	
Grade	**NAC-4**	**MC-08LS**	**MC-04NH**
Matrix	Polystyrene+DVB		
Functional group	Sulfonic acid		
Ionic form	Na^+		H^+
Shipping weight (g/ℓ)	780	845	750
Moisture retention (%)	57~67	43~49	65~70
Total capacity (eq/ℓ)	1.20↑	2.00↑	1.20↑
Effective Size (㎛)	400↑	UPS	UPS
Uniformity coefficient	1.6↓	1.1↓	1.1↓
Particle size (㎛)	300~1200	600±50	500±50
Operating temp. (℃)	120↓		
Operating pH range	0~14		
Swelling rate ($Na^+ \rightarrow H^+$)	8%	9%	9%

Type	WBA Porous	SBA Porous Type 2	
Grade	**AW30**	**AMP24**	**AMP26N**
Matrix	Polystyrene+DVB		
Functional group	Tertiary amine	Type 2 (Dimethylethanolammonium)	
Ionic form	Free Base	Cl^-	
Shipping weight (g/ℓ)	700	655	680
Moisture retention (%)	48~58	54~64	46~52
Total capacity (eq/ℓ)	1.50↑	1.00↑(Cl^-)	1.10↑
Effective Size (㎛)	400↑		400↑
Uniformity coefficient	1.6↓		
Particle size (㎛)	425~1,200	300~1200	
Operating temp. (℃)	60↓	70(OH^-), 90(Cl^-)	50(OH^-), 70(Cl^-)
Operating pH range	0~9	0~14	
Swelling rate ($Cl^- \rightarrow OH^-$, FB → Cl^-)	20%	14%	

Chelating resins

In contrast to typical Ion exchange resins, the chelating resin selectively separates and removes a metal ion with a functional group that can form a chelate (complex) with the metal ion. Chelating resins with various functional groups are used in the following applications.

Characteristics and applications

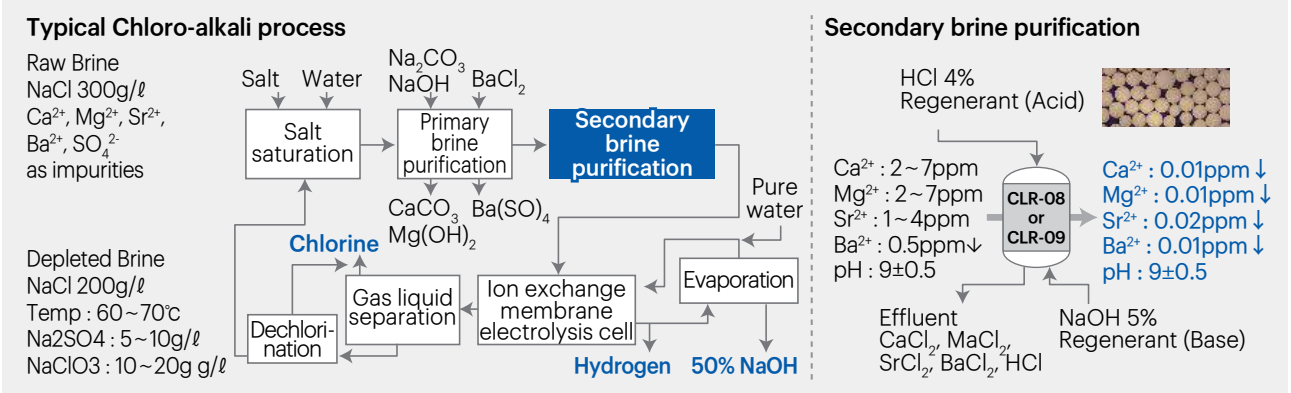
Functional group	Grade	Ionic form	TEC (eq/ℓ)	Features	Application	Equivalent
Imino-diacetate	CLR-08 (Gaussian) CLR-08UPS (UPS)	Na	Cu^{2+} 0.5↑ Ca^{2+} 0.4↑	• Greater selectively for multivalent ions (Ca^{2+}, Mg^{2+}, Sr^{2+}, etc.) from very highly concentrated monovalent ions(Na^{+}, etc.) • Less leakage of multivalent ions	• Secondary brine purification • Selective removal of bivalent ions • Removal of heavy metals • Recovery of rare metals	Lewatit TP208 Amberlite IRC748 Diaion CR11 Purolite S930
Amino-methyl phos-phonate	CLR-09 (Gaussian) CLR-09UPS (UPS)	Na	Ca^{2+} 0.6↑	• Slightly higher operating capacity than CLR-08 • Slightly more leakage of multivalent ion than CLR-08	• Secondary brine purification • Selective removal of bivalent ions	Lewatit TP260 Amberlite IRC747 Purolite S940
Thiouronium	CLR-10	H	1.1↑	• Greater selectivity for mercury(Hg)	• Mercury removal in wastewater	Purolite S924
Polyamine	CLR-20	OH	4mol as copper↑	• Greater selectivity for heavy metals except alkali metal ions(Na^{+}, K^{+}, etc) and alkaline earth metal ions (Ca^{2+}, Mg^{2+}, etc)	• Separation of heavy metals from alkali metal ions and alkaline earth metal ions	Diaion CR20
Glucamine	CLR-B3	Free base	0.6eq/ℓ as boron↑	• Greater selectivity for boron(B) from highly concentrated anions	• Boron removal from wastewater	Diaion CRB03 Amberlite IRA743 Purolite S108
Aminophos-phonate	CLR-F	Al	11g as fluorine↑	• Greater selectivity for fluoride(F) even from low concentration	• Fluoride removal from desulfurization wastewater	
Triethy-lamine	CLR-N	Cl	1.0↑	• Greater selectivity for nitrate than anion resins	• Selective removal of nitrate	Amberlite IRA996 Purolite A520E

Secondary brine purification

In the Chlor-alkali process that electrolyzes salt(NaCl) to produce caustic soda(NaOH) and chlorine (Cl_2), the hardness components (Ca, Mg) in the concentrated saltwater should be removed to protect ion exchange membrane electrolysis cell and the process stability. TRILITE CLR-08, CLR-09 can selectively remove hardness components efficiently in the presence of a high concentration of Na ions.

The adsorbed hardness component is first regenerated with HCl and desorbed, and then regenerated with NaOH and converted into Na-type for re-use.

TRILITE CLR-08 is recommended when Sr and Ba ions are strictly managed, and CLR-09, which feature larger exchange capacity than CLR-08, is recommended when Ca, Mg ions are more strictly managed, thus required for more economical operation.



