

Introduction to Samyang Corporation & TRILITE



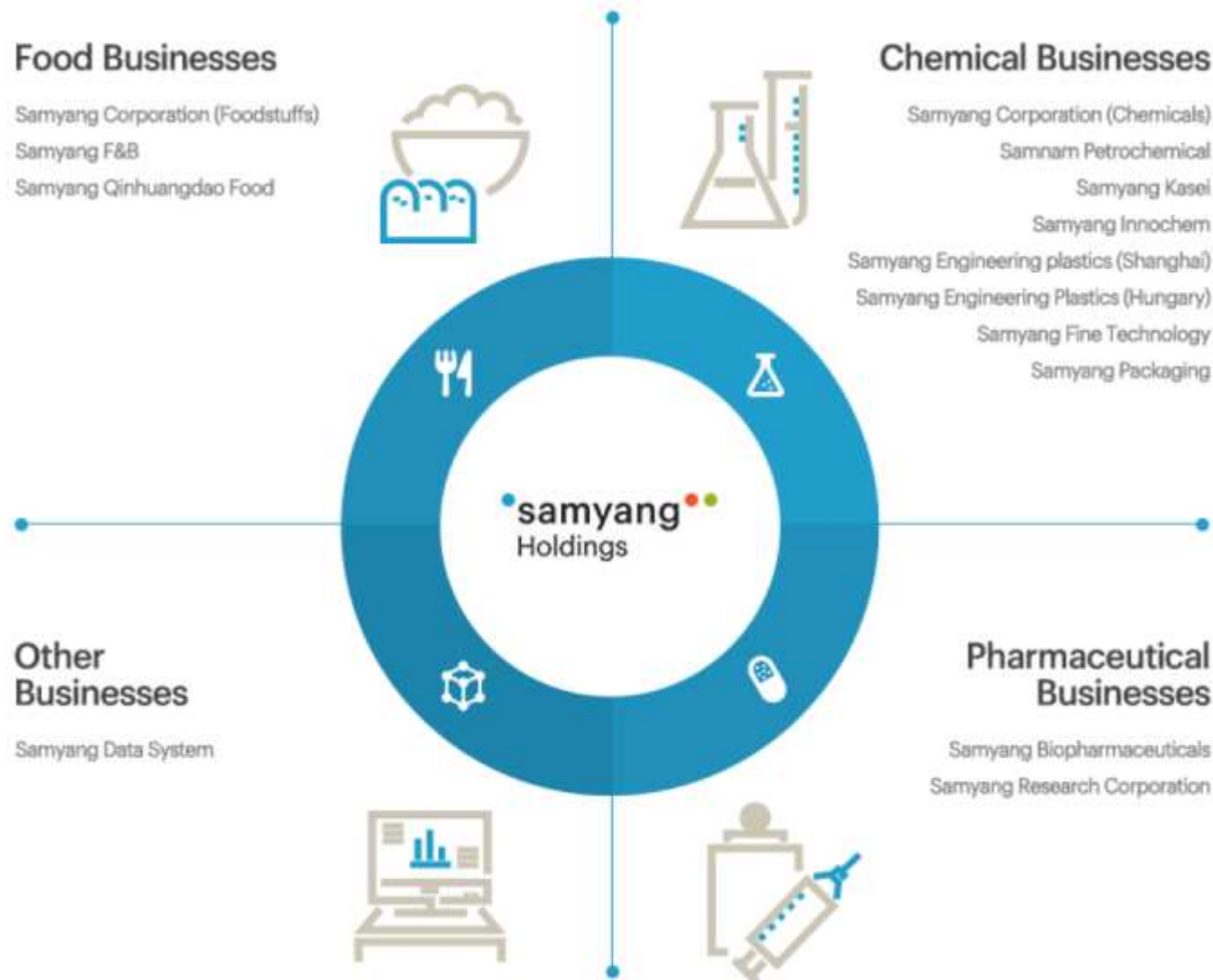
Samyang Corporation Ion exchange resin
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TEL) 82-2-740-7732~7, FAX) 82-2-740-7709
<http://samyangtrilite.com>



1. Samyang Group Overview

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- Established in 1924 / Employees : 3,200 / Sales : USD 3.8 billion (2018)



2. Product Line of Samyang Group

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(Business Domain)	(Subsidiaries)	(Product line)							
Chemical Business	Samyang Corporation	Engineering Plastics	Ion Exchange Resin(Non-UPS)	IT Appliance Materials					
	Samnam Petro-Chemicals	Terephthalic acid							
	Samyang Kasei	Poly Carbonate							
	Samyang Eng'g Plastics (Shanghai)	Engineering Plastics							
	Samyang Innochem	Bisphenol-A							
	Samyang Eng'g Plastics (Hungary)	Engineering Plastics							
	Samyang Fine Technology	Ion Exchange Resin(UPS※)							
	Samyang Packaging	PET Bottle	PET Preform	Aseptic Bottling					
									
	Samyang Corporation	Samyang Petro-Chemicals	Samyang Kasei	Samyang Innochem	Samyang FineTechnology				
Food Business	Samyang Corporation	Sugar	Sweetener	Cooking Oil	Homemade Mix	Hangover Cure	Home Baking Products	Margarine & Shortening	Olive & Grape Seed Oil
		Starch	Starch Sugar	Sugar Alcohol	Health Functional Food	Cosmetics			
	Samyang F&B	Salad & Grill Restaurant	Salad & Brunch Cafe						
	Samyang Qinhuangdao Food	Starch Sugar							
Pharmaceutical Business	Samyang Biopharm	Medical Device	Carcinostatic Agent	Patch					
Other Business	Samyang Data Systems	IT Service							

※ UPS : Uniform particle sized



3. Locations (HQ, Plant, Technical Center of TRILITE)

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TRILITE
삼양 트리라이트
Ion Exchange Resin

- **Technical sales force by 3 fields**
 - Demineralization/Ultrapure water/Condensate polishing/Catalyst
 - Food/Amino acid/Pharmaceuticals
 - Wastewater/Chelating/purification
- **One stop service**
 - Analysis of IER
 - Equipment Diagnosis
 - Design support
 - Technical seminar
 - Trouble shooting guide



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



Gunsan
UPS Resin Plant



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fine technology

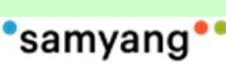
- **Since 2016**
- **Joint venture with Mitsubishi Chemicals**
- **Production Capacity : 20,000kℓ/yr**
(Cation 13,000kℓ/yr , Anion 7,000kℓ/yr)
- **Product line**
 - Uniform particle sized resins
 - Ultrapure water grade(for OLED, LCD)
 - Chromatography resins

Ulsan
UPW/Tailored/Specialty Resin Plant



samyang
Corporation

- **Since 1976**
- **Technology licensed by Mitsubishi Chemicals & Self-development**
- **Production Capacity : 7,000kℓ/yr**
(Cation 4,000kℓ/yr , Anion 3,000kℓ/yr)
- **Product line**
 - Ultrapure water grade(for semiconductor)
 - Tailored resins(food, catalyst, pharmaceuticals)
 - Specialty resins(chelating, synthetic adsorbents)



4. Overview of Samyang Fine Technology Corp.

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Samyang Fine Technology Corporation is a joint venture founded by Samyang Corporation and Mitsubishi Chemical Corporation, which is leading IER(ion exchange resin) maker in Korea and Japan.

Samyang Fine Technology Corporation is Asia's largest specialized UPS(uniform particle sized) IER plant.

We fulfill customer satisfaction with innovative technologies and strict quality control.



History)

2016.04 Completion ceremony

2015.12 Commercial operation initiation

2014.01 Samyang Fine Technology established

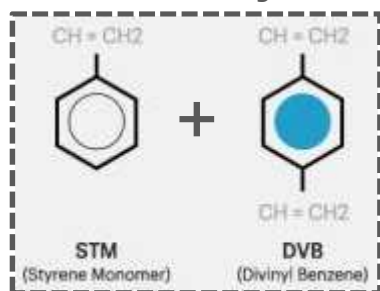
2013.07 Samyang Corporation and Mitsubishi Chemical Corporation signed a joint venture agreement



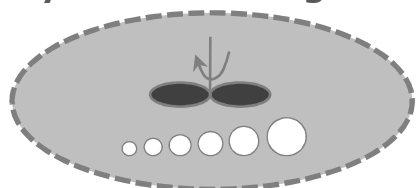
5. Cutting-edge Technology Droplet Generator

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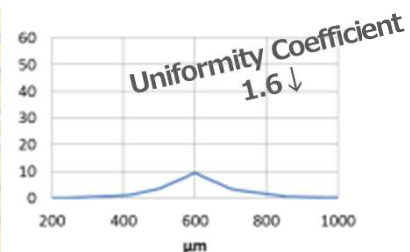
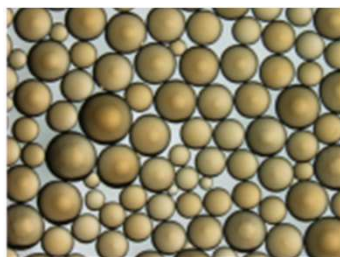
Conventional Technology (Raw Material Adjustment)



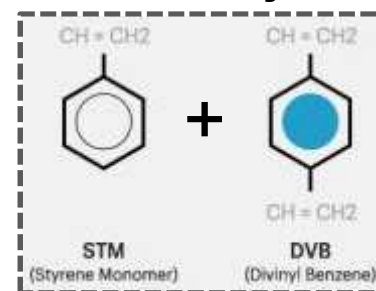
(Polymerization - Agitation)



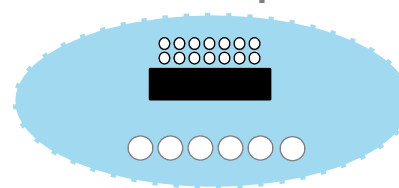
(Post-treatment - Functional Group)



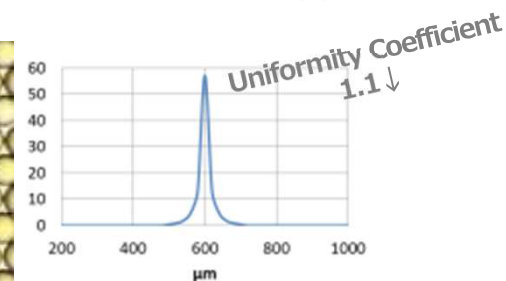
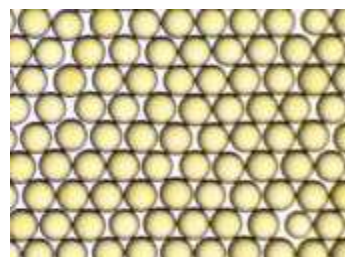
UPS(uniform particle sized) Technology (Raw Material Adjustment)



(Polymerization - Droplet Generator)

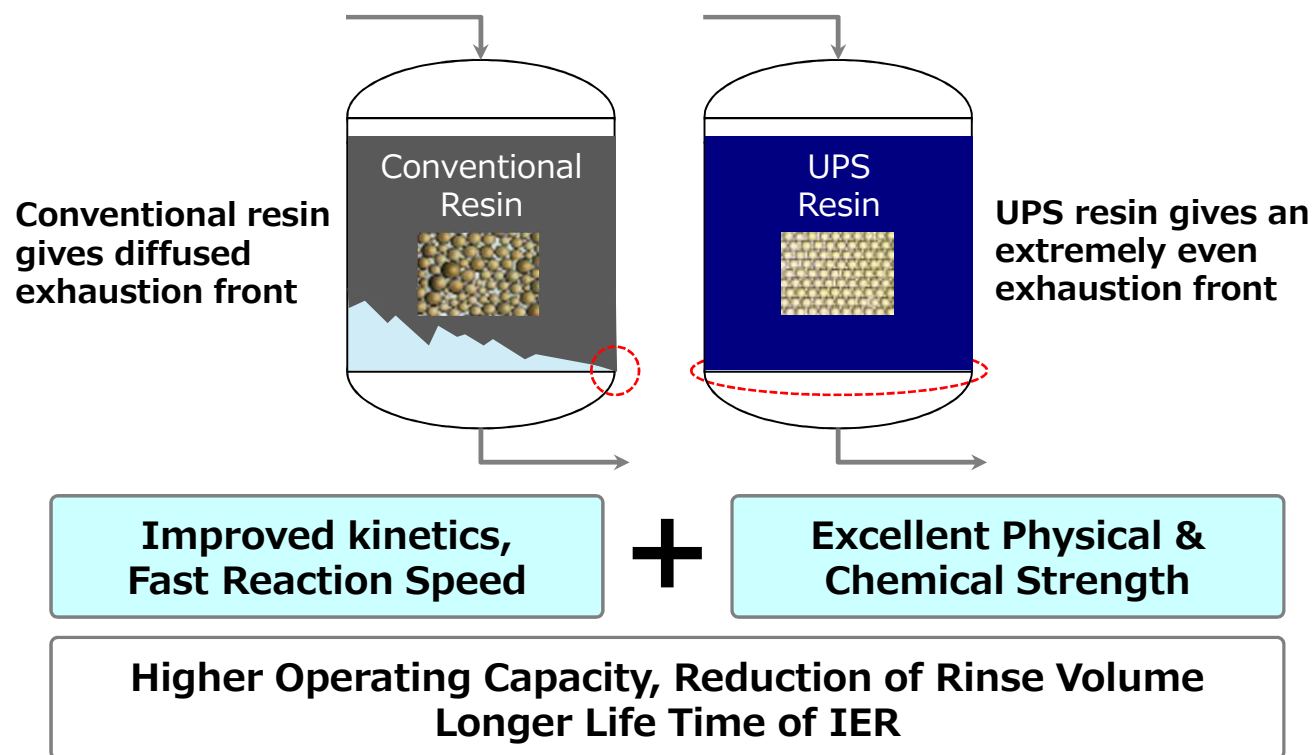


(Post-treatment - Functional Group)

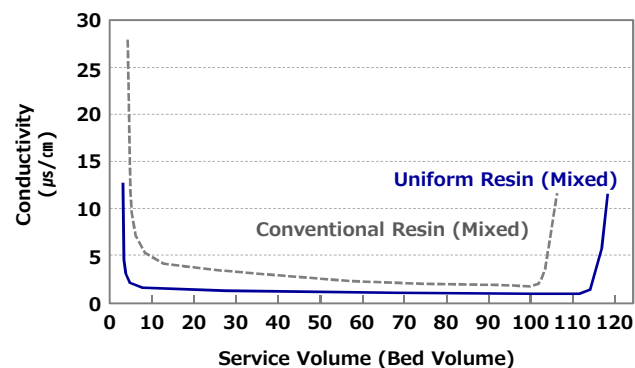
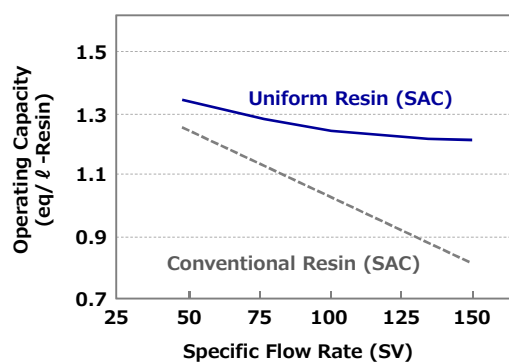


