samyang

TRILITE
삼양 트리라이트
Ion Exchange Resin

TRILITE

Ion Exchange Resins

Samyang Corporation
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Samyang Group Overview

TRILITE 삼양 트리라이트 Ion Exchange Resin

Established in
1924

Employees
3,300

Sales (2023)
3.8 Bn.

Food Businesses

- Sugar
- Starch sugar
- Sweeteners
- Flour
- Cooking oil
- Modified fats
- Pre-mixes
- Nutritional supplements

Pharmaceutical Business

- Surgical sutures
- Antibiotics
- Patches

Packaging

- Pet bottles
- Aseptic Business

Other Business

- Data system
- Beauty business

Chemical Business

- Polycarbonate Engineering plastics
- **Ion exchange resins & EDI**
- Bisphenol A
- Terephthalic acid
- Electronic Materials
- Cosmetic ingredients

- Samyang Corp.
- Samnam Petrochem
- Samyang Kasei
- Samyang Innochem
- Samyang Fine Technology

TRILITE Water treatment Specialty Chemicals & Equipment

TRILITE 삼양 트리라이트 Ion Exchange Resin

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) Specilaized 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.

TRILITE at a glance

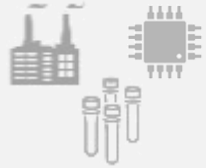
1

Only manufacturer of ion exchange resin in Korea

+2

Own factories in Ulsan and Gunsan, Other OEM factories

+200



Above 200 products in Power, UPW, Foods, Catalysts

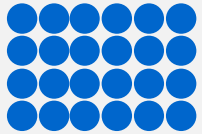
+400

Together with 400 partners around the world

+50

Exporting to more than 50 countries around the world

1.1 ↓

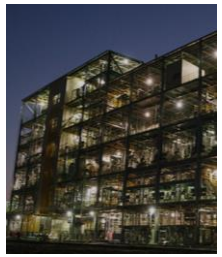


Premium UPS Resins with Uniformity coefficient less than 1.1

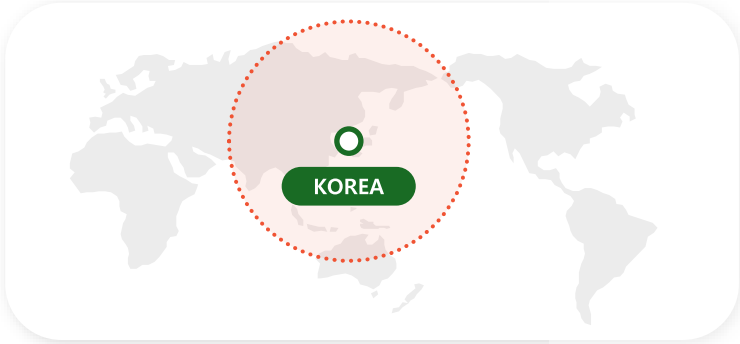
Locations (Head Quarter, Plants, Tech-center)

TRILITE 삼양 트리라이트 Ion Exchange Resin

- **Technical sales force**
  - Demineralization/Power plant/UPW/Catalyst
  - Food
  - Wastewater/Chelating resin/Purification
- **One Stop Service**
  - Analysis of IER
  - System design support (IER/EDI)
  - Technical seminars / Trouble shooting



- **Samyang Fine Technology Corporation (Since 2016)**
- **Largest production capacity in Asia**
- **Product line**
  - Uniform particle sized resins, EDI resins
  - Ultrapure water grade resins(OLED, LCD)
  - Chromatography resins

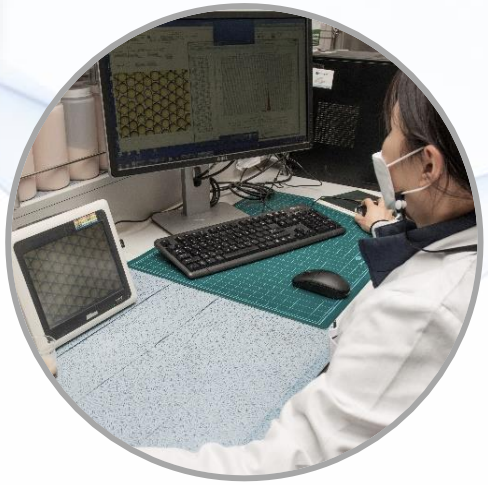


- **IER Tech-center**
- **Analysis of IER**
- **New product development (Tailored/Specialty)**
- **Application process development**

- **Samyang Corp. Ulsan plant (Since 1976)**
- **Customized Tailored resin Production**
- **Product line**
  - Ultrapure water grade resins (semiconductors)
  - Tailored resin (starch sugar, nucleic acid, catalyst, etc)
  - Specialty resin(chelating resin, synthetic adsorbents, etc)

Overview of Samyang Fine Technology Corp.

TRILITE
삼양 트리라이트
Ion Exchange Resin



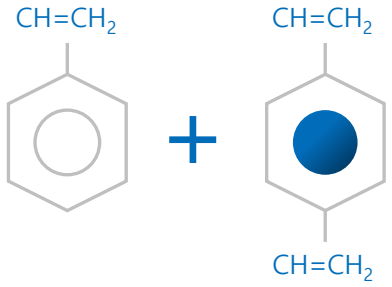
Commercial operation begun since 2016, it boasts **the latest facilities and the largest production scale for UPS resin production in Asia**. It is well received by customers for its **strict quality control and delivery time compliance** under the ISO9001 quality assurance system.

How to make Ion Exchange Resins?

TRILITE 삼양 트리라이트 Ion Exchange Resin

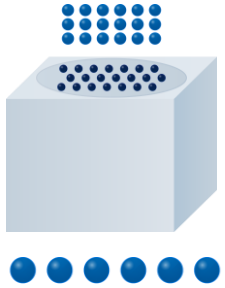
Jetting Technology by Droplet Generator

Raw material adjustment



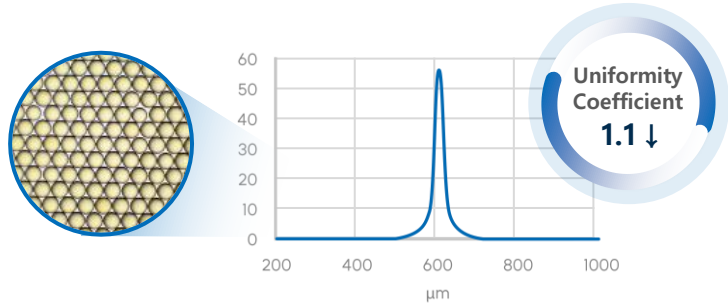
Styrene monomer Divinyl Benzene

Polymerization
by **Droplet Generator**



Produces equal size polymers

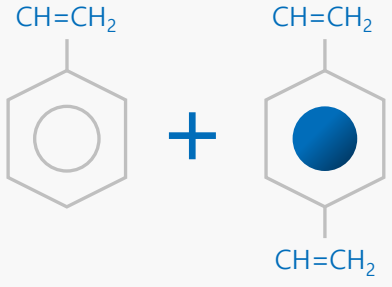
Post treatment
Introducing functional group



Uniformity Coefficient 1.1 ↓

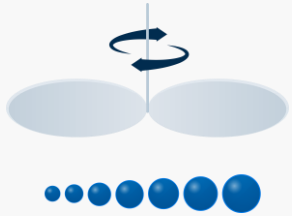
Conventional Technology

Raw material adjustment



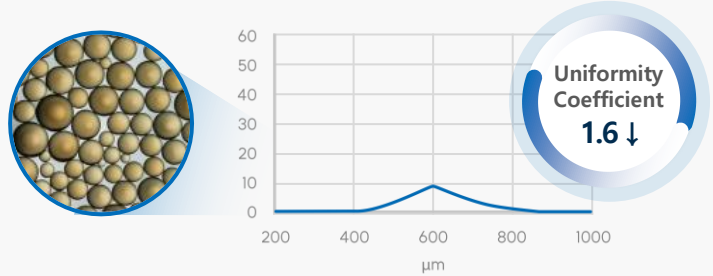
Styrene monomer Divinyl Benzene

Polymerization
By **Agitation**



Produces random size polymers

Post treatment
Introducing functional group

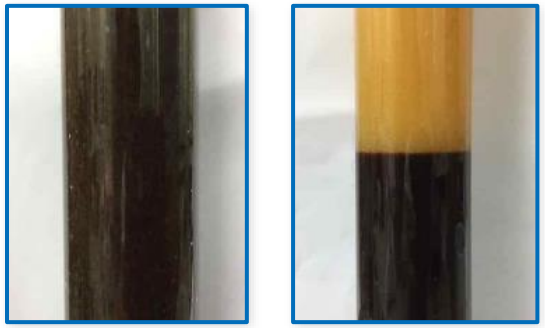


Uniformity Coefficient 1.6 ↓

What is the advantage of TRILITE UPS Resins?

TRILITE 삼양 트리라이트 Ion Exchange Resin

01 Physical Stability & Separability

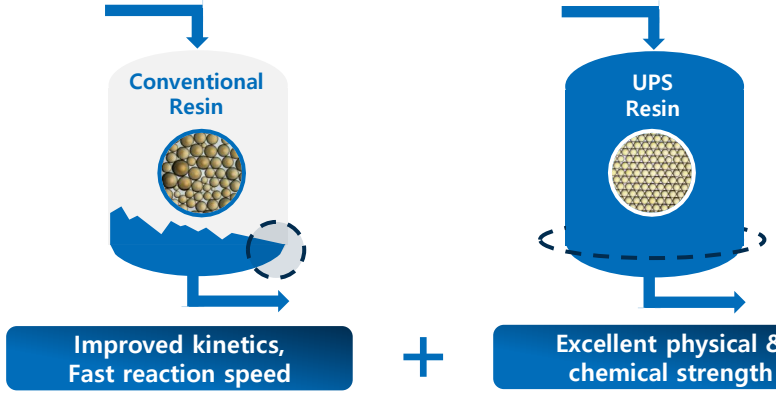


(Mixing)

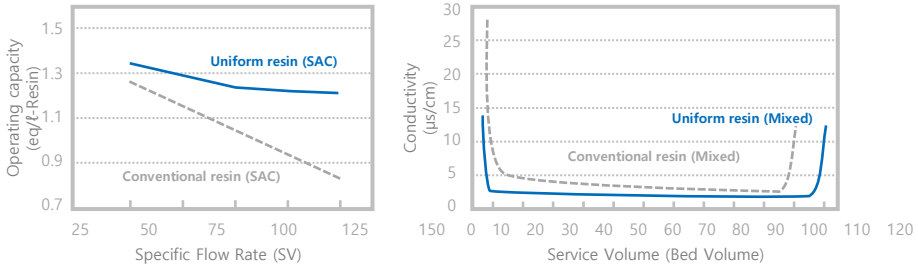
[Cation : MC-10H, Anion : MA-10OH]

- **High separability** of mixed bed resins by optimizing specific gravity and particle size distribution
- Excellent **physical stability**
- Outstanding **osmotic strength**

02 Lower running cost



Higher operating capacity, reduction of rinse volume
Longer lifetime of ion exchange resins

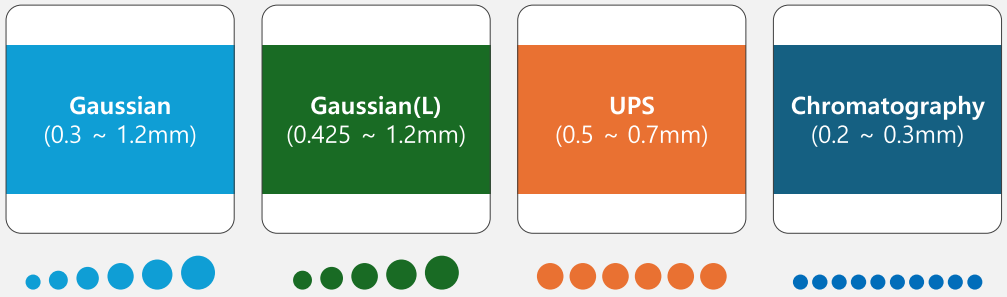


Next Generation IER, high performance low cost

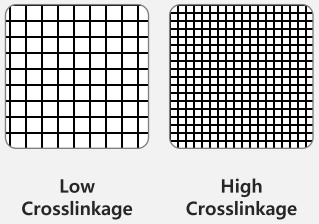
How can Ion exchange resins be classified?

TRILITE 삼양 트리라이트 Ion Exchange Resin

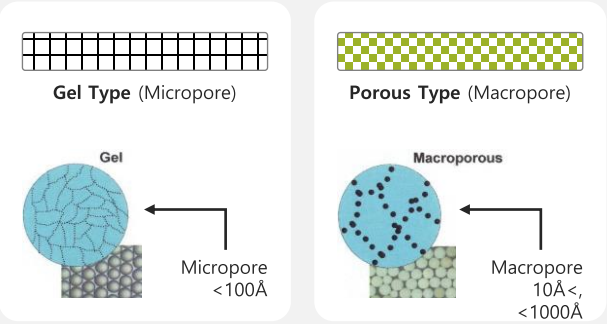
Particle distribution, size, uniformity coefficient



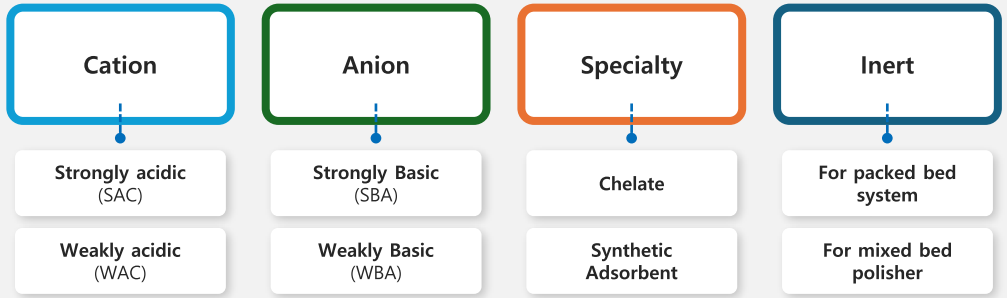
Crosslinkage



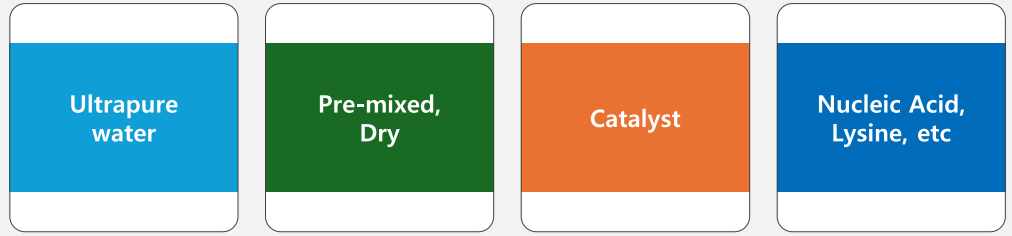
Porosity



Functional Group



Post-treatment / Tailored resin



What is Ion exchange resisns Used for?

Water treatment	• Softening • Demineralization • Condensate polishing • Nuclear power
Ready to use mixed resins	
Ultrapure water	
Chelating resins	• Secondary brine purification • Wastewater treatment
Chromatography	• Fructose/glucose separation) • Amino acid separation) • Acid purification)
Food	• Starch sugar refining • Sugar refining • Nucleic acid, lysine separation
Catalyst	**Synthetic adsorbents**
Layered bed anion resins	**Inert resins**
EO/EG cycle water treatment	**Dry type resins**

Water treatment

TRILITE 삼양 트리라이트 Ion Exchange Resin

※ TEC: Total Exchange Capacity

	Type	Strongly acid 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㎜	Type1	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	1.0 ↑	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 ↑	0.60~0.70㎜		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)	1.35 ↑	0.3~1.2㎜ (MB) for mixed bed
		KH-70	1.9 ↑			KA-12	1.2 ↑	
		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 resin (WAC)			Weakly basic anion resin (WBA)			
Premium					UPS Porous	AW90	1.6 ↑	0.50~0.60㎜
Performance	Gaussian Porous	WCA10L	4.5 ↑	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) + Carboxylate			(Polystyrene+DVB) + Tertiary Amine			

Water treatment

Softening		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 can form scale and cause problems in water treatment systems. The softening devices produce soft water by removing hardness components from raw water with cation exchange resins. In general, strongly acid cation exchange resins are used in the water softening, and purified salts are used as regenerant. When the hardness component is high in raw water, it is treated with weakly acid cation resins.

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

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

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

When food grade softening is required, such as a food company, it is necessary to use an appropriate food grade ion exchange resins.