Treatment of heavy metal wastewater in the plating process

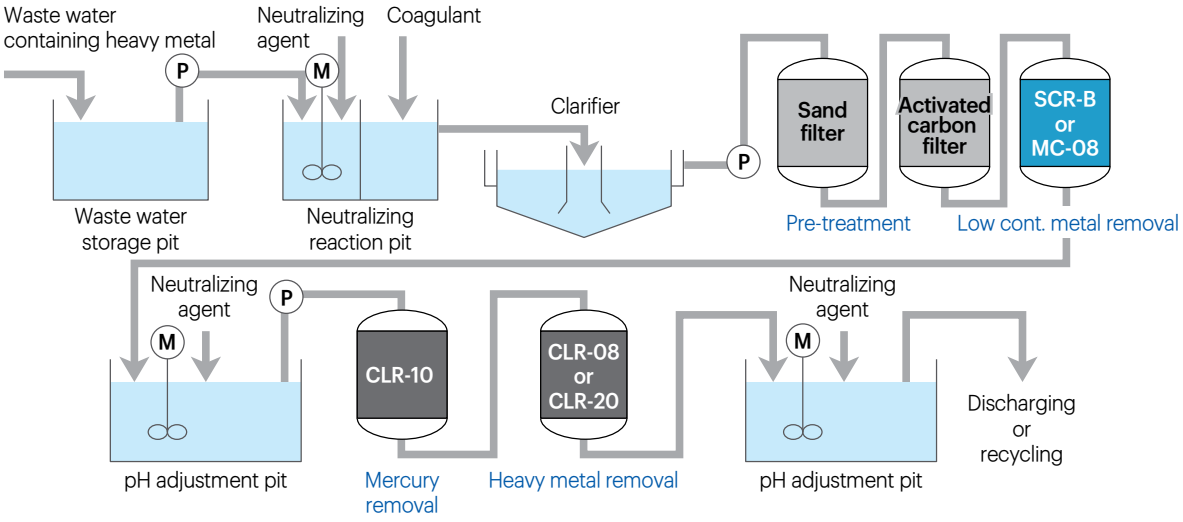
For this application, various impuriteis including heavy metals (zinc, copper, chromium, nickel, cadmium, gold, silver, etc.) are discharged into wastewater. A general plating process consists of performing a pretreatment (degreasing and acid pickling) on the surface of the metal to be plated in the preparation step and then electroplating in a plating solution. After plating, the solution contaminated with the plating material is collected into a recovery tank, then the plating material is washed with a large volume of water. Since harmful substances are contained in this process, it is treated with ion exchange resin by dividing it by system according to its properties along with other process cleaning wastewater.

In the case of ion exchange resins or chelate resins, an appropriate pretreatment(neutralization, aggregation, sand filter, activated carbon, etc) is essential because the amount of ions that can be exchanged is limited and is vulnerable to the inflow of nonionic substances such as organic substances. A typical process is as follows.

Case1) Targeting only heavy metals : SAC resins (TRILITE SCR-B, MC-08, etc) removes low concentrated alkali metals and alkali earth metals(Ca, Sr, etc), and the chelating resins removes highly concentrated specific heavy metals. If Mercury is contained, CLR-10 is recommended and for general heavy metals CLR-08, CLR-20 are recommended.

Case2) Low pH including free acids : SBA resins (TRILITE KA-10, MA-12, etc) removes free acids and apply for Case 1). When pH level exceeds 4, it is not necessary to use pretreatment with SBA resins.

Case3) Removing both metals and free acids(complex anion) : recommends SBA resins (TRILITE KA-10, MA-12, etc).

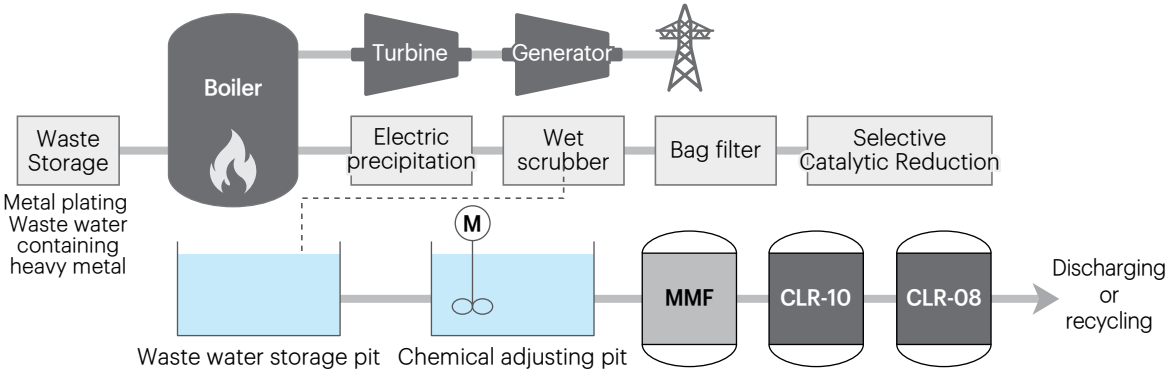


General process of resource recovery facility

Various heavy metals including mercury may be detected in leachate after incineration in waste incineration plants. In this case, if appropriate pretreatment (neutralization, coagulation, precipitation, sand filter, activated carbon, etc.) is performed and chelating resin is used, the quality of the effluent water can be efficiently managed.

TRILITE CLR-10removes mercury efficiently, CLR-08 is used for general heavy metal removal.

Typical application of chelating resins to resource recovery facility

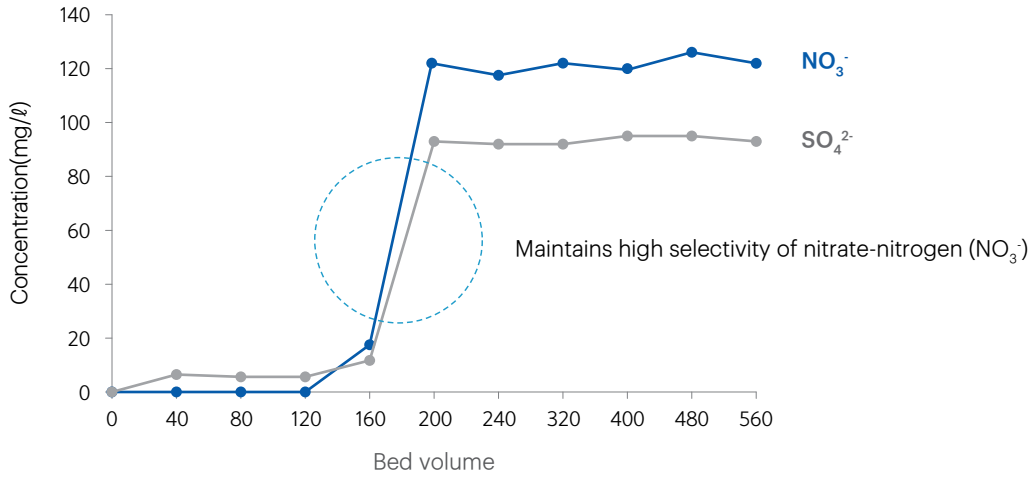


Selective removal of nitrates from drinking water

Nitrate in drinking water is known to be lethal to infants under 6months and should be removed at concentrations above 10ppm. Recently, as a result of stamping outs of animals due to AI and foot-and-mouth disease in Korea, cases of nitrate-nitrogen in groundwater are increasing. The allowable limit of nitrate-nitrogen as drinking water is less than 10ppm(10mg NO_3^- - N/ℓ).

A general strong base anion exchange resin exhibits greater selectivity to sulfuric acid (SO_4^{2-}) ions than to nitrate nitrogen (Nitrate, NO_3^-). For this reason, there was not much need for the nitrate removal resin when the concentration of sulfate ion is relatively lower compared to nitrate nitrogen. But, if it is high, there may be problems such as a decrease in the operating capacity of nitrate nitrogen and sometimes leakage beyond the breakthrough point.

TRILITE CLR-N efficiently removes nitrate nitrogen from drinking water by adopting a specialized functional group with high selectively of nitrates.



