ASTOM Corporation

NEOSEPTA Ion exchange membrane

EDCORE Tubular membrane electrode apparatus

ACILYZER ED Electrodialyzer

ACILYZER EDR Electrodialysis reversal

ACILYZER DD Diffusion dialyzer

ACILYZER BPED Bipolar membrane electrodialyzer

PRODUCTS CATALOGUE

ION EXCHANGE MEMBRANES / Electrodialyzers, Diffusion Dialyzers

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ASTOM Corporation

World-class Ion Exchange Technology

ASTOM provides top quality products and services with its world-class hydrocarbon-based ion exchange membranes and electrodialysis technology validated by more than fifty years of accumulation in industries.
ASTOM's ion exchange membrane **NEOSEPTA** and its dialyzer, **ACILYZER**, onto which NEOSEPTA is mounted, offer excellent ionic separation technology.

Ion exchange membrane
NEOSEPTA P.3
Ion exchange membranes are membranes that are selectively permeable to ions with features such as low electric resistance and high chemical stability.

Electrodialyzer
ACILYZER ED P.5
Our electrodialyzers can desalt, concentrate, refine and recover ionic substances in aqueous solution with ion exchange membranes and the power of electricity.

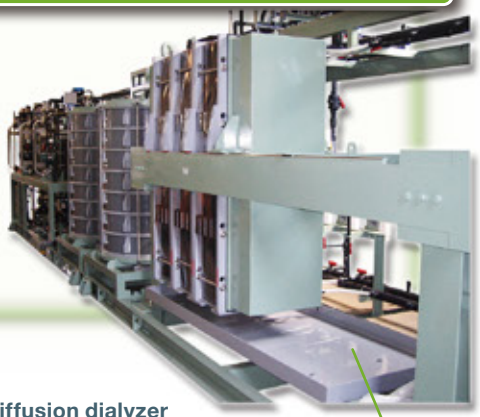
Electrodialysis reversal
ACILYZER EDR P.7
The EDR is a kind of ED system which is operated by periodically changing its polarity to provide better performance from a cost-effective and maintenance standpoint as compared to those of conventional ED.

Ion Exchange Membranes

Electrodialyzers, Diffusion Dialyzers

Tubular membrane electrode apparatus
EDCORE P.11
The tubular membrane electrode apparatus is different from an ordinary sheet type ion exchange membrane and offers various other useful characteristics.

Bipolar membrane electrodialyzer
ACILYZER BPED P.9
The device integrates bipolar membranes to split water into proton and hydroxyl ion, results in producing an acid and a base from a corresponding salt such as an inorganic salt and an organic salt.



Diffusion dialyzer
ACILYZER DD P.8
The device recovers free acid from waste acid using concentration difference as a driving force for acid transfer across the membrane. This system achieves low operating cost because of its limited use of electricity.

Important Notice to Purchaser

You must evaluate and determine whether product is suitable for your intended application. Since conditions of product use are outside of our control and vary widely, the following is made in lieu of all express or implied warranties (including the warranties of merchantability or fitness for particular purpose) : ASTOM's only obligation and your only remedy is replacement of product that is shown to be defective when you receive it. In no case will ASTOM be liable for any special, incidental damages based on breach of warranty or contact, negligence, strict tort, or any other theory.

Applications

Applied technology
•Application

Salt Production

Electrodialysis ACILYZER ED
•Salt production from seawater [Detail in P.13]

Foods/Pharmaceuticals

Electrodialysis ACILYZER ED
•Desalination of soy sauce [Detail in P.13]
•Desalination of amino acids
•Desalination of plum seasoning liquid and plum vinegar
•Desalination of organic acids
•Desalination of carbohydrate solution (desalination of oligo saccharide) [Detail in P.13]
•Desalination of cheese whey
•Stabilization of wine
•Desalination of intermediate for medicines

Bipolar membrane electrodialysis ACILYZER BPED
•Production of organic acid from organic acid salt (production of gluconic acid) [Detail in P.13]
•Production of amino acid from amino acid salt

Drinking Water Production

Electrodialysis reversal ACILYZER EDR
•Desalination and removal of hardness from underground water [Detail in P.14]
•Removal of nitrate nitrogen from underground water [Detail in P.14]

Waste Solution Treatment

Electrodialysis ACILYZER ED
•Desalination/concentration of leachate from landfill [Detail in P.14]
•Desalination/concentration of waste solution (from the manufacturing process of semiconductors/metals) [Detail in P.15]

Bipolar membrane electrodialysis ACILYZER BPED
•Production of acid and alkali from waste solution with salt [Detail in P.15]

Acid / Alkali Recovery

Diffusion dilalysis ACILYZER DD
•Acid recovery of stainless pickling process [Detail in P.16]

Electrodialysis / Diffusion dilalysis ACILYZER ED / ACILYZER DD
•Acid recovery of aluminum plate pickling process [Detail in P.16]
•Acid recovery of aluminum foil pickling process [Detail in P.17]
•Acid recovery of metal pickling process

Bipolar membrane electrodialysis ACILYZER BPED
•Production of acid and alkali from inorganic salt

Electrodialysis ACILYZER ED
•Recovery of alkali waste solution [Detail in P.17]

Other fields

Ion exchange membranes NEOSEPTA
•Production of ultra pure water
•Membrane for batteries

Electrodialysis ACILYZER ED
•Desalination of deep sea water
•Recovery of plating solution
•Recovery of Amine

Tubular membrane electrode apparatus EDCORE
•Electric deposition coating

Ion exchange membrane

NEOSEPTA

About ion exchange membranes

Ion exchange membranes are selectively permeable to ions and are divided into cation exchange membranes and anion exchange membranes.
Since negative-charged groups are fixed to cation exchange membrane, anions are rejected by the negative charge and cannot permeate through the cation exchange membrane (Figure 1-1). This is because cation exchange membranes are only permeable by cations. The anion exchange membranes per form the opposite way compared to cation Exchange membranes (Figure 1-2). These selective permeations are carried out by DC current at an electorodialyzer.

