



DIAION™ Technical Guide

Ion Exchange Resin for Ultra Pure Water



Ultra Pure Water

In the semiconductor and display (LCD, OLED) manufacturing process, etching and cleaning using chemicals are indispensable processes. In diluting the chemicals used in this etching / cleaning step and rinsing those chemicals remained, ultrapure water (UPW) is essential. UPW including extremely low impurities is as close to theoretical pure water as possible.

Especially for ultrapure water used in the rinsing process, the following quality is required.

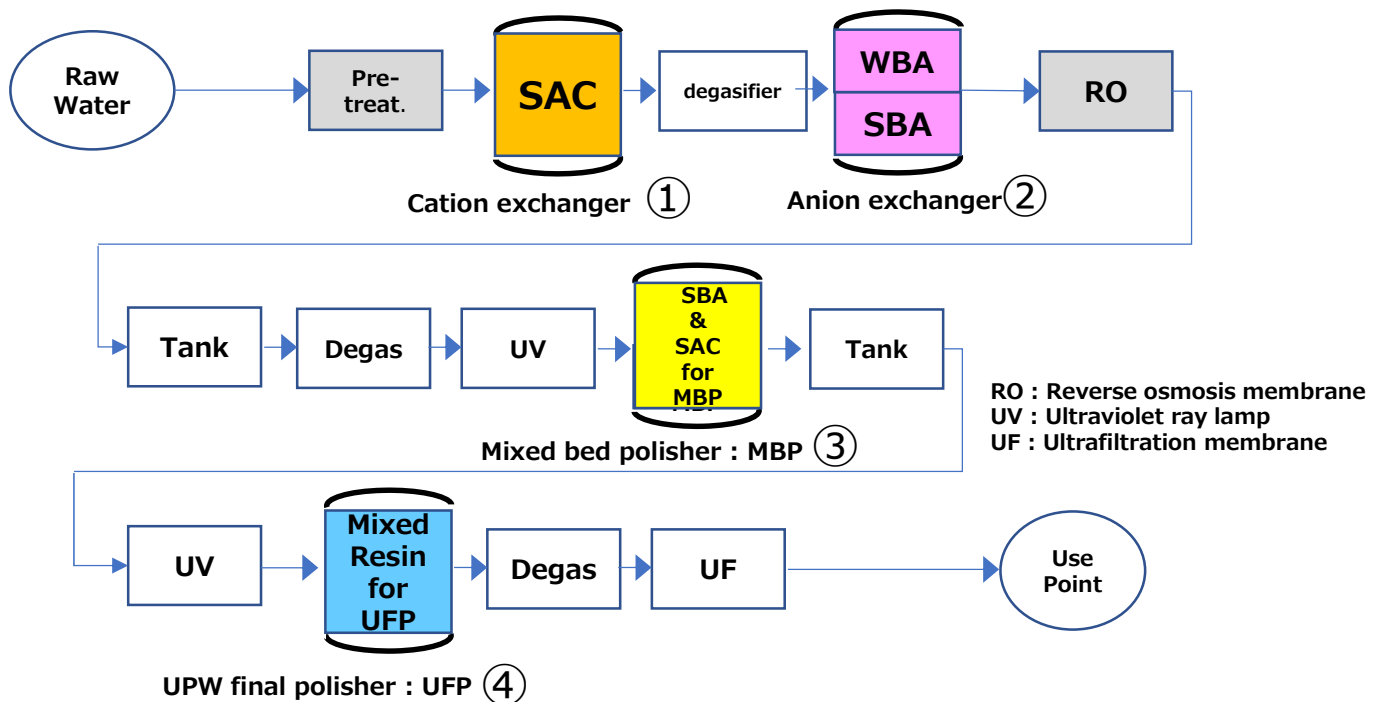
- * Total organic carbon (TOC) is low.
- * Electrical conductivity (EC) is as equivalent to that of theoretical pure water as possible
- * The number of fine particles is extremely small.
- * Ionic components are extremely low

Therefore, DIAION grades for ultrapure water are under the strict quality control.