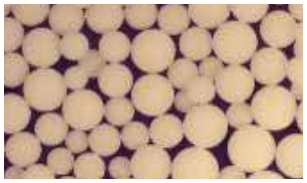
When the value of SO_4^{2-} / NO_3^- is great than 1, that is, when the concentration of NO_3^- is relatively lower than that of SO_4^{2-} TRILITE CLR-N, which has high selectivity for nitrate-nitrogen is recommended.

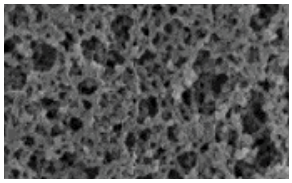
Type	**Regeneration level** (Co-current, 100% NaCl base)	**TRILITE CLR-N operating capacity**
SO_4^{2-} / NO_3^- > 1	125g/ℓ-R	0.4eq/ℓ-R (20g as $CaCO_3$/ℓ-R)

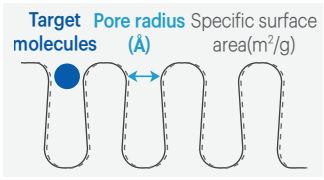
Type	**Chelating resins**						
Grade	**CLR-08(UPS)**	**CLR-09(UPS)**	**CLR-10**	**CLR-20**	**CLR-B3**	**CLR-F**	**CLR-N**
Matrix	Polystyrene + DVB						
Functional group	Iminodiacetate	Amino-methylphos-phonate	Thiouronium	Polyamine	Glucamine	Aminophos-phonate	Triethylamine
Ionic form	Na^+	Na^+	H^+	OH^-	Free base	Al^{3+}	Cl^-
Total capacity (eq/ℓ)	Cu^{2+} 0.5↑ Ca^{2+} 0.4↑	Ca^{2+} 0.6↑	1.1↑	4mol↑ as copper	0.6eq/ℓ as boron↑	11g↑ as fluorine	1.0↑
Particle size (㎛)	400~1,000 (700±50)	400~1,000 (650±50)	300~1,250	400~1,250	300~1,250	300~1,000	300~1,250

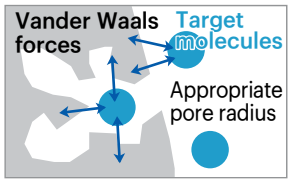
Synthetic adsorbents

Synthetic adsorbents do not have a functional group but feature a large specific surface areas and pores, so they can adsorb various organic substances by Vander Waals force. It is used for various proposes such as the purification of pharmaceuticals and semiconductor chemicals.





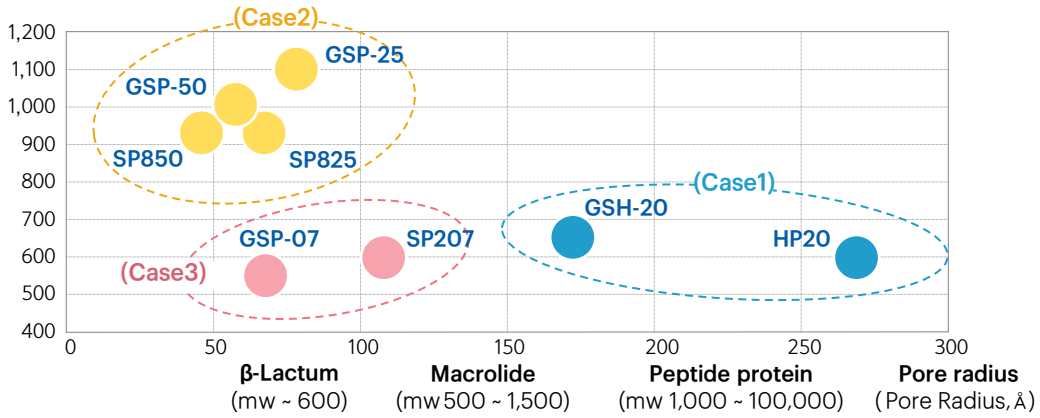




Synthetic adsorbents recommendation

Type		Grade		Features
Polystyrene type	Standard type	Performance	HP20	Relatively large pore radius, appropriate for adsorption of large molecules(>1,000mw). Easily elutes and separates the target material.
		Basic	GSH-20	
	Special type	Performance	SP825, SP850	Very large surface area and small pore radius, appropriate for adsorption of small molecules(<1,000mw) and exclusion of Basic large molecules.
		Basic	GSP-25, GSP-50	
	Chemically modified	Performance	SP207	Charging into bromine, very high hydrophobicity and selectivity to non-polar materials. With the strong adsorption strength, large amount of eluent may be required, and the large specific gravity can treat a dense solution.
		Basic	GSP-07	
Methacrylic type		Performance	HP2MGL	The methacrylic matrix feature high hydrophobicity and is suitable for adsorption of highly polar organic substances.

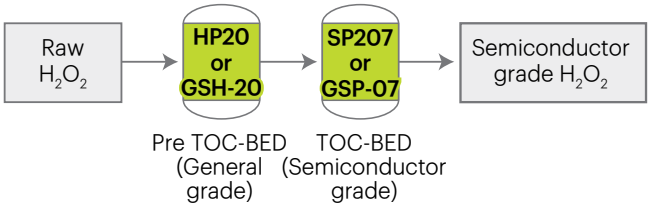
Specific surface area (m^2/g)



Type	Case	Guide	
Selectivity (molecular weights	Case1) Solution containing large amount of organics	Performance	HP20 > SP207 > SP825 > SP850
		Basic	GSH-20 > GSP-07 > GSP-25 > GSP-50
	Case2) Adsorption when mw < 1,000	Performance	SP850 > SP825 > HP20 > SP207
		Basic	GSP-50 > GSP-25 > GSH-20 > GSP-07
	Case3) Adsorption when mw < several thousands)	Performance	SP207 > SP850 > SP825 > HP20
		Basic	GSP-07 > GSP-50 > GSP-25 > GSH-20
Elution	Elution rate tends to decrease with mall radius and large adsorption force.	Performance	HP20 > SP825 > SP850 > SP207
		Basic	GSH-20 > GSP-25 > GSP-50 > GSP-07

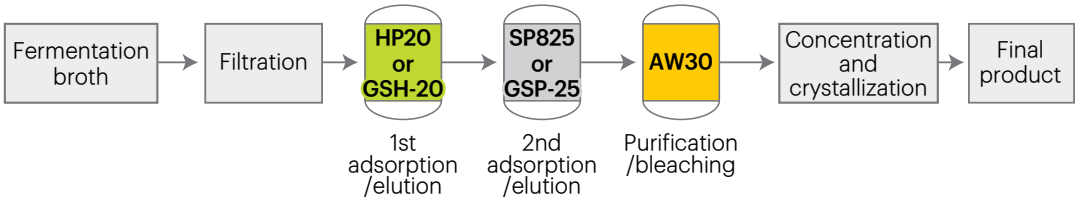
Purification of hydrogen peroxide using synthetic adsorbent

Hydrogen peroxide (H_2O_2) for semiconductors or electrical electronics must be removed from TOC components (diisobutylcarbinol, trimethylbenzene, etc) and ionic components, which are impurities contained in general grade hydrogen peroxide, and can be purified using synthetic adsorbents.