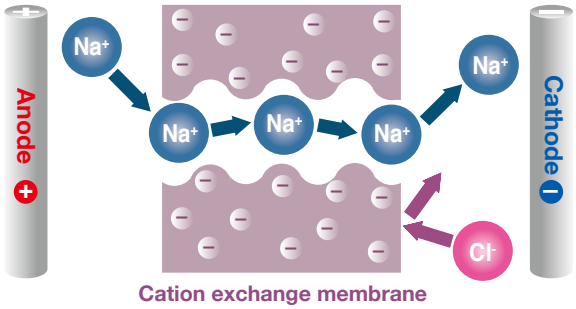


Figure 1-1: Selective permeability of cation exchange membrane

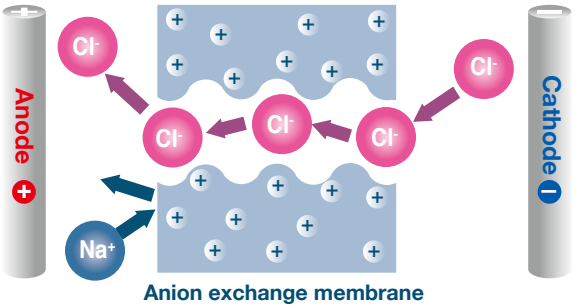


Figure 1-2: Selective permeability of anion exchange membrane

Differences between ion exchange membranes and ion exchange resins

Similar behavior happens in ion exchange resin. The ion exchange resin is in the granular form and performs as adsorptive exchange of ions (Figure 2). But it requires regeneration when adsorptive capacity is consumed. On the contrary, as the ion exchange membrane allow ions to permeate by DC electric current, no regeneration is required and allows for continuous use for an extended period of time.

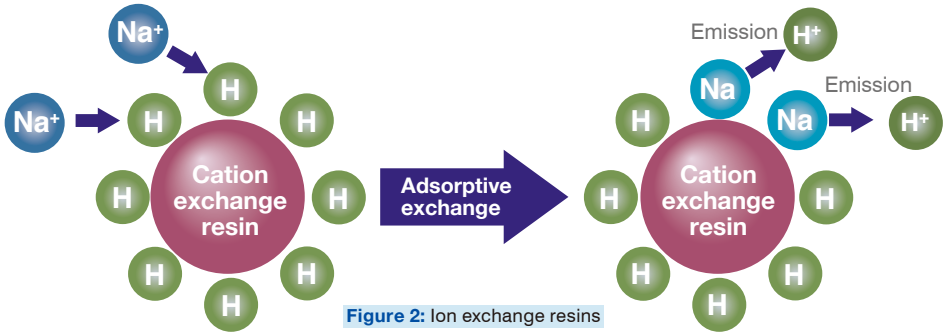


Figure 2: Ion exchange resins

Characteristics of ion exchange membrane NEOSEPTA

❶ High ionic selectivity
NEOSEPTA has excellent ionic selectivity which enables an efficient operation of electrodialysis.

❷ Low electric resistance
Although NEOSEPTA is provided with backing material for reinforcement, the electric resistance is low which is very important for plant operation costs.

❸ High mechanical strength
With backing material for reinforcement, NEOSEPTA demonstrates physical strength and ease of handling.

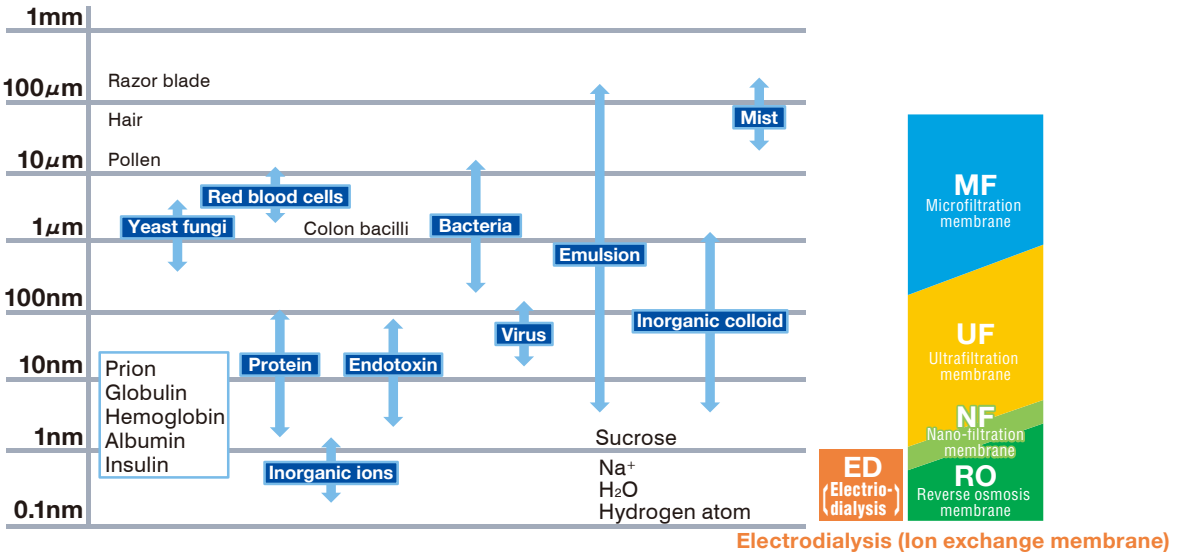
❹ High chemical stability
NEOSEPTA is stable against various kind of chemicals.

❺ High dimensional stability
Since NEOSEPTA has a chemically stable structure, it demonstrates high dimensional stability in a practical use by limiting swelling and shrinking resulting from change of temperature, composition, concentration, etc.

❻ Low diffusion of solute and solvent
Since NEOSEPTA has a low diffusion coefficient of solute or solvent, undesired back diffusion or transfer can be minimized.

❼ Ability to separate monovalent ions and multivalent ions
Specific membranes enable separation of monovalent and multivalent ions in the solution.

Application range of Electrodialysis



Electrodialysis (Ion exchange membrane)

Grades and properties —Standard-grade membranes and special-grade membranes of NEOSEPTA

Standard-grade membranes: Used for general concentration and desalination.
Special-grade membranes: We have various membranes with specific characteristics such as selective permeability for monovalent ions, chemical stability, etc.