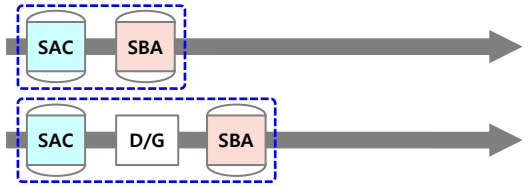
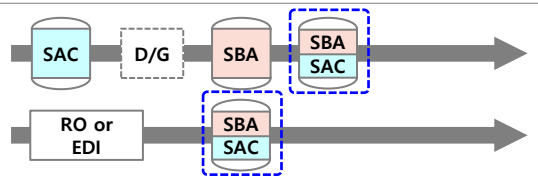
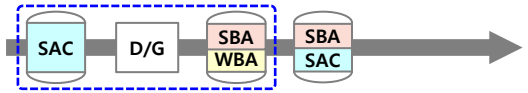
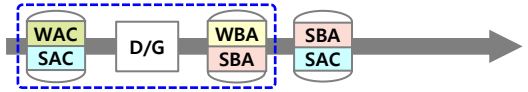
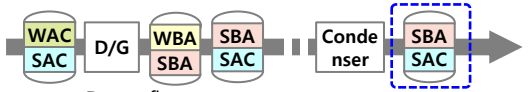
KH-80 SCR-B

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

TRILTIE	Grade	Spec.	Day1	Day2	Day3	Day4	Day7
KH-80	**Food**	**< 20**	**12**	**13**	**13**	**13**	**14**
SCR-B	Tech	-	145	149	153	160	183

Water treatment

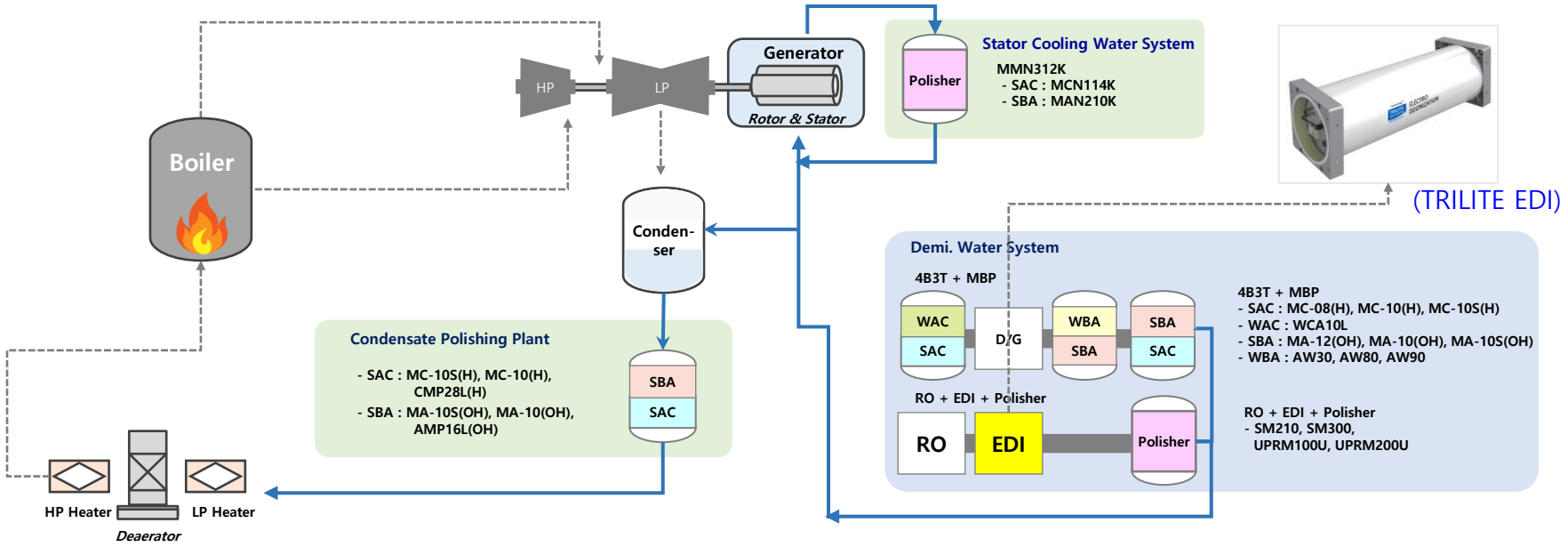
TRILITE 삼양 트리라이트 Ion Exchange Resin

Demineralization system		Treated water quality	Product Line	SAC	SBA	WAC	WBA
2B2T (2Bed 2Tower) Cation Exchanger + Anion Exchanger **2B3T** Cation Exchanger + Degasifier + Anion Exchanger		1~2μs/cm ↓ SiO_2 20~100ppb ↓	Performance	MC-08 MC-10	MA-12 MA-20		
			Basic	SCR-B UKC-08 UKC-10 KC-08	SAR10 SAR20 UKA-12 KA-12 KA-20		
Working MB (Mixed Bed)		1μs/cm ↓ SiO_2 100ppb ↓	Performance	MC-08 MC-10	MA-20		
			Basic	SCR-B	SAR20MB		
2B2T or 2B3T or **RO or EDI + MBP** (Mixed Bed Polisher)		0.1μs/cm ↓ SiO_2 5~10ppb ↓	Premium	MC-10S(H)	MA-10S(OH)		
			Performance	MC-08 MC-10	MA-10		
			Basic	SCR-B	SAR10MB KA-10MB		
3B3T+MBP	 Layered bed Up-flow system	10~17MΩ·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 Down-flow system	10~17MΩ·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)	 Down-flow system	0.1μs/cm ↓ SiO_2 10ppb ↓	Premium	MC-10S(H) MC-14H	MA-10S(OH) MA-15OH		
			Performance	MC-08H MC-10H	MA-12OH MA-10OH		
RO(Reverse Osmosis) **+** **Polisher**(Polishing Resin)	 Non-regenerable	15~18MΩ·cm ↑ SiO_2 5~10ppb ↓	Premium	UPRM100U, UPRM200U, UPRM300U			
		10~17μs/cm ↑ SiO_2 10ppb ↓	Performance	SM210, SM300			
			Basic	SM200			

※ Anion grade name + (P) means anti-clumping treatment. Anion resin used for MB or MBP requires anti-clumping treatment that helps separation of cation and anion.

Power Plant

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								
TRILITE 삼양 트리라이트 Ion Exchange Resin	Strongly Acidic Cation resin (SAC)				Strongly Basic Anion resin (SBA)			
	Type	Grade name	TEC (eq/ℓ)	Particle distribution	Type	Grade name	TEC (eq/ℓ)	Particle distribution
Gau-ssian	Porous	CMP28L	2.05 ↑	0.425~1.2㎜	Porous type1	AMP16L	1.3 ↑	0.425~1.2㎜
		CMP28LH	1.8 ↑			AMP16LOH	1.1 ↑	
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-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 polisher	
UPS	UPRM100U Mixed Resin ratio = 1 : 1 as same equivalent
Gau-ssian	SM210 or SM300 Mixed Resin ratio = 1 : 1 as same equivalent
Stator Cooling Water System	
UPS	MMN312K Mixed Resin ratio = 1 : 1 as same equivalent

CASE STUDY

TRILITE 삼양 트리라이트 Ion Exchange Resin

CPP Running Test

*CPP: Condensate Polishing Plant

Project overview

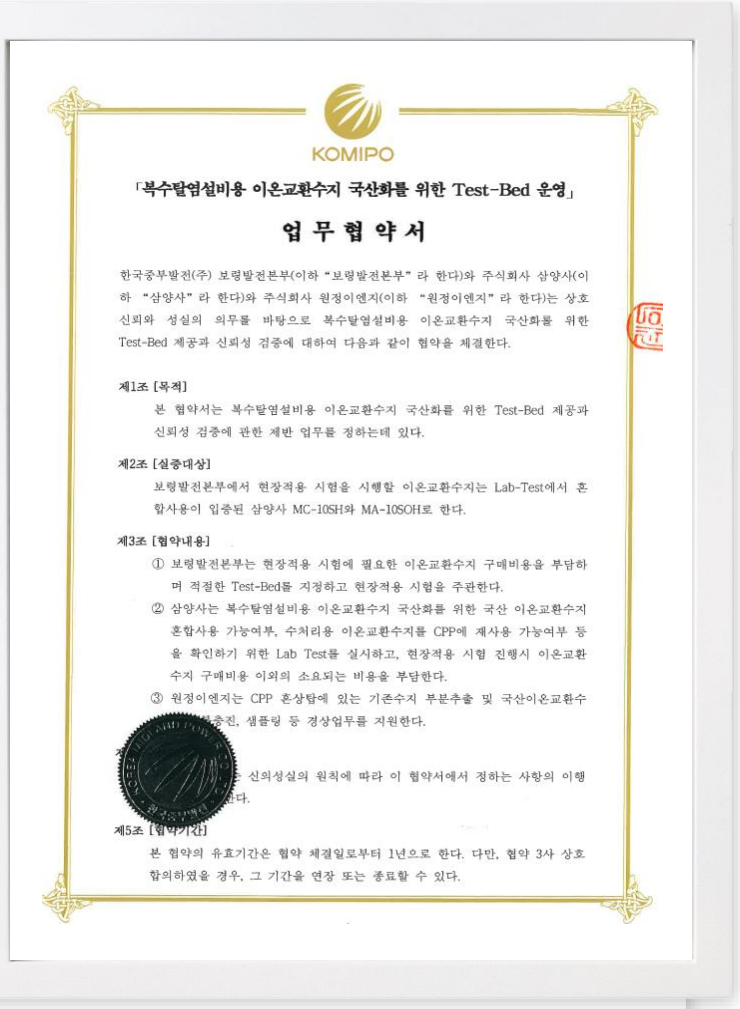
Project
- KOMIPO Power plant CPP Mixed Running Test

Test period
- 2020. 07. 30 ~ 2020. 11. 04

Grade
- TRILITE MC-10H
- TRILITE MA-10OH

Test measurement
- Outlet water quality: 0.1μs/㎝ ↓
- Designed treated capacity : 700,000m3 ↑
- Comparison for physical and chemical strength
- Separability test with existed resins up to ratio

Test results
- Outlet water: 0.082μs/㎝(on average)
- Treated throughput: 870,000m3 ↑
- Outstanding physical & chemical strength (Minimized broken resins)
- Excellent separability



KOMIPO

「복수탈염설비용 이온교환수지 국산화를 위한 Test-Bed 운영」

업 무 협 약 서

한국중부발전(주) 보령발전본부(이하 "보령발전본부"라 한다)와 주식회사 삼양사(이하 "삼양사"라 한다)와 주식회사 원정이엔지(이하 "원정이엔지"라 한다)는 상호 신뢰와 성실의 의무를 바탕으로 복수탈염설비용 이온교환수지 국산화를 위한 Test-Bed 제공과 신뢰성 검증에 대하여 다음과 같이 협약을 체결한다.

제1조 [목적]
본 협약서는 복수탈염설비용 이온교환수지 국산화를 위한 Test-Bed 제공과 신뢰성 검증에 관한 제반 업무를 정하는데 있다.

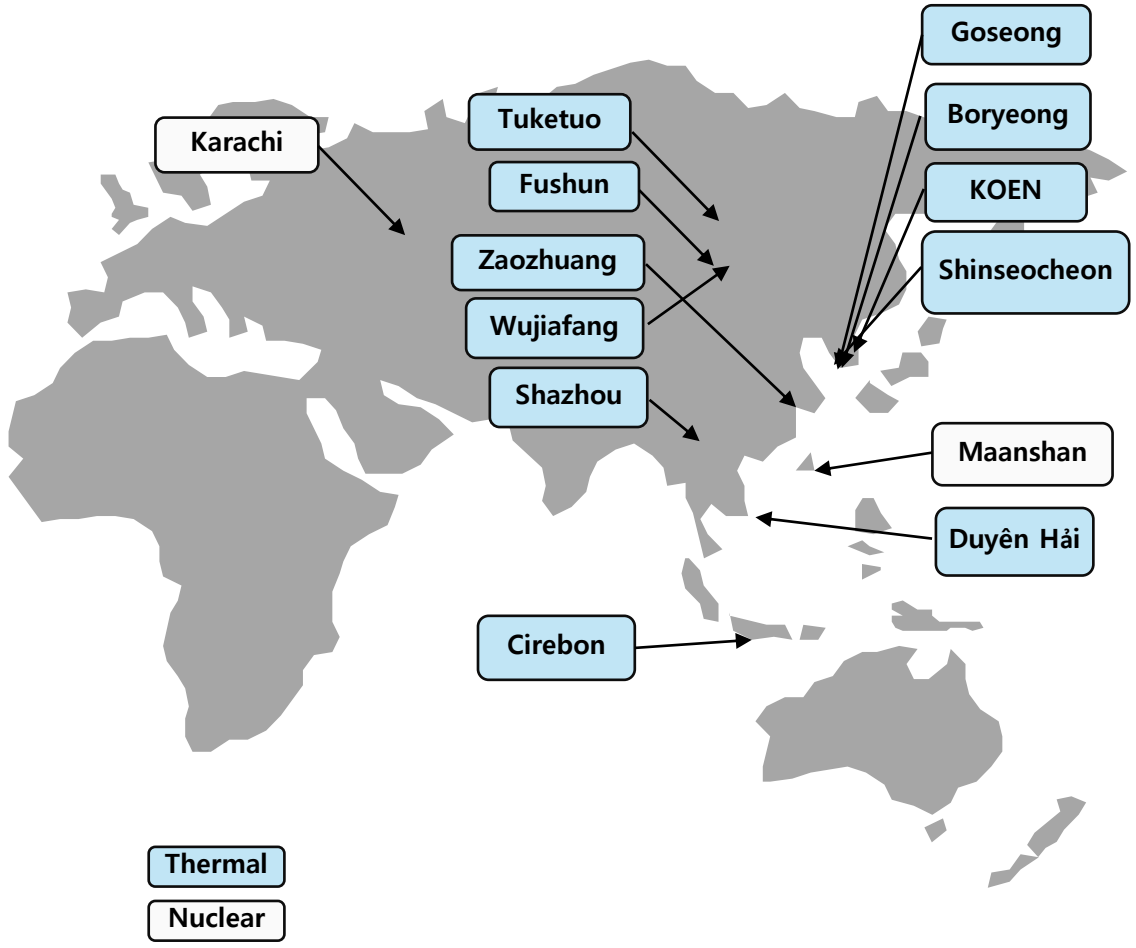
제2조 [실증대상]
보령발전본부에서 현장적용 시험을 시행할 이온교환수지는 Lab-Test에서 혼합사용이 입증된 삼양사 MC-10SH와 MA-10SOH로 한다.

제3조 [협약내용]
① 보령발전본부는 현장적용 시험에 필요한 이온교환수지 구매비용을 부담하며 적절한 Test-Bed를 지정하고 현장적용 시험을 주관한다.
② 삼양사는 복수탈염설비용 이온교환수지 국산화를 위한 국산 이온교환수지 혼합사용 가능여부, 수처리용 이온교환수지를 CPP에 재사용 가능여부 등을 확인하기 위한 Lab Test를 실시하고, 현장적용 시험 진행시 이온교환수지 구매비용 이외의 소요되는 비용을 부담한다.
③ 원정이엔지는 CPP 혼상탑에 있는 기존수지 부분추출 및 국산이온교환수 [illegible]충진, 샘플링 등 경상업무를 지원한다.

[illegible] 신의성실의 원칙에 따라 이 협약서에서 정하는 사항의 이행 [illegible]다.

제5조 [협약기간]
본 협약의 유효기간은 협약 체결일로부터 1년으로 한다. 다만, 협약 3사 상호 합의하였을 경우, 그 기간을 연장 또는 종료할 수 있다.

Major CPP reference

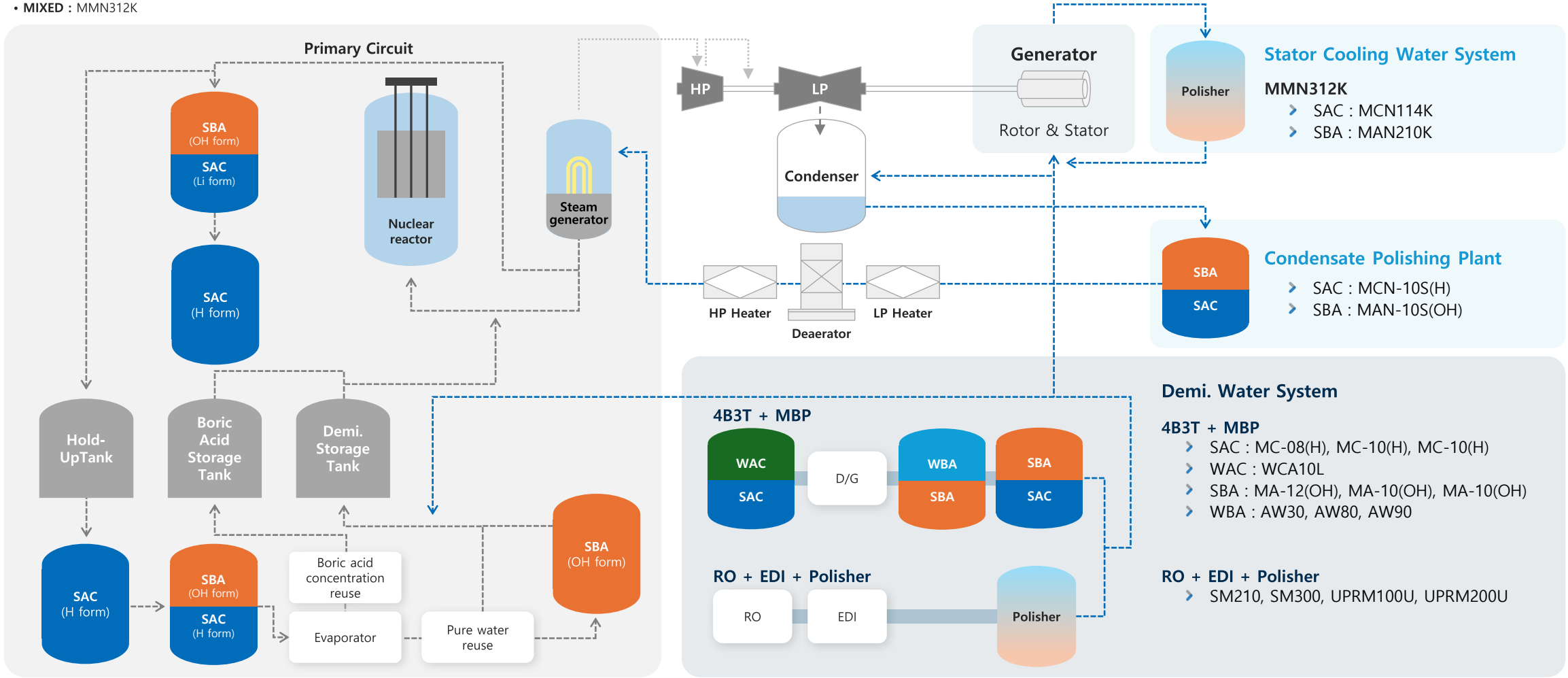


Company	Capacity (MW)	Resin grades
Cirebon Steam Power Plant PT Cirebon Electric Power (CEP)	660 x 1	MC-10H, MA-10OH
Duyên Hải Power Generation Complex	660 X 3	MC-10H MA-10OH
KOEN Samcheonpo Power Plant	560 X 6	MC-10H MA-10OH
Goseong Coal Fired Power Plant Korea South-East Power Co.	1,000 x 2	MC-10H MA-10OH
ShinSeocheon Thermal Power Plant Korea Midland Power Co., Ltd	1,000 x 1	MC-10H MA-10OH
Boryeong Coal-fired Power Plant	500 x 8	MC-10H, MA-10OH
MAANSHAN NUCLEAR POWER PLANT No2 & No3 (Taiwan)	951 X 2	MC-10HUP, MA-10OHUP
WUJIANFANG POWER PLANT (China Inner Mongol)	660 x 2	MC-10H MA-10OH
SHAZHOU POWER PLANT (China Zhangjiagang)	1.000 x 2 630 x 2	MC-10H MA-10OH
ZAOZHUANG POWER PLANT (China Shandong)	300 x 2	MC-10H MA-10OH
FUSHUN POWER PLANT (China Liaoning)	500 x 2	MC-10H MA-10OH
TUKETUO POWER PLANT (China Inner Mongol)	600 x 8 300 x 2	MC-10H MA-15OH

Power Plant

Typical power plant steam turbine loop and IER selection

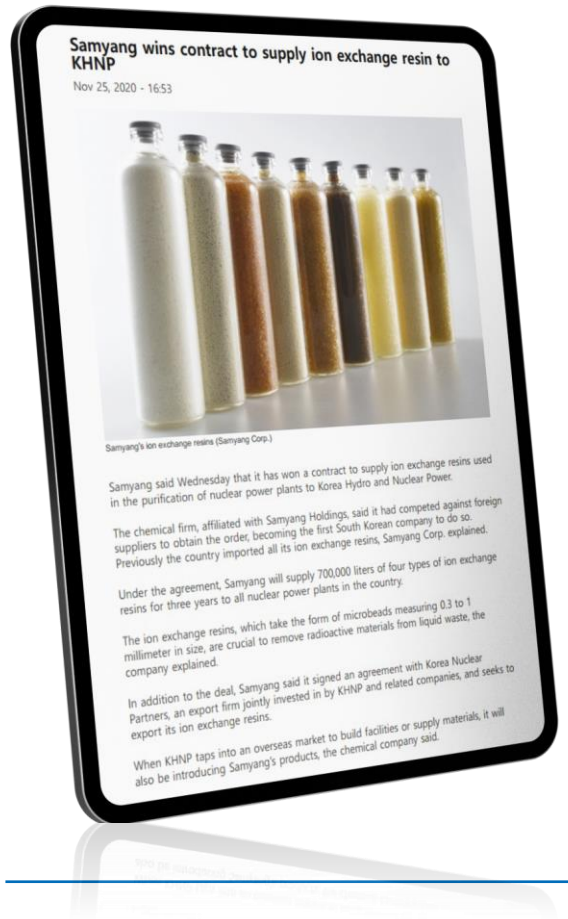
- **SAC :** MCN116K
- **SBA :** MAN210K
- **MIXED :** MMN312K



CASE STUDY

TRILITE 삼양 트리라이트 Ion Exchange Resin

Nuclear primary circuit grade Spec-in


Samyang wins contract to supply ion exchange resin to KHNP

Nov 25, 2020 - 16:53

Samyang's ion exchange resins (Samyang Corp.)