6. Next Generation IER, high performance low cost

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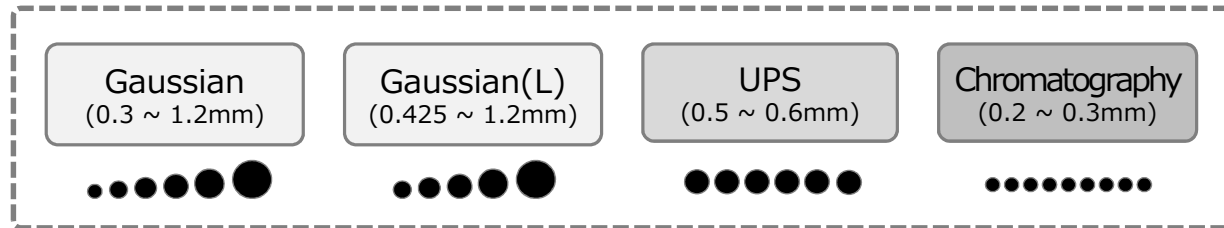


“Lower Running Cost and Capital Expenditure”

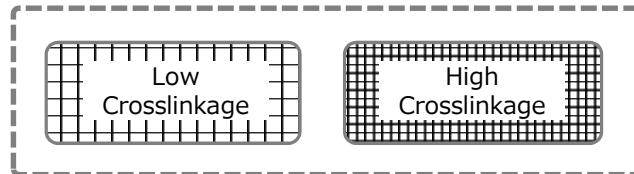


7. Product line of TRILITE

(Particle Distribution, Size)



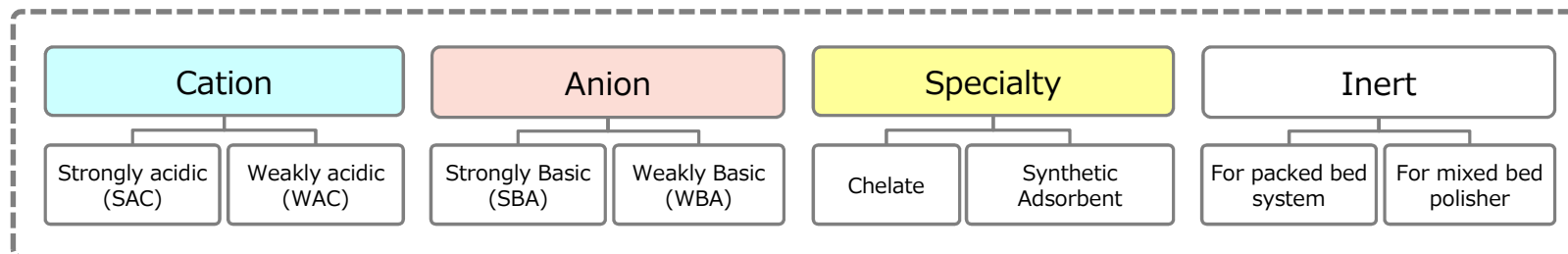
(Crosslinkage)



(Porosity)



(Functional Group)



(Post-treatment / Tailored Resin)



7. Product line of TRILITE

Water treatment

- Softening
- Demineralization
- Condensate polishing
- Nuclear power

Catalyst

Ultrapure water

Chromatography

- Fructose/glucose separation
- Amino acid separation
- Acid purification

Food

- Starch sugar refining
- Sugar refining
- Nucleic acid, lysine separation

Chelating resins

- Secondary brine purification
- Wastewater treatment

Synthetic adsorbents

Ready to use mixed resins

Layered bed anion resins

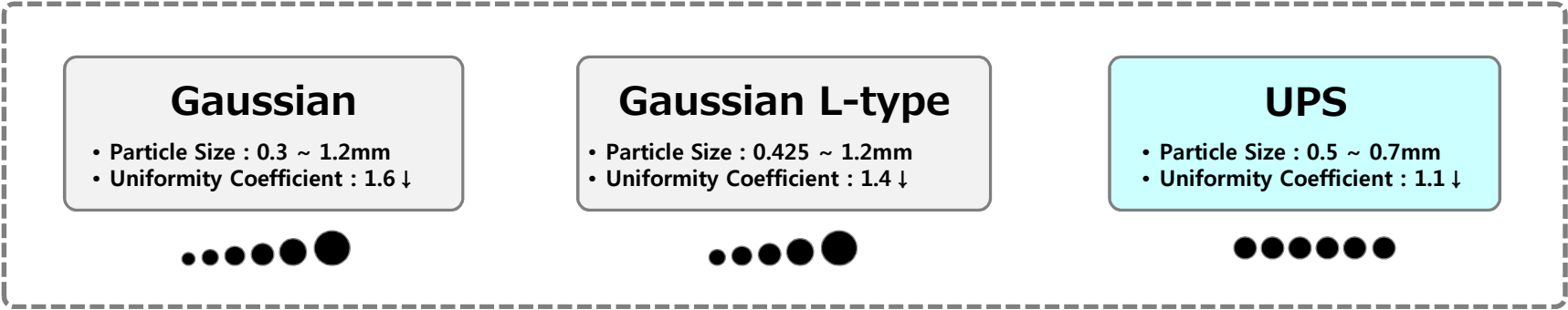
Inert resins

EO/EG cycle water treatment



7. Product line of TRILITE

(Particle Distribution, Size)



(Classification by IER layer)

Single Bed	
Layered Bed	
Mixed Bed	

(Classification by regeneration system)

Co-current Regeneration System	Counter-current Regeneration System		
	Water Blocking System	Packed Bed	
		Upflow System	Downflow System
Gaussian	Gaussian or L-type	UPS IER	

7. Product line of TRILITE

Water treatment



※ TEC: Total Exchange Capacity

Performance Product Line

Uniformity Coefficient (U.C)	Strongly acidic cation resins (SAC)		Strongly basic anion resins (SBA)		
	Grade name	TEC (eq/ℓ)	Type	Grade name	TEC (eq/ℓ)
1.1 ↓	MC-08	2.0 ↑	Type1	MA-12	1.3 ↑
	MC-10	2.2 ↑		MA-10	1.35 ↑
	MC-14	2.5 ↑		MA-15	1.4 ↑
			Type2	MA-20	1.3 ↑

Basic Product Line

1.4~1.6 ↓	SCR-B	2.0 ↑	Type1	SAR10	1.3 ↑
				SAR12	1.3 ↑
			Type2	SAR20	1.3 ↑

Economy Product Line

1.1~1.2 ↓	UKC-08	2.0 ↑	Type1	UKA-12	1.3 ↑
			WBA	AW80	1.5 ↑
1.4~1.6 ↓	KC-07	1.9 ↑	Type1	KA-10	1.3 ↑
	KH-70	1.9 ↑		KA-12	1.3 ↑
	KC-08	2.0 ↑	Type2	KA-20	1.3 ↑
	KH-80	2.0 ↑			



7. Product line of TRILITE

Water treatment

TRILITE
삼양 트리라이트
Ion Exchange Resin

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※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Type	Strongly acidic cation resins (SAC)			Strongly basic anion resins (SBA)			
		Grade name	TEC (eq/ ℓ)	Particle distribution	Type	Grade name	TEC (eq/ ℓ)	Particle distribution
Performance	UPS Gel 	MC-08	2.0 ↑	0.55~0.65mm	Type1	MA-12	1.3 ↑	0.53~0.63mm
		MC-08H	1.8 ↑	0.57~0.67mm		MA-12OH	1.0 ↑	0.57~0.67mm
		MC-10	2.2 ↑	0.60~0.70mm		MA-10	1.35 ↑	0.50~0.60mm
		MC-10H	1.9 ↑	0.61~0.71mm		MA-100H	1.0 ↑	0.54~0.64mm
		MC-14	2.5 ↑	0.60~0.70mm		MA-15	1.4 ↑	0.55~0.65mm
		MC-14H	2.4 ↑			MA-150H	1.2 ↑	0.58~0.68mm
					Type2	MA-20	1.3 ↑	0.53~0.63mm
Basic	Gaussian Gel 	SCR-B	2.0 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm	Type1	SAR10(MB)	1.3 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm
						SAR12	1.3 ↑	
					Type2	SAR20(MB)	1.3 ↑	
Economy	UPS Gel 	UKC-08	2.0 ↑	0.60~0.70mm	Type1	UKA-12	1.2 ↑	0.55~0.65mm
		UKC-10	2.2 ↑	0.60~0.70mm				
		UKC-12	2.3 ↑	0.60~0.70mm				
	Gaussian Gel 	KC-07	1.9 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm	Type1	KA-10	1.3 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm
		KH-70	1.9 ↑			KA-12	1.3 ↑	
		KC-08	2.0 ↑		Type2	KA-20	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)			
Performance	Gaussian, UPS Porous	WCA10L	4.2 ↑	0.425~1.2mm	WBA	AW90	1.6 ↑	0.50~0.60mm
Basic	UPS Porous					AW80	1.5 ↑	0.50~0.60mm
Economy	Gaussian Porous					AW30L	1.5 ↑	0.425~1.2mm
	Functional group	(Polystyrene+DVB) + Carboxylate			(Polystyrene+DVB) + Tertiary Amine			

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7. Product line of TRILITE

Water treatment

TRILITE
삼양 트리라이트
Ion Exchange Resin

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

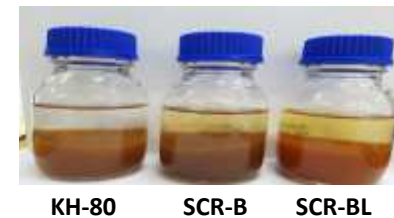
Sodium hypochlorite(NaClO), Free chlorine(Cl₂), Ozone(O₃)

When softeners are used with oxidizing agents such as sodium hypochlorite or free chlorine, it is recommended to use highly crosslinked strongly acidic cation ion exchange resin with high resistance to oxidation.

IER Selection		ClO ₂ Concentration	Cl ₂ or O ₃ Concentration
Performance	MC-08	0.1ppm ↓	0.2ppm ↓
Basic	SCR-B		
Economy	KC-07, KC-08		
Performance	MC-10	0.15ppm ↓	0.3ppm ↓
Economy	UKC-10		
Economy	UKC-12	0.2ppm ↓	0.4ppm ↓

Food grade softening

When food grade softening is required, it is needed to select a suitable food grade ion exchange resin. Examples are as follows.



(NSF Test method)
100 ml of ion exchange resin is put into 100 ml of water at 70°C, and APHA(unit of chromaticity) is measured with a visible spectrophotometer.

IER	Grade	Spec.	Day 1	Day 2	Day 3	Day 4	Day 7
KH-80	Food	< 25	12	13	13	13	14
SCR-B	Tech	-	145	149	153	160	183
SCR-BL	Tech	-	53	55	191	257	347

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7. Product line of TRILITE

Water treatment

TRILITE
삼양 트리라이트
Ion Exchange Resin

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Demineralization system		Line	SAC	SBA	WAC	WBA
2B2T (2Bed 2Tower) Cation Exchanger + Anion Exchanger 2B3T Cation Exchanger + Degasifier + Anion Exchanger		Performance	MC-08 MC-10	MA-12 MA-20		
		Basic	SCR-B	SAR10 SAR20		
		Economy	UKC-08 UKC-10 KC-08	UKA-12 KA-12 KA-20		
Working MB (Mixed Bed)		Performance	MC-08	MA-20P		
		Basic	SCR-B	SAR20MB		
2B2T or 2B3T + MBP (Mixed Bed Polisher)		Performance	MC-08 MC-10	MA-10P		
		Basic	SCR-B	SAR10MB		
3B3T+MBP		Performance	MC-08 MC-10	KA18LB		AW90
		Basic	SCR-B	KA18LB		AW80
		Economy	UKC-08 UKC-10	KA18LB		AW30L
4B3T+MBP		Performance	MC-08 MC-10	KA18LB	WCA10L	AW90
		Basic	SCR-B	KA18LB	WCA10L	AW80
		Economy	UKC-08 UKC-10	KA18LB	WCA10L	AW30L
4B3T+MBP+ CPP (Condensate Polisher)		Performance	MC-10H MC-14H	MA-100H MA-150H		

※ 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.

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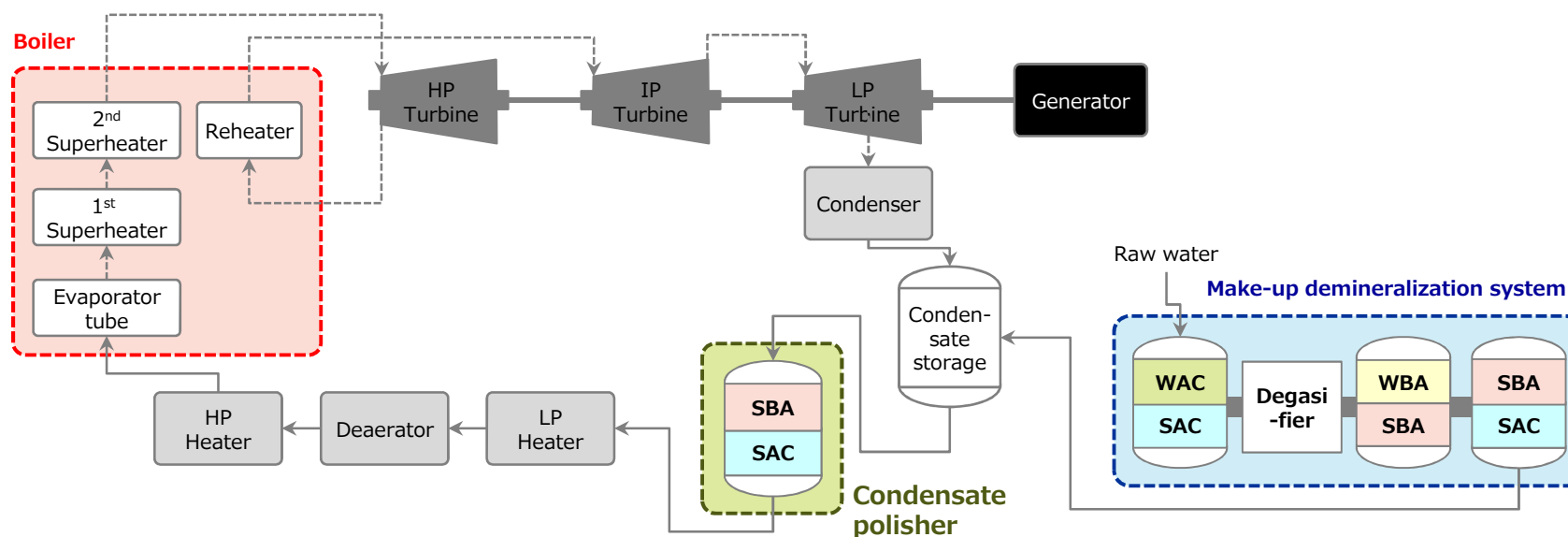
7. Product line of TRILITE

Water treatment

TRILITE
삼양 트리라이트
Ion Exchange Resin

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(Typical power plant steam turbine loop and IER selection)



Fast kinetics according to high uniformity, higher separation rate between Cation & Anion, high physical & chemical strength