Handling precaution for NEOSEPTA membranes

To maximize the performance of NEOSEPTA, please read the following instructions.

1. Keep the NEOSEPTA wet and never let it become dry.
2. To prevent damage and deterioration of the membrane, avoid folding or contact with foreign substances.
3. When storing, be sure to keep the NEOSEPTA in a dark and cool place to avoid drying.
4. Prevent the membrane from contacting solutions containing oil, oxidizing agents, and/or polymer electrolyte (surfactant, etc.).

Comparison table for detailed specification of Cation/Anion Exchange Membrane

Title		Cation Exchange Membrane			Anion Exchange Membrane			
		Standard grade	Special grade		Standard grade	Special grade		
		CSE	CMB	CXP-S	ASE	AHA	AXP-D	AID
Characteristics	Type	Strong Acid (Na type)			Strong Base (Cl type)			Weak Base (Cl type)
	Characteristics	High mechanical strength	High mechanical strength / Alkali resistance	Monovalent cation permselectivity	High mechanical strength	High mechanical strength / Alkali resistance	Monovalent anion permselectivity	Proton blocking
	Electric resistance (Ω·cm²)	1.8	4.5	2.0	2.6	4.1	2.5	4.3
	Burst strength (MPa)	≧0.35	≧0.40	≧0.20	≧0.35	≧0.90	≧0.20	≧0.70
	Thickness(mm)	0.16	0.21	0.10	0.15	0.22	0.10	0.16
	Application	・Desalination of foods ・Desalination / concentration of inorganic salt ・Removal of hardness and nitrogen from underground water	・Alkali recovery ・Acid and alkali production (BPED) ・Diaphragm	・Acid recovery ・Separation of metals ・Salt production	・Desalination of foods ・Desalination/ concentration of inorganic salt ・Removal of hardness and nitrogen from underground water	・Alkali recovery ・Diaphragm	・Desalination of foods ・Salt production ・Nitrogen removal from underground water	・Acid recovery (DD) ・Production of acids and alkalis (BPED)
Recommended field of application	Temperature(℃)	≦40	≦60	≦40	≦40	≦60	≦40	≦40
	pH	0-14	0-14	0-10	0-14	0-14	0-8	0-2

Electric resistance : Measured on alternative current after equilibration with a 0.5N-NaCl solution at 25℃ (0.5N-HCl solution as for AID membrane)
Burst Strength : Mullen Bursting strength
Thickness : Wet membrane
CXP-S, AXP-D and AID membranes are new products, so the above specifications are subject to change without any notice for product improvement
Please contact us about the product not on the list and used for other applications

Astom's ion exchange membrane **NEOSEPTA** and our high performance dialyzer, **ACILYZER**, which integrates NEOSEPTA, offer efficient separation technology on the ionic substance level.