Samyang said Wednesday that it has won a contract to supply ion exchange resins used in the purification of nuclear power plants to Korea Hydro and Nuclear Power.

The chemical firm, affiliated with Samyang Holdings, said it had competed against foreign suppliers to obtain the order, becoming the first South Korean company to do so. Previously the country imported all its ion exchange resins, Samyang Corp. explained.

Under the agreement, Samyang will supply 700,000 liters of four types of ion exchange resins for three years to all nuclear power plants in the country.

The ion exchange resins, which take the form of microbeads measuring 0.3 to 1 millimeter in size, are crucial to remove radioactive materials from liquid waste, the company explained.

In addition to the deal, Samyang said it signed an agreement with Korea Nuclear Partners, an export firm jointly invested in by KHNP and related companies, and seeks to export its ion exchange resins.

When KHNP taps into an overseas market to build facilities or supply materials, it will also be introducing Samyang's products, the chemical company said.

Project Overview

Project

KHNP nuclear power plant for primary circuit

Contract

2020.10.01 ~ 2023.09.30 (3years)

Specification

	Unit	Cation	Anion
Total Exchange Capacity	eq/ℓ	> 2.4	> 1.2
Ion Conversion Rate	%	>99	>95
△TOC	μg/ℓ	< 10	< 10
low metal traces	Mg/kg of Dry Resin	Na<50, K<40, Ca<25, Mg<50, Fe<50, Cu<5, Co<5, Al<10, Pb<5, Hg<20	

Test measurement

Certified by the third-party authorized Institution

TRILITE GRADE

- TRILITE MCN116K (SAC)
- TRILITE MAN210K (SBA)
- TRILITE MMN312K(Mixed)

Results

Quality Certified by Veritas(Fr), affigio(Ge), NWT(USA)

Total Volume

699,200L

TRILITE resins for primary circuit feature very high exchange capacity and extremely low TOC leakage, and produce high purity water. Excellent H/OH conversion rate and low metal traces contribute to stable operation of power plants

Water treatment

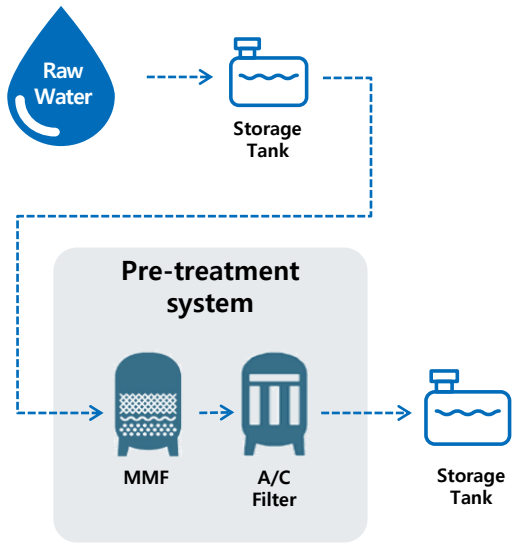
TRILITE 삼양 트리라이트 Ion Exchange Resin

Major reference list

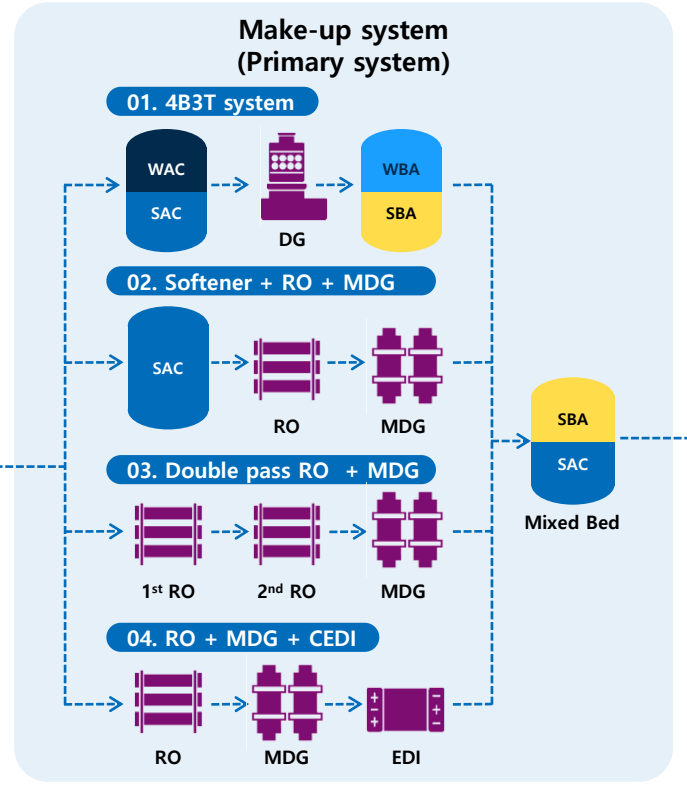
	Oil & Petrochemical	Electronics	Thermal Power	Nuclear Power	Steel
(Korea)	SK energy GS Caltex LOTTE CHEMICAL LG Chem S-OIL SK chemicals	SAMSUNG ELECTRONICS SAMSUNG DISPLAY SK hynix LG Display	KEPCO Korea Electric Power Corp. KOREA DISTRICT HEATING CORP. POSCO ENERGY GS E&R SK E&S	KHNP Korea Hydro & Nuclear Co.	posco HYUNDAI STEEL
(Global)	sabic Sipchem 台塑企業	SMIC SAMSUNG SDI TIANMA Visionox	EDF IRKUTSKENERGO Irkutsk Power Generation and Distribution Company AES - VCM Mong Duong Power Co. Ltd. emba EMBA Electricity Production	中核集团 CNNC 台灣電力公司 Taiwan Power Company Pakistan Atomic Energy Commission	**Paper** APP sinarmas

Ultrapure Water

TRILITE 삼양 트리라이트 Ion Exchange Resin



- **MMF :** Multi-media filter
- **A/C Filter :** Activated carbon filter
- **DG :** Degasifier
- **MDG :** Membrane degasifier
- **H/E :** Heat exchanger

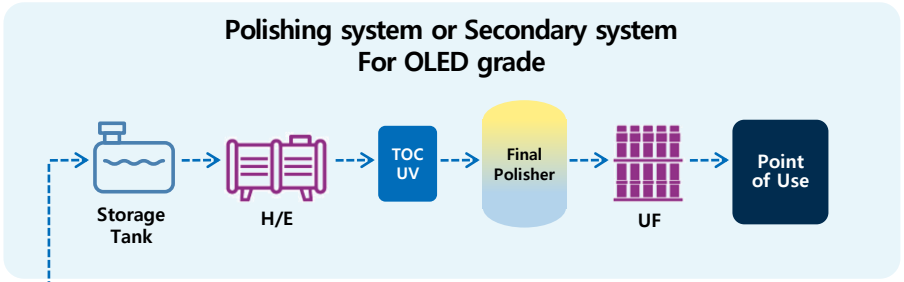


IER recommendation

01 **4B3T system :**
- SAC : MC-08(H), MC-10(H)
- WAC : WCA10L
- SBA : KA18LB, MA-12(OH), MA-10(OH)
- WBA : AW30, AW80, AW90

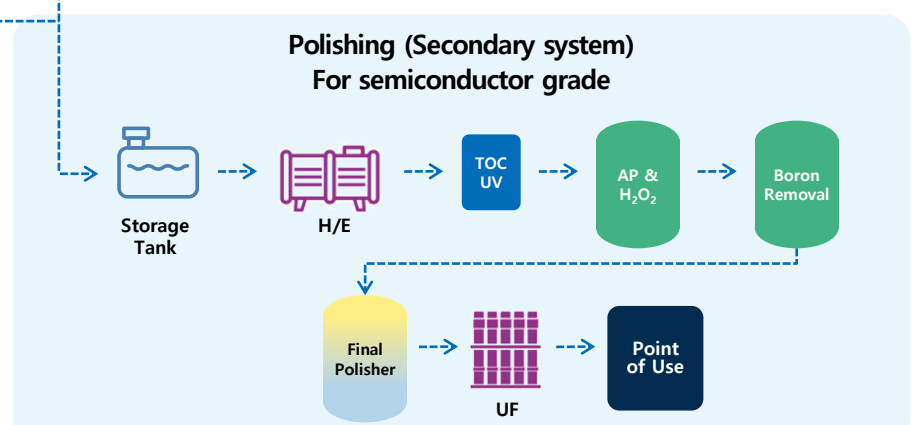
02 **Softener :** MC-08(H), SCR-B(H)

03 **Mixed Bed (Regenerable) :**
- SAC : MC-10(H), UPRC220U
- SBA : MA-10(OH), UPRA220U



IER recommendation

01 **Final polisher for OLED grade (Non-regenerable)**
- UPRM200U, UPRM300U



IER recommendation

01 **AP(Anion polisher) :** UPRA300U

02 **H_2O_2 removal :**UPHR1

03 **Boron removal :** CLR-B3UP

04 **Final polisher for Semiconductor grade** (Non-regenerable) : UPRM300U, UPRM400U

Ultrapure Water

TRILITE 삼양 트리라이트 Ion Exchange Resin

TRILITE UPW Resin

UPRM200U

UPRM400U

Specification of Ultrapure water

UPRM200U	UPRM400U
Resistivity ≥ 18.1 MΩ·cm	Resistivity ≥ 18.2 MΩ·cm
TOC ≤ 5ppb	TOC ≤ 1ppb
Silica ≤ 5ppb	Silica ≤ 1ppb
	Metal ≤ 0.1 ppt
	Boron ≤ 1ppt

Ultrapure Water

TRILITE
삼양 트리라이트
Ion Exchange Resin

TRILITE Ultrapure water ion exchange resin product line

TRILITE ultrapure water ion exchange resin is produced through strict quality control in the latest facilities and has the following features.

① Strict standard for uniformity coefficient (1.1 ↓), to result in high operating capacity at fast service flow
② Very high conversion rate of resins to minimize ionic leakage(H^+, OH^-)
③ Strict quality control over TOC(Total organic carbon) and trace metal ions

TRILITE ultrapure water ion exchange resins are supplied to various ultra-pure water facilities in Korea and abroad, and have a reliable reference from OLED(Samyang Display, LG Display, etc) to semiconductor (Samsung Electronics, SK Hynix, etc.). Samyang is contributing to enhancing competitiveness of customers with stable quality management and timely deliver

TRILITE ultrapure water ion exchange resins vary in grades according to different outlet conditions and the characteristics are as follows.

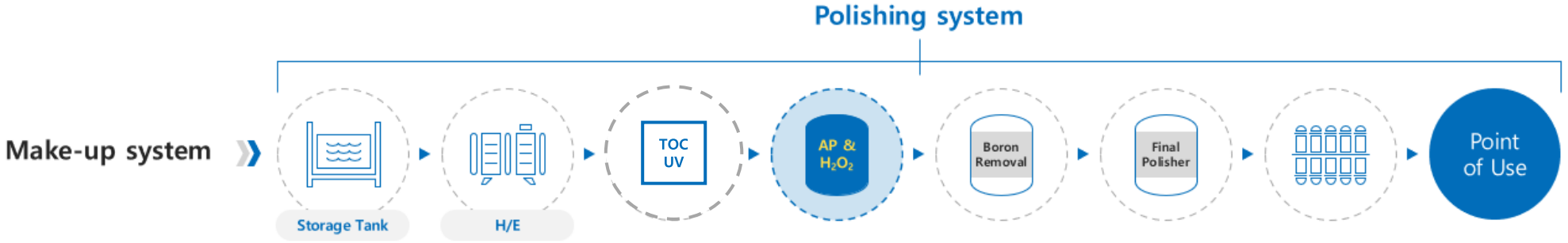
Grade Series	Representative grade	Cation conversion rate	Anion conversion rate		Outlet condition	Remark and application
		H^+(%)	OH^-(%)	Cl^-(%)		
UPR100 Series	UPRM100U	99.0 ↑	95.0 ↑	1.0 ↓	Guarantee) Resistivity > 17.0MΩ·cm Actual) Resistivity > 18.0MΩ·cm	Production of high resistivity UPW Production of general electronics grade demineralized water, and Final polisher
UPR200 Series	UPRM200U	99.9 ↑	95.0 ↑	1.0 ↓	Resistivity > 18.1MΩ·cm(in 30 min) △TOC < 5 ppb (in 120min)	Production of very high resistivity and Low TOC level UPW Demineralized water for LCD/OLED Final polisher
UPR300 Series	UPRM300U	99.9 ↑	97.0 ↑	0.1 ↓	Resistivity > 18.2MΩ·cm(in 30 min) △TOC < 1 ppb (in 180min)	Production of very high resistivity and very low TOC level UPW LCD/OLED, semiconductor grade final polisher
UPR400 Series	UPRM400U	99.9 ↑	97.0 ↑	0.1 ↓	Resistivity > 18.2MΩ·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	Production of very high resistivity, very low TOC level, very low metal ion leakage UPW Semiconductor grade final polisher

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

Ultrapure Water

TRILITE 삼양 트리라이트 Ion Exchange Resin

Hydrogen Peroxide removal



TOC UV decomposes TOC components in treated water using UV OF 185nm, which has a high 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). Here, ion exchange resin with very low TOC leakage (△TOC<1ppb) should be selected.

TOC-UV not only decomposes TOC components, but also generates hydrogen peroxide (H_2O_2) of about 30 ppb or less by reacting with H_2O by hydroxyl radicals. The generated hydrogen peroxide deteriorates the AP at the later process, causing performance degradation , and causing a problem in the process and causing wafer defects.

H_2O_2 removal resin TRILITE UPHR1 extends the stability and life of the Polishing system by removing H_2O_2 and anions generated by TOC UV treatment.

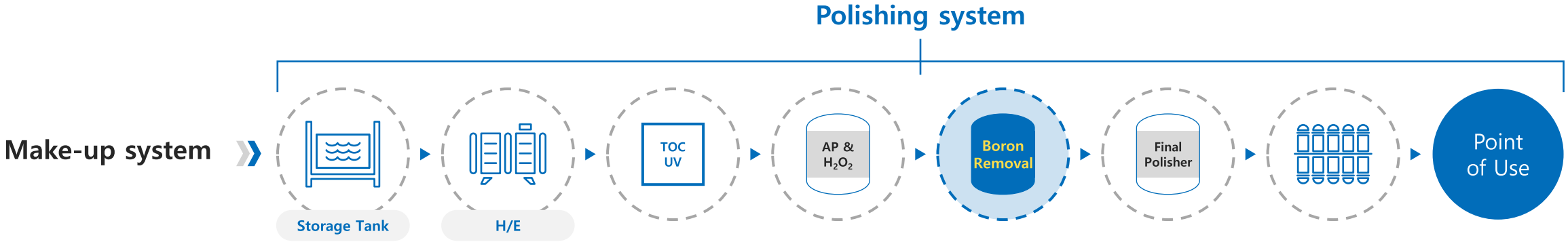
TRILITE UPHR1 has been supplied to Semiconductor manufacturer in South Korea and ultra-pure water facilities at various sites, proving its excellent performance.

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 generation of O_2 deteriorates life cycle (resin degradation and high TOC)
UPHR1	$CH_2N(CH_3)_3^+$ $CH_2N(CH_3)_3^+$ SO_3^{2-} $CH_2N(CH_3)_3^+OH^-$ + H_2O_2 → $CH_2N(CH_3)_3^+$ $CH_2N(CH_3)_3^+$ SO_3^{2-} + $2H_2O$	Fast H_2O_2 removal rate and removes anions and CO_2

	Grade	Inlet Condition	Outlet condition
Hydrogen Peroxide removal (H_2O_2 removal)	UPHR1	Resistivity >18.2MΩ·cm TOC < 1 ppb	Guaranteed: Resistivity > 18.2MΩ·cm (in 24 hr) Guaranteed: △TOC < 1.0 ppb ((in 24 hr) H_2O_2 removal > 16g H_2O_2/ℓ-Resin Metal <1 ppt

Ultrapure Water

Boron removal resin



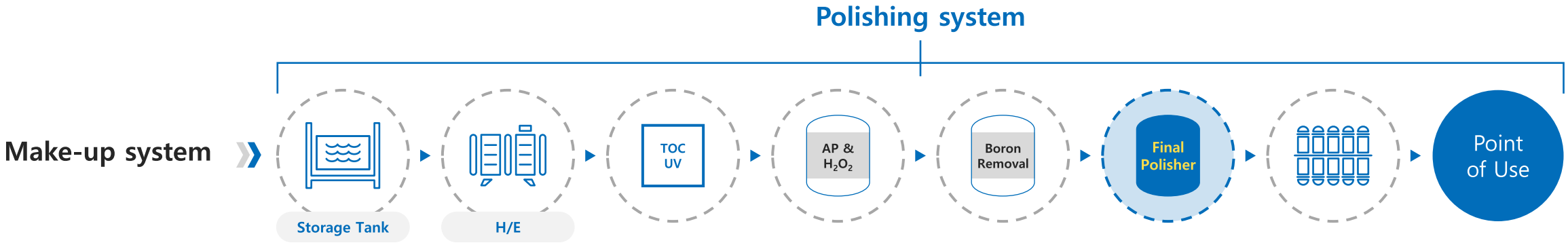
- Boron(boron, B) has very weak selectivity with ion exchange resins in water and is eluted first because of its weak affinity, reducing the stability and life of the polishing system.
- Boron is used as a dopant in semiconductor production, and since unintended inflow of boron affects semiconductor performance, boron must be managed very strictly as less than 1 ppt in the semiconductor manufacturing process to realize stable operation.

TRILITE	Grade	Exchange capacity	Inlet Condition	Outlet condition
Boron Polisher	**CLR-B3UP**	TEC (eq/ℓ) : 0.9 ↑ Boron exchange capacity (eq/ℓ) : 0.4 ↑	Resistivity > 17.5MΩ·cm TOC < 2 ppb	△TOC < 1 ppb (in 48 hours)

Ultrapure Water

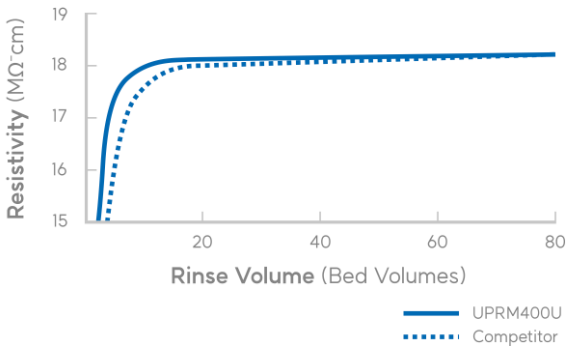
TRILITE 삼양 트리라이트 Ion Exchange Resin

Semiconductor Final Polisher

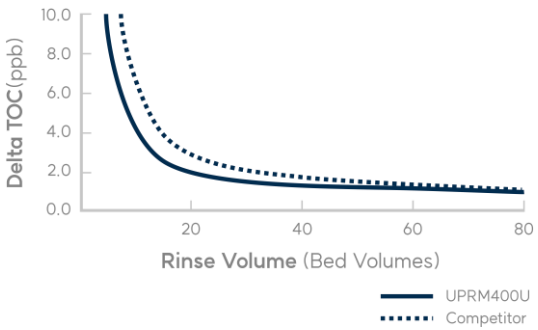


❶ Strict standard for uniformity coefficient (1.1 ↓), to result in high operating capacity at fast service flow
❷ Excellent conversion rate of resins to minimize ionic leakages Resistivity 18.2MΩ·cm (in 30 min), H^+ 99.9%, OH^- 97.0%
❸ Strict quality control over TOC(Total organic carbon) and trace metal ions: △TOC < 1ppb (in 180min)

Resistivity > 18.2MΩ·cm in 30 min



Delta TOC < 1 ppb in 3 hrs



Metal ion leakage analysis report

[Unit : ppt]

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

※ Feed water quality : Resistivity > 17.5MΩ.cm, TOC < 2ppb, SV=30

Ultrapure Water

TRILITE 삼양 트리라이트 Ion Exchange Resin

Semiconductor Final Polisher

TRILITE UPRM400U is a premium grade that minimizes metal ion leakage, and its features are as follows.