Condensate polishing resins							
Strongly acidic cation resins (SAC)				Strongly basic anion resins (SBA)			
Type	Grade name	TEC (eq/ℓ)	Particle distribution	Type	Grade name	TEC (eq/ℓ)	Particle distribution
Gaussian	Porous 	CMP28L	2.05 ↑	Porous type1	AMP18L	1.3 ↑	0.425~1.2mm
		CMP28LH	1.8 ↑		AMP18LOH	1.0 ↑	
UPS	Gel 	MC-10	2.2 ↑	Gel type1	MA-10	1.35 ↑	0.50~0.60mm
		MC-10H	1.9 ↑		MA-10OH	1.0 ↑	0.54~0.64mm
		MC-14	2.5 ↑		MA-15	1.4 ↑	0.55~0.65mm
		MC-14H	2.4 ↑		MA-15OH	1.2 ↑	0.58~0.68mm

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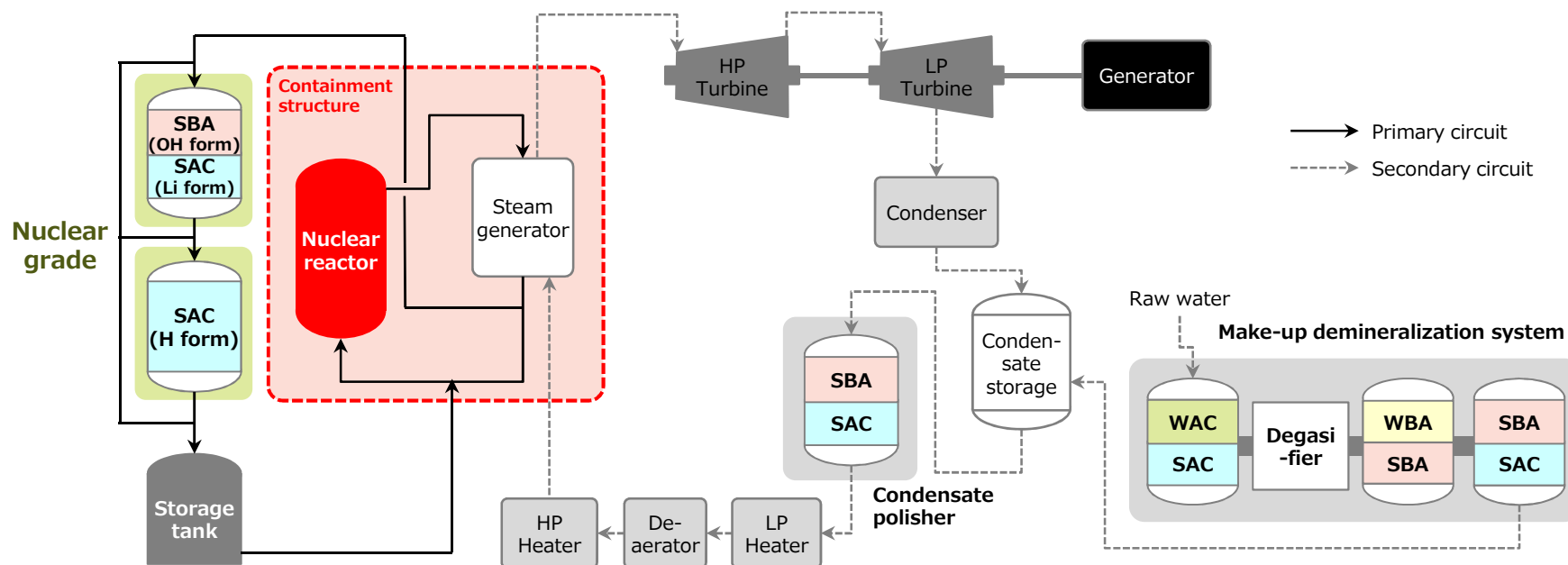
7. Product line of TRILITE

Water treatment

TRILITE
삼양 트리라이트
Ion Exchange Resin

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(Pressure water reactor type nuclear power plant steam turbine loop and IER selection)



High ion exchange capacity with high crosslinkage, low TOC leakage with less rinse water consumption
High conversion rate to ensure maximum ionic load & minimum kinetic leakage, very low level of heavy metal ion impurities

Nuclear Grade resins (for primary circuit)								
Strongly acidic cation resins (SAC)					Strongly basic anion resins (SBA)			
Type	Grade name	TEC (eq/ ℓ)	Particle distribution		Type	Grade name	TEC (eq/ ℓ)	Particle distribution
Gel	MCN116K	2.4 ↑	0.60~0.70mm		Gel type1	MAN210K	1.1 ↑	0.58~0.65mm
MMN316K / Mixed Resin ratio = 1 : 1 as same equivalent (MCN116K : MAN210K)								

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삼양 트리라이트
Ion Exchange Resin

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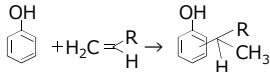
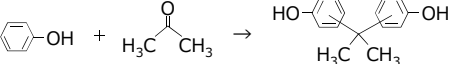
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7. Product line of TRILITE

※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Strongly acidic cation resins for catalyst (SAC for catalyst)								
	Type	Grade name	TEC (eq/ℓ)	Particle distribution		Type	Grade name	TEC (eq/ℓ)	Particle distribution
Gaussian	Gel catalyst	PCC30H	1.1 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm (XL-type) 0.7~1.2mm	UPS	Gel catalyst	MC-04H	1.2 ↑	0.47~0.57mm
		PCC40H	1.2 ↑						
	Porous Catalyst 	CMP08H	1.0 ↑		Gaussian	Porous Catalyst 	SPC400H	1.0 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm
		CMP28H	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	Catalytic resins	Equivalent
Hydrolysis of methyl acetate	$\text{CH}_3\text{COOCH}_3 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COOH} + \text{CH}_3\text{OH}$	CMP08LH	
Esterification reaction	$\text{RCOOH} + \text{ROH} \rightarrow \text{RCOOR} + \text{H}_2\text{O}$	PCC40H, MC-08H, CMP08LH, SPC160H, SPC180H, SPC400LH	
Synthesis of methyl methacrylate	$\text{CH}_2 = \text{C} \begin{smallmatrix} \text{CH}_3 \\ \text{COOH} \end{smallmatrix} + \text{CH}_3\text{OH} \rightarrow \text{CH}_2 = \text{C} \begin{smallmatrix} \text{CH}_3 \\ \text{COOCH}_3 \end{smallmatrix} + \text{H}_2\text{O}$	SPC180H	
Alkylation of phenol		SPC260H, SPC320H	Amberlyst15Wet
Synthesis of Bisphenol A		PCC30H, PCC40H	
Methyl tertiary butyl ether(MTBE)	$\text{H}_2\text{C} = \text{C}(\text{CH}_3)_2 + \text{CH}_3\text{OH} \rightarrow \text{H}_3\text{C} - \text{C}(\text{CH}_3)_2 - \text{OMe}$	SPC280H	Amberlyst35Wet
t-amyl methyl ether(TAME)	$\text{H}_2\text{C} = \text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3 + \text{CH}_3\text{OH} \rightarrow \text{H}_3\text{C} - \text{C}(\text{CH}_3)(\text{CH}_2\text{CH}_3) - \text{OMe}$	SPC160H, SPC180H	



7. Product line of TRILITE

Ultrapure water

TRILITE
삼양 트리라이트
Ion Exchange Resin

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	Ultrapure water grade cation resins					Ultrapure water grade anion resins				
	Type	Grade name	TEC (eq/ℓ)	Outlet condition	Particle distribution	Type	Grade name	TEC (eq/ℓ)	Outlet condition	Particle distribution
UPS	Gel	UPRC100U	1.8 ↑	Guarantee) Resistivity > 17.0 MΩ·cm (in 10min.)	0.57~0.67mm	Gel type1	UPRA100U	1.0 ↑	Guarantee) Resistivity > 17.0 MΩ·cm (in 10min.)	0.57~0.67mm
		UPRC120U	1.9 ↑	Actual) Resistivity > 18.0 MΩ·cm (in 10min.)	0.61~0.71mm		UPRA120U	1.0 ↑	Actual) Resistivity > 18.0 MΩ·cm (in 10min.)	0.54~0.64mm
							UPRA140U	1.2 ↑		0.58~0.68mm
		UPRC200U	1.8 ↑	Resistivity > 18.1MΩ·cm (in 30min)	0.57~0.67mm		UPRA200U	1.0 ↑	Resistivity > 18.1MΩ·cm (in 30min)	0.57~0.67mm
		UPRC220U	1.9 ↑	△TOC<5ppb (in 120min)	0.61~0.71mm		UPRA220U	1.0 ↑	△TOC<5ppb (in 120min)	0.54~0.64mm
							UPRA240U	1.2 ↑		0.58~0.68mm
		UPRC300U	1.8 ↑	Resistivity > 18.2MΩ·cm (in 30min)	0.57~0.67mm		UPRA300U	1.0 ↑	Resistivity > 18.2MΩ·cm (in 30min)	0.57~0.67mm
		UPRC320U	1.9 ↑	△TOC<1ppb (in 180min)	0.61~0.71mm		UPRA320U	1.0 ↑	△TOC<1ppb (in 180min)	0.54~0.64mm
							UPRA340U	1.2 ↑		0.58~0.68mm

Ultrapure water grade mixed resins										
	Type	Grade		Cation TEC		Anion TEC	H ⁺ (%)	OH ⁻ (%)	Cl ⁻ (%)	Outlet condition
UPS	Gel	UPRM100U	=	1.8 ↑	+	1.0 ↑	99.0 ↑	90.0 ↑	1.0 ↓	Guarantee) Resistivity > 17.0 MΩ·cm (in 10min.) Actual) Resistivity > 18.0 MΩ·cm (in 10min.)
		UPRM120U	=	1.9 ↑	+	1.0 ↑	99.0 ↑	90.0 ↑	1.0 ↓	
		UPRM140U	=	1.9 ↑	+	1.2 ↑	99.0 ↑	90.0 ↑	1.0 ↓	
		UPRM200U	=	1.8 ↑	+	1.0 ↑	99.0 ↑	95.0 ↑	1.0 ↓	Resistivity > 18.1MΩ·cm (in 30min) △TOC<5ppb (in 120min)
		UPRM220U	=	1.9 ↑	+	1.0 ↑	99.0 ↑	95.0 ↑	1.0 ↓	
		UPRM240U	=	1.9 ↑	+	1.2 ↑	99.0 ↑	95.0 ↑	1.0 ↓	
		UPRM300U	=	1.8 ↑	+	1.0 ↑	99.9 ↑	97.0 ↑	0.1 ↓	Resistivity > 18.2MΩ·cm (in 30min) △TOC<1ppb (in 180min) Na<1, Fe<1, Ca<1, Zn<0.5, Al<0.5, Cu<0.5
		UPRM320U	=	1.9 ↑	+	1.0 ↑	99.9 ↑	97.0 ↑	0.1 ↓	
		UPRM340U	=	1.9 ↑	+	1.2 ↑	99.9 ↑	97.0 ↑	0.1 ↓	

※ Feed water(100 Series) : Conductivity 10μs/cm RO outlet, SV36 Feed water(200, 300 Series) : Resistivity > 17.5MΩ·cm, TOC<2ppb, SV=30

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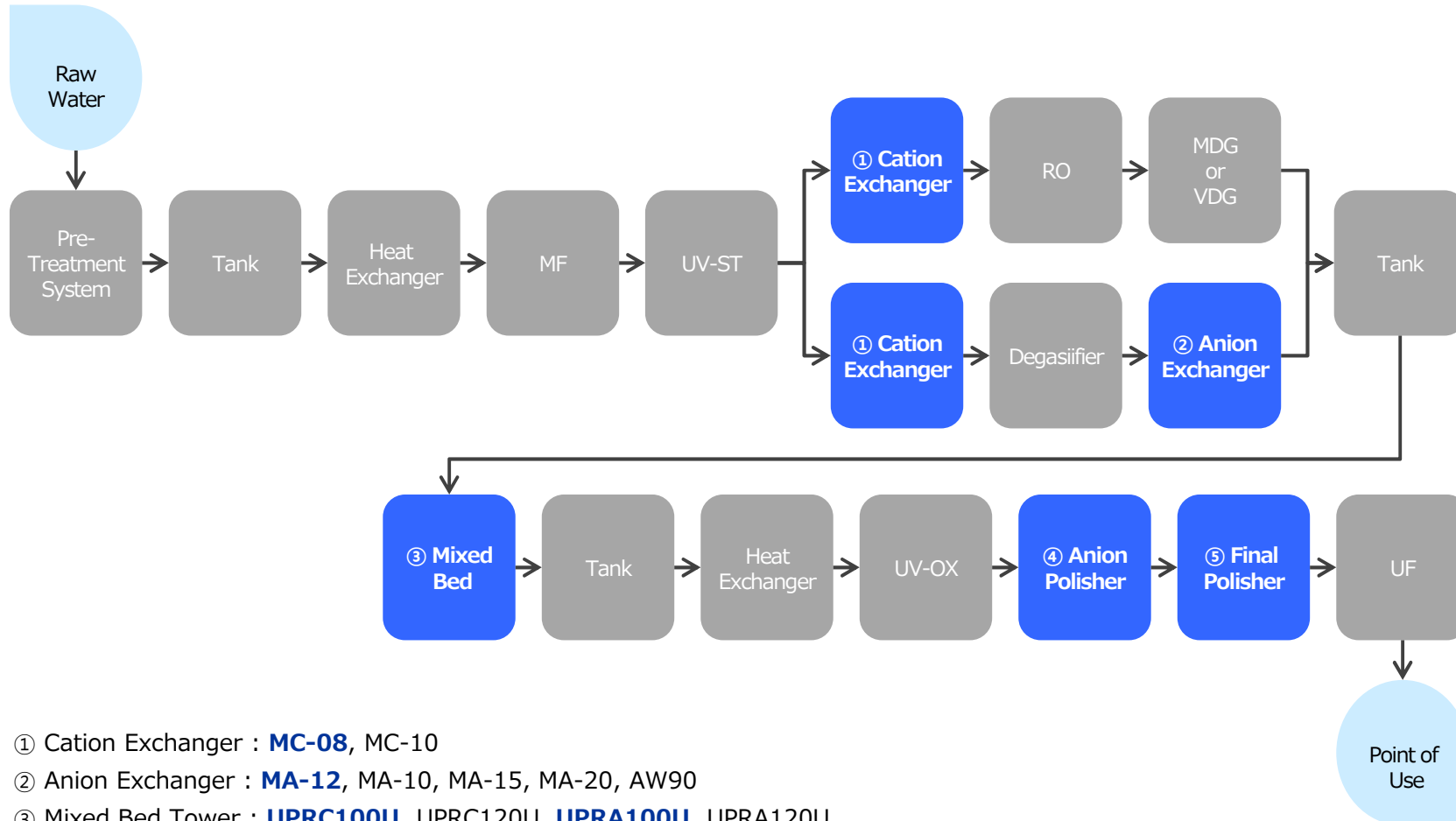
7. Product line of TRILITE

Ultrapure water

TRILITE
삼양 트리라이트
Ion Exchange Resin

19/49

(Demineralization system for ultrapure water and IER selection)



① Cation Exchanger : **MC-08**, MC-10

② Anion Exchanger : **MA-12**, MA-10, MA-15, MA-20, AW90

③ Mixed Bed Tower : **UPRC100U**, UPRC120U, **UPRA100U**, UPRA120U

④ Anion Polisher : **UPRA200U**, UPRA220U, UPRA240U, **UPRA300U**, UPRA320U, UPRA340U