Mitsubishi Chemical is able to provide a stable supply of a full lineup of differentiated and extremely clean ion exchange resins. DIAION for ultrapure water is used by leading companies around the world in the semiconductor and display fields.

The ultrapure water production system (for semiconductor and LCD / OLED manufacture) is composed of the primary system consisting of ion exchange, degassing, RO, UV equipment, etc., and the UPW system consisting of UV, ion exchange, degassing, UF equipment, etc.

Ion exchange resins are indispensable for thoroughly removing the ionic components in water, and treatment processes using ion exchange resins are essential for the UPW production process.



- ① SAC: strongly acidic cation exchange resin for cation exchange bed (UBK08, UBK10)
- ② WBA: weakly basic anion exchange resin for anion exchange bed (JA310, JA310C)
- ② SBA: strongly basic anion exchange resin for anion exchange bed (UBA120, UBA100)
- ③ MBP: strongly basic anion exchange resin for MBP (PA312LTUMB, UBA15MBOH) (regenerable type)
 strongly acidic cation exchange resin for MBP (UBKN1UMB, UBK10MBH) (regenerable type)
- ④ UFP: mixed-bed resin for UFP (SMT200L, USMT100, SMT50) (non-regenerable type)

The figure below shows the desalination performance (resistivity) and the amount of eluted organic matters (TOC: Total Organic Carbon), which are indicators of the quality of UPW at the outlet of the mixed resin for final polisher.

The resistivity rises quickly during the initial rinsing after filling the resin into a column. The initial TOC elution is also suppressed to a low level, and the Δ TOC decreases quickly. Furthermore, the leakage of metallic impurities is also reduced to the ppt (ng/L) level.

Resistivity

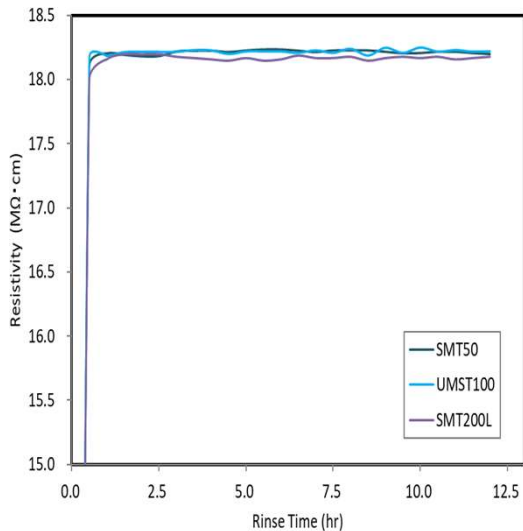


Fig. 1 Rinse Performance for mix bed - Resistivity
Resin volume 500 mL-R, Flow rate SV 30

Δ TOC

※Feed Water : Resistivity>17.5MΩ·cm, TOC<1ppb
Resin volume : 500 ml Flow rate : SV=30

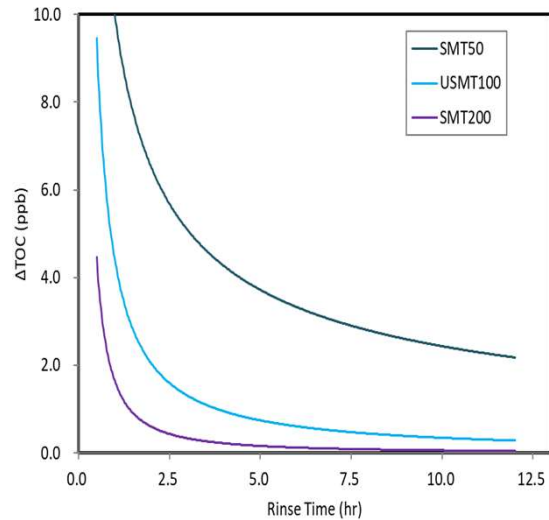


Fig. 2 Rinse Performance for mix bed - delta TOC
Resin volume 500 mL-R, Flow rate SV 30

As a result of the column rinsing test of SMT200L, the leakage of metallic impurities (Na, Mg, Al, K, Ca, Cr, Fe, Ni, Cu, Zn, Mo, Sn, Pb) were all less than 0.1 ppt.