■ Final polisher outlet specification (Korean company "S")

Item	Spec	UPRM300U	UPRM400U
Resistivity*	> 18.2 MΩ·cm	O (in 30min)	O (in 30min)
△TOC*	< 1 ppb	O (in 180min)	O (in 180min)
Particle (> 0.05μm)	< 200 pcs/ℓ	O	O
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

■ Korean company "S" Metal ion leakage analysis report

Sample	Day	Li	Na	Mg	Al	K	Ca	Cr	Mn	Fe	Co	Ni
IN	0일											
	5일차	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
OUT Out	0일											
	5일차	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Cu	Zn	Sr	Ba	Pb	F	Cl	NO2	Br	NO3-	SO42-	PO43-	NH4+
0.05	0.10	0.05	0.05	0.05	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5
0.05	0.10	0.05	0.05	0.05	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.7

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

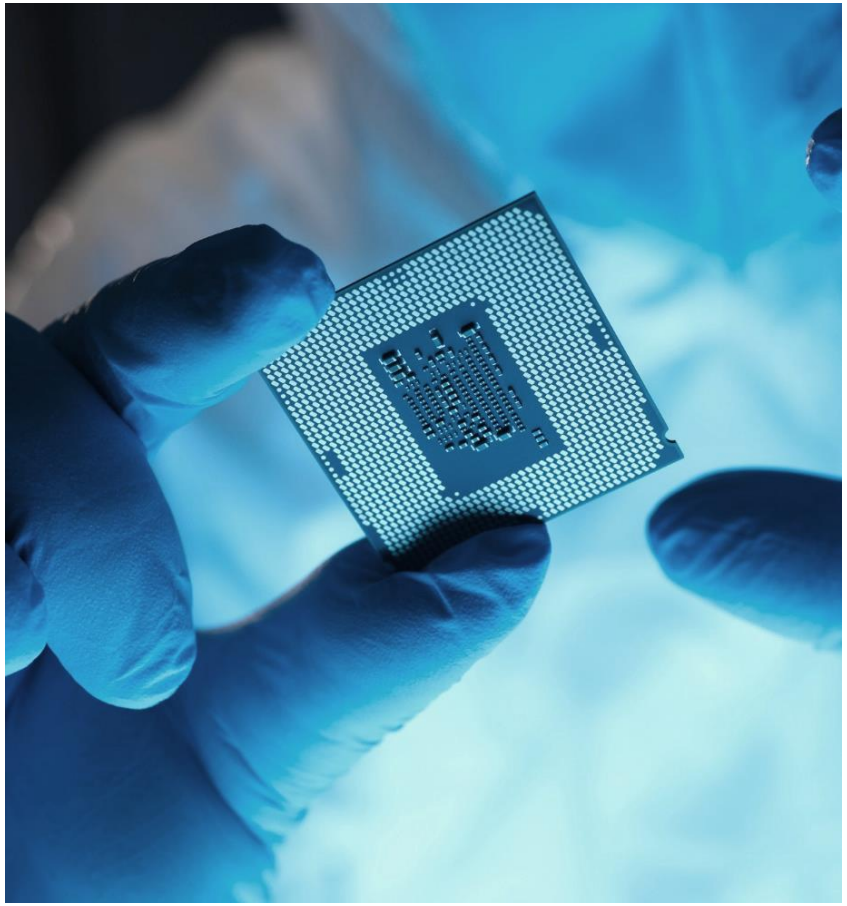
F	Cl	NO2	Br	NO3	SO4	PO4	NH4
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

CASE STUDY

TRILITE 삼양 트리라이트 Ion Exchange Resin

Semiconductor Final Polisher Spec-in

Project overview



Project

- UPRM400U Performance Evaluation Process

Test period

- Development & Lab test : 3 years
- Field test : 6 months
- Operation Test : 2 years

Grade

- TRILITE UPRM400U

Test measurement

- Performance comparison test with existed grade

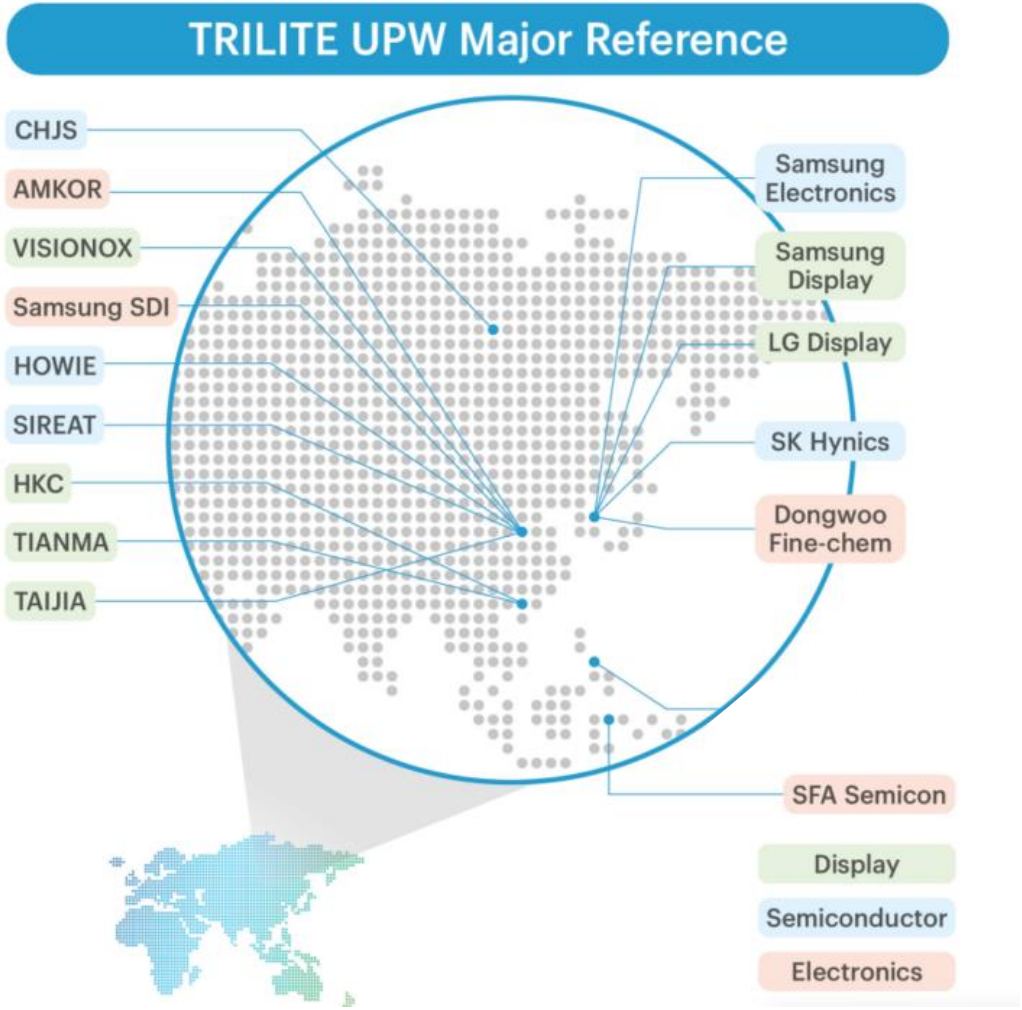
Test results

- Exchange capacity result
  : 7% better than competing equivalent
- Metal Ion Leakage
  : Similar or better (Metal 0.1ppt below)
- Chemical osmotic strength test
  : Similar or better(Outstanding stability)
- Particle size analysis & whole bead count
- Similar or better(U.C.: 1.1 below)

Ultrapure Water

TRILITE 삼양 트리라이트 Ion Exchange Resin

Final polisher reference



Customer Name	Grade
Samsung Electronics	UPRM400U
SK Hynix	UPRM400U
Samsung Display	UPRM200U
LG Display	UPRM200U
Samsung SDI	UPRM200U
DONGWOO FINE-CHEM	UPRM400U
CHJS	UPRM400U
SIREAT	UPRM300U
HOWIE	UPRM300U
TIANMA	UPRM200U
HKC	UPRM200U
VISIONOX	UPRM200U
TAIJIA	UPRM200U
Amkor	UPRM400U
SFA Semicon	UPRM200U

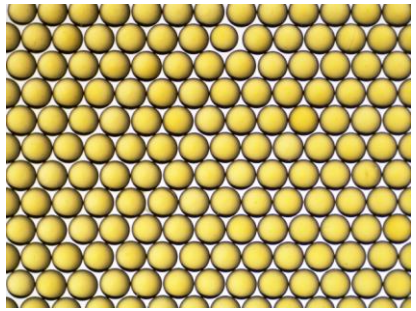
Chromatography

TRILITE 삼양 트리라이트 Ion Exchange Resin

MCK Series the Best ion exchange resin for chromatography resins

TRILITE MCK Series is a chromatographic separation resin with a uniform particle size distribution of fine particles. Major application is high purity sugar separation such as Fructose/Glucose separation and sugar recovery from molasses, acid recovery, etc.
The main principle of chromatographic separation is as follows.

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)



Cross-linkage	Ionic form	Particle distribution			
		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㎛)			

※ 离子大小和交联度是为了参考

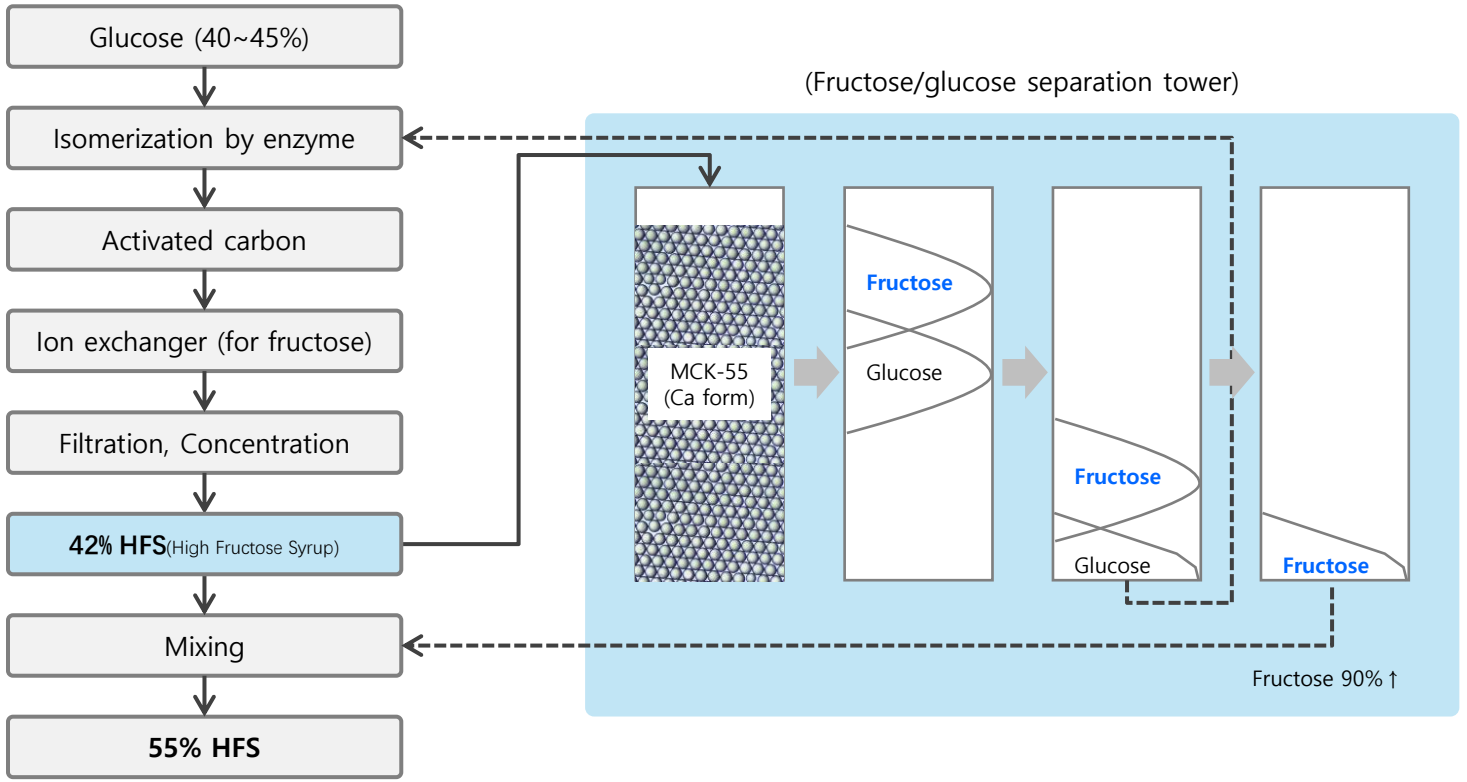
Chromatography

TRILITE 삼양 트리라이트 Ion Exchange Resin

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 a reversible reaction. 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%, wi th the IER technology.

A typical process to treat the fructose/glucose mixture with the Ca+ type ion exchange resin tower is described as below. As the mixture passes through the IER layer, glucose moves faster than fructose which has a higher affinity with Ca ion. In this principal, glucose elutes in before the fructose. The collection of glucose is sold as a finished product, and the fructose I s put to the previous process to react with the isomerization enzyme.



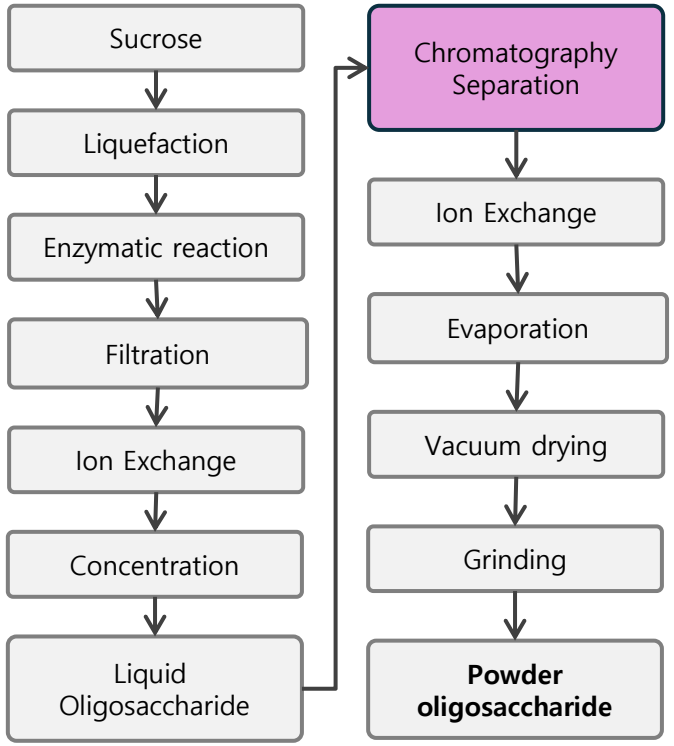
Chromatography

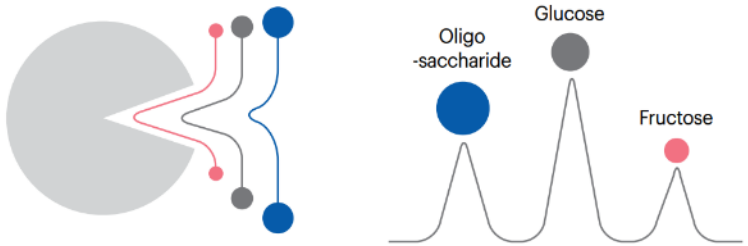
TRILITE
삼양 트리라이트
Ion Exchange Resin

Fructo-oligosaccharide separation using size-exclusive chromatography

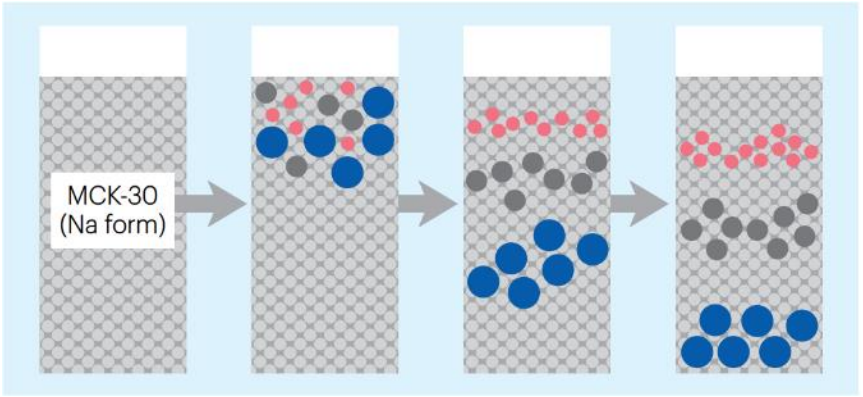
Oligosaccharides exist through condensation polymerization of monosaccharides such as glucose, fructose, and galactose, and are classified into disaccharides, trisaccharides, and polysaccharides according to the number of bonds. Due to the nature of c ondensation polymerization, there is a limited concentration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

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





(Oligosaccharide/fructose/glucose separation tower)



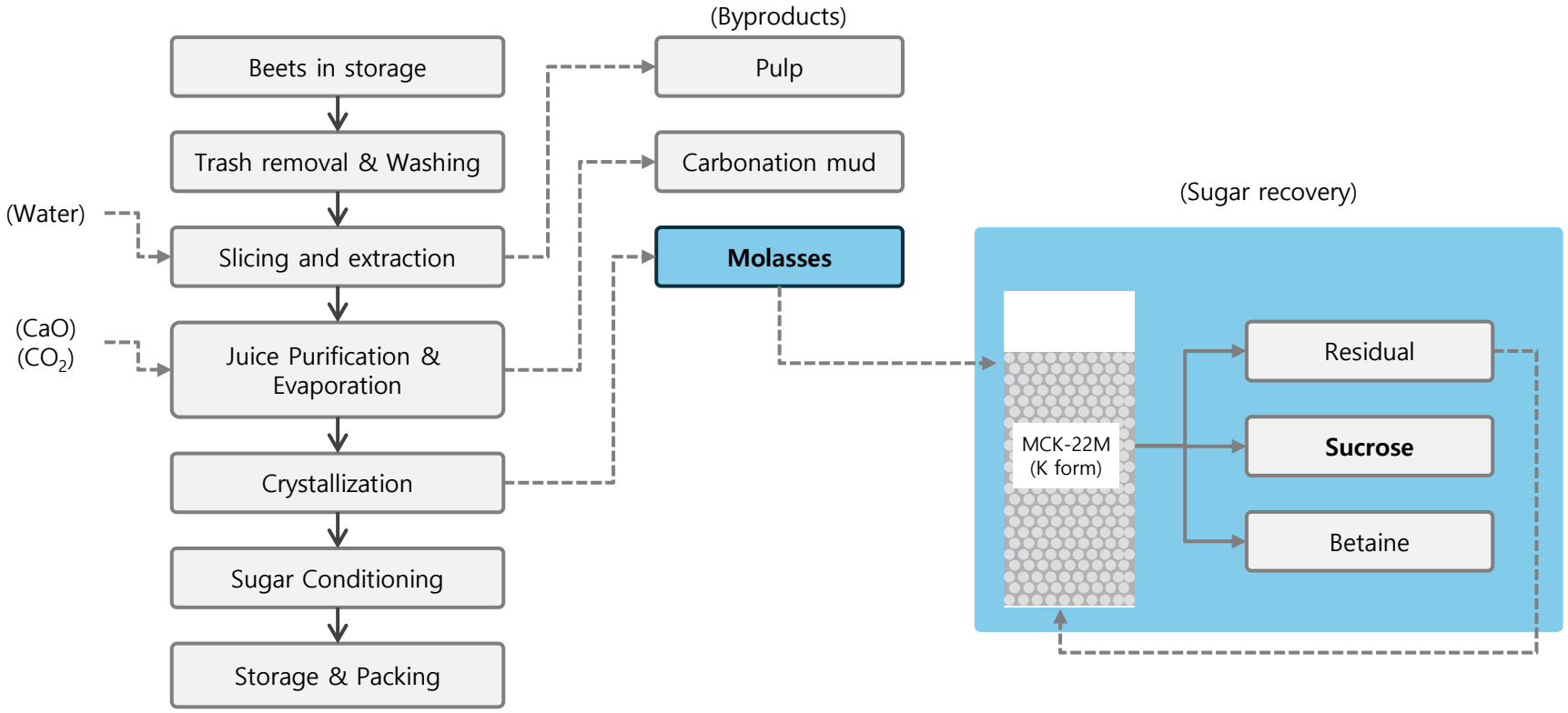
Chromatography

TRILITE 삼양 트리라이트 Ion Exchange Resin

Sucrose recovery from molasses using ion exclusion chromatography

After the sugar cane or sugar beet juice is concentrated to separate the sugar crystals, the mother liquor remaining as a by-product contains sugar, salt, and non-sugar substances. This is called molasses, and was mainly fermented and used as feed for livestock. Molasses contains about 50% or more of sugar, and as a method for recovering it, the production of sugar of 90 to 93% purity can be increased through ion exclusion chromatography separation process using K-type chromatography resin.