⑤ Final Polisher : **UPRM200U**, UPRM220U, UPRM240U, **UPRM300U**, UPRM320U, UPRM340U

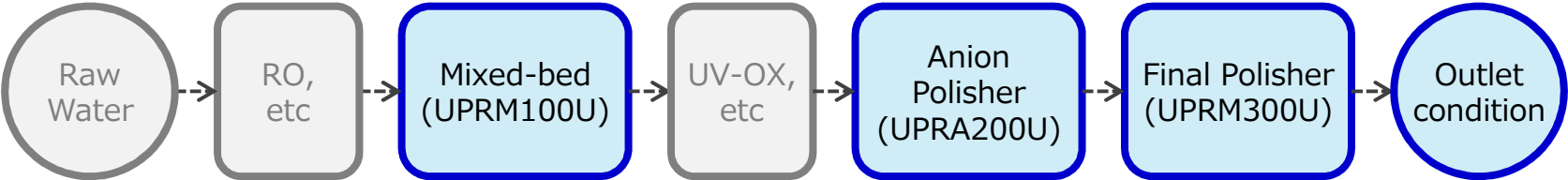


7. Product line of TRILITE

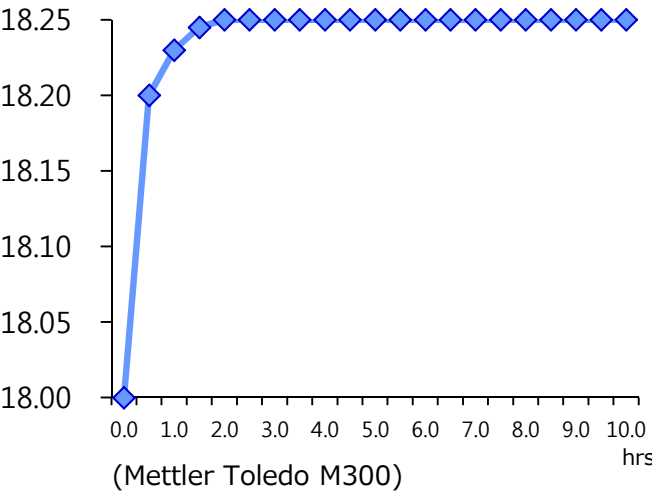
Ultrapure water

TRILITE
삼양 트리라이트
Ion Exchange Resin

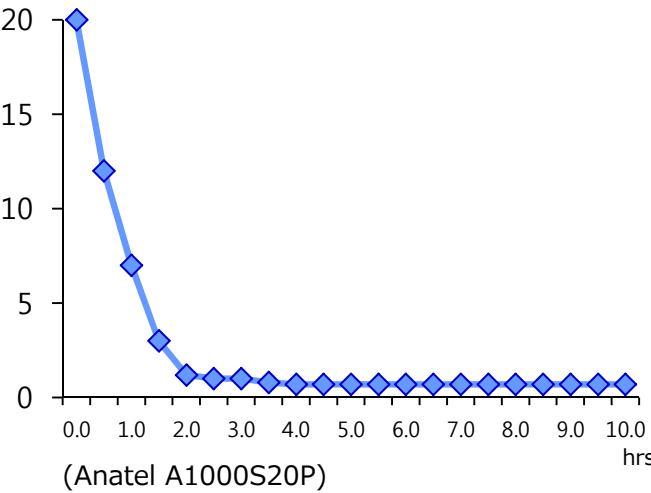
(Outlet condition of TRILITE UPW Resins)



① Resistivity (MΩ·cm)



② TOC (ppb)



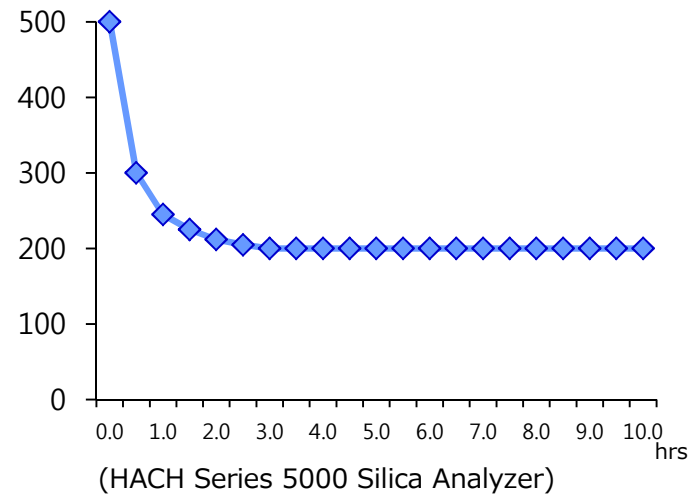
7. Product line of TRILITE

Ultrapure water

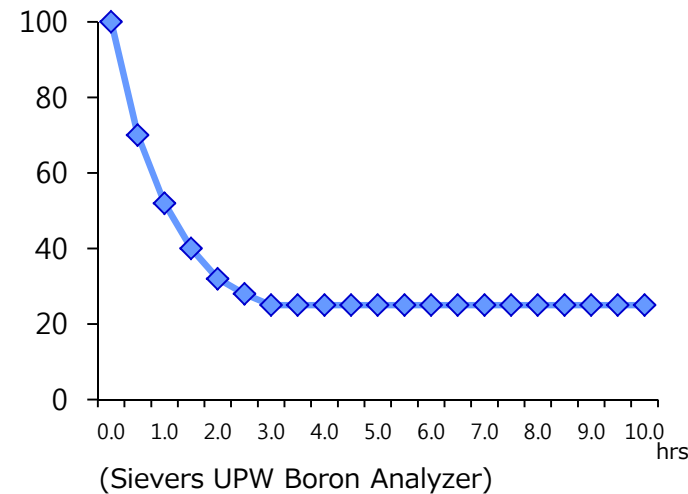
TRILITE
삼양 트리라이트
Ion Exchange Resin

(Outlet condition of TRILITE UPW Resins)

③ Total Silica (ppt)



④ Boron (ppt)



⑤ Metals (ppt)

Li	Be	Na	Mg	Al	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu
< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Zn	Ga	As	Sr	Mo	Ag	Cd	Sn	Sb	Ba	Au	Pb	Bi	
< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	

⑥ Particle (0.05 μ m/ml): None
(RION XP-L4W)

7. Product line of TRILITE

Chromatography

TRILITE
삼양 트리라이트
Ion Exchange Resin

※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin		Chromatography cation resins				Chromatography anion resins																																																										
		Type	Grade name	TEC (eq/ ℓ)	Ionic form	Particle distribution	Type	Grade name	TEC (eq/ ℓ)	Ionic form	Particle distribution																																																					
UPS 	Gel	MCK-30	1.6 ↑	Na	210~230μm	Gel type1	MA-13J	1.35 ↑	Cl	270~330μm																																																						
		MCK-32	1.6 ↑	K	205~220μm		MA-13F	1.4 ↑	Cl	220~240μm																																																						
		MCK-35	1.6 ↑	Ca	200~220μm	Gel type2	MA-23F	1.4 ↑	Cl	220~240μm																																																						
		MCK-30J	1.6 ↑	Na	290~300μm		<table><tr><th colspan="2"></th><th>Ionic form</th><th>Grade Example</th><th>Application Example</th></tr><tr><td colspan="2" rowspan="3">UPS SAC Gel Type</td><td>Na</td><td>MCK-30</td><td>Glucose/Oligosaccharide</td></tr><tr><td>K</td><td>MCK-22M</td><td>Sucrose from molasses</td></tr><tr><td>Ca</td><td>MCK-55</td><td>Fructose/Glucose</td></tr><tr><td rowspan="2">UPS SBA Gel Type</td><td>Type1</td><td rowspan="2">Cl</td><td>MA-13J</td><td>Biodiesel refining</td></tr><tr><td>Type2</td><td>MA-23F</td><td>Acid purification</td></tr><tr><td colspan="5"></td></tr><tr><td colspan="5"></td></tr><tr><td colspan="5"></td></tr><tr><td colspan="5"></td></tr><tr><td colspan="5"></td></tr><tr><td colspan="5"></td></tr></table>							Ionic form	Grade Example	Application Example	UPS SAC Gel Type		Na	MCK-30	Glucose/Oligosaccharide	K	MCK-22M	Sucrose from molasses	Ca	MCK-55	Fructose/Glucose	UPS SBA Gel Type	Type1	Cl	MA-13J	Biodiesel refining	Type2	MA-23F	Acid purification																													
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			Type2		MA-23F	Acid purification																																																										
		MCK-32J	1.6 ↑	K	280~295μm																																																											
		MCK-35J	1.6 ↑	Ca	280~285μm																																																											
		MCK-30L	1.6 ↑	Na	310~345μm																																																											
MCK-32L	1.6 ↑	K	320~340μm																																																													
MCK-35L	1.6 ↑	Ca	300~330μm																																																													
MCK-30K	1.6 ↑	Na	340~360μm																																																													
MCK-32K	1.6 ↑	K	330~360μm																																																													
MCK-35K	1.7 ↑	Ca	330~360μm																																																													
MCK-35M	1.6 ↑	Ca	290~320μm																																																													
MCK-22K	1.6 ↑	K	335~365μm																																																													
MCK-22M	1.6 ↑	K	290~320μm																																																													
MCK-50	1.9 ↑	Na	210~220μm																																																													
MCK-52	2.0 ↑	K	205~225μm																																																													
MCK-55	2.0 ↑	Ca	200~220μm																																																													
Functional group	Sulfonate				Type1 : TMA, trimethylamine Type2 : DMEA, dimethylethanolamine																																																											



7. Product line of TRILITE

(MCK series are the best choice as resins for chromatographic separation)

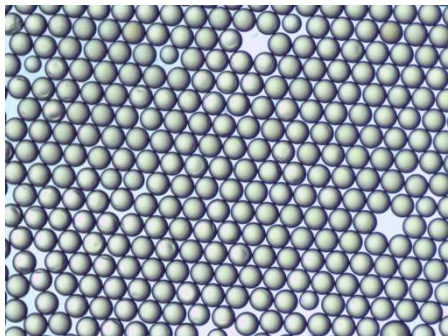
TRILITE MCK series are high quality uniform particle sized strongly acidic cation exchange resins used for chromatographic separation.

TRILITE MCK series are developed and manufactured by state-of-the-art technology, providing excellent characteristics and resin performance.

Lower uniformity coefficient (1.05~1.10) than other resins for chromatographic separation
→ Excellent separation efficiency



Higher physical & chemical strength
→ Longer life time



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

※ The data of crosslinkage and average particle size is reference

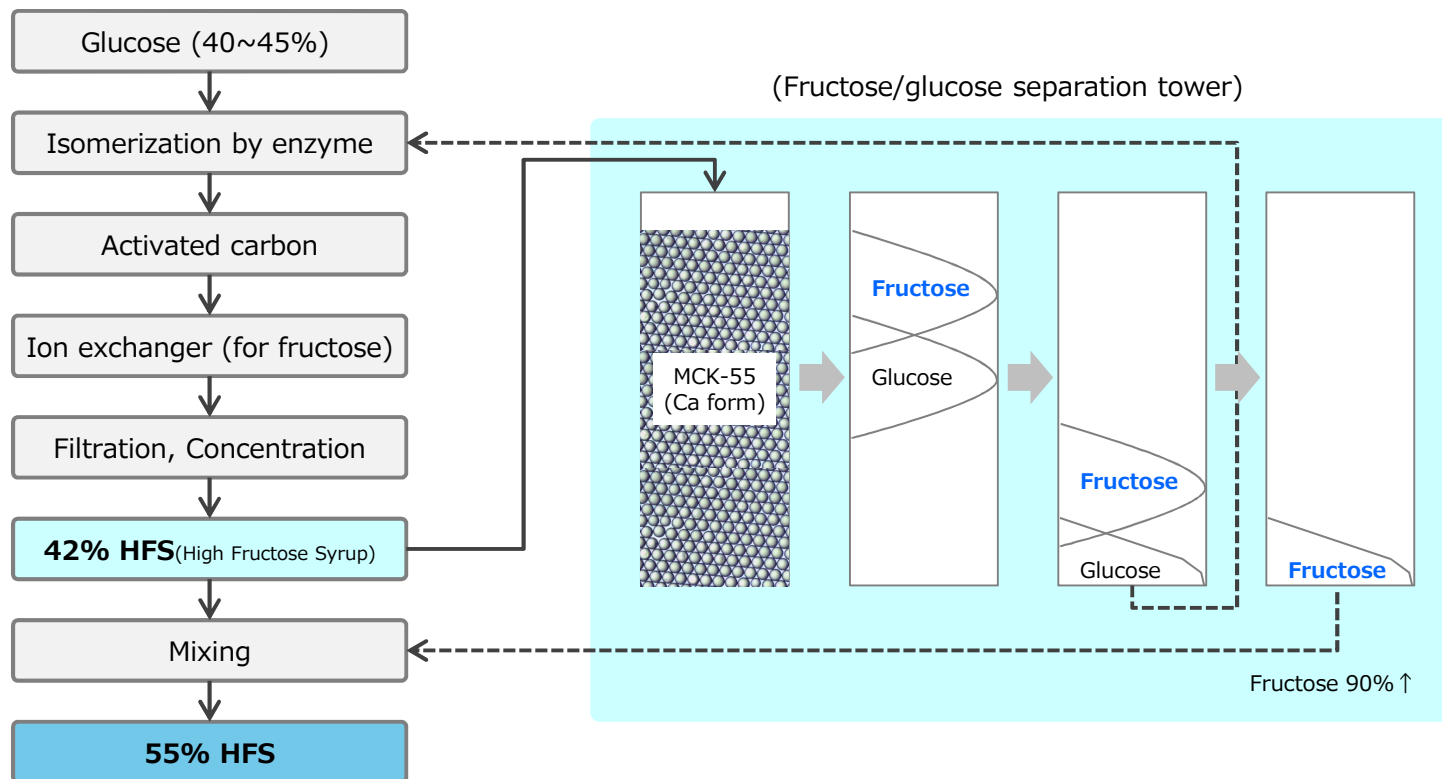


7. Product line of TRILITE

(Fructose/glucose separation by MCK-55)

Isomerization of fructose by the use of enzyme produces 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%, with 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 layers, glucose moves slower than fructose as it has a higher affinity with Ca ion. In this principal, fructose elutes in before the glucose. The collection of glucose is sold as a finished product, and the fructose is put to the previous process to react with isomerization enzyme.