In particular, the non-regenerable mixed-bed resin SMT200L is extremely excellent for obtaining high-quality UPW.

The characteristics (type, constituent resin, rinsing characteristics, etc.) of the two types of mixed resins for UPW Final Polisher (UFP) and Mixed Bed Polisher (MBP) used in the UPW production system are summarized in the table below.

Puroduct	Application	Regeneration	Type	Matrix	Outlet condition	
					Resistivity	Δ TOC
SMT200L	UPW Polisher	Non-regenerable	Mixed	Gel	$\geq 18.1 \text{ M}\Omega \cdot \text{cm}$	$\leq 1.0 \text{ ppb}$
USMT100				Gel(Uniform)	$\geq 18 \text{ M}\Omega \cdot \text{cm}$	$\leq 2.0 \text{ ppb}$
SMT50				Gel	$\geq 18 \text{ M}\Omega \cdot \text{cm}$	$\leq 5.0 \text{ ppb}$
UBKN1UMB	Mixed Bed Polisher	regenerable	SAC	Gel(Uniform)	$> 18 \text{ M}\Omega \cdot \text{cm}$	$< 2.0 \text{ ppb}$
PA312LTUMB				Porous		
UBK10MBH				SAC	$> 18 \text{ M}\Omega \cdot \text{cm}$	$< 2.0 \text{ ppb}$
UBA15MBOH				SBA		

As the control of boron in ultrapure water is becoming severer, the special chelating resin (UPW grade) having B-selective adsorption ability is used for removing boron. DIAION™ CRBT03, UPW grade chelating resin uses N-methylglucamine as functional group and is optimized for minimum TOC leakage.

Ultra Pure Water

半導体やディスプレイ（LCD、OLED）製造工程では、薬品を利用したエッチングや洗浄が必須の工程である。このエッチング・洗浄に使われる薬品の希釈、また薬液を除去するリンスにおいては、不純物を極限まで除去した、理論純水に近い水(以下、超純水)が必須である。