Ion exclusion chromatography is a principle in which an electrolyte containing ions of the same sign as the charge of an ion exchanger, is eluted before a non-electrolyte using the property of being excluded from each other by ions and repulsive forces.

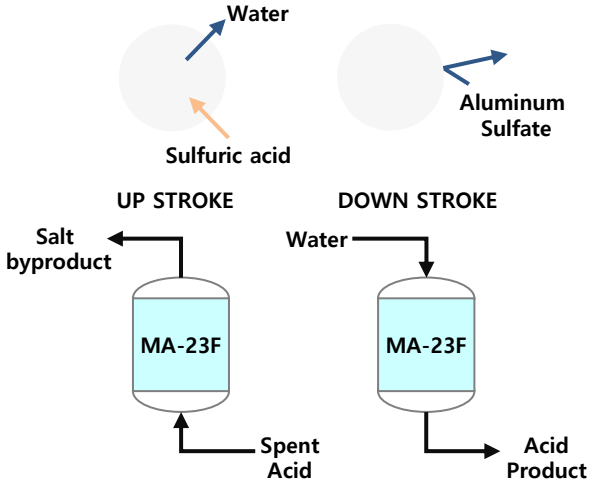


Chromatography

TRILITE 삼양 트리라이트 Ion Exchange Resin

Acid purification using MA-23F resin

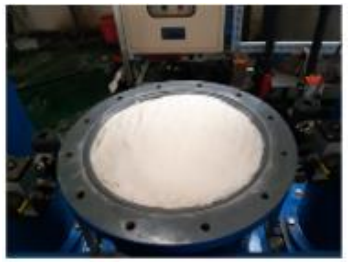
Acid purification process is based on the principle of acid retardation using anion chromatography resins.
When the acid and is salt pass through the ion exchange resin vessel filled with the acid form of the anion exchange resin(SO_4), the acid(H_2SO_4) is adsorbed to the ion exchange resin, but Metal salts($Al_2(SO_4)_3$) are based on the principle that they are not adsorbed. When the ion exchange resin is washed with water, salts that are not adsorbed are washed away and acid is adsorbed to be separated.



The acid recovery facility is called APU(Acid purification unit) and the actual operation is divided into an upstream process and a downstream process, and in the upstream process, metal salts are excluded by the chromatography resin and flowed out before the acid, separated as a by-product, and purified during the downstream process. The acid can be desorbed and recovered.

In general, it is possible to realize 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 (g/ℓ)	Ni (g/ℓ)	Cu (g/ℓ)	HNO_3 (g/ℓ)	HF (g/ℓ)	Metal (g/ℓ)	HCl (eq/ℓ)	Co (g/ℓ)	Zn (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%

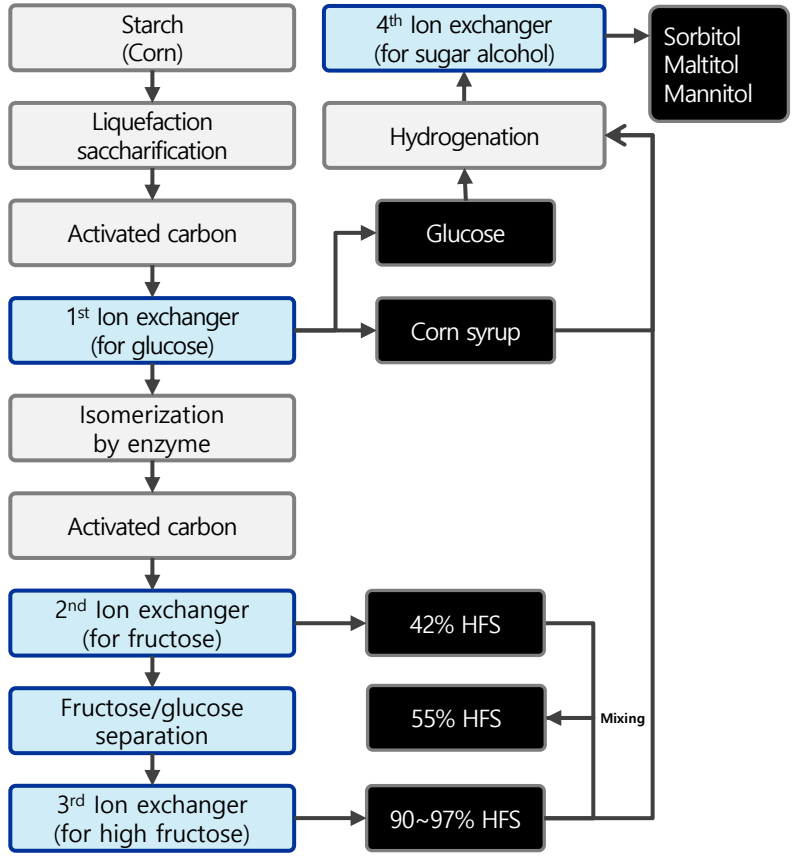



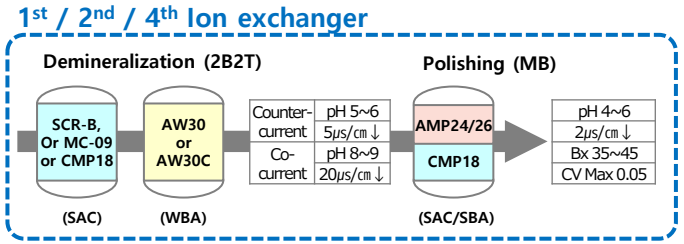
Starch sugar refining

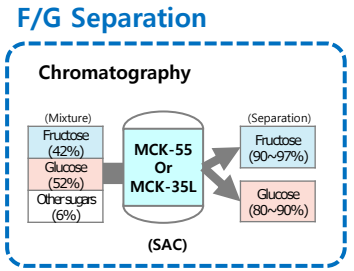
Starch sugar refining process

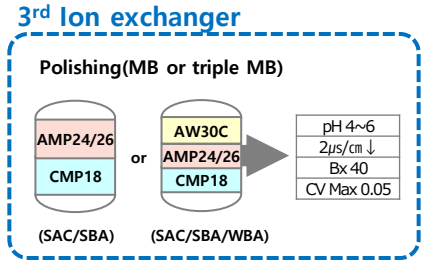
When purifying starch sugar and sugar alcohol, the organic matter content or viscosity of the feed solution is higher than that of general water treatment. As the adsorption ability greatly affects the yield, so ion exchange resin should be optimized for each process. Samyang Corporation is the only company in the world that produces ion exchange resins and starch sugars, and supplies optimized ion exchange resins based on insights on starch sugars and improves the products through continuous technical discussions with customers.

Ion exchange resins for food application should be strictly controlled for impurities and foreign substances during production, and should be handled as food grade when trading internationally. In addition a food additive license is required and HALAL certification is required for products of for Islamic countries.









Starch sugar refining

Starch sugar refining resins

For starch sugar producing 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 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.

※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Strong acid cation resin (SAC)				Strong base anion resin (SBA)			
	Type	Grade	TEC (eq/ℓ)	Particle distribution	Type	Grade	TEC (eq/ℓ)	Particle distribution
Gaussian	Gel	SCR-B	2.0 ↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜	Porous type2	AMP24	1.0 ↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜
	Porous	CMP18	1.8 ↑			AMP26	1.1 ↑	
UPS	Gel	MC-08	2.0 ↑	0.55~0.65㎜				
Functional group	Sulfonate				Type2 : DMEA, dimethylethanolamine			

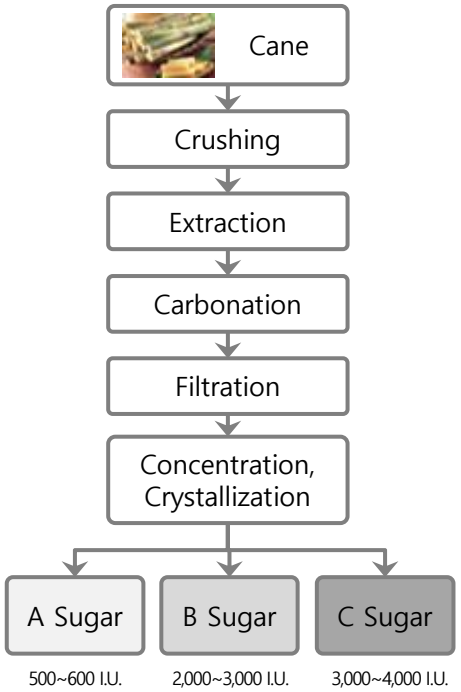
	Weak base anion resin (WBA)					
	Type	Grade	TEC (eq/ℓ)	SBA/WBA Ratio	Particle distribution	Remark and application
Gaussian	Porous	AW30	1.5 ↑	10/90	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜	Economical results for starch sugar refining and decolorization. But, care must be taken for the isomerization is expected (Fructose refining) due to high strong basicity.
		AW30C	1.6 ↑	5/95		High WBA concentration and excellent heat resistance(100℃) . Applicable without heat exchanger and to the process where isomerization is expected.
UPS		AW30M	1.5 ↑	10/90	0.50~0.90㎜	Recommended for Upflow system due to low uniformity coefficient.
		AW90	1.6 ↑	17/83	0.50~0.60㎜	
Functional group	Tertiary Amine					

Sugar refining

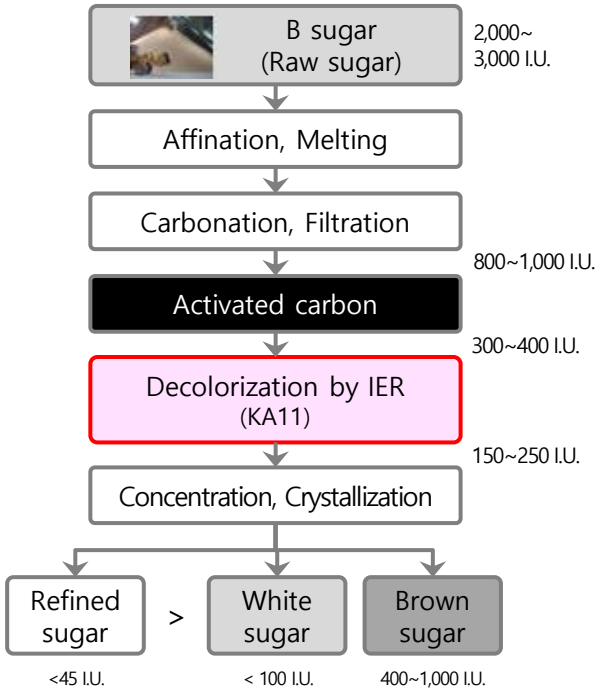
※ TEC: Total Exchange Capacity

	Sugar refining resin (with Activated carbon)				Sugar refining resin (without Activated carbon)			
	Type	Grade	TEC (eq/ℓ)	Particle distribution	Type	Grade	TEC (eq/ℓ)	Particle distribution
Gaussian	Gel type1 (Polystyrene+ DVB)	KA-11	0.9↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜	Porous (Polyacrylate+ DVB)	ASP10	0.9↑	0.425~1.2㎜
	Porous type1 (Polystyrene+ DVB)	AMP14(L)	1.0↑					
Functional group	TMA, trimethylamine				Quaternary ammonium			

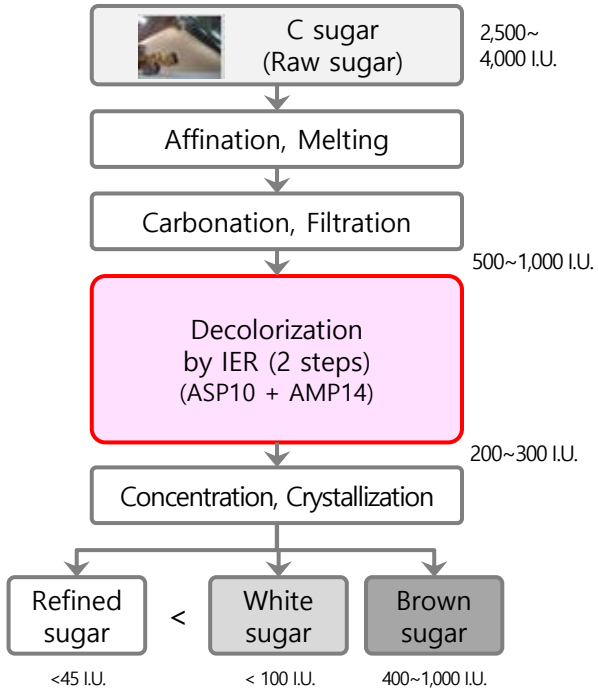
(Cane sugar refining process)



(Sugar refining process with A/C)



(Sugar refining process without A/C)

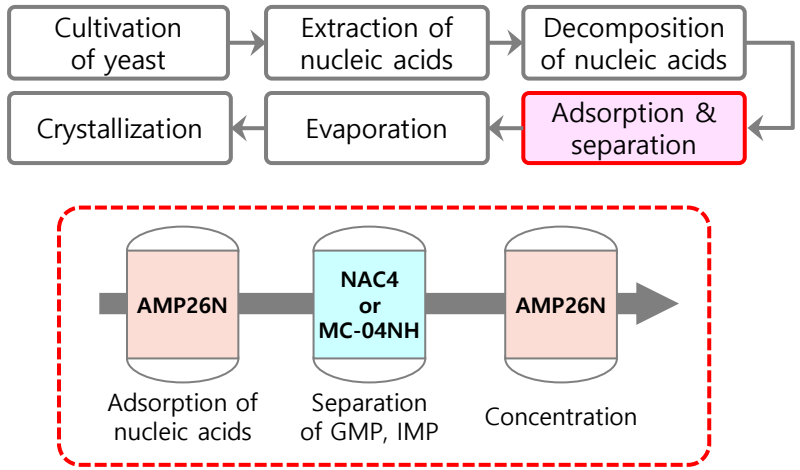


Nucleotide, MSG refining

Nucleotide, MSG refining process and ion exchange resins

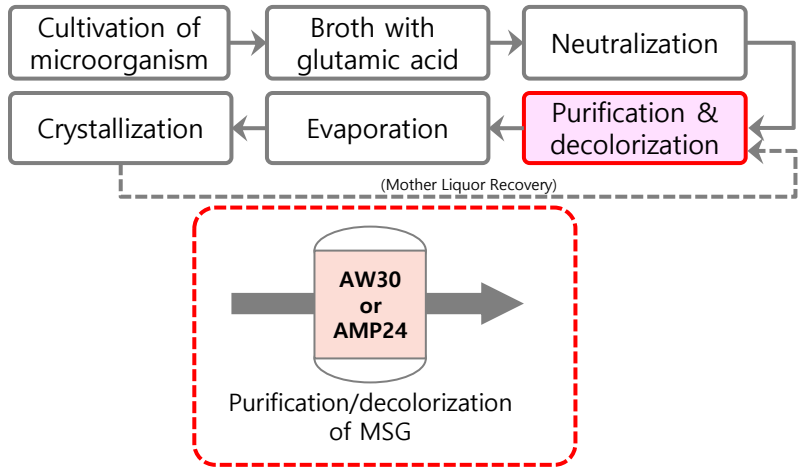
Nucleotide is used as a seasoning and raw material of seasonings, and TRILITE AMP26N and NAC-4 are optimized products for the adsorption, separation and concentration of nucleic acid substances, with outstanding performance and long life cycle.
Also, MSG is another major seasoning and raw material of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

(Nucleotide refining process)



※ GMP : Guanosine monophosphate
IMP : Inosine monophosphate

(MSG refining process)



※ MSG : Monosodium glutamate

※ TEC: Total Exchange Capacity

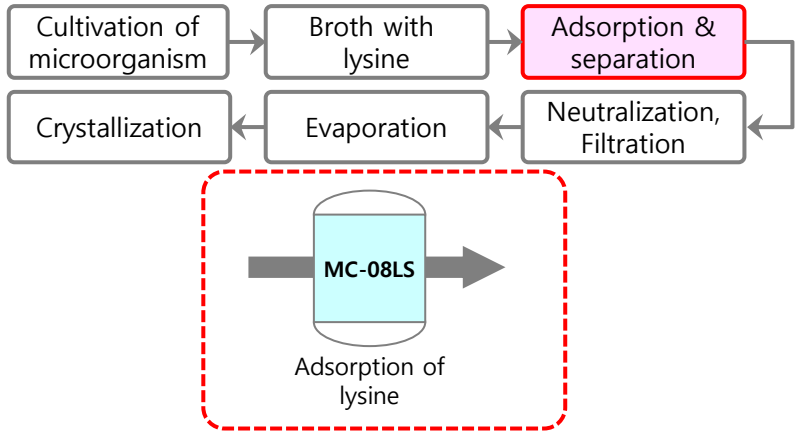
TRILITE 삼양 트리라이트 Ion Exchange Resin	Nucleotide refining resins				MSG refining resins			
	Type	Grade	TEC (eq/ℓ)	Particle distribution	Type	Grade	TEC (eq/ℓ)	Particle distribution
Gaussian	Gel tailored SAC	NAC-4	1.2↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜	Porous tailored WBA	AW30	1.5↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜
	Porous tailored SBA	AMP26N	1.2↑		Porous tailored SBA Type2	AMP24	1.0↑	
UPS	Gel tailored SAC	MC-04NH	1.2↑	0.47~0.57㎜				

Lysine, Arginine refining

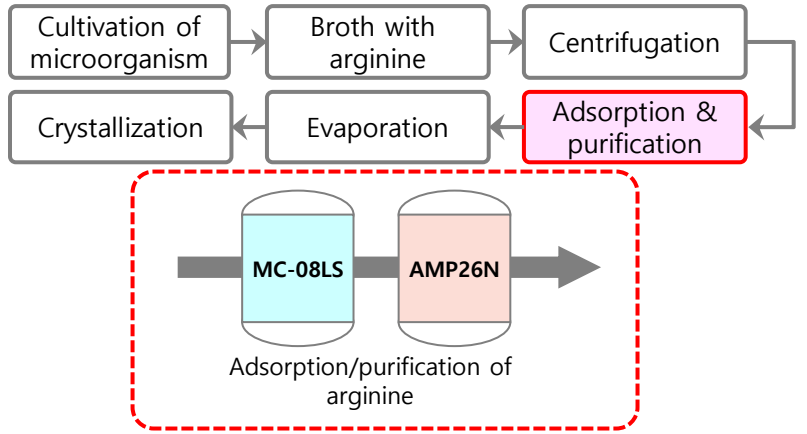
Lysine, Arginine refining process and ion exchange resins

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 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.