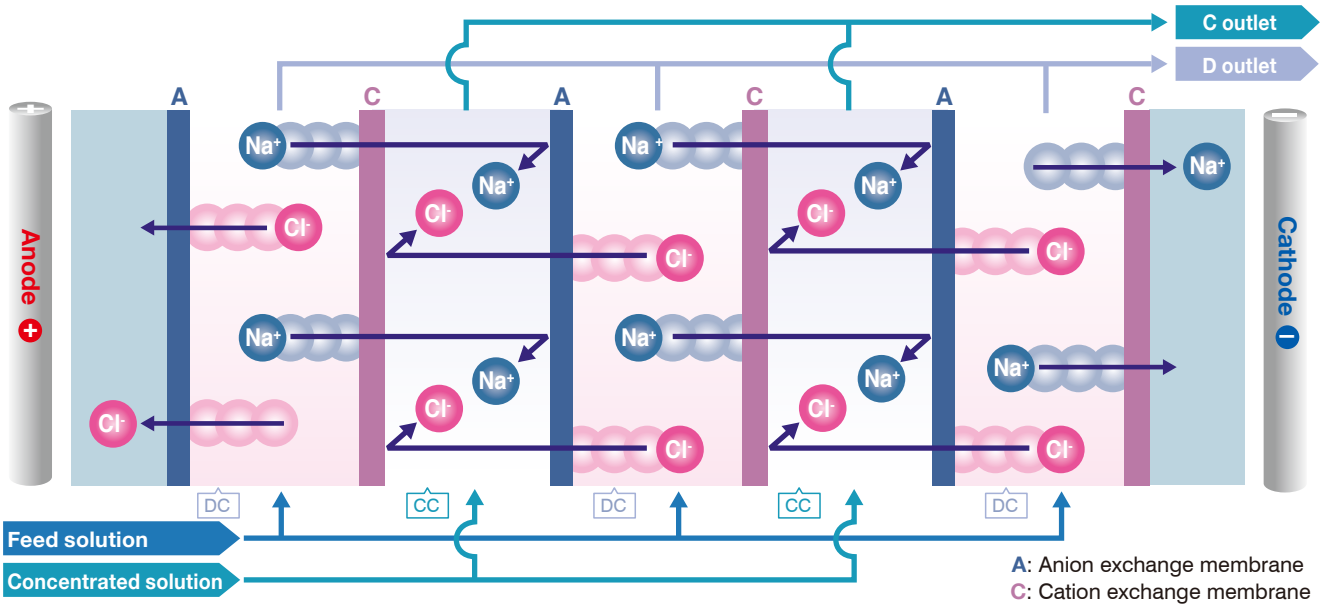
Electrodialyzer

ACILYZER ED

About Electrodialysis

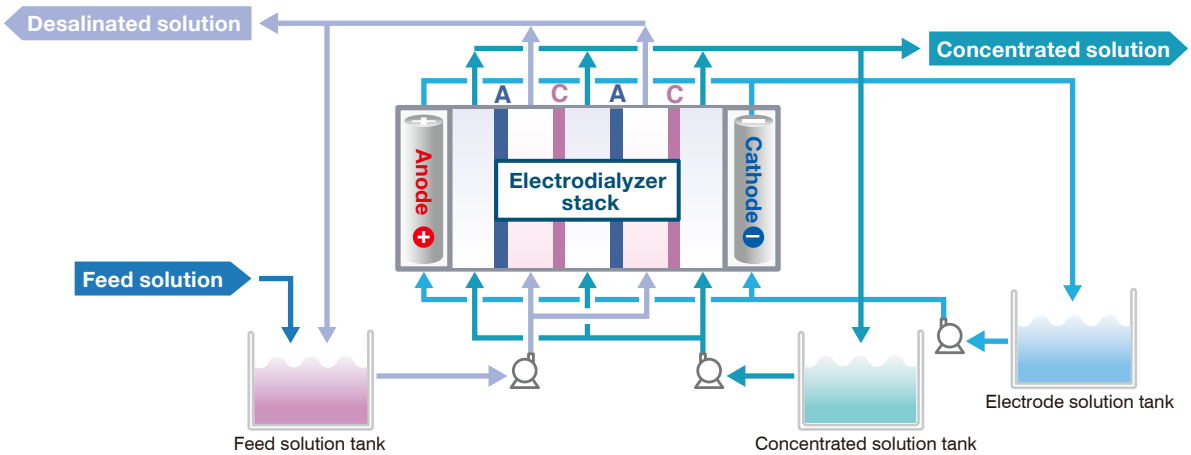
The electrodialyzer uses permselective ion exchange membranes and electrical energy to separate ionic substances in aqueous solution, enabling efficient desalination, concentration, refining and recovery.

Electrodialysis is a separation technology utilizing electrophoresis of ionic substances in solutions and the selective permeability of ion exchange membranes. There are two types of ion exchange membranes. Cation exchange membrane selectively allows cation permeation and anion exchange membrane selectively allows anion permeation. In an electrodialyzer, a large number of these membranes are arranged alternately between two electrodes and direct current is applied to separate ions in solution (Figure 3).



A: Anion exchange membrane
C: Cation exchange membrane
CC: Concentration compartments
DC: Desalination compartments

Figure 3: Principle chart



A: Anion exchange membrane
C: Cation exchange membrane

Figure 4: Electrodialyzer flow chart

Characteristics of Electrodialyzer ACILYZER ED

1. Desalinates, concentrates, refines and recovers ionic substances.
2. Selectively separates ionic substances.
3. Removes ionic substances from non-ionic valuables.
4. Requires no heating or pressurization which keeps components consistent.
5. The rates of desalination and concentration can be controlled.
6. No regeneration required and continuous operation for an extended period of time is possible.
7. Electrodialyzer produces a low noise and low vibration compared with RO and also features ease of handling.

Application examples of Electrodialyzer ACILYZER ED

- Salt production from seawater
- Desalination of soy sauce
- Desalination of oligosaccharide
- Desalination/concentration of leachate from a landfill
- Desalination/concentration of processing waste solution
- Acid recovery of aluminum plate pickling process
- Recovery of alkali waste solution

Line up of ACILYZER ED

AC02

AC25

AC50

AC140

	Model	standard processing capacity	Scale of standard equipment
Small scale	AC02	10L/Hr	80(W)×64(D)×142(H)cm
Medium scale	AC10	100L/Hr	200(w)×130(D)×180(H)cm
	AC25	1,000L/Hr	350(w)×140(D)×210(H)cm
Large scale	AC50	1,000L/Hr or more	Please contact us directly for information.
	AC140	10,000L/Hr or more	

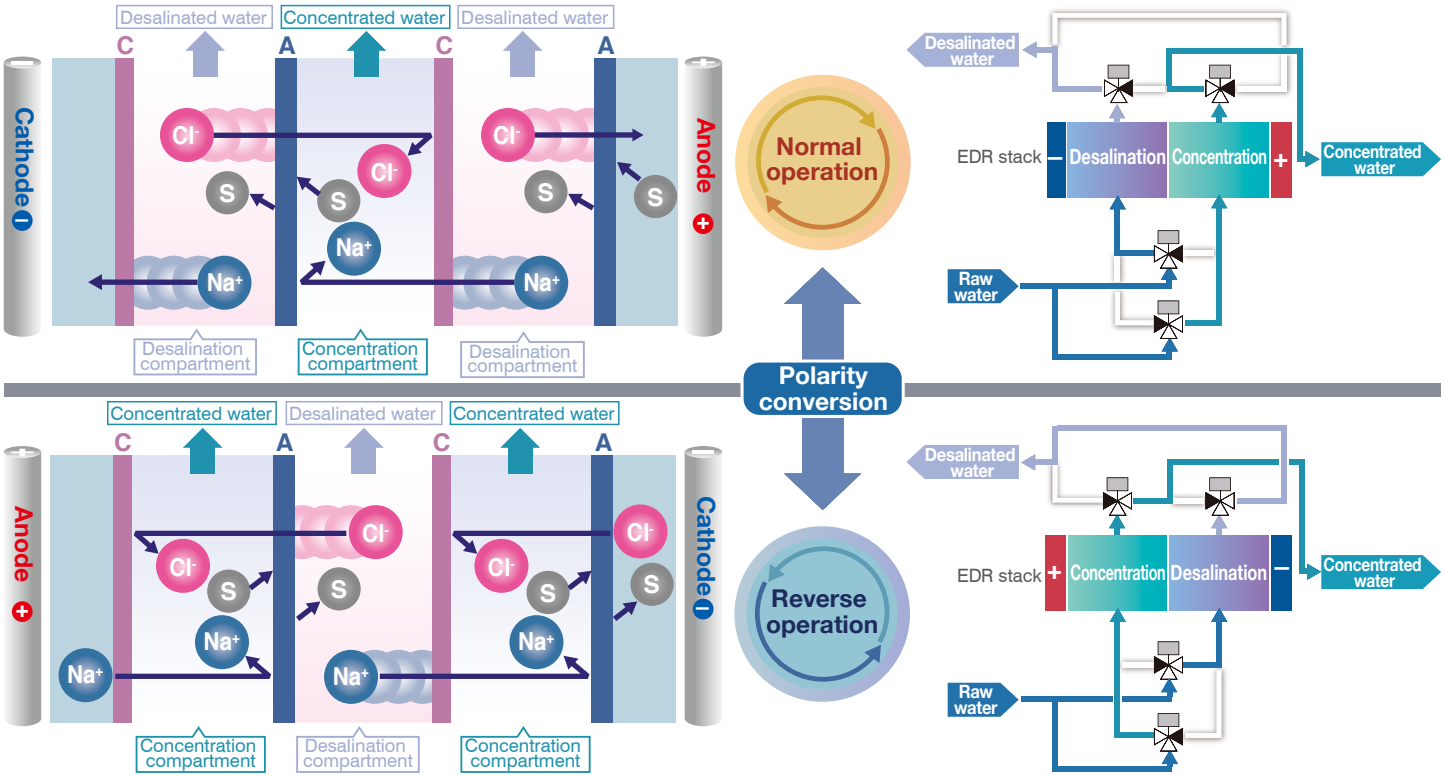
"Standard processing capacity" indicates 95% desalination ,i.e., 6% (1N) salt water can be desalinated down to 0.3% (0.05N).