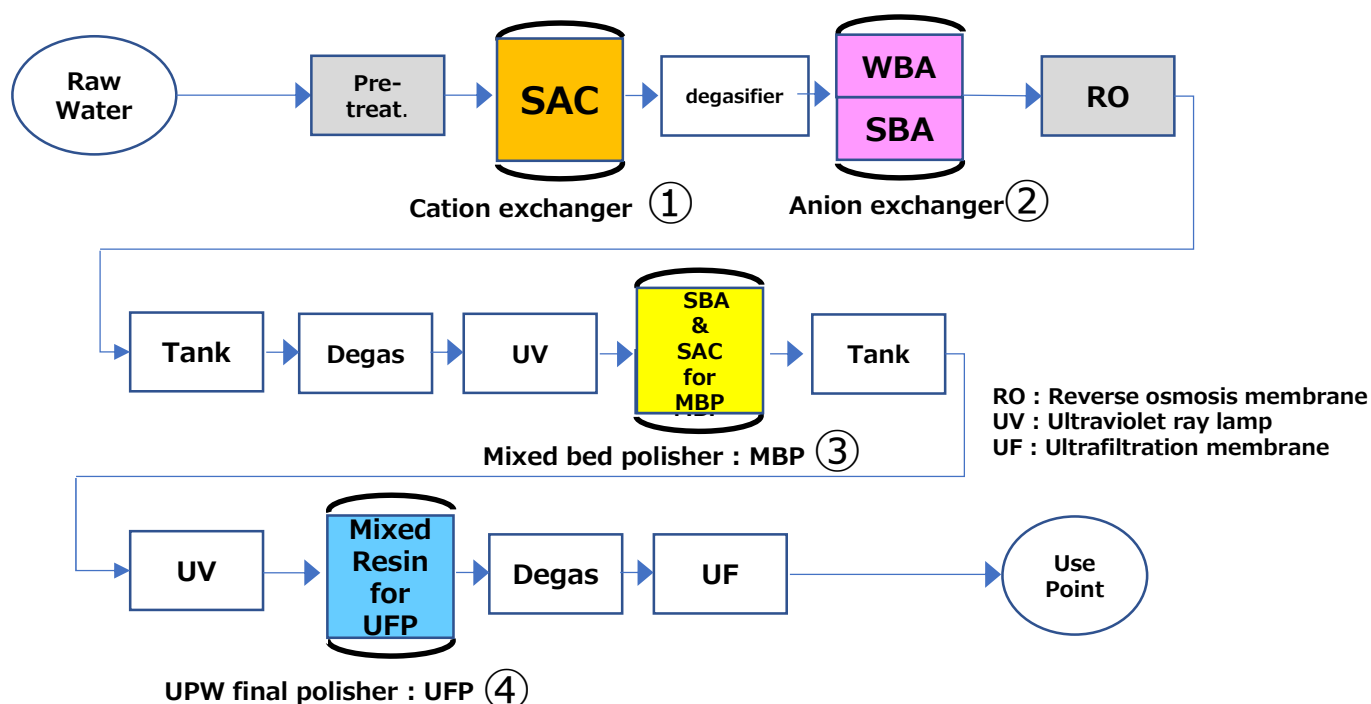
特に洗浄工程で使用される超純水には、

- * 全有機炭素（TOC）が低いこと
- * 電気伝導度（EC）が理論純水並の値を満足すること
- * 水中に存在する微粒子数が極微量であること
- * イオン成分のリークが極めて低いこと

が要求されることから超純水用DIAIONは、厳格な品質管理が行われている。

三菱ケミカルは、差異化された非常にクリーンなイオン交換樹脂をフルラインナップで、安定供給可能である。超純水用DIAIONは、半導体やディスプレイ分野において世界中の一流会社で採用されている。

超純水製造システム（半導体、LCD/OLED製造用）は、イオン交換、脱気、RO、UV装置等で構成された一次システムと、UV、イオン交換、脱気、UF装置等で構成された超純水システムから構成されている。水中のイオン成分を徹底的に除去するためにはイオン交換樹脂が不可欠で、超純水製造工程にはイオン交換樹脂による処理工程が必須である。



- ① : SAC カチオン交換床用強酸性陽イオン交換樹脂 (UBK08, UBK10)
- ② : WBA アニオン交換床用弱塩基性陰イオン交換樹脂 (JA300A, JA310C)
- ③ : SBA アニオン交換床用強塩基性陰イオン交換樹脂 (UBA120, UBA100)
- ④ : MBP MBP用強塩基性陰イオン交換樹脂 (PA312LTUMB, UBA15MB) (再生タイプ)
MBP用強酸性陽イオン交換樹脂 (UBKN1UMB, UBK10MB) (再生タイプ)
- ⑤ : UFP UFP用混合樹脂 (SMT200L, USMT100, SMT50) (非再生タイプ)

以下の図に、ファイナルポリシャー用混合樹脂出口での超純水水質の目安である脱塩性能（比抵抗）及び溶出有機物量（TOC）を示した。

樹脂塔充填後の初期洗浄時における比抵抗の立上りが早く、また初期TOC溶出も低く抑えられ、 Δ TOCの減少が早い。

更に、金属・イオン類のリークもpptレベルまで低減されていることが特色である。特に高品位の超純水を得るには、非再生型の混合樹脂SMT 200Lが極めて優れている。