(Lysine production process)



(Arginine production process)



※ TEC: Total Exchange Capacity

	Lysine refining resin				Arginine refining resins			
	Type	Grade	TEC (eq/ℓ)	Particle distribution	Type	Grade	TEC (eq/ℓ)	Particle distribution
UPS	Gel tailored SAC	MC-08LS	2.0↑	0.55~0.65㎜	Gel tailored SAC	MC-08LS	2.0↑	0.55~0.65㎜
Gaussian					Porous tailored SBA Type2	AMP26N	1.1↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜

Ready to use mixed resins

TRILITE 삼양 트리라이트 Ion Exchange Resin

Selection guide of ready to use mixed resins

The mixed resins produce high-purity pure water without a huge capital equipment but used with cartridge and pressure vessels, and generally not regenerated.

TRILITE SM200, SM210 are widely applied for Wire-EDM feature high throughput compared to competing products and TRILITE SM300 is widely used for post-RO polisher, producing very high purity water, near to UPW level (Resistivity >17.0MΩ·cm), and specialized for trace impurities such as SiO_2.

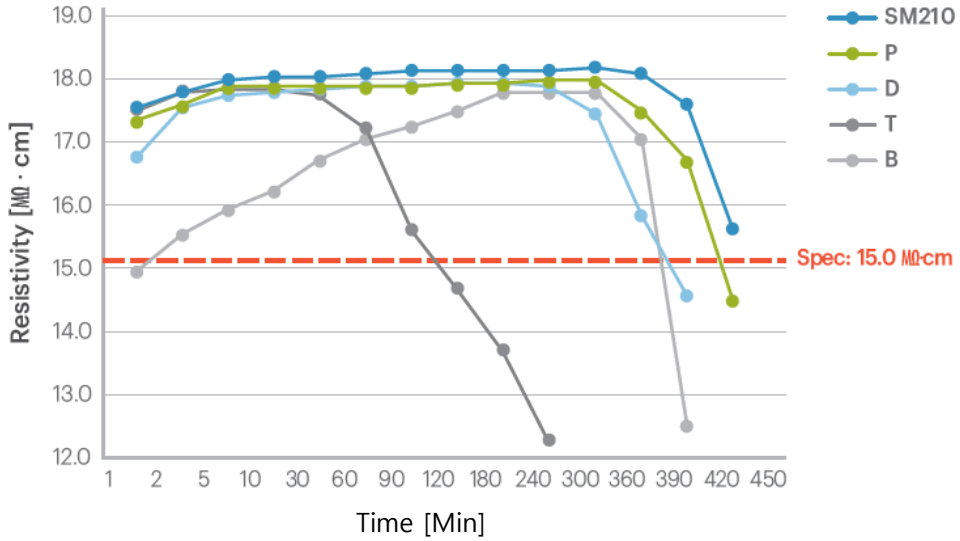
Grade	Feature & Application	Components		Inlet, Outlet	
				Inlet	Outlet
SM200	Simple production of pure water from tab water EDM(Wire-cutting)	SAC (H+ 99.0% ↑)	SBA (OH-90.0% ↑)	Potable water Conductivity 150㎲/㎝ SV36	Guaranteed Resistivity > 10.0 MΩ·cm (in 10min.) Actual Resistivity > 15.0 MΩ·cm (in 10min.)
SM210	Simple production of pure water from tab water Demineralization system	SAC (H+ 99.0% ↑)	SBA (OH-95.0% ↑)		Guaranteed Resistivity >15.0 MΩ·cm (in 10min.) Actual Resistivity > 17.0 MΩ·cm (in 10min.)
SM300	High resistivity Excellent SiO_2 removal MB for post-RO or EDI	SAC (H+ 99.0% ↑)	SBA (OH-95.0% ↑)	Post-RO Conductivity 10 ㎲/㎝ SV36	Guaranteed Resistivity > 15.0 MΩ·cm (in 10min.) Actual Resistivity > 17.0 MΩ·cm (in 10min.)
UPRM100U (UPW grade)	Very high resistivity Electronics grade UPW	SAC (H+ 99.0% ↑)	SBA (OH-95.0% ↑)		Guaranteed Resistivity > 17.0 MΩ·cm (in 10min.) Actual Resistivity > 18.0 MΩ·cm (in 10min.)
UPRM200U (UPW grade)	Very high resistivity Very low △TOC level OLED UPW Final polisher	SAC (H+ 99.9% ↑)	SBA (OH-95.0% ↑)	UPW >17.5MΩ·cm TOC < 2ppb SV30	Resistivity > 18.1 MΩ·cm (in 30min.) △TOC < 5ppb (in 120min)
UPRM300U (UPW grade)	Extremely high resistivity Extremely low △TOC level Semiconductor UPW Final polisher	SAC (H+ 99.9% ↑)	SBA (OH-97.0% ↑)		Resistivity > 18.2 MΩ·cm (in 30min.) △TOC < 1ppb (in 180min)
UPRM400U (UPW grade)	Extremely high resistivity Extremely low △TOC level Low metal ion leakage Semiconductor UPW Final polisher	SAC (H+ 99.9% ↑)	SBA (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

Quality management, Quality comparison test, Packing types

TRILITE mixed resins are subjected to strict quality control through automatic water collection pilots for each production batch, and can be supplied in various packing types.

TRILITE mixed resins are received for its superior throughput and stable quality compared to competing products.



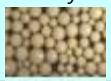
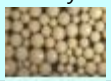
*Feed water: pH 6.2, Conductivity 139.0μs/cm, Resin volume 0.5ℓ, Flow rate 0.3ℓ/min, SV=36

Performance comparison test summary

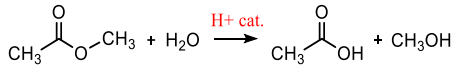
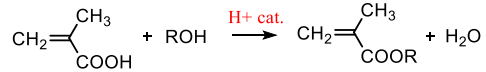
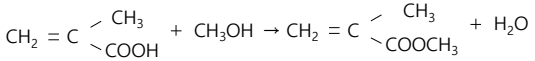
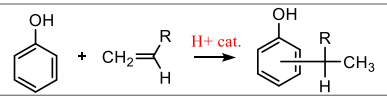
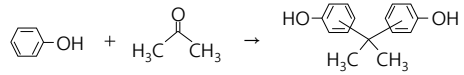
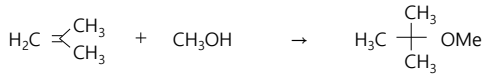
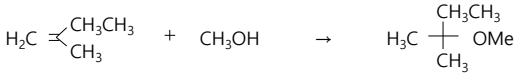
- TRILITE SM210 compared to four types of mixed bed resins of competitors
- All samples showed results of purity higher than than 15.0MΩ·cm
- As the collected throughput increases, SM210 resulted most stable purity

Catalyst

※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Strongly acidic cation resins for Catalyst (SAC for catalyst)								
	Type	Grade	TEC (eq/ℓ)	Particle distribution		Type	Grade	TEC (eq/ℓ)	Particle distribution
Gaussian	Gel Catalyst	PCC20H	0.7↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜ (XL-type) 0.7~1.2㎜	UPS	Gel Catalyst	MC-04H	1.2↑	0.47~0.57㎜
		PCC40H	1.2↑						
	Porous Catalyst 	CMP08LH	1.0↑		Gaussian	Porous Catalyst 	SPC400H	1.0↑	(General type) 0.3~1.2㎜ (L-type) 0.425~1.2㎜
		CMP28LH	2.0↑				SPC160H	1.5↑	
		SPC260H	1.7↑				SPC180H	1.5↑	
		SPC280H	2.0↑				SPC320H	1.9↑	

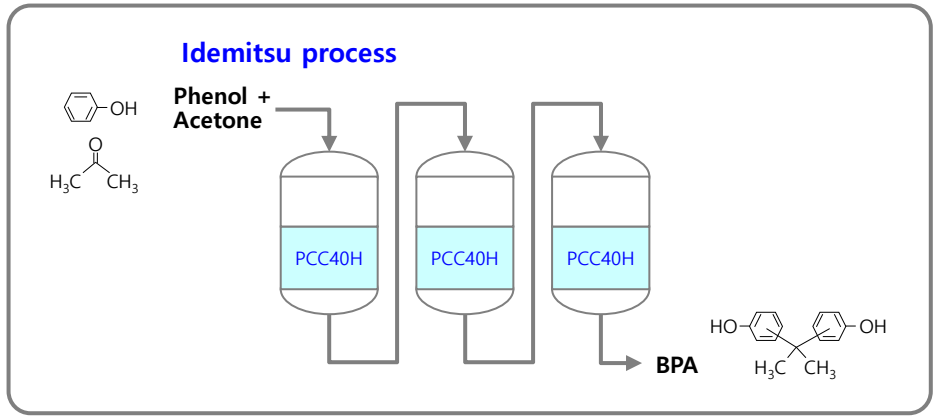
(Typical catalysis application and selection of catalytic resins)

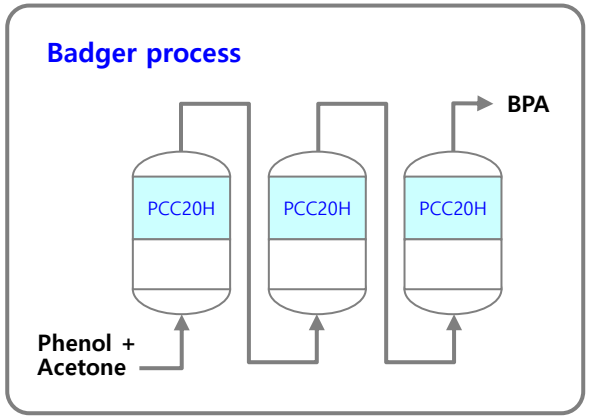
Application	Reaction Mechanism	Catalyst resins	Equivalent
Hydrolysis of methyl acetate		CMP08LH	DIAION PK208LH
Esterification reaction		PCC40H, MC-08H, CMP08LH, SPC160H, SPC180H, SPC400LH	
Synthesis of MMA(methyl methacrylate)		SPC180H	
Alkylation of phenol		SPC260H, SPC320H	Amberlyst15Wet
Synthesis of Bisphenol A		PCC20H PCC40H	DIAION SK104H Lewatit K1131S
Methyl tertiary butyl ether(MTBE)		SPC260H, SPC280H	Amberlyst35Wet
t-amyl methyl ether(TAME)		SPC160H, SPC180H	Lewatit K2621

Catalyst

Bisphenol-A(BPA) Catalyst

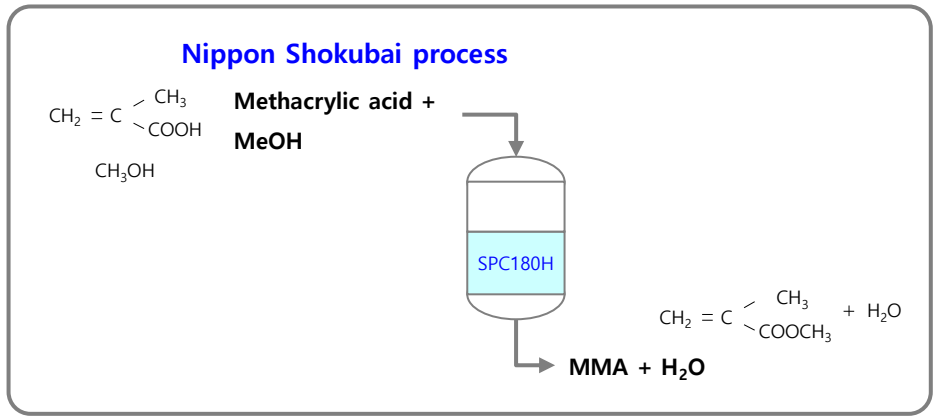
Bisphenol-A(BPA) is used as a raw material for manufacturing various plastics such as polycarbonate or epoxy resin, and high-purity Bisphenol-A can be produced by using an ion exchange resin as a catalyst in a mixture of phenol and acetone.





(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 and can be produced by using an ion exchange resin as a catalyst in a mixture of methacrylic acid and methanol.

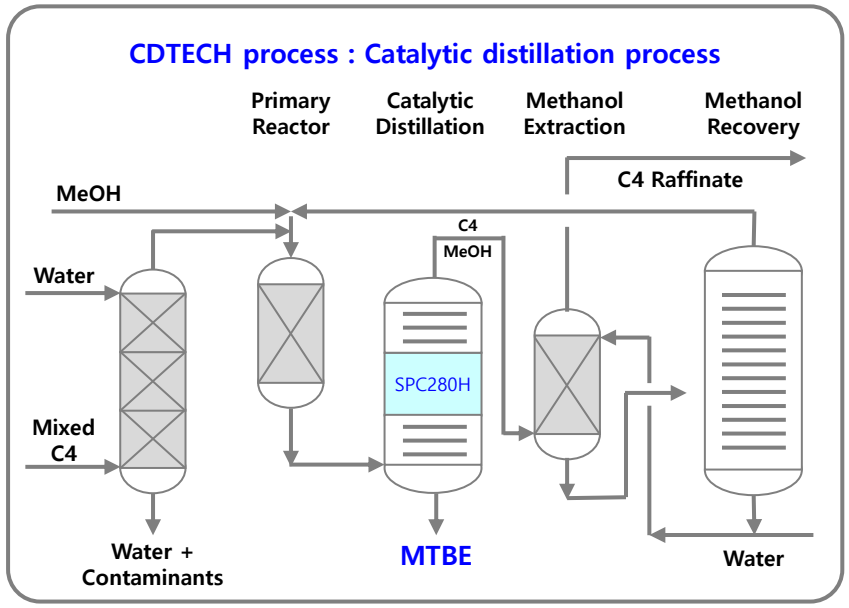


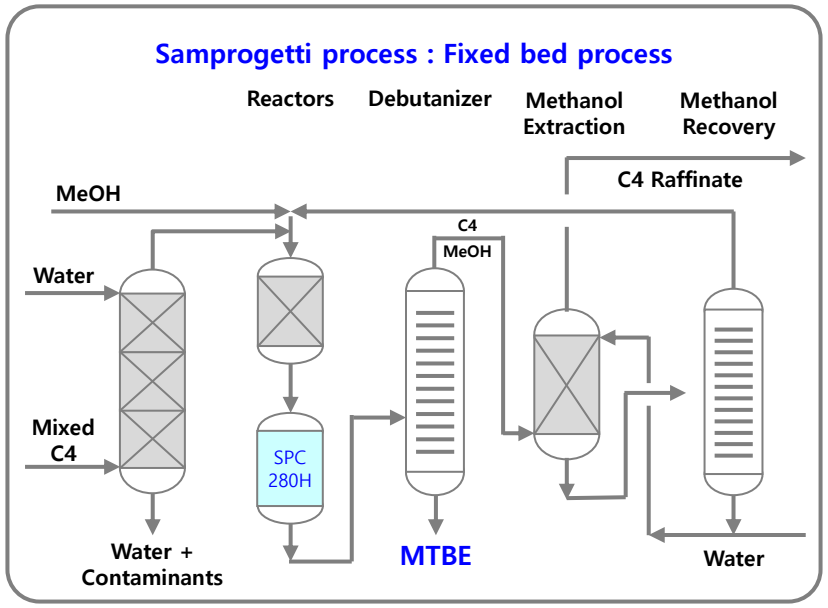
Catalyst

TRILITE 삼양 트리라이트 Ion Exchange Resin

MTBE(Methyl tertiary butyl ether) Catalyst

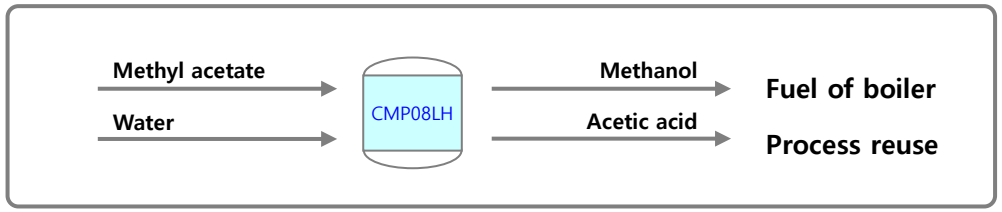
MTBE (Methyl tertiary butyl ether) is an ether compound containing oxygen in its molecular structure and is widely used as an octane number improver in gasoline. Cracking MTBE can produce high-purity isobutene, which is a raw material of MMA. Isobutene and methanol can be produced b selectively catalyzing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





MA(Methyl acetate) Hydrolysis Catalyst

When producing terephthalic acid(TPA), a raw material for polyester fiber, methyl acetate is produced as a by-product, which 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.



Chelating resins

TRILITE 삼양 트리라이트 Ion Exchange Resin

Types, characteristics and application of chelating resins

The chelating resins selectively remove or separtes specific ions through chelate bonding with metal ions not through ion exchange but forming chelate. Chelating resins with various exchangers are used in a wide range of uses by type, and their features are as follows.