Electrodialysis Reversal

ACILYZER EDR

About Electrodialysis Reversal

The EDR is a kind of ED system, which is operated by periodically changing its polarity to provide better, more cost-effective performance and maintenance work compared to those of conventional ED (Figure 5).



A: Anion exchange membrane
C: Cation exchange membrane
S: Scale

Figure 5: Principles of Electrodialysis Reversal

Characteristics of electrodialysis reversal ACILYZER EDR

1. High water recovery
2. Scale deposit can be prevented
3. Improves the durability of membranes.
4. Saves power consumption.
5. Desalination ratio of raw water can be easily controlled.
6. Water with a high level of SiO_2 can be treated without forming precipitation on ion exchange membrane.

Application examples of electrodialysis reversal ACILYZER EDR

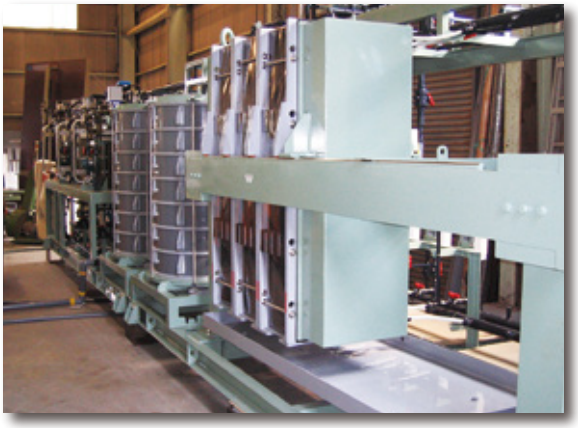
- The desalination and removal of hardness component from underground water
- Removal of nitrate nitrogen from underground water

Line up of ACILYZER EDR

	Model	Standard processing capacity	Scale of standard equipment
Medium scale	AC17R	2,000L/Hr	Please contact us directly for information.
Large scale	AC70R	2,000L/Hr or more	

Diffusion Dialyzer

ACILYZER DD



About Diffusion Dialyzer

Diffusion dialysis recovers acid using a concentration difference of solution on both sides of the ion exchange membrane.

In one example of diffusion dialysis for recovering acid, only anion exchange membrane is put between waste acid compartment and acid recovery compartment. With supplying waste acid containing metal ion through the bottom of waste acid compartment and water through the top of acid recovery compartment, free acid from the waste acid permeates through the anion exchange membrane into the water side by diffusion, driven by the concentration difference between each solution while metal ion does not permeate due to the rejection from the anion exchange membrane (Figure 6).

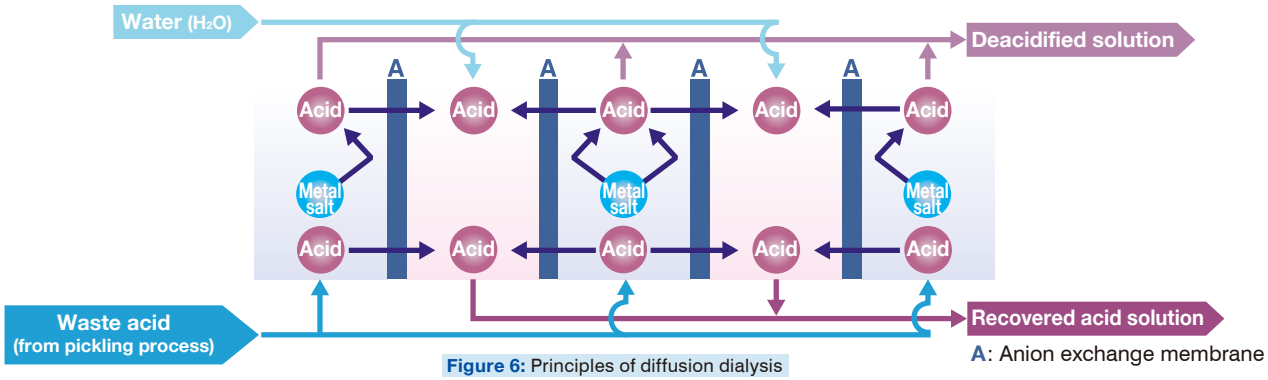


Figure 6: Principles of diffusion dialysis

A: Anion exchange membrane

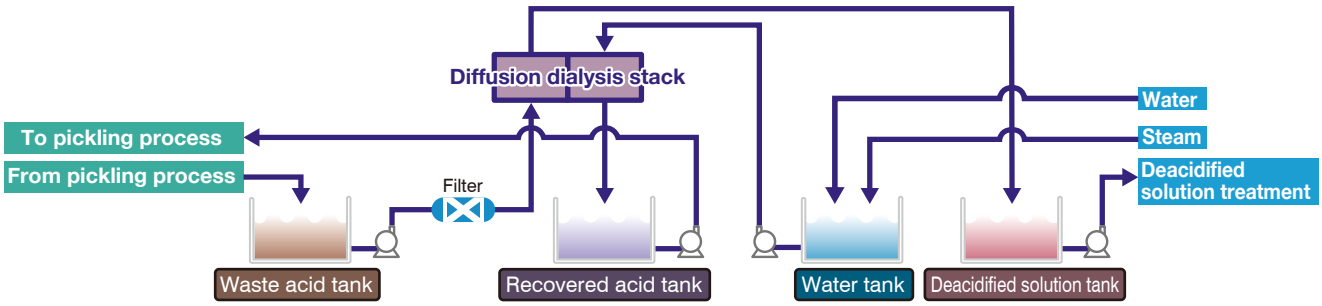


Figure 11: Diffusion dialyzer flow chart

Characteristics of diffusion dialyzer ACILYZER DD

1. Efficiently recovers free acid from waste acid discharged from the pickling process.
2. Provides low operation cost since diffusion transfer is driven by a concentration difference.
3. Recovers and recycles free acid, which reduces neutralization cost for waste acid.
4. Removes metals continuously from the pickling processing tank which allows easy control of concentration in recovered acid tank.
5. A simple structure makes equipment maintenance easy.