7. Product line of TRILITE

Starch sugar

TRILITE
삼양 트리라이트
Ion Exchange Resin

25/49

※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Strongly acidic cation resins (SAC)				Strongly basic anion resins (SBA)			
	Type	Grade name	TEC (eq/ℓ)	Particle distribution	Type	Grade name	TEC (eq/ℓ)	Particle distribution
Gaussian	Gel	SCRB	2.0 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm	Porous type2	AMP24	1.0 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm
	Porous	CMP18	1.8 ↑					
UPS	Gel	MC-08	2.0 ↑	0.55~0.65mm				
Functional group	Sulfonate				Type2 : DMEA, dimethylethanolamine			

TRILITE 삼양 트리라이트 Ion Exchange Resin	Weakly basic anion resins (WBA)					
	Type	Grade name	TEC (eq/ ℓ)	SBA/WBA Ratio	Particle distribution	Application
Gaussian	Porous	AW30L	1.5 ↑	25/75	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm	It can be used economically for the decolorization process and it is widely used in the starch sugar refining process. However, SBA ratio is a little bit high, so it should be used with caution in processes where isomerization reaction is concerned.
UPS		AW30C	1.6 ↑	5/95		High WBA ratio and excellent resistance to high temperature (100℃ ↓). It can be used in a process that the temperature of the process liquid is high or isomerization reaction is concerned(Fructose refining).
		AW90	1.6 ↑	17/83	0.50~0.60mm	Low uniformity coefficient, it is recommended to be used in upflow process.
Functional group	Tertiary Amine					



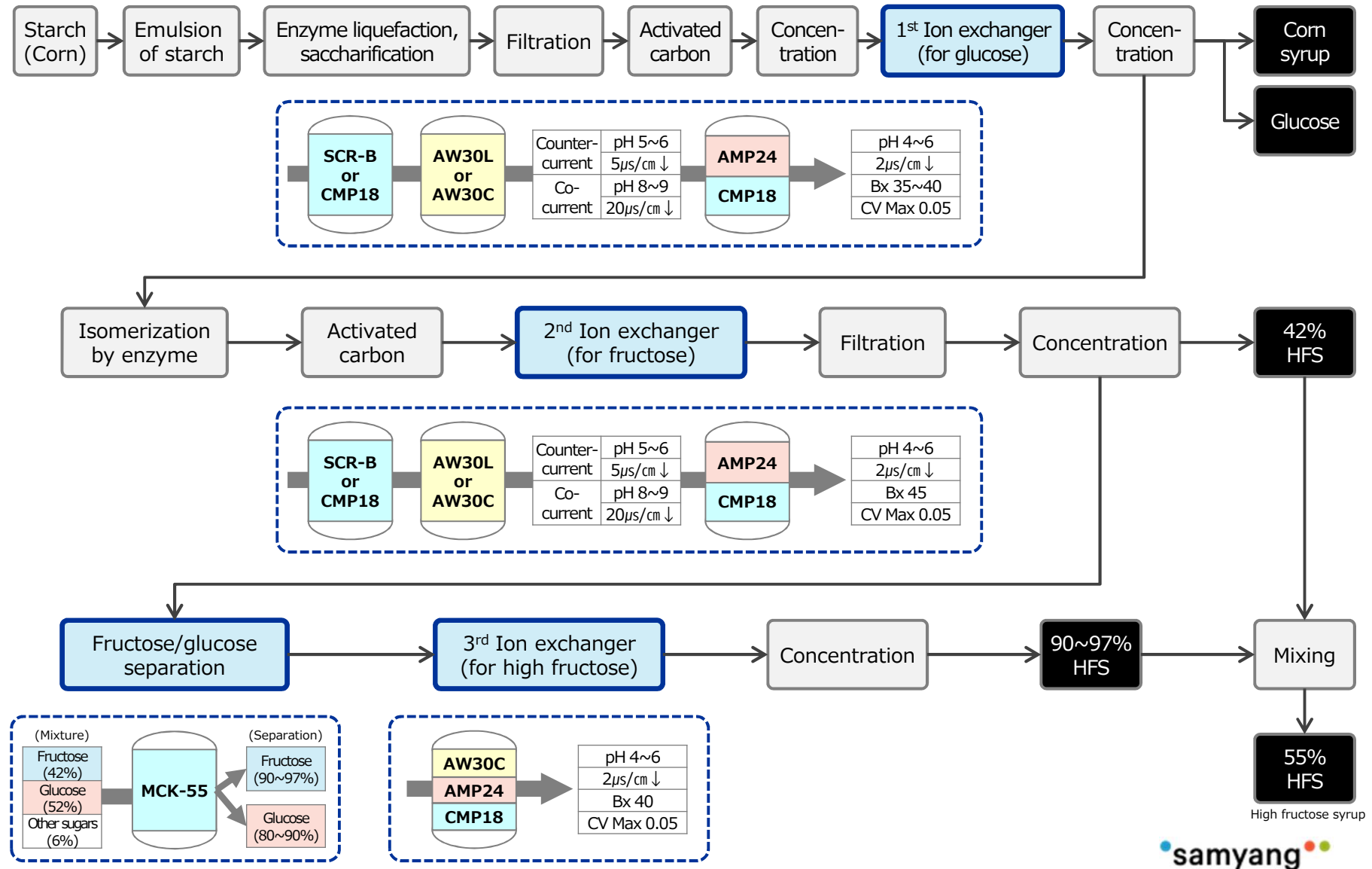
7. Product line of TRILITE

Starch sugar

TRILITE
삼양 트리라이트
Ion Exchange Resin

26/49

(Typical process of starch sugar refining and fructose/glucose separation)



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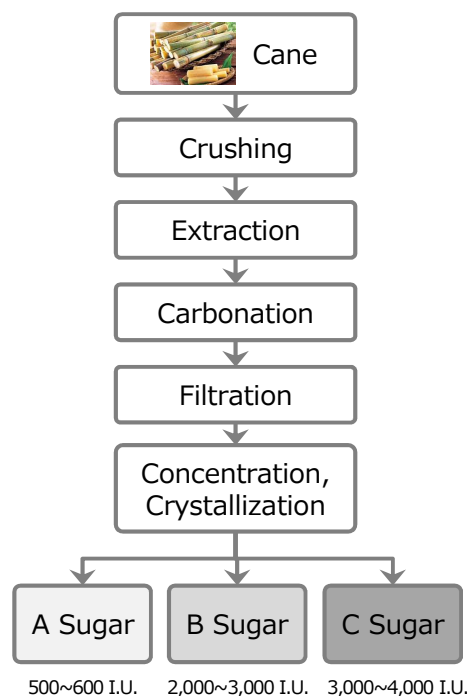


7. Product line of TRILITE

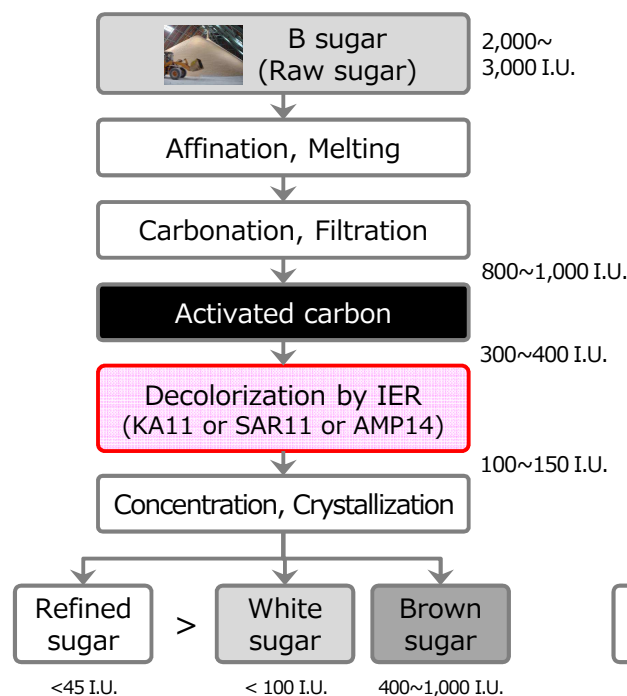
※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Sugar refining resins (With activated carbon)				Sugar refining resins (Without activated carbon)			
	Type	Grade name	TEC (eq/ ℓ)	Particle distribution	Type	Grade name	TEC (eq/ ℓ)	Particle distribution
Gaussian	Gel type1	KA-11 SAR11	0.9 ↑	(General type) 0.3~1.2mm (L-type) 0.425~1.2mm	Porous (Polyacrylate +DVB)	ASP10	0.9 ↑	0.425~1.2mm
	Porous type1 (Polystyrene +DVB)	AMP14	1.0 ↑					
Functional group	TMA, trimethylamine				Quaternary ammonium			

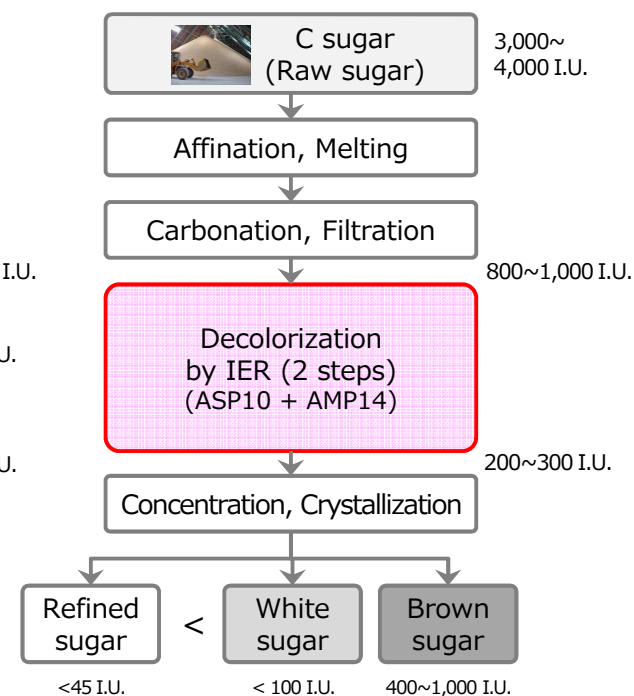
(Cane raw sugar refining process)



(Sugar refining process with A/C)



(Sugar refining process without A/C)



7. Product line of TRILITE

Nucleic acid, Lysine

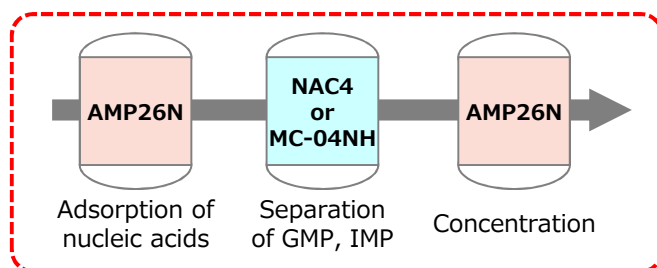
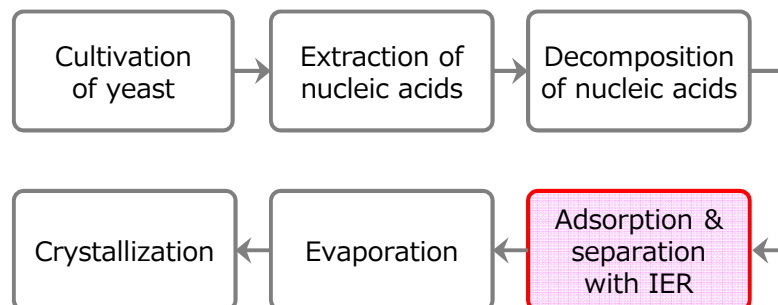
TRILITE
삼양 트리라이트
Ion Exchange Resin

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※ TEC: Total Exchange Capacity

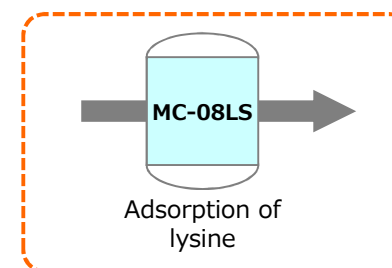
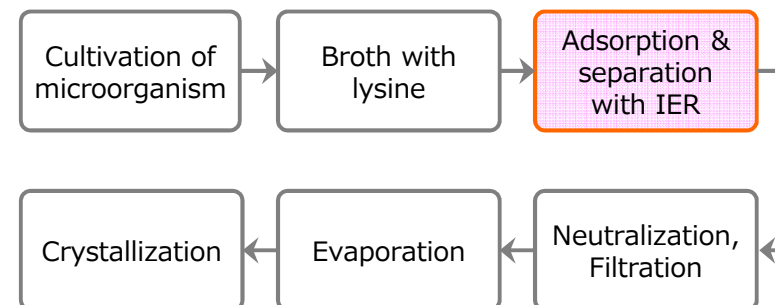
	Nucleic acids adsorption resins				Lysine adsorption resins			
	Type	Grade name	TEC (eq/ℓ)	Particle distribution	Type	Grade name	TEC (eq/ℓ)	Particle distribution
Gaussian	Gel tailored SAC	NAC4	1.2 ↑	(General type) 0.3~1.2mm				
	Porous tailored SBA	AMP26N	1.2 ↑	(L-type) 0.425~1.2mm				
UPS	Gel	MC-04NH	1.2 ↑	0.47~0.57mm	Gel tailored SAC	MC-08LS	2.0 ↑	0.55~0.65mm

(Typical process of nucleic acid adsorption/separation process)



※ GMP : Guanosine monophosphate
IMP : Inosine monophosphate

(Typical process of lysine adsorption/separation process)



※ Lysine : essential amino acid



7. Product line of TRILITE

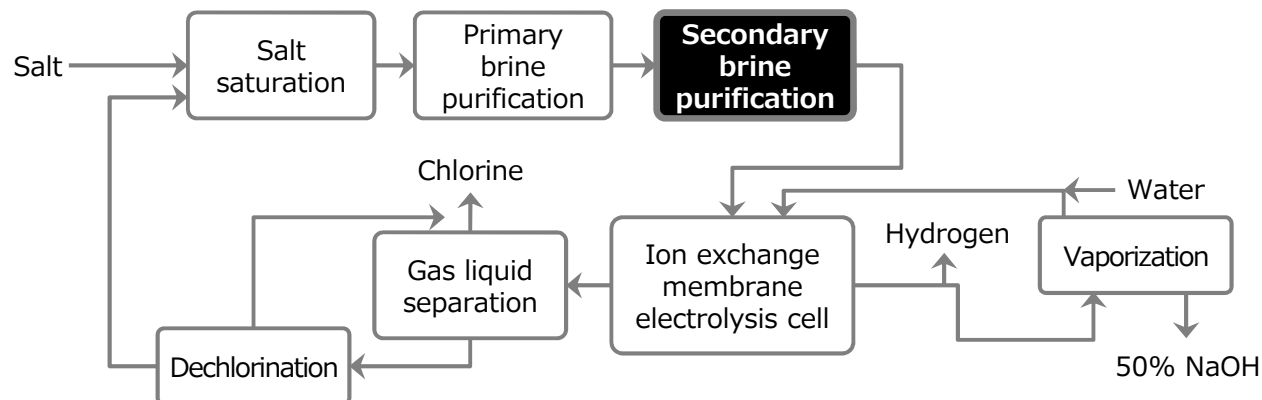
Chelating resins

TRILITE
삼양 트리라이트
Ion Exchange Resin

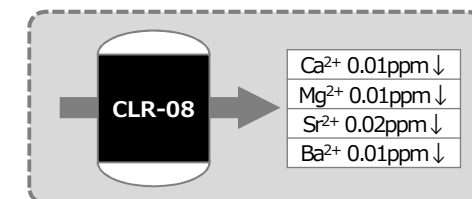
29/49

	Chelating resins						
	Grade name	Functional group	Ionic form	TEC (eq/ℓ)	Particle distribution	Application	Equivalent
Gaussian	CLR-08	Iminodiacetate	Na	Cu^{2+} 0.5 ↑ Ca^{2+} 0.4 ↑	0.4~1.0mm	Brine purification	Lewatit TP208 Amberlite IRC748 Diaion CR11 Purolite S930
	CLR-09	Aminomethyl phosphonate	Na	Ca^{2+} 0.6 ↑	0.4~1.0mm	Brine purification	Lewatit TP260 Amberlite IRC747 Purolite S940
	CLR-10	Thiouronium	H	1.1 ↑	0.3~1.25mm	Mercury removal	Eporous-Z7 Purolite S924
	CLR-20	Polyamine	OH	4mol as copper ↑	0.4~1.25mm	Heavy metal removal	Diaion CR20 Eporous MX-8C
	CLR-B3	Glucamine	Free base	0.6eq/ℓ as boron ↑	0.3~1.25mm	Boron removal	Diaion CRB03 Amberlite IRA743 Purolite S108
	CLR-B3UP	Glucamine	Free base	0.6eq/ℓ as boron ↑	0.3~1.25mm	Boron polisher (TOC 5ppb ↓)	Diaion CRBT03
	CLR-F	Aminophosphonate	Al	11g as fluorine ↑	0.3~1.0mm	Fluoride removal	Eporous-K1
	CLR-N	Triethylamine	Cl	1.0 ↑	0.3~1.25mm	Nitrate removal	Amberlite IRA996 Purolite A520E