Functional group	Grade	Ionic form	TEC (eq/ℓ)	Remarks	Application	Equivalent
Iminodiacetate	CLR-08 (Gaussian) CLR-08UPS (UPS)	Na	Cu^{2+} 0.5 ↑ Ca^{2+} 0.4 ↑	Great selectivity to multivalent ion (Ca^{2+}, Mg^{2+}, Sr^{2+}, etc) among the highly concentrated monovalent ions (Na^{+}, etc) Minimized leakage of multivalent ions	• Secondary brine purification • Selective removal of divalent ions among monovalent ions • Removal of heavy metals in wastewater • Rare metal recovery	Lewatit TP208 Amberlite IRC748 Diaion CR11 Purolite S930
Aminomethyl phosphonate	CLR-09 (Gaussian) CLR-09UPS (UPS)	Na	Ca^{2+} 0.6 ↑	Slightly greater operating capacity and slightly more leakage of multivalent ions than CLR-08	• Secondary brine purification • Selective removal of divalent ions among monovalent ions	Lewatit TP260 Amberlite IRC747 Purolite S940
Thiouronium	CLR-10	H	1.1 ↑	Great selectivity for mercury(Hg) and low adsorption rate and capacity to other heavy metals	• Mercury removal from wastewater	Purolite S924
Polyamine	CLR-20	OH	4mol as copper ↑	Excellent selectivity for heavy metals and alkali metal ions(Na^{+}, K^{+} , etc) and alkali earth metals(Ca^{2+}, Mg^{2+},etc) are not adsorbed.	• Separation of heavy metals among alkali metal ions and alkaline earth metal ions	Diaion CR20
Glucamine	CLR-B3	Free base	0.6eq/ℓ as boron ↑	High selectivity for boron, even in presence of high concentration of anions other than boron.	• Removal of boron from wastewater	Diaion CRB03 Amberlite IRA743 Purolite S108
Aminophosphonate	CLR-F	Al	11g as fluorine ↑	Fluorine(F) ions can be selectively adsorbed and removed to a low concentration	• Fluoride removal in desulfurization wastewater	
Triethylamine	CLR-N	Cl	1.0 ↑	Removes nitrates more selectively than anion exchange resins.	• Selective removal of nitrate	Amberlite IRA996 Purolite A520E

Chelating resins

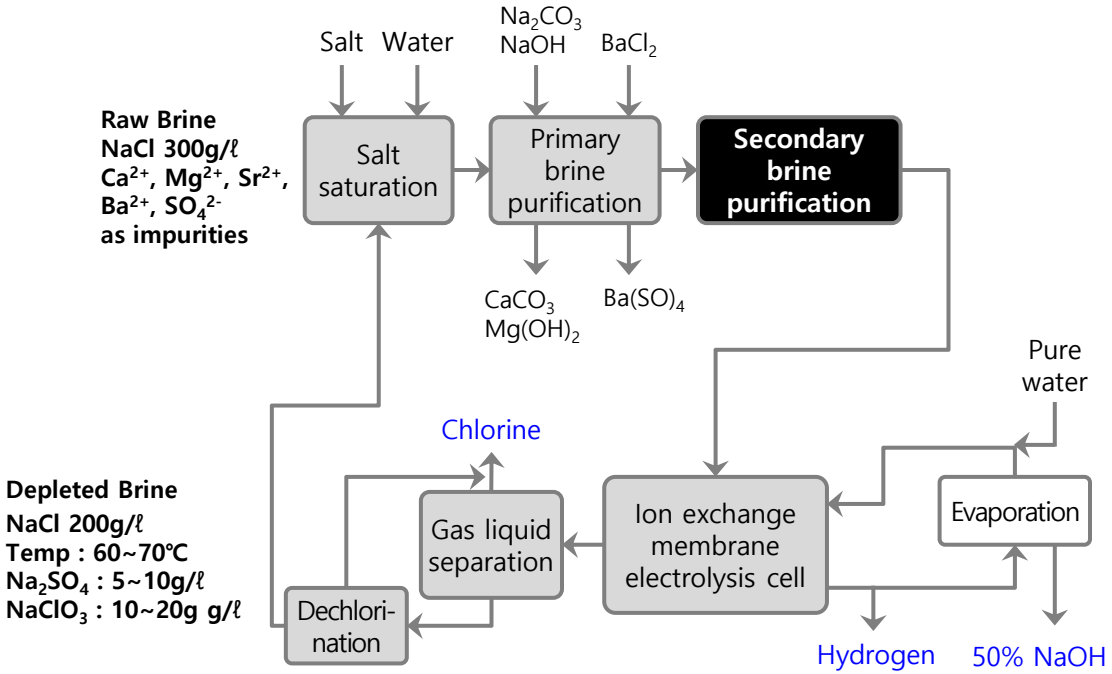
Secondary brine purification

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 salt water 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 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.

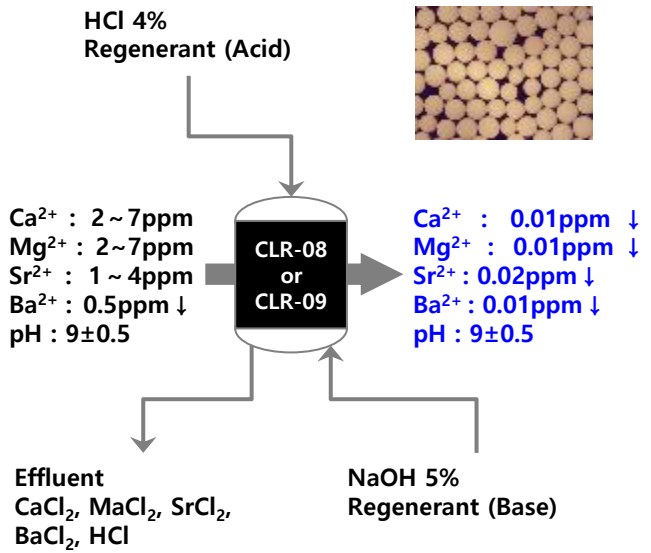
TRILITE CLR-08 is recommended when Sr and Ba ions are strictly managed, and CLR-09, which feature larger exchange capacity than CLR-08, is recommended when Ca, Mg ions are more strictly managed, thus required for more economical operation.

TRILITE CLR-08 and CLR-09 have been supplied to domestic and abroad caustic soda plants and well acknowledged with quality. These resins are available in both non-uniform and UPS grades.

(Chloro-alkali process)



(Secondary brine purification)



Chelating resins

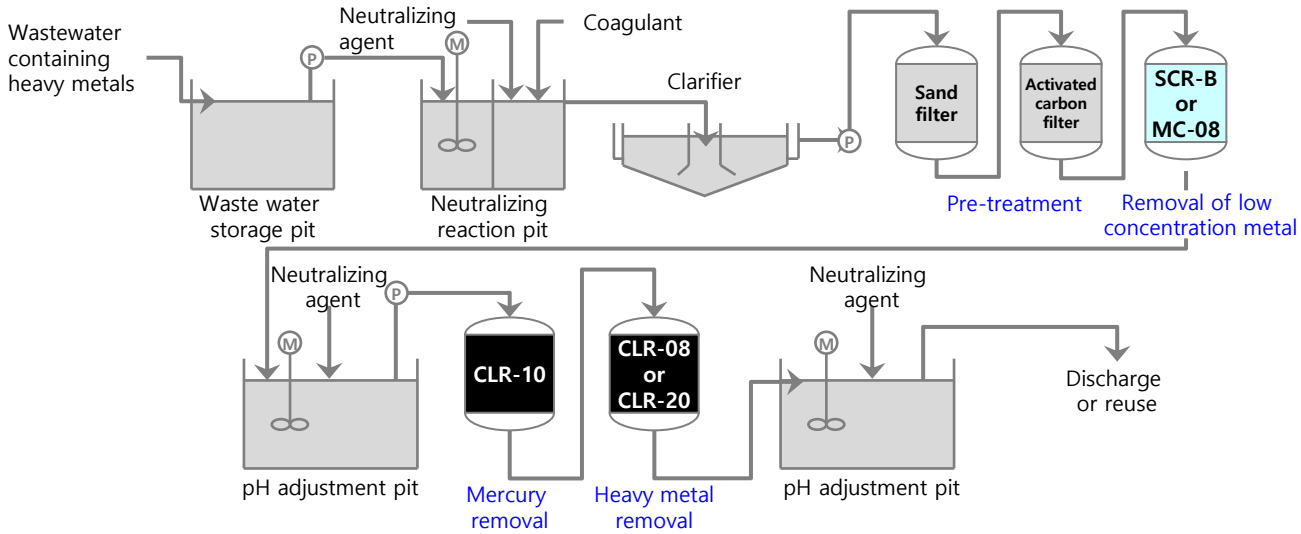
In the plating process, various metals including heavy metals (zinc, copper, chromium, nickel, cadmium, gold, silver, etc.) are discharged into wastewater. A general plating process consists of performing a pretremment such as degreasing and acid pickling on the surface of the metal to be plated in the preparation step, and then electroplating in a plating solution. After plating, the solution contaminated with the plating material is collected in a recovery tank, and then the plating material is washed with a large amount of water. Since harmful substances are contained in this cleaning wastewater, 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, 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) To target only heavy metals : SAC(TRILITE SCR-B, MC-08, etc.) is used to remove-low concentration alkali metals and alkaline earth metals (Ca, Sr, etc.), and chelate resins are used for specific heavy metal concentrations. In the presence of mercury, CLR-10, and for general heavy metals, CLR-08, and CLR-20 are recommended.

Case2) Low pH, containing free acids : Case1) is applicable after removing free acids by SBA(TRILITE SAR-10, MA-12 etc.) Pretreatment with SBA is not required when pH is 4 or higher.

Case3) Containing both metal and free acid present in the form complex anion : Strongly basic anion exchange resins (TRILITE SAR-10, MA-12, ETC.) are recommended.



Chelating resins

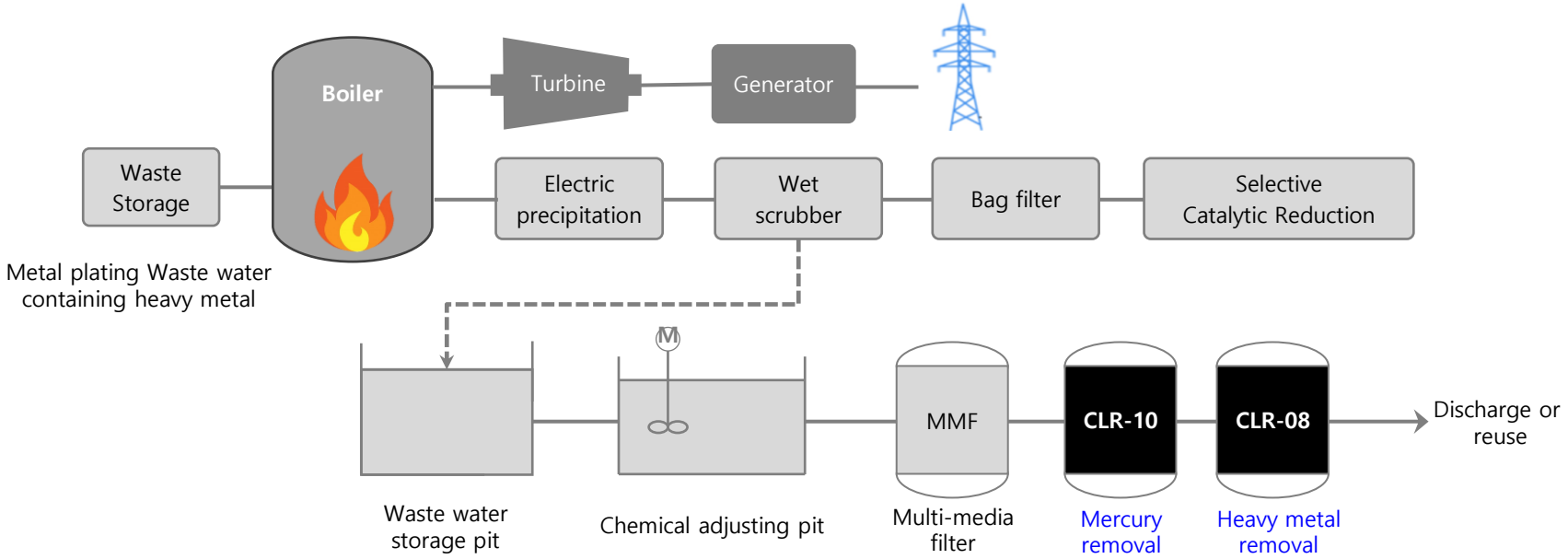
TRILITE 삼양 트리라이트 Ion Exchange Resin

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

Below is an example of the use of chelating resins in general resource recover facilities.



Chelating resins

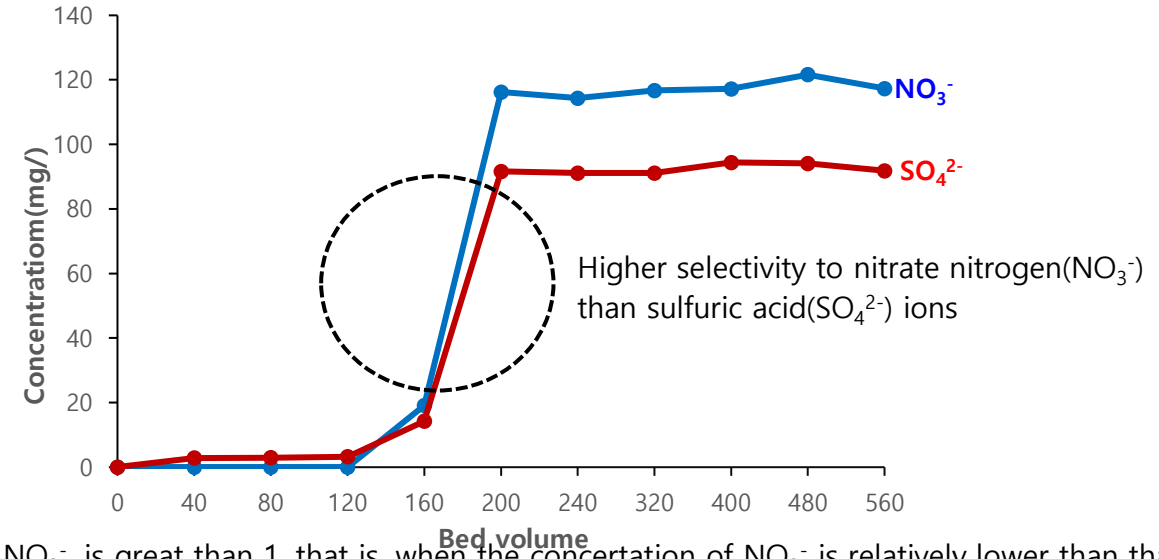
TRILITE 삼양 트리라이트 Ion Exchange Resin

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 selectively to sulfuric acid (SO_4^{2-}) ions than to nitrate nitrogen (Nitrate, NO_3^-). For this reason, there was not much need of 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 can efficiently remove 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 concertation of NO_3^- is relatively lower than that of SO_4^{2-} TRILITE CLR-N, which has high selectivity for nitrate nitrogen is recommended.

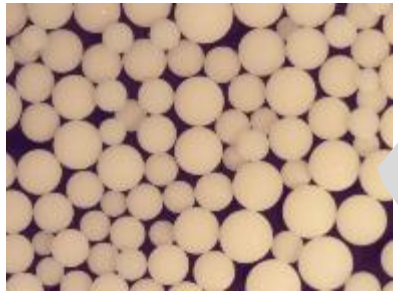
Type	Regeneration level (Co-current, 100% NaCl base)	TRILITE CLR-N Operating capacity
SO_4^{2-} / NO_3^- > 1	125g/ℓ-R	0.4eq/ℓ-R (20g as $CaCO_3$/ℓ-R)

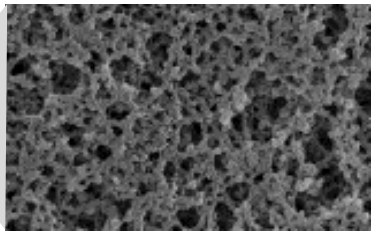
Synthetic Adsorbents

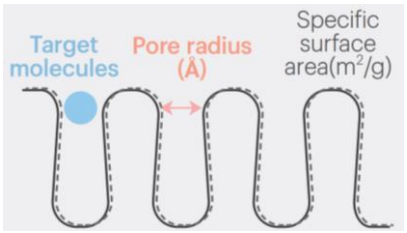
TRILITE 삼양 트리라이트 Ion Exchange Resin

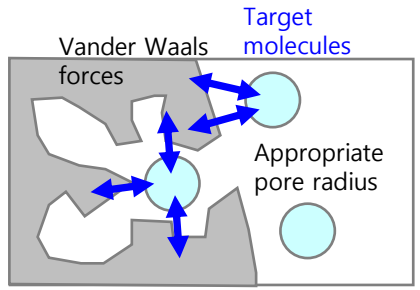
Types of synthetic adsorbents

Synthetic adsorbents do not have functional group, but feature 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 purification of pharmaceuticals and semiconductor chemicals.





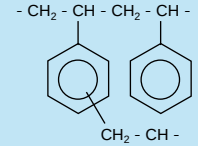
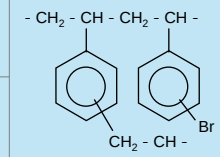
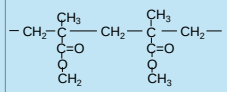




Type		Grade		Remarks
Polystyrene type	Standard type	Performance	HP20	Feature relatively large pore radius, hence appropriate for adsorption of large molecules(>1,000mw). Easily elutes and separates the target material.
		Basic	GSH-20	
	Special type	Performance	SP825, SP850	Feature very large surface area and small pore radius, hence appropriate for adsorption of small molecules(<1,000mw) and exclusion of large molecules.
		Basic	GSP-25, GSP-50	
	Chemically modified	Performance	SP207	By charging into bromine, the hydrophobicity is very high and the selectivity to non-polar materials is very high. Due to 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	HP2MG	The methacrylic matrix feature high hydrophobicity and is suitable for adsorption of highly polar organic substances.

Synthetic Adsorbents

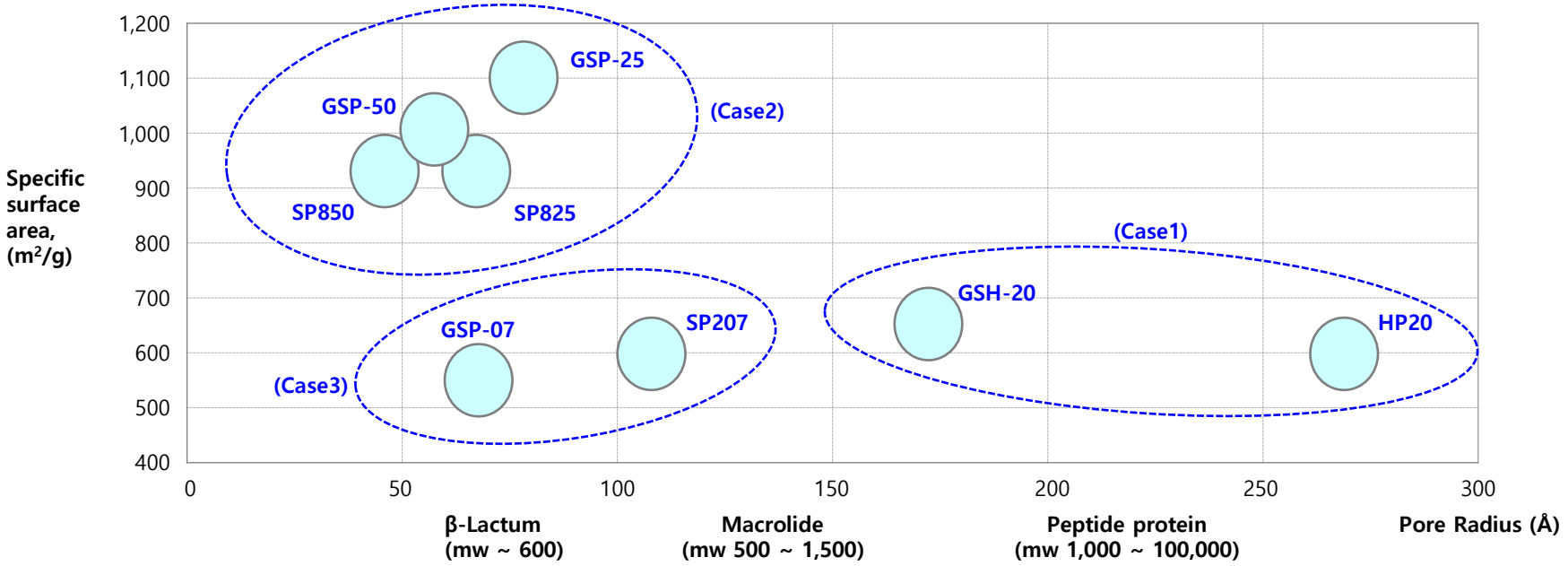
TRILITE 삼양 트리라이트 Ion Exchange Resin

Synthetic adsorbents									
		Grade		Chemical Structure	Specific surface Area (㎡/g)	Pore volume (㎖/g)	Pore radius (Å)	Particle Distribution (mm)	Application
Poly-styrene	Standard type	Performance	HP20		590	1.3	290	0.2~1.2	Separation/purification/ bleaching of proteins, antibiotics, food, etc.
		Basic	GSH-20		600	1.0~1.5	100	0.315~1.25	
	Special type	Performance	SP825		930	1.4	70	0.2~1.2	Cephalosporin-C adsorption, separation/purification of antibiotics
			SP850		930	1.1	45	0.25~0.85	
		Basic	GSP-25		1,100	1.2~1.6	80	0.25~0.7	
			GSP-50		1,100	0.9~1.1	60	0.25~0.7	
	Chemically modified	Performance	SP207		600	1.0	110	0.25~0.85	Chemical purification for semiconductors, removal of hydrophobic organic compounds
		Basic	GSP-07		550	0.8~1.0	70	0.25~0.7	
Methacrylic		Performance	HP2MGL		570	1.3	240	0.3~1.2	Separation/purification of substances with hydrogen bonding functional groups(ester or amino group, etc.)