Application examples of diffusion dialyzer ACILYZER DD

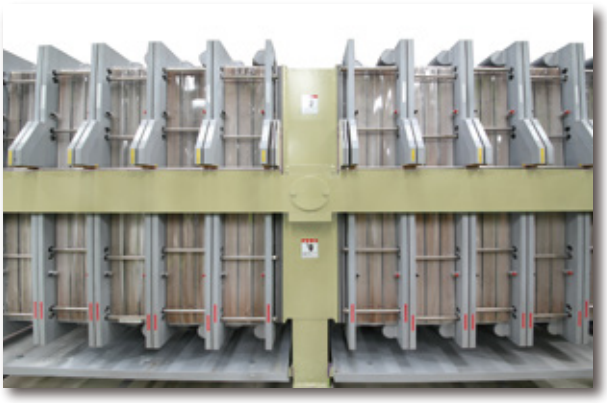
- Acid treatment
- Acid recovery of aluminum plate pickling process
- Acid recovery of aluminum foil pickling process
- Acid recovery of the metal pickling process

Line up of ACILYZER DD

	Model	Standard processing capacity	Scale of standard equipment
Small scale	AC02D	0.4L/Hr	80(w)×64(D)×142(H)cm
Medium scale	AC10D	20L/Hr	200(w)×130(D)×180(H)cm
	AC25D	250L/Hr	350(w)×140(D)×210(H)cm
Large scale	AC50D	250L/Hr or more	Please contact us directly for information.

Bipolar Membrane Electrodialyzer

ACILYZER BPED



About Bipolar Membranes

A bipolar membrane is an ion exchange membrane composed of an anion exchange layer and a cation exchange layer (Figure 10).
Applying bipolar membrane with DC current, water is split inside the membrane and then proton (H^+) and hydroxyl ion (OH^-) are generated. This unique function of water splitting is utilized for production of an acid and a base from a corresponding salt in combination with conventional monopolar ion exchange membrane.

About Bipolar Membrane Electrodialysis

By supplying inorganic salt (e.g., Na_2SO_4) to the 3 compartment process bipolar membrane electrodialysis stack (Figure 8), which combines anion, cation and bipolar membranes, the anion (SO_4^{2-}) will permeate through the anion exchange membrane and combine with the H+ ion which is split at the bipolar membrane to produce acid (H_2SO_4). On the other hand, the cation (Na^+) will permeate through the cation exchange membrane and combine with the OH^- ion which is split at the bipolar membrane to produce alkali (NaOH) (the opposite reaction of neutralization will occur).

Organic acid and alkali are produced by supplying organic acid salt (weak acid salt) into the 2 compartment bipolar electrodialyzer stack (Figure 9) that is made of bipolar membranes and cation exchange membranes combined together.

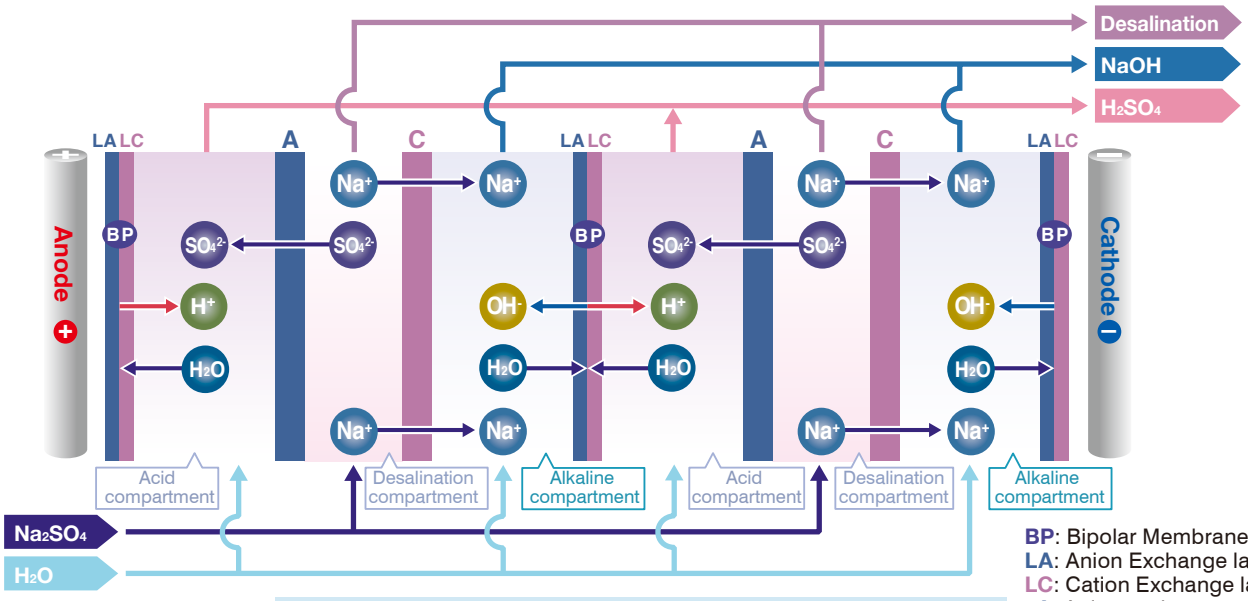
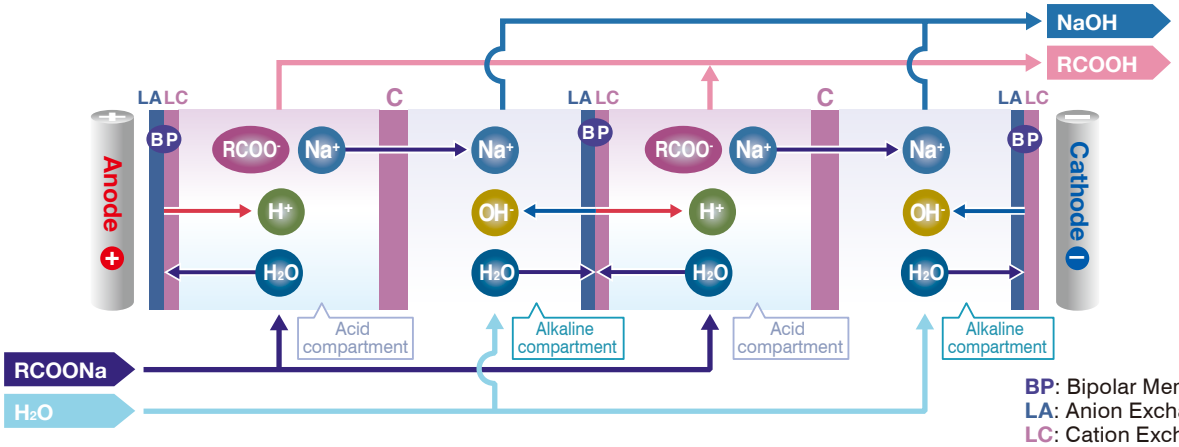