(Typical process of chloro-alkali process)



(Secondary brine purification)



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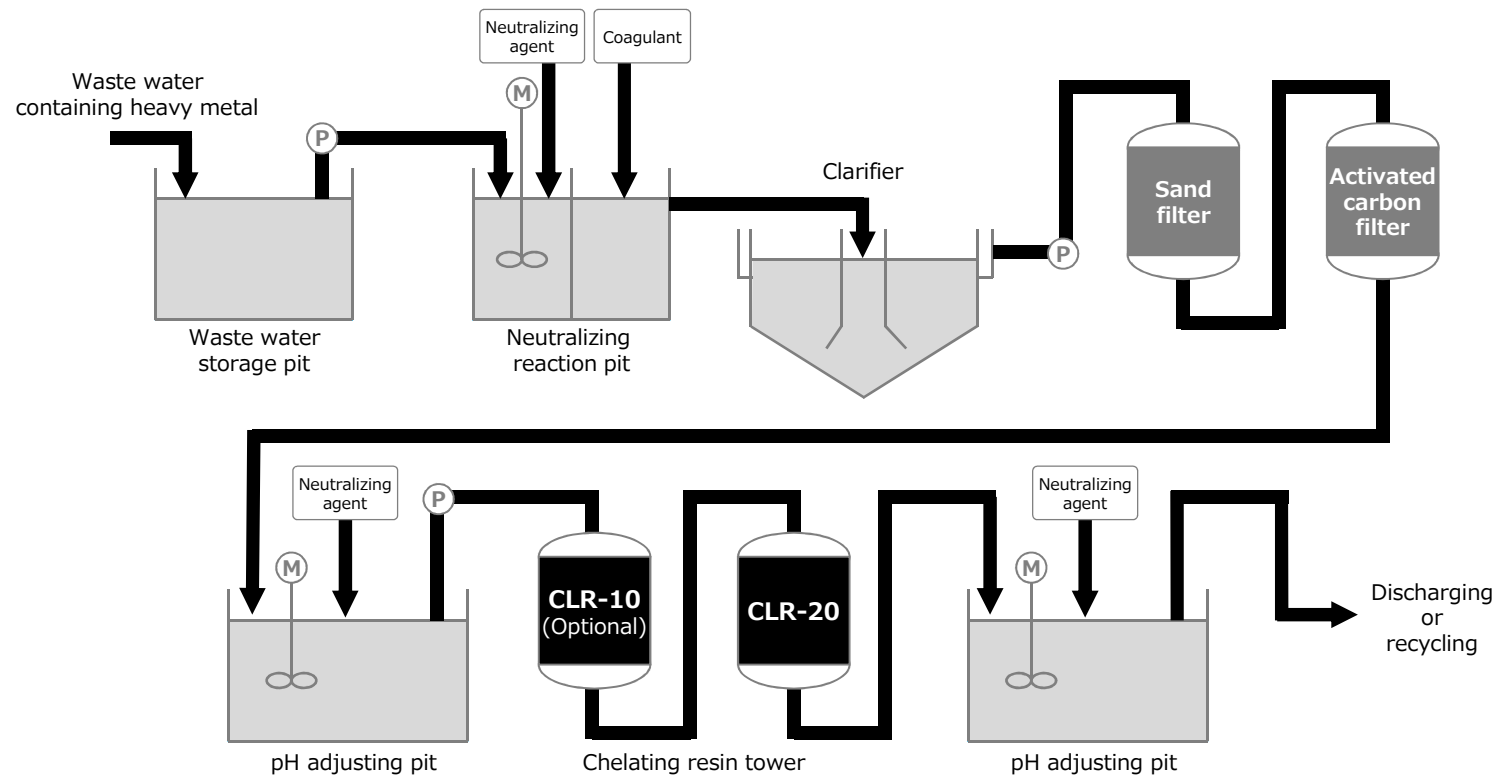
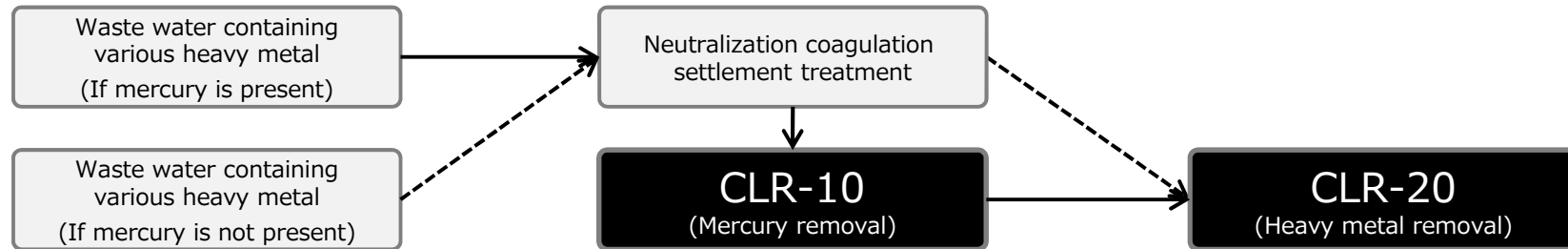
7. Product line of TRILITE

Chelating resins

TRILITE
삼양 트리아이트
Ion Exchange Resin

30/49

(Typical process of removing heavy metal from waste water)



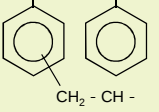
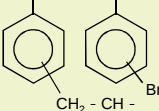
7. Product line of TRILITE

Synthetic adsorbents

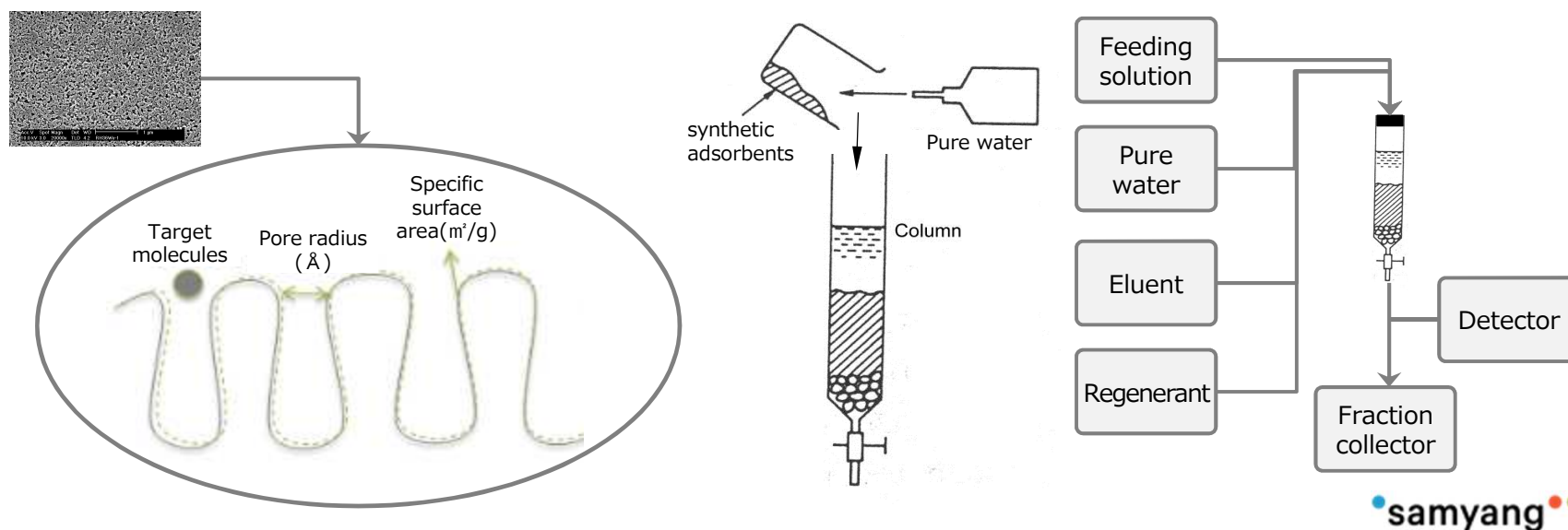
TRILITE
삼양 트리라이트
Ion Exchange Resin

31/49

※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Synthetic adsorbents							
	Grade name	Chemical structure	Specific surface area(m ² /g)	Pore volume (ml/g)	Pore radius (Å)	Particle distribution	Application	Equivalent
Styrene type	GSH-20		750 ↑	1.0~1.5	50~80	0.31~1.25mm	Purification and decolorization of protein, antibiotics and food	Diaion HP20
	GSP-25		1,100 ↑	1.2~1.6	45~55	0.25~0.7mm		Diaion SP825
	GSP-50		1,000 ↑	0.9~1.1	30~50	0.25~0.7mm		Diaion SP850
Chemically modified styrene type	GSP-07		600 ↑	0.8~1.0	50~70	0.25~0.7mm		Diaion SP207

(The reaction mechanism of synthetic adsorbents and experimental apparatuses)



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7. Product line of TRILITE

Synthetic adsorbents

TRILITE
삼양 트릴라이트
Ion Exchange Resin

32/49

(Selection of Synthetic adsorbents)

Aromatic standard type
GSH-20

Bigger pore radius

Suitable for absorbing large molecules (> 1,000mw)

Easy elution of absorbed materials

Aromatic special type
GSP-25, GSP-50

Larger specific surface area, smaller pore radius than GSH20

Suitable for selectively absorbing small molecules (< 1,000mw)

Easy elution of absorbed materials

Aromatic chemically modified
GSP-07

Highly hydrophobic and **strong adsorption ability**

May require a large amount of regenerant

Shipping density is high, so can be used in high density solutions

(How to use synthetic adsorbents)

	Procedure	Flow rate (SV)	Flow volume (BV)	Remarks
Conditioning	Backwash	-	-	Removal of small and broken particles
	Pretreatment	1~5	5~10	Alcohol or aqueous alcoholic solution
	Washing	1~5	3~4	Water of buffer solution (same pH as feed solution)
Adsorption, Elution	Adsorption	0.5~3	Loading amount should be lower than maximum adsorption capacity	
	Washing	1~5	0.5~1	Removal of feed solution
	Elution	0.5~3	2~10	Separating absorbed target materials from adsorbent. If the elution is difficult, use organic solvents such as alcohol and acetone as eluent. In case of electrolyte, use acid and alkali as eluent.
	Washing	1~5	3~4	Water of buffer solution (same pH as feed solution)
Regeneration	Regeneration	0.5~3	3~4	Operate with organic solvents such as alcohol, acetone, IPA and acid, alkali once in a few cycles
	Washing	1~5	3~4	Rinse of adsorbent

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7. Product line of TRILITE

Ready to use mixed resins

TRILITE
삼양 트리라이트
Ion Exchange Resin

33/49

(Selection of Ready to use mixed resins)

Grade name	Feature & Application	Components	Treated Water Quality	
SM200	Simple production of pure water from tap water For Laboratories, Wire-cutting(EDM)	KC-08H(H ⁺ 99.0% ↑) KA-12OH(OH ⁻ 90.0% ↑) Mixed ratio(Volume) : 45:55	Out	Guarantee) Resistivity > 10.0 MΩ-cm (in 10min.) Actual) Resistivity > 15.0 MΩ-cm (in 10min.)
			Feed	Conductivity 150μs/cm Potable water, SV36
SM210	Simple production of pure water from tap water For Laboratories, Wire-cutting(EDM)	SCR-BH(H ⁺ 99.0% ↑) SAR12OH(OH ⁻ 95.0% ↑) Mixed ratio(Volume) : 45:55	Out	Guarantee) Resistivity > 10.0 MΩ-cm (in 10min.) Actual) Resistivity > 15.0 MΩ-cm (in 10min.)
			Feed	Conductivity 150μs/cm Potable water, SV36
SM300	High Resistivity and superb SiO ₂ removal ability MB for Post-RO and EDI	SCR-BH(H ⁺ 99.0% ↑) SAR12OH(OH ⁻ 95.0% ↑) Mixed ratio(Volume) : 40:60	Out	Guarantee) Resistivity > 15.0 MΩ-cm (in 10min.) Actual) Resistivity > 17.0 MΩ-cm (in 10min.)
			Feed	Conductivity 10μs/cm RO outlet, SV36
UPRM100U (UPS grade)	Very high resistivity Electronics Grade Ultrapure water	UPRC100U(H ⁺ 99.0% ↑) UPRA100U(OH ⁻ 95.0% ↑) Mixed ratio(Capacity) : 50:50	Out	Guarantee) Resistivity > 17.0 MΩ-cm (in 10min.) Actual) Resistivity > 18.0 MΩ-cm (in 10min.)
			Feed	Conductivity 10μs/cm RO outlet, SV36
UPRM200U (UPS grade)	Very high resistivity, Low ΔTOC level LCD, OLED Ultrapure water final polisher	UPRC200U(H ⁺ 99.0% ↑) UPRA200U(OH ⁻ 95.0% ↑) Mixed ratio(Capacity) : 50:50	Out	Resistivity > 18.1MΩ-cm (in 30min.) ΔTOC < 5ppb (in 120min.)
			Feed	Resistivity > 17.5MΩ-cm, TOC < 2ppb, SV30
UPRM300U (UPS grade)	Extremely high resistivity Extremely low ΔTOC level Metal ion < 0.1ppt Semiconductor Ultrapure water final polisher	UPRC300U(H ⁺ 99.9% ↑) UPRA300U(OH ⁻ 97.0% ↑) Mixed ratio(Capacity) : 50:50	Out	Resistivity > 18.2MΩ-cm (in 30min.) ΔTOC < 1ppb (in 180min.) Metal ion < 0.1ppt
			Feed	Resistivity > 17.5MΩ-cm, TOC < 2ppb, SV30

(Pressure vessel
for RO unit)