Synthetic Adsorbents

TRILITE 삼양 트리라이트 Ion Exchange Resin

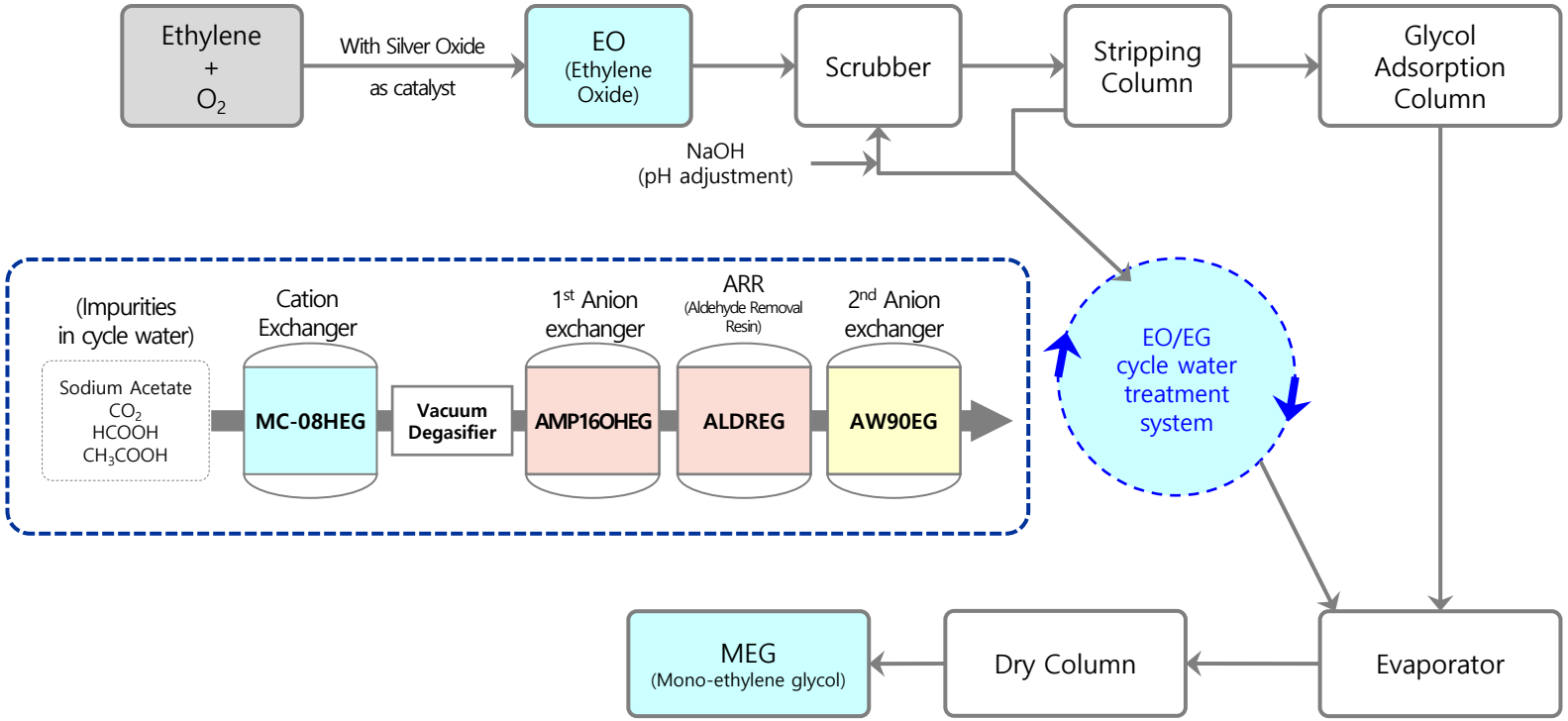
Selection guide of synthetic adsorbents



Type	Case	Guide
Selectivity(molecular weights)	Case1) Adsorption of all materials from solution containing large amount of organics(mw > tens of thousands)	Performance: HP20 > SP207 > SP825 > SP850 Basic: GSH-20 > GSP-07 > GSP-25 > GSP-50
	Case2) Adsorption of material from solution with large amount of organic content(mw<1,000)	Performance: SP850 > SP825 > HP20 > SP207 Basic: GSP-50 > GSP-25 > GSH-20 > GSP-07
	Case3) Adsorption of materials (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

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.



The main roles of each facility are as follows

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

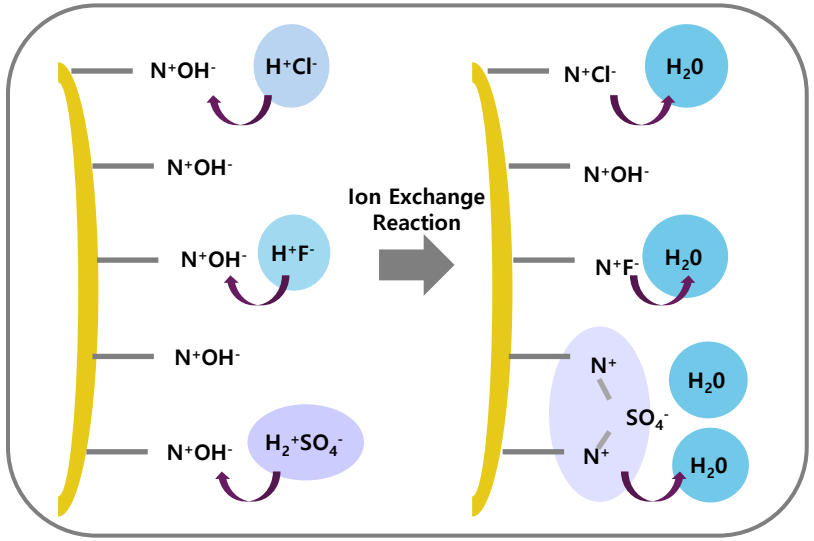
Dry type resins

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 high-precision electrical and electronic manufacturing process such as semiconductors and OLEDs.

TRILITE dry type resins are supplied in the most optimized specification for various customers, to maximize the field workability and performance by supplying customized products with different ionic forms, moisture content, and particle sizes.

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

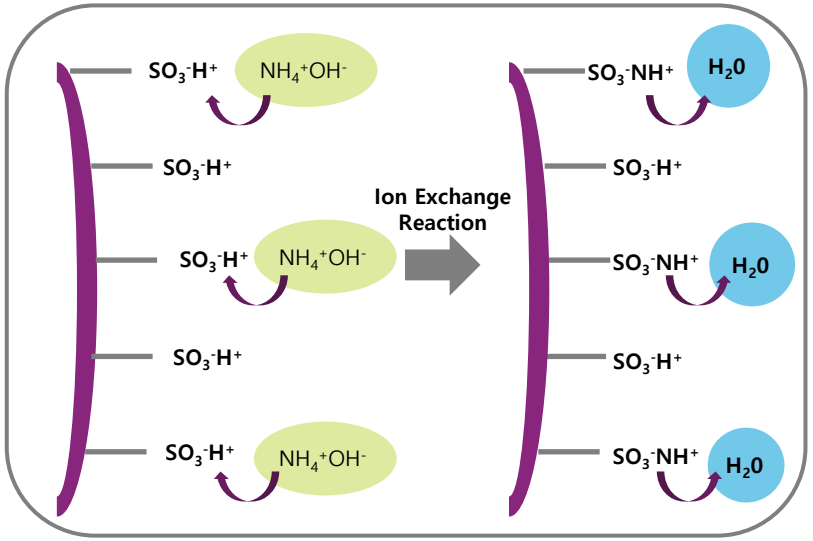
(Acid gas removal mechanism)



<Reaction pathway of Acid gas>

$$\text{-R-N-OH} + \text{HCl} \rightarrow \text{-R-N-Cl} + \text{H}_2\text{O}$$
$$\text{-R-N-OH} + \text{HF} \rightarrow \text{-R-N-F} + \text{H}_2\text{O}$$
$$2(\text{-R-N-OH}) + \text{H}_2\text{SO}_4 \rightarrow 2(\text{-R-N-})\text{SO}_4 + 2\text{H}_2\text{O}$$

(Base gas removal mechanism)



<Reaction pathway of Base gas>

$$\text{R-SO}_3\text{H} + \text{NH}_4\text{OH} \rightarrow \text{R-SO}_3\text{NH}_4 + \text{H}_2\text{O}$$

Dry type resins

TRILITE 삼양 트리라이트 Ion Exchange Resin

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 (Customizable upon request)			
Shipping weight, (g/ℓ) (Reference)	780	800	750	650
Uniformity coefficient	1.6 ↓	1.1 ↓	1.6 ↓	1.6 ↓

Product analysis / Quality control

TRILITE 삼양 트리라이트 Ion Exchange Resin

TRILITE 삼양 트리라이트 Ion Exchange Resin

Product Hopper

Sampling

ISO9001 Lloyd's Register LRQA

Basic product analysis

Bulk Density | Moisture retention | Exchange capacity | Particle distribution | Whole bead count

Optional product analysis for H/OH type resin, catalyst, ultrapure water resin

H/OH Conversion rate | Resistivity | △ TOC

Periodical product analysis

Osmotic shock stability | Friability

DI water | 2N NaOH | 2N HCL | Column

DB

Quality Test

N

Process analysis

Y

Packing

Sample storage (4 years)

Customer

CoA(From DB)

Shipping

Quality assurance system

TRILITE
삼양 트리라이트
Ion Exchange Resin

We carry out strict quality control and conduct continuous audits from reputable quality organizations, ISO9001, Halal Certification for export to Islamic countries and VERITAS certification for power generation industries.

ISO9001 Certificate

Lloyd's Register LRQA

Lloyd's Register LRQA

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Samyang Fine Technology Corporation
63, Jayumuyeok 1-gil
Gunsan-si, Jeonbuk, Korea

has been approved by Lloyd's Register Quality Assurance to the following Quality Management System Standards:

ISO 9001: 2015

The Quality Management System is applicable to:

Manufacture of ion exchange resin.

Approval Certificate No: SEO 6040809

Original Approval: 29 August 2016
Current Certificate: 29 August 2016
Certificate Expiry: 28 August 2019

Issued by: LRQA (Korea) Ltd for and on behalf of Lloyd's Register Quality Assurance Limited

HALAL Certificate

MUI
JAKIM
KMF

KOREA MUSLIM FEDERATION

HALAL CERTIFICATION

TO WHOM IT MAY CONCERN

Halal Committee of Korea Muslim Federation hereby certifies that the products listed below mentioned have met the Halal requirements in accordance with the Islamic law.

1. Cation Exchange Resin
2. Anion Exchange Resin

(Two Products Only)

Distributor : Samyang Corporation
Manufacturer : Samyang Corporation Ulsan plant

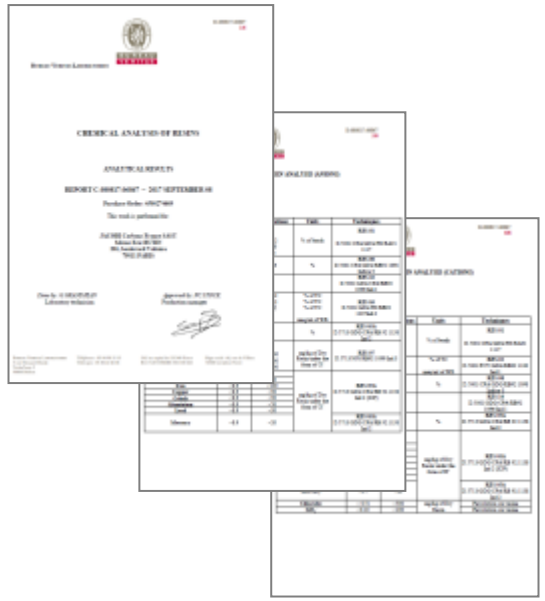
Valid until : 07. Jan. 2018

Yours in Islam

Muhammad Kim Dong Seo
Chairman of the Halal Committee

Veritas Certificate

BUREAU VERITAS



Packing type

TRILITE 삼양 트리라이트 Ion Exchange Resin

25ℓ PE bag	1,000ℓ Ton bag	50ℓ/200ℓ Plastic drum	5ft³/7ft³ Fiber drum	5ℓ Vacuum packing
 Heat-sealing type  valve type	 valve type  Square type			

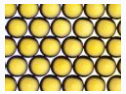
Packaging type & Pallet information

Type	Material	Dimension(cm)	Weight (kg)	Capacity (LT)	Standard palletization	
					Quantity (Method)	Dimension (W x L x H, m)
25ℓ PE bag (Heat-sealing)	PE	48 x 71 x 10	130(g)	25	1000L (4bagX10layers or 5bagX8layers)	1.1 x 1.1 x 1.2 1.1 x 1.1 x 1.0
25ℓ PE bag (Valve)	PE	45 x 54 x 13	130(g)	25	1050L (6bagX7layers)	1.1 x 1.1 x 1.0
1000ℓ Round type	PP(Inner PE)	Ø107 × 121(H)	3.5	800~1000	1000L	1.1 x 1.1 x 1.2
1000ℓ Square type	PP(Inner PE)	104 x 104 x 100(H)	3.4	800~1000	1000L	1.1 x 1.1 x 1.1
		104 x 104 x 120(H)	3.5	1,100	1100L	1.1 x 1.1 x 1.2
50ℓ Plastic drum	HDPE	Ø41.5 × 61.5(H)	3.8	50~60	800L (8 drum X 2layers)	1.1 x 1.1 x 1.5
200ℓ Plastic drum	HDPE	Ø58.5 × 97.5(H)	10.3	200	800L (4 drum X 1layers)	1.1 x 1.1 x 1.1
5ft3 Fiber drum	Liner	Ø53 × 76(H)	7.4	5 ft3 (141ℓ)	20 ft3 (566ℓ) (4drum X 1layers)	1.1 x 1.1 x 0.9
7ft3 Fiber drum	Liner	Ø53 × 100(H)	8.5	7 ft3 (198ℓ)	28 ft3 (792ℓ) (4drum X 1layers)	1.1 x 1.1 x 1.2
5ℓ Vacuum packing	NY + PET + LLDPE	480 x 280 x 0.15(mm)	39.6(g)	5	500ℓ 20box(5ℓ X 5ea)	1.1 x 1.1 x 1.3

Cross reference guide

TRILITE 삼양 트리라이트 Ion Exchange Resin

There are only three major companies with UPS resin (Uniformity Coefficient 1.1↓) technology in the world" → ①**Samyang** & Mitsubishi, ②Dow, ③Lanxess

Type		Samyang TRILITE	Mitsubishi DIAION	Dupont Amberlite/Ambertec	Lanxess Lewatit	Purolite
		UC 1.1↓	UC 1.1↓	UC 1.1↓	UC 1.1↓	UC 1.2↓
UPS Gel 	SAC	**MC-08**	UBK08	HPR1100/1200 Na	MP S100	PFC/PPC100
		MC-08H	UBK08H	HPR1200 H	MP S100H	PFC/PPC10 0H
		MC-10	UBK10	HPR1300 Na	MP S108	SGC-650C
		MC-10H/MC-10SH	UBK10H	HPR1300/1400/650 H	MP S108H	SGC-650C H
		MC-14(M)H		HPR1600 H		
	SAC (Chromatography)	**MCK series**	UBK500 series	Refer to Chromatographic resin cross reference guide.		
	SBA_Type 1	**MA-12**	UBA120	HPR4200/4800 Cl	MP M500	PFA/PPA400
		MA-12OH	UBA120OH	HPR4200/4800 OH	MP M500 OH	PFA/PPA400 OH
		MA-10	UBA100	HPR4700/550 Cl	MP M800	SGC-550A
		MA-10OH/MA-10SOH	UBA100OH	HPR4700/550 OH	MP M800OH	SGC-550A OH
		MA-15	UBA150	HPR4700/550 Cl	MP M800	SGC-550A
		MA-15OH	UBA150OH	HPR4700/550 OH	MP M800OH	SGC-550A OH
	SBA_Type 2	**MA-20**	UBA200	HPR4100 Cl	MP M600	PFA/PPA200
	Mixed Bed (UPW)	**UPRM100U**			NM60	UCW 3600
		UPRM200U		UP6150, MR-450 UPW	1292MD, NM60SG	UCW 3700
		UPRM300U		UP6040, MR-300 UPW	1294MD	UCW 9966
UPS Porous	WBA	**AW80/AW90**		HPR9500	MP64/MP68	
		UC 1.6↓	UC 1.6↓	UC 1.6~1.8↓		
Gaussian Gel 	SAC	**SCR-B(KC-08)**	SK1B	HCR-S, IRC120 Na	C249/C267	C100
	SAC_Food grade	**KH-70/KH-80**		HCR-S/S, SR1L		C100E
	SBA	**SAR10(KA-10)**	SA10		ASB1	A400
		SAR11(KA-11)	SA11			
		SAR12(KA-12)	SA12	IRA402 Cl		A600
		SAR20(KA-20)	SA20	IRA410 Cl	ASB1	A200
	Mixed Bed	**SM200/210/300**		MB20/MB9L	NM91	MB400
Gaussian Porous 	SAC	**CMP/SPC Series**	PK series		SP120	C150, C160
	SBA	**AMP Series**	PA series	IRA900/910 Cl	MP500	A500
	SBA(Food, Styrene)	**AMP14(L)**	PA308	FPA90/FPA900	S6368	A502PS
	SBA(Food, Acryl)	**ASP10**		FPA98	S5528	A860S
	WAC	**WCA10L**	WK40/WK60L	IRC83	CNP80	C105
	WBA	**AW30**	WA30	IRA96	MP62	A100
	Chelating	**CLR series**	CR series		TP207/208	S930Plus
Inert resin		**TR70/TR30**		14i, 62i, 600i	IN42	IP1, IP4

TRILITE
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Ion Exchange Resin

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