Figure 8: Na_2SO_2 based 3 compartment process of bipolar membrane electrodialysis

BP: Bipolar Membrane
LA: Anion Exchange layer
LC: Cation Exchange layer
A: Anion exchange membrane
C: Cation exchange membrane



BP: Bipolar Membrane
LA: Anion Exchange layer
LC: Cation Exchange layer
C: Cation exchange membrane

Figure 9: Organic acid salt-based 2 compartment process bipolar membrane electrodialysis

Principles of Bipolar Membrane

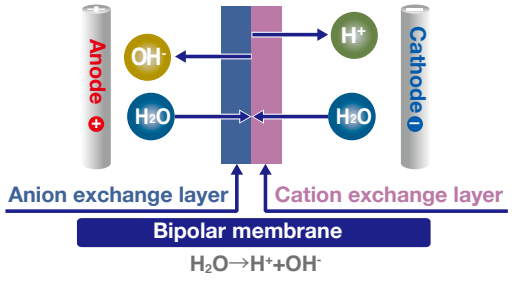


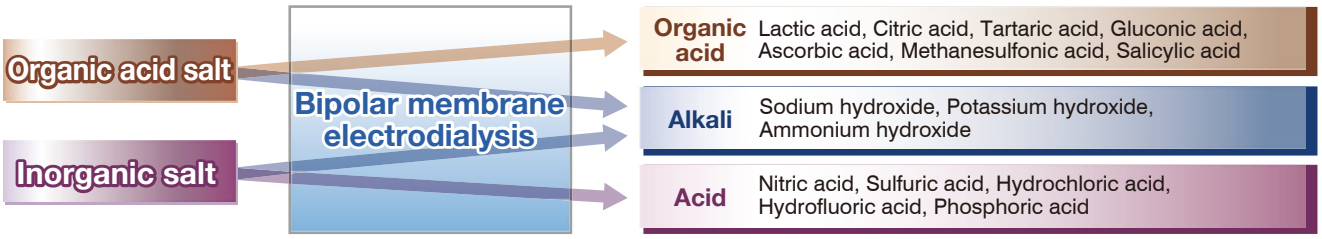
Figure 10: Principles of Bipolar Membrane

Specifications of Bipolar Membrane

Water splitting voltage*1	1.0V*2
Water splitting efficiency*1	≧0.98
Burst strength	≧0.7MPa
Thickness	0.28mm

*1 1N NaOH・1N HCl 10A/dm2 30℃
*2 Potential difference measured between silver-silver chloride electrodes

Example of production with Bipolar Membrane Electrodialyzers



Characteristics of Bipolar Membrane Electrodialyzer ACILYZER BPED

1. Splits water into acid (H^+) and alkali (OH^-) with relatively low voltage.
2. Due to the absence of electrode reaction, no oxidation-reduction reaction takes place. Therefore, there will be no byproduct.
3. Produces acid and alkali from inorganic salt or organic acid salt in a single process.
4. Controls the concentration rate of acid and alkali.
5. Different from electrolytic processing, no electrodes are required for through every single cell and, therefore, fewer fumes generated.
6. Produces less waste solution.
7. Withstands continuous operations for an extended time since no regeneration process, like ion exchange resin process, is required.

Application examples of Bipolar Membrane Electrodialyzers

- Production of organic acid from organic acid salt
- Production of amino acid from amino acid salt
- Production of acid and alkali from waste solution with salt
- Production of acid and alkali from inorganic salt

Line up of ACILYZER BPED

	Model	Standard processing capacity	Scale of standard equipment
Small scale	AC3B-02 / AC2B-02	15L/Hr	140(W)×70(D)×150(H)cm
Medium scale	AC3B-10 / AC2B-10	200L/Hr	220(W)×180(D)×170(H)cm
Large scale	AC3B-50 / AC2B-50	200L/Hr or more	Please contact us directly for information.


AC3B-02 / AC2B-02


AC3B-50 / AC2B-50

3B in the model number refers to the 3 compartment process and 2B refers to 2 compartment process.
"**Standard processing capacity**" indicates that 7% (1N) sodium sulfate solution can be processed down to 3.5 % (0.5N) through the 3 compartment process.

Tubular membrane electrode apparatus

EDCORE

About EDCORE

EDCORE is a tubular membrane electrode apparatus utilizing of seamless tubular ion exchange membranes. It is used to recover free anion occurring during the electro deposition coating process and other processes. Different from products of ordinary ion exchange membrane sheet, it offers various unique features.

Characteristics of tubular membrane electrode apparatus EDCORE

❶ High physical strength

EDCORE is a simply structured electrode apparatus that requires no supporting device because the membrane maintains excellent physical strength. Since there is no supporting device, it maximizes the membrane area (conductive area) and anolyte circulation rate which contributes to a lower outbreak of foreign substances such as bacteria.