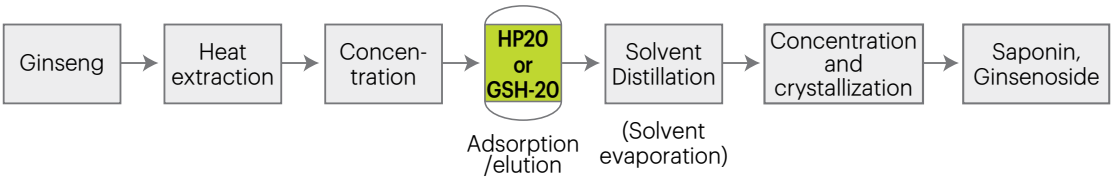
Extraction and purification of antibiotics and anticancer agents using synthetic adsorbent

Synthetic adsorbents are widely applied in the process of separating/purifying the target substances after the cultivation of high concentration strains used as pharmaceutical raw materials, and can effectively extract substances to be adsorbed from fermentation broth and remove impurities, so high purity and the recovery rate can be expected.



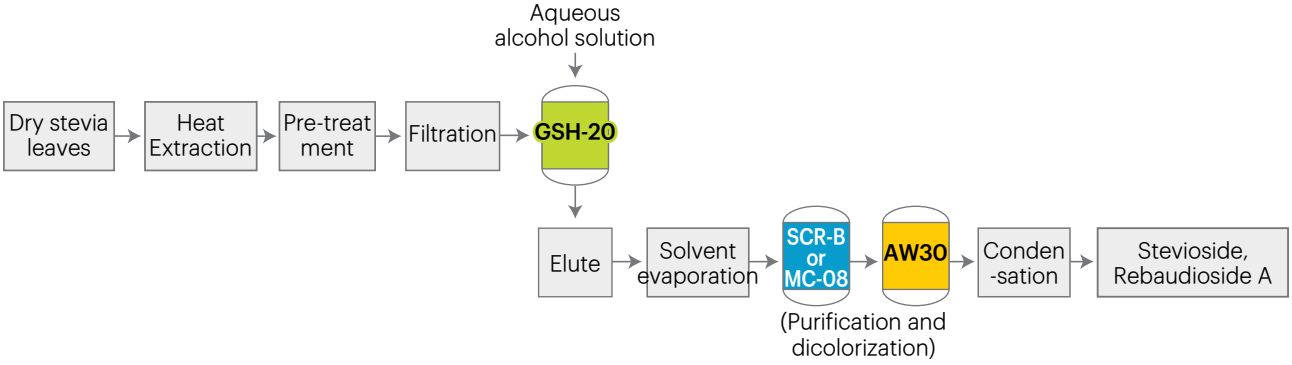
Purification of functional food additives using synthetic adsorbents

Functional food additives such as saponin, ginsenosie, and polyphenol can be efficiently extracted using synthetic adsorbents.

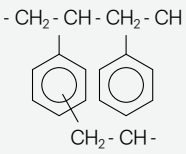
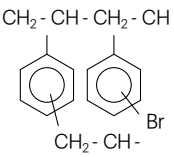
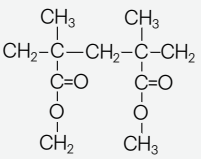


Purification of Stevioside and Rebaudioside A using synthetic adsorbents

Stevia(Stevia Rebaudiana Bertoni) can be separated from the water-soluble extracts, extracted from dry leaves of Stevia and hot water. Synthetic adsorbents are used to extract Steviol glycoside from the water-soluble extracts. Among the steviol glycosides, sweet taste ingredients such as stevioside and rebaudioside A are most general ingredients in this application.



Synthetic adsorbents

Type	Polystyrene/DVB Type								Methacrylic
	Standard type		Special type				Chemically modified		
Grade	HP20	GSH-20	SP825	SP850	GSP-25	GSP-50	SP207	GSP-07	HP2MGL
Chemical Structure									
Specific surface area (m^2/g)	590	600	930	930	1,100	1,100	600	550	570
Pore Volume (mℓ/g)	1.3	1.0~1.5	1.4	1.1	1.2~1.6	0.9 ~ 1.1	1	0.8~1.0	1.3
Pore Radius (Å)	290	100	70	45	80	60	110	70	240
Particle size (㎛)	200 ~ 1,200	315 ~ 1,250	200 ~ 1,200	250 ~ 850	250 ~ 700	250 ~ 700	250 ~ 850	250 ~ 700	300 ~ 1,200

Applications

GSH-20, HP20

Widely used in refining of pharmaceuticals and natural extracts, since these are suitable for adsorbing large molecules because of their relatively large pore sizes and superior adsorption/ desorption. GSH-20 is widely used in various industrial applications, especially adsorption, desalting and Decolorization of natural products and small proteins.

GSP-25, GSP-50, SP825, SP850

These feature a much larger surface area and a narrower, more uniform pore-size distribution than GSH-20. They offer nearly one and half times the surface area of GSH-20. With large surface area and narrower pore radius, These selectively adsorbs small molecules and excludes larger molecules. These grade are recommended for adsorption, desalting and decolorization.

GSP-07, SP207

With high hydrophobicity, TRILITE GSP-07 has higher selectivity for non-polar molecules than standard aromatic adsorbents, due to its chemically bonded bromine to the aromatic rings. It is suitable for upward flow and batch processes due to its high specific gravity but also for treatment of heavy liquid such as purification of hydrogen peroxide in electric and electronic industry.

HP2MGL

It is a methacrylic type medium polar adsorbent without aromatic chemicals. It is used for desalting and adsorption of organic chemicals with relatively high polarity by utilizing the hydrophilic matrix.

Ready to use mixed resins

Ready to use mixed resins produce high purity water more conveniently. Up to the usage of water volume, they are widely used for cartridges or pressure vessels that do not require a complicated regeneration process. The primary application for TRILITE SM200, SM210 is in Wire EDM applications. It features an outstanding amount of treated water compared to other ready-to-use mixed resins in the market. TRILITE SM300 used after RO(Reverse osmosis) in Make-up systems, results in treated water quality close to that of Ultrapure water (Resistivity > 15.0MΩ·cm). UPW Grade mixed resins UPRM Series is used for the Final polisher in the UPW process (Pre-treatment → Demineralization → UPW production).