比抵抗

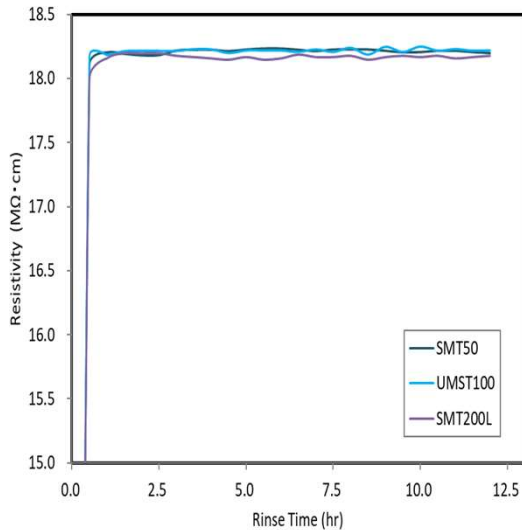


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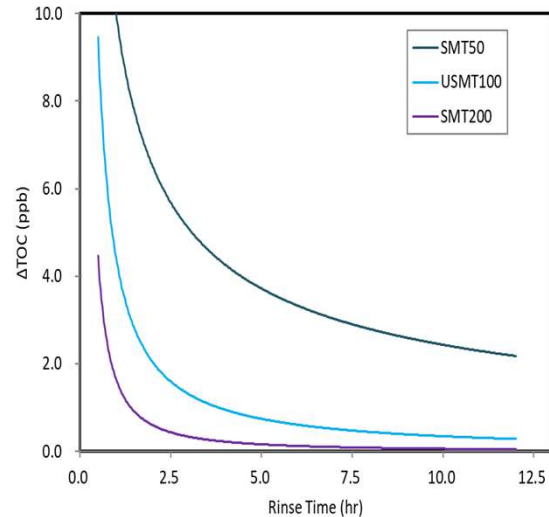


Fig. 2 Rinse Performance for mix bed - delta TOC
Resin volume 500 mL-R, Flow rate SV 30

金属・イオン類

SMT200Lのカラム洗浄試験の結果、金属・イオン類（Na, Mg, Al, K, Ca, Cr, Fe, Ni, Cu, Zn, Mo, Sn, Pb）のリークは、何れも0.1ppt 未満であった。

超純水製造システムで使用される2種類の混合樹脂（UPW Final Polisher(UFP)用とMixed Bed Polisher(MBP)用）の特性（タイプ、構成樹脂、洗浄特性等）を下表にまとめた。

Puroduct	Application	Regeneration	Type	Matrix	Outlet condition	
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SMT200L	UPW Polisher	Non-regenerable	Mixed	Gel	$\geq 18.1 \text{ M}\Omega \cdot \text{cm}$	$\leq 1.0 \text{ ppb}$
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PA312LTUMB				Porous		
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UBA15MBOH				SBA		

尚、超純水中のホウ素の管理も厳しくなっており、B選択的吸着能を持つ特殊なキレート樹脂（UPWグレード）がホウ素除去に用いられている。



[Affiliates and Distributor]
<Japan, Asia>

Mitsubishi Chemical Aqua Solutions Co., Ltd. (Tokyo)
www.mcas.co.jp E-mail: info@mcas.co.jp

<Europe, Africa, Middle East>

Resindion S.R.L. (Milan)
www.resindion.com E-mail: info@resindion.com

<Taiwan, China, SEA>

Tai-Young Chemical Co, Ltd. (Kaohsiung)
E-mail: service@diaion.com.tw

<China>

Mitsubishi Chemical (China) Co., Ltd (Shanghai)
E-mail: MCCN-DG-MCN_SH_AQUA@mchcgr.com

<N & S America>

Itochu Chemicals America Inc. (New York)
www.itochu-ca.com
E-mail: s&ptsales@itochu-ca.com

Mitsubishi Chemical Corporation

www.diaion.com E-mail: #MCC-HO-DIAION-HP@m-chemical.co.jp

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