(Cartridge polisher
for wire-cutting)



samyang

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7. Product line of TRILITE

Layered bed anion resins
 Inert resins

TRILITE
 삼양 트리라이트
 Ion Exchange Resin

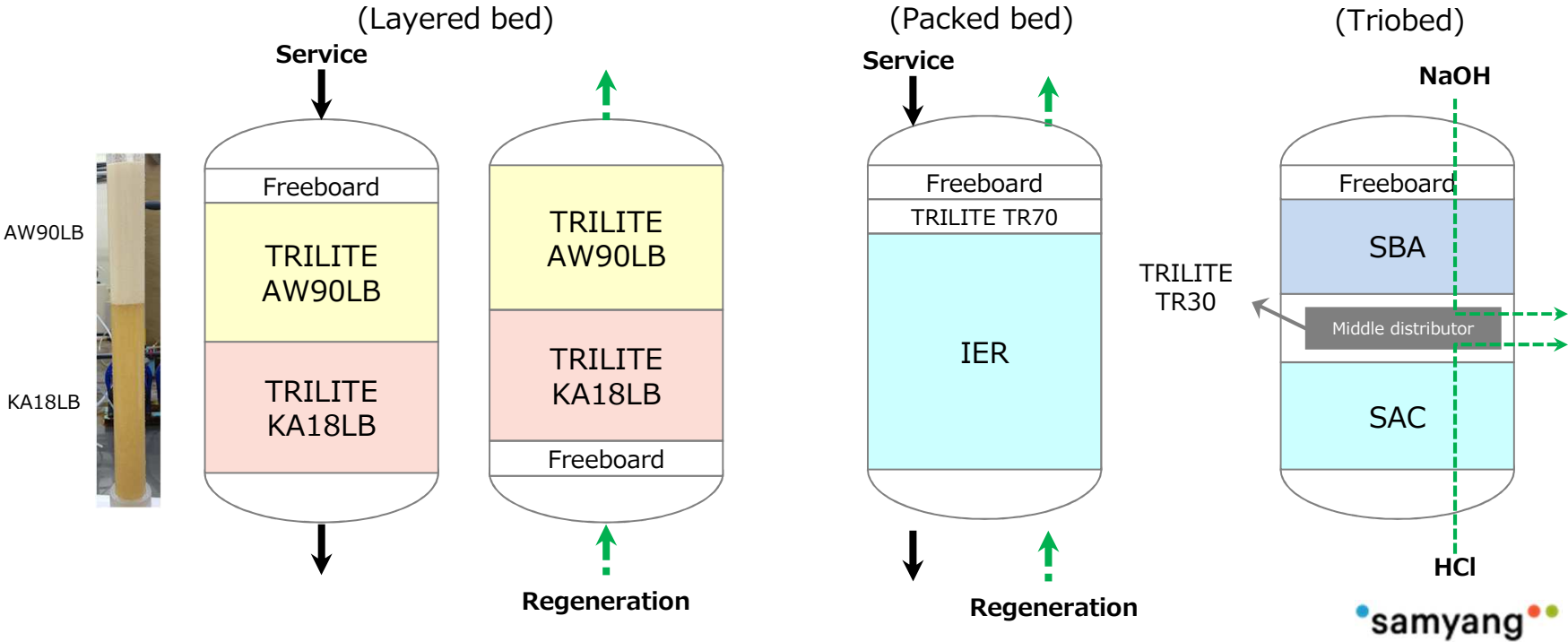
TRILITE

삼양 트리라이트

Ion Exchange Resin

	Layered bed anion resins				Inert resins				
	Type	Grade name	TEC (eq/ ℓ)	Particle distribution	Grade name	Matrix	Shipping density(g/ ℓ)	Particle distribution	Application
UPS	Porous WBA	AW90LB	1.6 ↑	0.5~0.6mm	TR70	Poly-ethylene	500	1.2~1.8mm	Inert resin for packed bed
Gaussian	Gel type1	KA18LB	1.3 ↑	0.6~1.2mm	TR30	Polystyrene +DVB	725	0.7~0.9mm	Inert resin for triobed

※ TEC: Total Exchange Capacity



7. Product line of TRILITE

EO/EG cycle water treatment

TRILITE
삼양 트리라이트
Ion Exchange Resin

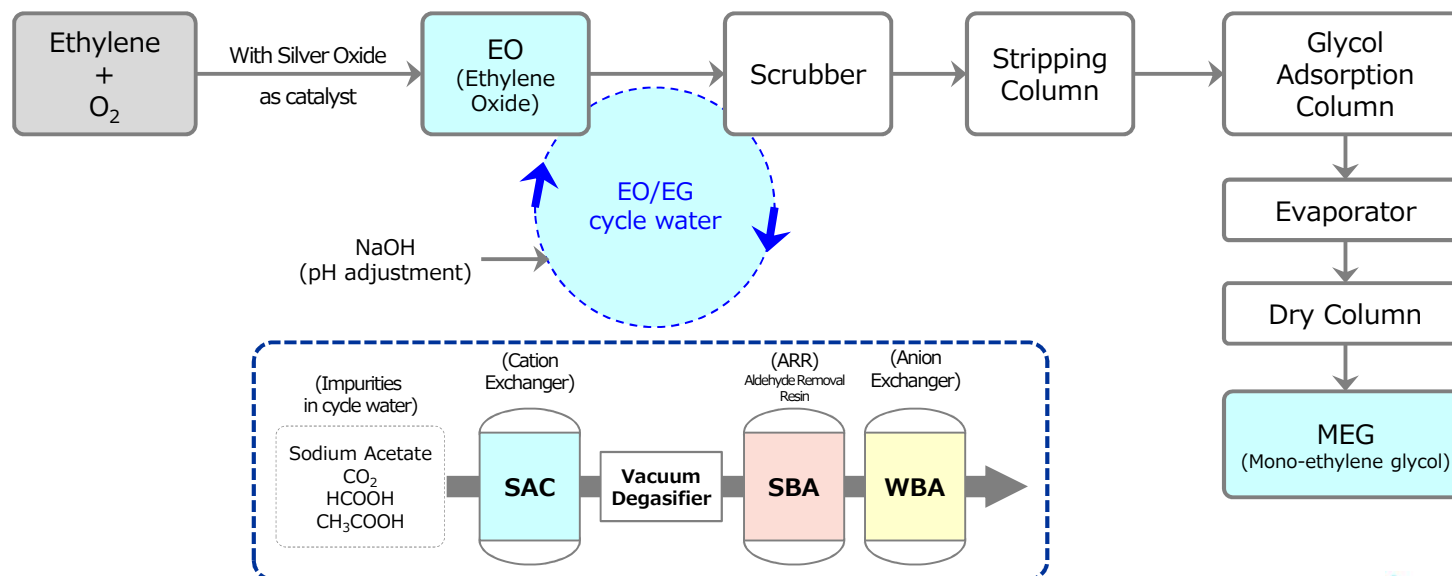
35/49

※ TEC: Total Exchange Capacity

TRILITE 삼양 트리라이트 Ion Exchange Resin	Strongly acidic cation resins (SAC)				Strongly basic anion resins (SBA)			
	Type	Grade name	TEC (eq/ℓ)	Particle distribution	Type	Grade name	TEC (eq/ℓ)	Particle distribution
Gaussian	Cation Exchanger	SPC260EGH	1.7 ↑	0.3~1.2mm	ARR	AMP16EG	1.2 ↑	0.3~1.2mm

TRILITE 삼양 트리라이트 Ion Exchange Resin	Weakly basic anion resins (WBA)			
	Type	Grade name	TEC (eq/ℓ)	Particle distribution
UPS	Anion Exchanger	AW90EG	1.6 ↑	0.50~0.60mm

(Typical MEG production process)

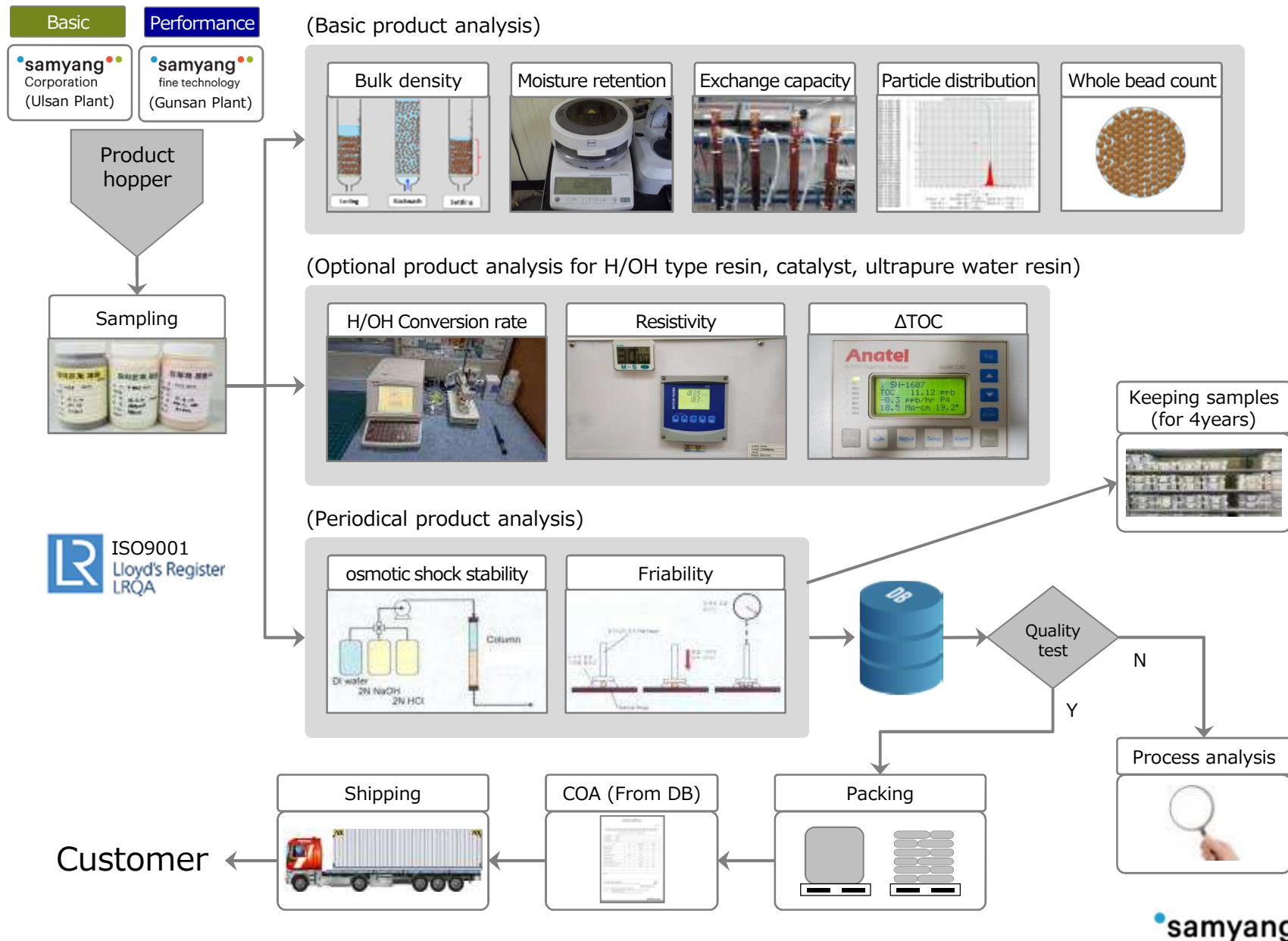


samyang

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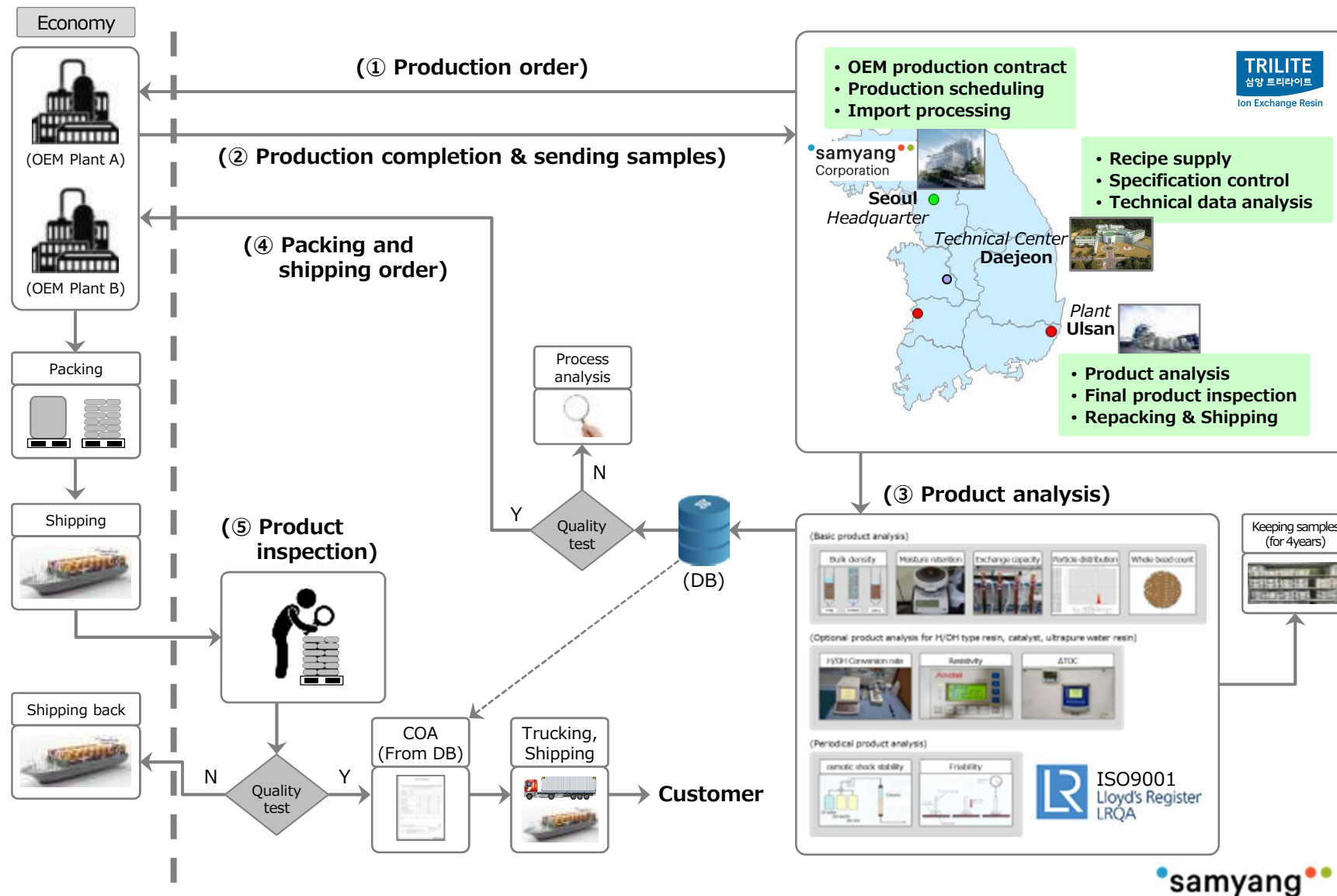


8. Product analysis / Quality control



9. Product analysis / Quality control (OEM)

TRILITE OEM products are manufactured under the strict quality control; the recipe and the technical guidance. Our quality management system assures the credible quality of final products.



10. Quality assurance system

Quality standard and total quality management
are both necessary for any organization to become world class.
The commitment to total quality operations is a way of life in Samyang.