Application wise major features and treated water quality

Grade	Feature & Application	Components	Water quality	
			Inlet	Outlet
SM200	Simple production from potable water EDM(Wire-cutting)	Cation (H^+ 99.0%↑) Anion (OH^- 90.0%↑)	Potable Water Conductivity 150μs/cm SV36	Guaranteed Resistivity >10.0 MΩ·cm (in 10min.)
				Actual Resistivity >15.0 MΩ·cm (in 10min.)
SM210	Simple production from potable water Demineralization	Cation (H^+ 99.0%↑) Anion (OH^- 95.0%↑)		Guaranteed Resistivity >10.0 MΩ·cm (in 10min.)
				Actual Resistivity >15.0 MΩ·cm (in 10min.)
SM300	High resistivity excellentSiO_2 removal Post RO, EDI MB	Cation (H^+ 99.0%↑) Anion (OH^- 95.0%↑)	Post-RO Conductivity 10μs/cm SV36	Guaranteed Resistivity >15.0 MΩ·cm (in 10min.)
				Actual Resistivity >17.0 MΩ·cm (in 10min.)
UPRM100U (UPS)	Very high resistivity Electronic Grade UPW	Cation (H^+ 99.0%↑) Anion (OH^- 95.0%↑)		Guaranteed Resistivity >17.0 MΩ·cm (in 10min.)
				Actual Resistivity >18.0 MΩ·cm (in 10min.)
UPRM200U (UPS)	Very high resistivity Low △TOC OLED UPW Final polisher	Cation (H^+ 99.9%↑) Anion (OH^- 95.0%↑)	UPW >17.5 MΩ·cm TOC < 2ppb SV30	Resistivity >18.1 MΩ·cm (in 30min.) △TOC < 5ppb (in 120min)
UPRM300U (UPS)	Very high resistivity Very low △TOC Semicon. UPW Final polisher	Cation (H^+ 99.9%↑) Anion (OH^- 97.0%↑)		Resistivity >18.2 MΩ·cm (in 30min.) △TOC < 1ppb (in 180min)
UPRM400U (UPS)	Very high resistivity Very low △TOC Low metal ion leakage Semicon. UPW Final polisher	Cation (H^+ 99.9%↑) Anion (OH^- 97.0%↑)		Resistivity >18.2 MΩ·cm (in 30min.) △TOC < 1ppb (in 180min) Metal ion leakage < 0.1 ppt

Ready to use mixed resins

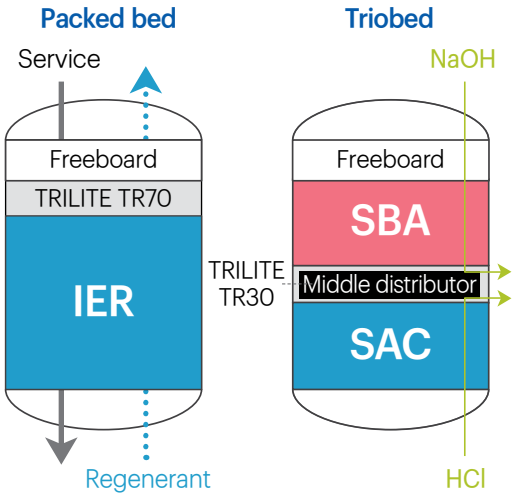
Type	Ready to use mixed resins		
Grade	**SM200**	**SM210**	**SM300**
Matrix	Polystyrene+DVB		
Functional group	Mixed resin		
Shipping weight (g/ℓ)	700		
Particle size (μm)	300~1,200 (Uniformity coefficient, 1.6↓)		
Operating temp. (℃)	50↓		
Ionic form	H^+ (H% 99.0%↑) OH^- (OH% 90.0%↑)	H^+ (H% 99.0%↑) OH^- (OH% 95.0%↑)	H^+ (H% 99.0%↑) OH^- (OH% 95.0%↑)
Mixed ratio (Volume)	45:55	45:55	40:60
Operating capacity (eq/ℓ)	0.4↑ (Feed : Conduct. 150μs/cm Potable water, SV36)	0.5↑ (Feed : Conduct. 150μs/cm Potable water, SV36)	0.5↑ (Feed : Conduct. 10μs/cm RO outlet, SV36)
Outlet condition (Resistivity)	Resistivity > 10.0 MΩ·cm (Feed : Potable water)	Resistivity > 10.0 MΩ·cm (Feed : Potable water)	Resistivity > 15.0 MΩ·cm (Feed : RO outlet)

※ The data for Shipping weight and Operating capacity is for reference.

Inert resin

Inert resins are non-functionalized polymers developed for use as an upper layer in a packed-bed system and also used to enhance separation of cation and anion exchange resins before regeneration process in the Triobed system.

Type	Inert resins	
Grade	**TR70**	**TR30**
Matrix	Polyethylene	Polystyrene + DVB
Functional group	-	
Shipping weight (g/ℓ)	500	670~720
Particle size (㎛)	1,200~1,800	680~750
Operating temp. (℃)	90↓	100↓
Remarks	The specific gravity is lower than that of water, it locates as top layer within an IER tower, keeping the layers compact, preventing any loss of active finer resins and improving the regenerant distribution efficiency	The specific gravity lies in the middle of that of cation resins and anion resin. It forms a border between them. It eases separation of cation and anion resins, preventing any counter regeneration hence improving the purity of treated water

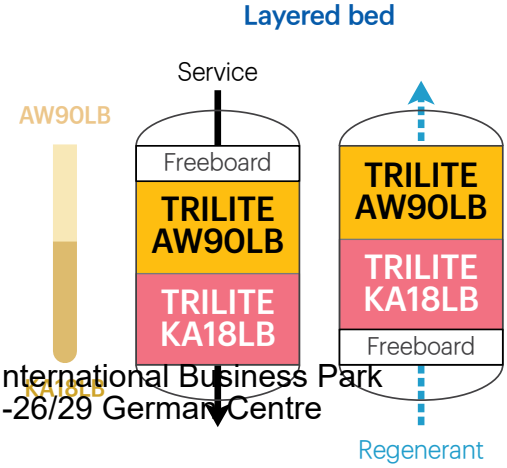


※ The data for Shipping weight is for reference.

Layered Bed Anion resin

A layered bed water treatment system allows economical production of pure water through simultaneous employment of Strongly Basic Anion(SBA) and Weakly Basic Anion(WBA) resins for an anion exchanger. Successive regeneration of WBA resin with regeneration wastewater of SBA resin enables high regeneration efficiency and the ability to cope with the change of raw water with good resistance to organic fouling of resins.

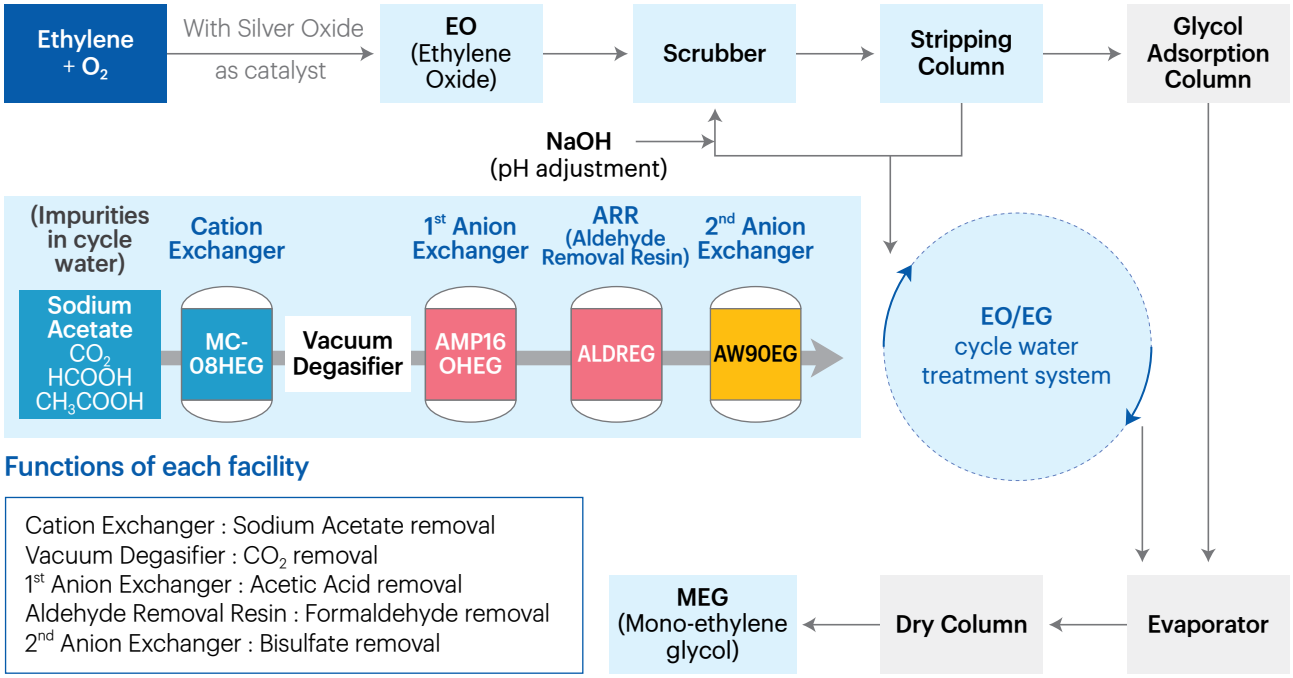
Type	Layered bed anion resins	
	WBA	**SBA**
Grade	AW90LB	KA18LB
Matrix	Polystyrene + DVB (Porous type)	Polystyrene + DVB (Gel type 1)
Functional group	Tertiary Amine	$-N^{+}(CH_3)_3$ (TMA, Trimethyl-ammonium)
Ionic form	Free Base	Cl^-
Specific gravity	1.04	1.11
Shipping weight (g/ℓ)	640	675
Moisture retention (%)	40~50	43~47
Total capacity (eq/ℓ)	1.6↑	1.3↑
Uniformity coefficient	1.1↓	1.4↓
Particle size (㎛)	550±50	600~1,200
Operating temp. (℃)	60↓	60↓ (OH^- type) 80↓ (Cl^- type)
Operating pH range	0~9	0~14
Swelling rate (FB → Cl^-, Cl^- → OH^-)	20%	24%



※ The data for Specific gravity/ Shipping weight/ Swelling rate is for reference.

EO/EG Cycle Water Treatment

In the production of mono-ethylene glycol, ethylene and oxygen generate EO through silver oxide catalyst, and then EG is produced by a hydrolysis reaction. In this process, impurities such as Sodium Acetate, Formaldehyde, CO_2, and Acetic Acid are included in the cycle water and removed from the EO/EG cycle water treatment system, and then recycled to the process.



Functions of each facility

Cation Exchanger : Sodium Acetate removal
Vacuum Degasifier : CO_2 removal
1st Anion Exchanger : Acetic Acid removal
Aldehyde Removal Resin : Formaldehyde removal
2nd Anion Exchanger : Bisulfate removal

Type	EO/EG Cycle Water Treatment			
	SAC	SBA	SBA	WBA
Grade	MC-08HEG	AMP16OHEG	ALDREG	AW90EG
Matrix	Polystyrene + DVB (Gel type)	Polystyrene + DVB (Porous type)	Polystyrene + DVB (Porous tpe)	Polyacryli-Polystyrene + DVB (Porous type)
Functional group	$-SO_3$ Sulfonic acid	$-N+(CH_3)_3$ Trimethylammonium	$-N+(CH_3)_3$ Trimethylammonium	Tertiary Amine
Ionic form	H^+	OH^-	Cl^-	Free Base
Shipping weight (g/ℓ)	800	650	630	640
Moisture retention (%)	50~56	60-68	50-60	40~50
Total capacity (eq/ℓ)	1.80↑	0.9↑	1.2	1.6↑
Uniformity coefficient	1.1↓	1.6↓	1.6↓	1.1↓
Particle size (㎛)	620±50	300~1,180	300 ~ 1,180	550±50
Operating temp. (℃)	120↓	70↓	60	60↓
Operating pH range	0~14	0~14	0~14	0~9

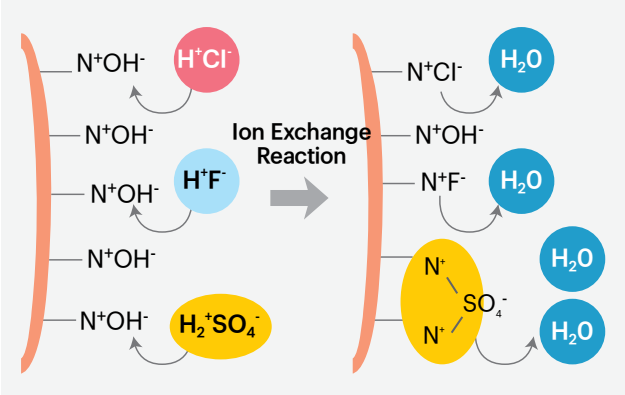
※ The data for Shipping weight is for reference.

Dry type resins

Dry type resins are used in gaseous chemical filters for the purpose of removing specific ions from the air. In general gaseous chemical filters remove AMC※ from industrial sites where odors and harmful gases are generated. Application of dry type resin is being widely applied to improve the yield of highprecision electrical and electronic manufacturing process such as semiconductors and OLEDs.

* AMC(Airborne molecular contamination) :
Molecular substances that may adversely affect the production process or humans.

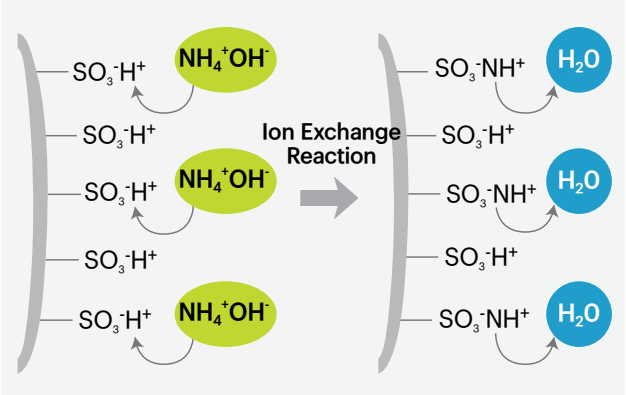
• Acid gas removal mechanism



<Reaction pathway of Acid gas>

$-R\text{-}N\text{-}OH + HCl \rightarrow -R\text{-}N\text{-}Cl + H_2O$
$-R\text{-}N\text{-}OH + HF \rightarrow -R\text{-}N\text{-}F + H_2O$
$2(-R\text{-}N\text{-}OH) + H_2SO_4 \rightarrow 2(-R\text{-}N\text{-})SO_4 + 2H_2O$

• Base gas removal mechanism



<Reaction pathway of Base gas>

$R\text{-}SO_3H + NH_4OH \rightarrow R\text{-}SO_3NH_4 + H_2O$

Dry type resins				
Grade	**KC-08HD SCR-BHD**	**MC-08HD**	**KA-12OHD SAR10MBOHD**	**AMP16OHD**
Matrix	Polystyrene+DVB			
Functional group	Sulfonic acid		Type 1 (Trimethylammonium)	
Ionic form	H^+		OH^-	
Total capacity (eq/ℓ)	1.7↑	1.8↑	1.0↑	0.8↑
Total capacity (meq/g)	2.9↑	3.0↑	1.8↑	1.6↑
Moisture retention (%)	10~35 (Customized production as per the reqeust.)			
Shipping weight (g/ℓ)	780	800	750	650
Uniformity coefficient	1.6↓	1.1↓	1.6↓	1.6↓

※ The specification of exchange capacity, shipping weight and uniformity coefficient is for raw material resins.