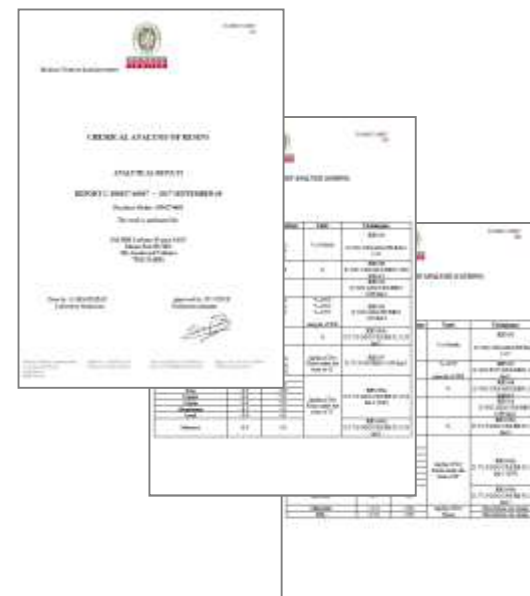
ISO9001 Certificate



HALAL Certificate



Veritas Certificate



11. Packing line, packing type

(Automatic packing line : 25 ℓ PE Bag)



(Manual packing line : 1,000 ℓ Bag, plastic/fiber drum)



25Liters
PE bag



1,000Liters
Ton bag



50Liters
Plastic drum



5 or 7ft³
Fiber Drum



5Liters
Vacuum bag



Palletizing, container loading



12. Technical service

1

Ion exchange resin analysis report



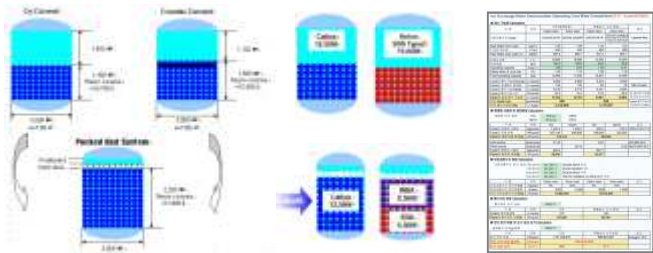
2

Ion exchange resin calculation program



3

Facilities diagnosis, retrofit proposal



4

Application process development



13. Major customers

Samyang has provided its TRILITE resins to practically every companies in Korea from 1970s since it is the only resin manufacturer in Korea. The below is a few of representative customers using TRILITE resins.

Oil & Petrochemical



Electronics



Power



Food



Steel



Engineering



14. Major References – Power & UPW

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Customer Name	Location	Application	Resin Type	Web Site
 KOREA ELECTRIC POWER	Seoul, Korea Indonesia South Afreeca	Demineralization Condensate Polishing	SCR-B / SAR10 / SAR20 / CMP / AMP / AW90 / UPRM / TR70	http://cyber.kepco.co.kr/kepco/main.do
 KOREA HYBRID & NUCLEAR POWER	Seoul, Korea	Demineralization Condensate Polishing	SCR-B / SAR10 / SAR20 / MC08 / MA12 / MA20 / UPRM	http://cms.khnp.co.kr
 SAMSUNG ELECTRONICS	Hwasung, Korea	Demineralization Chemical Purification	MC / MA / UPR Series	www.samsungsvc.co.kr
 SAMSUNG DISPLAY	Asan, Korea Suzhou, China	Demineralization UPW	MC / MA / UPR Series	http://www.samsungdisplay.com
 SAMSUNG ELECTRO-MECHANICS	Ulsan, Korea	Demineralization	SCR / SAR Series	http://www.samsungsem.co.kr
 SK HYNIX	Incheon, Korea	Demineralization Ultra Pure Water	MC / MA / UPR Series	http://skhynix.com
 LG DISPLAY	Gumi, Korea Paju, Korea China	Demineralization UPW	MC / MA / UPR Series	http://www.lgdisplay.com



14. Major References – Power (China & Taiwan) 43/49

Region	Customer Name (for Condensate polishing)		Products	
			Cation	Anion
China (16.6~)	JIANGSU SHAZHOU Power Plant		TRILITE MC-10H	TRILITE MA-100H
	NEIMENGGU TUOKETUO Power Plant			
	SHILIQUN Power Plant			
Taiwan (17.01~)	Maanshan Nuclear Power plant		TRILITE MC-10HUP	TRILITE MA-100HUP

电力工业热力发电设备及材料质量检验检测中心

检 验 报 告

编 号: TP81023-BA-121-2016		第 1 页 共 3 页	
产品名称	离子交换树脂	型号规格	见附表 1
委托单位	浙江海盐方板树脂科技有限公司	检验类别	委托检验
生产单位	-----	生产日期	-----
抽 样 人	-----	抽样日期	-----
检验地点	-----	检验方式	-----
送 样 人	朱红霞	受理日期	2016/06/04
检验日期	2016/06/04-2016/06/16	样品数量	1
检验地点	化学实验室	环境条件	室内
检验项目	耐热性能		
检验依据	DL/T953-2005《水处理用强碱性阴离子交换树脂耐热性能测定方法》		
检验设备	烘箱(1) 电子天平(3000)		
检验结果	按照 DL/T953-2005 规定的方法, 对 MA-100H 强碱性阴离子交换树脂(样品编号 16R0323) 耐热性能进行了检测, 所检测的结果符合《强碱性阴离子交换树脂》为 4.0%, 满足 DL/T771-2014《发电厂水处理用离子交换树脂通用规范》中国树脂耐热性能的要求。		
检验结论	合格		
报告日期: 2016 年 06 月 16 日			
检验: 朱红霞 复核: 孙磊 审核: 朱文昭 批准: 孙磊			

(Test result passed)

14. Major References – Power (Overseas, 2016~) 44/49

Company	Type	Capacity(MW)	Start Year	Resin Types	Delivery Date
MAANSHAN NUCLEAR POWER PLANT (Taiwan)	Nuclear CPP (PWR)	951 X 2	1985	MC-10HUP, MA-10OHUP	2017.02
Thermal Power Station-9 (Russia Angarsk)	Thermal Make-up	475	1958	MA-12 AW-90	2017.05
TUKETUO POWER PLANT (China Inner Mongol)	Thermal CPP	600 X 8 300 X 2	1995	MC-10H MA-15OH	2016.11
SHAZHOU POWER PLANT (China Zhangjiagang)	Thermal CPP	1,000 X 2 630 X 2	2006	MC-10H MA-10OH	2017.03
ZAOZHUANG POWER PLANT (China Shandong)	Thermal CPP	300 X 2	2015	MC-10H MA-10OH	2017.02
FUSHUN POWER PLANT (China Liaoning)	Thermal CPP	50 X 2	2016	MC-10H MA-10OH	2017.01
WUJIANFANG POWER PLANT (China Inner Mongol)	Thermal CPP	660 X 2	2017	MC-10H MA-10OH	2017.04
Tanjung Jati Power Plant - Unit 3&4 (PT. KPJB)	Thermal Make-up	660 MW x 2	2017	MC-08, MA-20, MA-12	2017.04
Tanjung Power Indonesia KALSEL-1 Coal Fired Power Plant	Demi. Make-up	1,000MW x 2	2017	MC-08H, MA-12	2017.05



14. Major References – Oil & Petrochemicals

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Customer Name	Location	Application	Resin Type	Web Site
 GS CALTEX	Yeosu, Korea	Demineralization	MC / MA Series / TR70	http://www.gscalex.com
	Ulsan, Korea	Demineralization, Methanol Purification	MC Series / MA Series / TR70 SPC Series	http://eng.skinnovation.com
 S-OIL	Ulsan, Korea	Demineralization	MC Series / MA Series / TR70 AW Series	http://www.s-oil.com
 HYUNDAI OILBANK	Daesan, Korea	Demineralization	MC Series / MA Series/ TR70	http://www.oilbank.co.kr
 HANWHA CHEMICAL	Yeosu, Korea	Demineralization	MC / MA / SCR / SAR Series	http://hcc.hanwha.co.kr
 KUMHO P&B CHEMICALS KUMHO P&B	Yeosu, Korea	BPA Catalyst	PCC Series	http://www.kpb.co.kr
 HYOSUNG	Jiaxing, China Ulsan, Korea	Catalyst (PTMEG / PTMA) / Demineralization	SPC / SCR / SAR Series	http://www.hyosung.co.kr



14. Major References – Chemicals, Steel/Fertilizer 46/49

Customer Name	Location	Application	Resin Type	Web Site
 LG CHEM	Seoul, Korea	Demineralization	MC Series / MA Series/ TR70 /SCR Series / SAR Series	http://www.lgchem.com
 LG MMA	Yeosu, Korea	MMA Catalyst	PCC / SPC Series	https://www.lgmma.com
 LOTTE CHEMICAL	Malaysia, Ulsan/ Yeosu/ Seosan, Korea	Demineralization EO/EG, Catalyst	SPC /MC / MA Series	http://www.lottechem.com
 POSCO	Pohang, Korea Jakarta, Indonesia	Ultra Pure Water Demineralization	MC Series / MA Series/ TR70 /SCR Series / SAR Series /UPRM Series	www.posco.co.kr
 HYUNDAI STEEL	Dangjin, Korea	Demineralization	SCR Series / SAR Series	https://www.hyundai-steel.com
 WUHAN Engineering	Wuhuan, CHINA	Catalyst (PTMEG / PTMA)	SPC / CMP / AMP Series	
 PT. Petrokimia Indonesia	Gresik, Indonesia	Demineralization	MC-08, AMP16	www.petrokimia-gresik.com



14. Major References – Food & Bio

47/49

Customer Name	Location	Application	Resin Type	Web Site
 Cheil Jaedang	Liaocheng, China Shenyang, China Jombang, Indonesia Incheon, Korea	Nucleic Acid / Lysine Sugar / Sweetener Demineralization	NAC4 / AMP / MC / MA Series / SCR-B / SAR10 / SAR11 / SAR20	http://cj.net
 Daesasng (Miwon)	Gresik, Indonesia Gunsan, Korea	MSG / Lysine Sweetener/ DI Water	MC Series / SCR-B / SAR20 / AW90	http://www.daesang.co.kr
 Ingredion Incorporated	Iecheon, Korea Bupyoung, Korea	Sweetener	CMP / AMP / SCR-B / SAR10 / MCK series	http://www.ingredion.com
 LG House hold and	Ulsan, Korea	Sorbitol purification Demineralization	SCR / SAR Series	http://www.lgcare.com



14. Major References - Eng'g Projects

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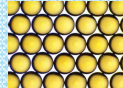
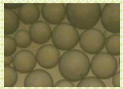
Customer Name (EPC)	Location (Project Name)	Application	Capacity	Web Site
 Samsung Engineering	Saudi Arabia, (Saudi ma'aden Ammonia Project)	Demineralization / Condensate Polishing System (ACF+2B2T+MBP)	280 m ³ /h x 2 trains 350 m ³ /h x 3 trains	http://www.samsungeengineering.co.kr
	Saudi Arabia, (APPC PDH/PP Project)	Demineralization (ACF+2B3T+MBP)	120 m ³ /h x 2 trains	
	India (IOCL MEG Project)	MEG Purification System / Cycle water treating unit	39 m ³ /h x 2 trains	
	Thailand	EO/EG Purification System / Cycle water treating unit	39 m ³ /h x 2 trains	
 Daelim Ind.	Saudi Arabia, (Umm Wu'al Ammonia Project)	Demineralization / Condensate Polishing System (ACF+2B2T+MBP)	280 m ³ /h x 2 train 350 m ³ /h x 3 train	https://www.daelim.co.kr/eng/main.do
 Mitsubishi Heavy Ind.	Saudi Arabia, (Ar-Razi Saudi Methanol Project)	Demineralization (S/F+ACF+2B3T+MBP)	100 m ³ /h x 2 trains	https://www.mhi-global.com/
	Algeria (Algeria Oman Fertilizerp Project)	Demineralization / Condensate Polishing System (ACF+2B3T+MBP)	325 m ³ /h x 4 trains 480 m ³ /h x 5 trains	



15. Cross reference guide

“Only 3 major companies possess UPS resin(Uniformity Coefficient 1.1↓) technology in the world”

→ ① **Samyang** & Mitsubishi, ② Dow, ③ Lanxess

Type			Mitsubishi DIAION	DOW		Lanxess Lewatit	Purolite
				Dowex	Amberjet/lite		
UPS Gel 	SAC	UC 1.1 ↓	UC 1.1 ↓	UC 1.1 ↓	UC 1.2 ↓	UC 1.1 ↓	UC 1.2 ↓
		MC-08	UBK08	Marathon C	1200	MP S100	PFC/PPC100
		MC-08H	UBK08H	Marathon CH	1200H	MP S100H	PFC/PPC100H
		MC-10	UBK10	Mono 650 C	1500	MP S108	SGC-650C
	SAC (Chromatography)	MC-10H	UBK10H	Mono 650 C H	1500H	MP S108H	SGC-650CH
		MCK series	UBK500 series			MDS series	
	SBA_Type 1	MA-12	UBA120	Marathon A	4200 Cl	MP M500	PFA/PPA400
		MA-12OH	UBA120OH	Marathon A OH	4200 OH	MP M500 OH	PFA/PPA400 OH
		MA-10	UBA100	Mono 550A	4400 Cl	MP M800	SGC-550A
		MA-100H	UBA100OH	Mono 550A OH	4400 OH	MP M800OH	SGC-550A OH
		MA-15	UBA150	Mono 550A	4400 Cl	MP M800	SGC-550A
	SBA_Type 2	MA-15OH	UBA150OH	Mono 550A OH	4400 OH	MP M800OH	SGC-550A OH
MA-20		UBA200	Marathon A2	4600 Cl	MP M600	PFA/PPA200	
UPW_Mixed Bed		UPRM100U					UCW 3600
	UPRM200U		MR-450 UPW	UP6150	1292MD	UCW 3700	
	UPRM300U		MR-3 UPW	UP6040	1294MD	UCW 9966	
UPS Porous	WBA	AW90		Monosphere 66		MP64/MP68	
Gaussian Gel 		UC 1.6 ↓	UC 1.6 ↓	UC 1.6~1.8 ↓			
	SAC	SCR-B(KC-08)	SK1B	HCR-S	IR120Na	C249/C267	C100
	SAC_Food grade	KH-70/KH-80		HCR-S/S			C100E
	SBA	SAR10(KA-10)	SA10	SBRP	IRA400	ASB1	A400
		SAR11(KA-11)	SA11		IRA401S		
		SAR12(KA-12)	SA12		IRA402		A600
		SAR20(KA-20)	SA20	SAR	IRA416	ASB1	A200
	Mixed Bed	SM200/210/300			MB20	NM91	MB400
Gaussian Porous 	SAC	CMP/SPC Series	PK series			SP120	C150, C160
	SBA	AMP Series	PA series	MSA	IRA900 OH	MP500	A500
	WAC	WCA10L	WK40/WK60L	MWC-1	IRC86	CNP80	C105
	WBA	AW30	WA30		IRA93SP	MP62	A100
	Chelating	CLR series	CR series			TP207/208	S930Puls
Inert resin		TR series		IF-62		IN49	IP1



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Line
ID: TRILITE



We chat
ID: TRILITE



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