Technical Services

TRILITE offers additional value by supplying a stable supply of high-quality products. Technical sales managers specialized in each field provide total solutions in response to a variety of customer needs, and customized technical services such as analysis services using the latest facilities and pilot tests for use development are provided from the Tech Center. Please experience the "TRILITE inside" Membership service.

1. Profession technical sales managers respond to real-time on-line, off-line inquiries with various technical information.

Real time communication
Telephone, e-mail, website, SNS

Technology library
Provision of technical information and data from website and technical engineers.

Technical webinars
On-site technical seminars, on-line webinars, technical training through YouTube.

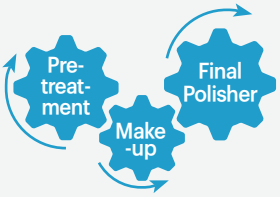
2. Providing total solution from general water treatment to special applications

Calculation program
Free TriAngle™ license for system design and technical support from professional engineers

Product replacement support
Replacement guidance for enhancing performance, Products and quanitities

- Low throughtput
- Analysis/Calculation of replacement
- Resin replacement/ performance improvement

Facility diagnosis and retrofit proposal
Professional consultant for facility diagnosis and improvements

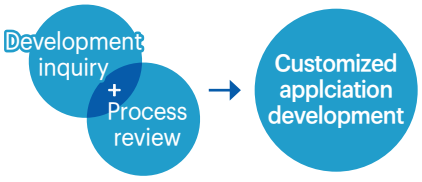


3. We offer value-added services from the only ion exchange resin Tech-center in South Korea.

Ion exchange resin analysis
Provision of resin analysis and solutions, periodically or timely inquiry

Resin analysis inquiry process
- Applying for sample analysis
- Receiving of request with sample
- Conduct of analysis
- Issuing analysis report

New application process development
Supports process improvement and new application development through product recommendation and pilot test, etc.

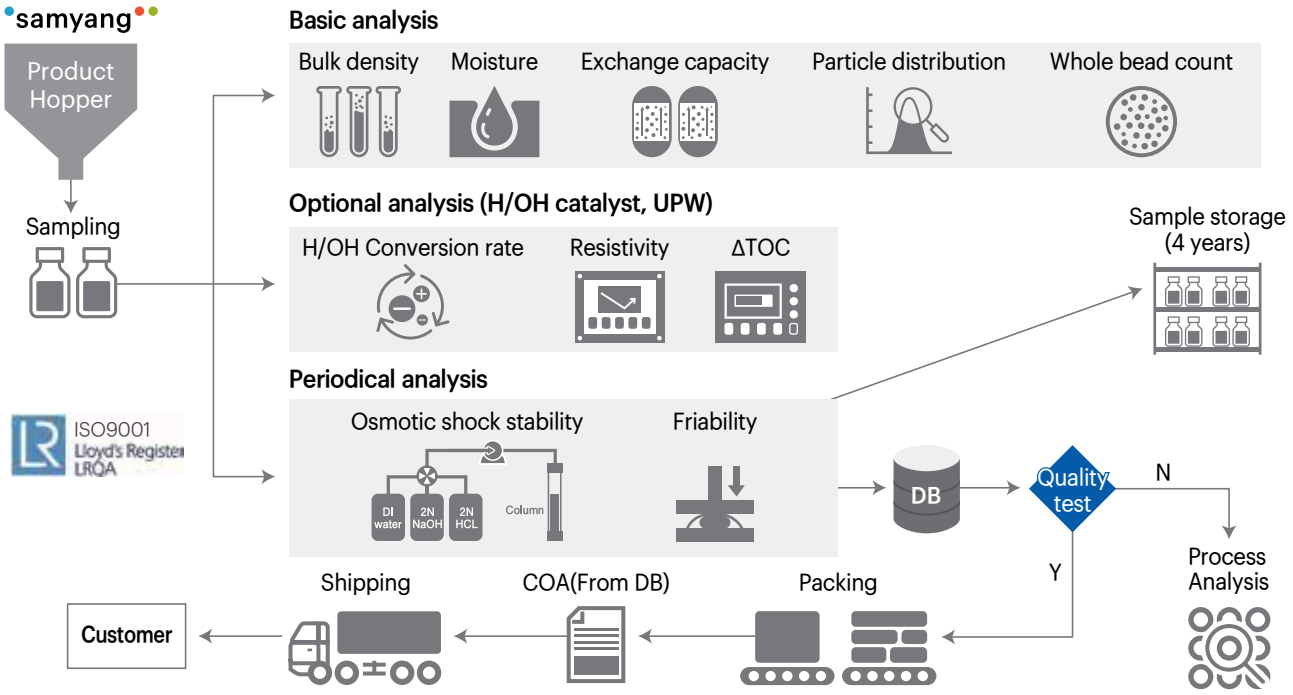


Inquiry to | Samyang Corporation | Ion Exchange Resin Team
• Tel : 02 740 7732~7 • Email : trilite@samyang.com • Homepage : www.samyangtrilite.com

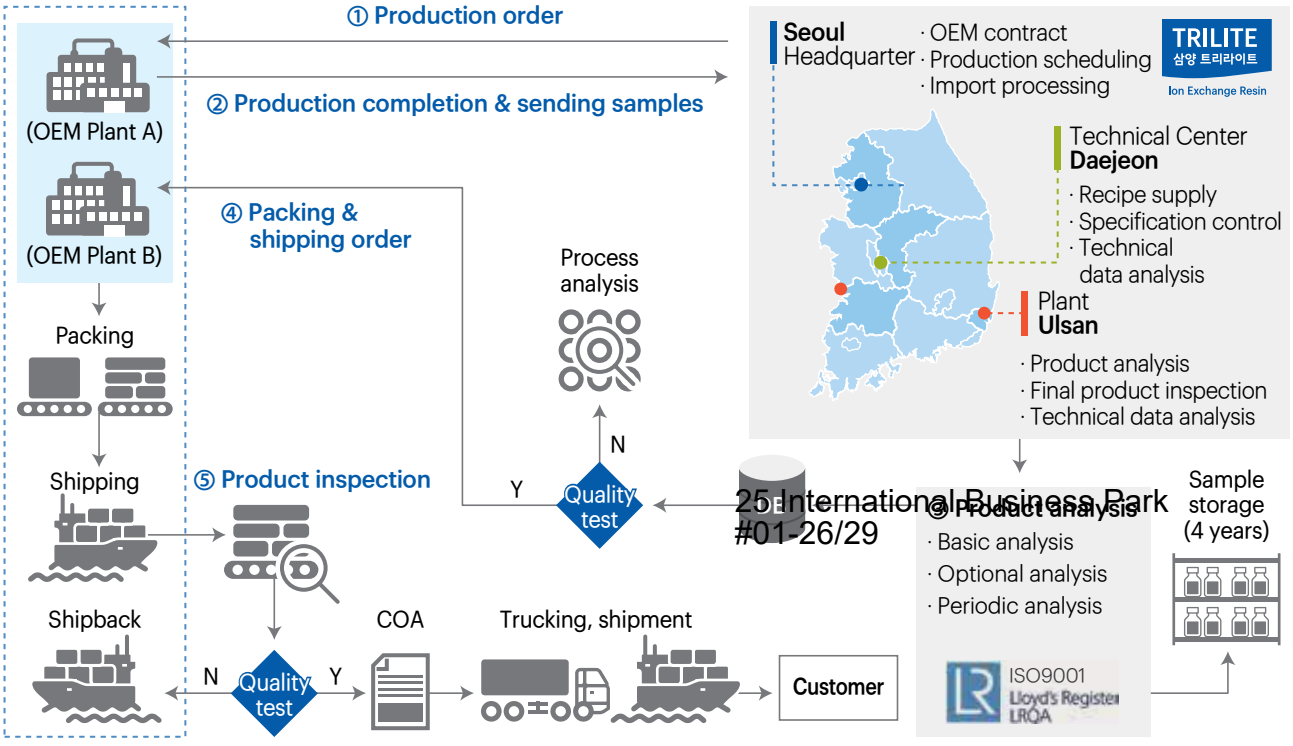
Quality Assurance System

TRILITE Ion Exchange Resins assure strict quality management under ISO9001 Quality Assurance System. TRILITE OEM products are being produced under the same quality assurance system, and through the pre-shipment & on-arrival sample test, Samyang assures the trustworthy quality of the products.

Premium **Performance**



Basic



Packing & Container Loading

Samyang TRILITE offers various packaging methods of ion exchange resins for the protection of goods and customer's convenience. We provide the best quality ion exchange resin with a safe and highly efficient packaging method. There is a 25ℓ PE bag for easy storage and handling, a large capacity 1,000ℓ bag (Super sack), 50ℓ plastic drum, and 5~7ft^3 fiber drum. To minimize product damage that may occur during the shipping process, we carry out loading and container work according to a systematic manual, and we seek customer satisfaction by sharing the work with customers after sharing pictures.

Application wise major features and treated water quality

25ℓ PE bag

- Different colors for each product types
- Heat sealing and valve types

1,000ℓ Supersack

- Large-scale industrial uses
- Circular or square shape

50 or 200ℓ Plastic drum

- UPW and power plants application
- Lever lock

5 or 7ft^3 Fiber drum

- Special applications
- Lever lock

• Packaging type & Pallet information

Type Material	Dimension (cm)	Capacity (ℓ)	Standard palletization	
			Quantity (Method)	**Dimension** (W x L x H, m)
25ℓ PE bag (Heat-sealing)	48 x 71 x 10	25	1000ℓ (4 bag x 10 layers or 5 bag x 8 layers)	1.1 x 1.1 x 1.2 1.1 x 1.1 x 1.0
25ℓ PE bag (Valve)	45 x 54 x 13	25	1050ℓ (6 bag x 7 layers)	1.1 x 1.1 x 1.0
1000ℓ Round type PP (Inner PE)	Ø107 × 121 (H)	800~1000	1000ℓ	1.1 x 1.1 x 1.2
1000ℓ Square type PP (Inner PE)	104 x 104 x 100 (H)	800~1000	1000ℓ	1.1 x 1.1 x 1.1
	104 x 104 x 120 (H)	1,100	1100ℓ	1.1 x 1.1 x 1.2
50ℓ Plastic drum HDPE	Ø41.5 × 61.5 (H)	50~60	800ℓ (8 drum x 2 layers)	1.1 x 1.1 x 1.5
200ℓ Plastic drum HDPE	Ø58.5 × 97.5 (H)	200	800ℓ (4 drum x 1 layers)	1.1 x 1.1 x 1.1
5ft^3 Fiber drum Liner	Ø53 × 76 (H)	5 ft^3 (141ℓ)	20 ft^3 (566ℓ)(4 drum x 1 layers)	1.1 x 1.1 x 0.9
7ft^3 Fiber drum Liner	Ø53 × 100 (H)	7 ft^3 (198ℓ)	28 ft^3 (792ℓ)(4 drum x 1 layers)	1.1 x 1.1 x 1.2
5ℓ Vacuum packing NY + PET + LLDPE	480 x 280 x 0.15 (mm)	5	500ℓ 20 box (5ℓ x 5 ea)	1.1 x 1.1 x 1.3

Certificates

TRILITE is being audited regularly to maintain the ISO9001 Quality Assurance System and also being carried on the improvement of its QA & QC processes. TRILITE is granted for its qualification following international certificate authorities, Halal for Islamic countries, and Veritas for power plants.

Inquiry to | Samyang Corp.

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- Email : trilite@samyang.com
- www.samyangtrilite.com

Homepage

Search **TRILITE** channel from Kakao Talk

ISO9001/14001

International certification for quality management system

NSF

The most prestigious international water certification issued by the American Sanitation Association

Korean FDA

식품의약품안전처

Certification for products produced in the food additive manufacturing process registered with the Ministry of Food and Drug Safety

Turkish Reach(KKDIK)

Certification for safe use and chemical substances regulated by Turkey MoEU (Ministry of Environment and Urban Development)

RoHS

Certification of the guidelines for the restriction of hazardous substances in force in the EU

Vertitas Certificate

Certification given to ion exchange resins for nuclear power generation by Bureau Veritas (France), which is recognized worldwide

* Bureau Veritas (France) is an institution which has the world wide experience and expertise to take on the quality certification of ion exchange resins for power plant.

EU Reach / SVHCs

Certification of chemical substances and safe use regulated by EU, certification of raw material registration required by EU REACH

MUI Halal Certificate

25 International Business Park
#01-26/29

Halal certification issued by MUI (Majelis Ulama Indonesia)

Cautions on Use of Ion Exchange Resins

1. Handling

Protective equipment must be used to protect eyes and skin, and resins must be handled in a place with good ventilation. Eye-wash facilities are recommended at the work spot. When resins are spilled on the floor, they are very slippery and may cause a person to fall. Avoid exposure to high temperature, sparks, flames, etc. Also, avoid contact or mixing with oxidizing agents such as nitric acid because ion exchange resins can explode on contact with nitric acid.

2. Storage

Resins should be stored in dry, cool, and dark places where a proper ventilation system is installed. The storage container and bag of fiber drum should be tightly closed to prevent intrusion of impurities and drying of resins. Do not store resins near oxidizing agents. At high temperatures, rapid degradation of resins may occur, and below 0℃, freezing of resins may occur which may cause physical breakage.

3. Disposal

Unused resins may be discarded in the landfill or by incineration following local regulations and the cautions mentioned above. A suitably fitted furnace is necessary for incineration because SO_X, NO_X, CO_X, and others will be generated from the incineration. Used resins may also be land-filled or incinerated as long as they contain no toxic or poisonous material such as heavy metals. Resin can only be discarded, as above, after the removal of poisonous material.

Factors affecting quality of resins in storage

1) Humidity
The ion exchange resin consists of about 50% water. When the dried resin comes in contact with moisture again, the resins may crack due to osmotic shock.

2) Freeze and Defrost
Sudden freezing and defrosting of resins can take place and this may have a physical effect on the ion exchange resin.

3) Abrupt temperature change
Sudden temperature changes can cause cracks on the surface of the ion exchange resin and cause physical deterioration.

4) Physical shock
Overloading of resins on the pallet for transport and storage should be avoided. Care should be taken as ion exchange resins are susceptible to physical shock.

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