❷ Reduction of deposits

The membranes are smooth surface and easy to cope with dimensional changes so that no wrinkles occur. Its wrinkleless construction prevents substances from depositing and minimizes the risk of coating failures due to the deposits.

❸ Low permeability of non-ionic substances

Since there is no permeability for non-ionic substances and the EDCORE' s permeability is zero for water of 0.8MPa or less, it can prevent contamination of the electrode solution.

❹ Easy handling

The EDCORE is light weight and sturdy, and able to be handled in a dry condition.
Its compact size makes flexible installations and easy maintenance is possible.

Detailed specifications of EDCORE

Product	Anion exchange type membrane electrode apparatus	
Membrane	Membrane type	Strong basic tubular anion exchange membrane
	Shape	Tubular and seamless (constant thickness)
	Material	Polyolefin-based + styrene/divinylbenzene-based material
	External dimension	Φ63mm
	Transport number	≒98%
Electrode	Material	SUS316
	External dimension	Φ48.6mm
Potting material		Rigid PVC
Line up	Length	Less than 4,000mm (negotiable)
	Weight	Approximately 15kg each in case of open vertical model with effective membrane length 2,100mm
	Line up	Open vertical model / Closed vertical model / Closed horizontal model
Others	Circulation amount of anolyte	≧3L/minutes (per each)
	Applicable temperature range	0-40℃
	Water permeability	0 (up to 0.8MPa)

Structure of EDCORE

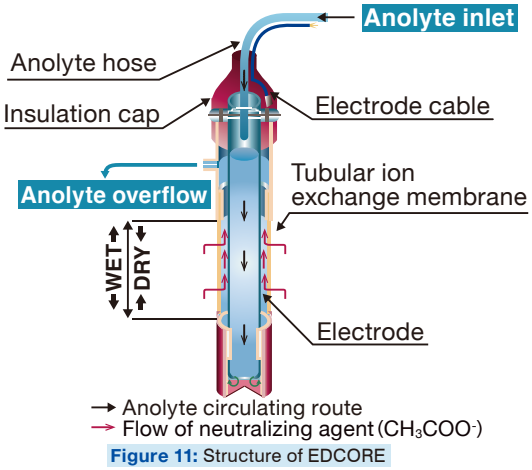


Figure 11: Structure of EDCORE

Principles of electro deposition coating

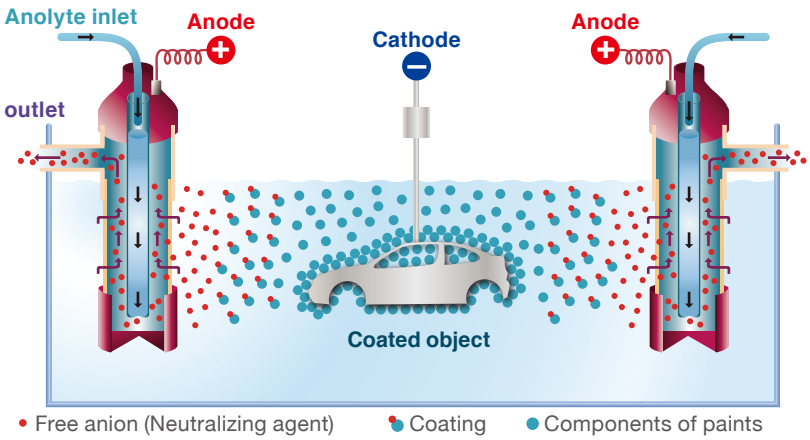


Figure 12: Principles of electro deposition coating

Application examples of tubular membrane electrode apparatus EDCORE

- Electro deposition coating for automobiles, building materials, consumer electronics, etc.

Desktop Electrodialyzer

You can check the availability of your requested electrodialysis through tests utilizing the desktop electrodialyzer.

Electrodialyzers MICRO ACILYZER S3

MICRO ACILYZER S3

S3 cartridge

- Electrodialysis test is available.
- Suitable membrane combination can be selected by changing type of cartridge.
- Conductivity, current, time and voltage are indicated.

Bipolar Membrane Electrodialyzer ACILYZER EX3B

ACILYZER EX3B

- Electrodialysis test with bipolar membrane is available.
- Normal electrodialysis test is also available.
- Suitable membrane combination can be selected by changing type of cartridge.
- Conductivity, current, time and voltage are indicated.

Comparison table for detailed specifications

Model	MICRO ACILYZER S3	ACILYZER EX3B
Functions	Desalination, concentration	Bipolar membrane electrodialysis
Indicators	Current, voltage, desalinated and concentrated solution conductivity, time, current integration	Current, voltage, conductivity in saline solution/acidic solution/alkaline solution, time, current integration
Effective membrane area	550cm^2	550cm^2
Electric conductive area	55cm^2/cell	55cm^2/cell
Operating mode	Constant voltage (4 patterns) / constant current	Constant voltage (4 patterns) / constant current
Terminating mode	Current, conductivity, time	Current, conductivity, time
Terminating condition	Current: 0.00-3.00Amp Conductivity ・desalinated solution: 0.0-200mS/cm ・concentrated solution: 0.0-500mS/cm Time: 0-999minutes	Current: 0.00-6.00Amp Conductivity ・desalinated solution: 0.0-200mS/cm ・acidic solution/ alkaline solution: 0.0-500mS/cm Time: 0-999minutes
Line capacity	150ml	150ml
Standard processing capacity	500ml/Hr(when usingAC-220-550)(*1)	2,000ml/Hr(*2)
Size	Width: 400mm, Height: 610mm, Depth: 420mm	Width: 400mm, Height: 610mm, Depth: 420mm
Weight	34kg	35kg
Power	AC 100V,single phase 50/60Hz	AC 100V,single phase 50/60Hz
Power consumption	Approx. 500W	Approx. 550W
Upper temperature limit	40℃	40℃

(*1) "**Standard processing capacity**" indicates 95% desalination that 6% (1N) salt water can be desalinated down to 0.3% (0.05N).
(*2) "**Standard processing capacity**" indicates that 7% (1N) sodium sulfate solution can be processed down to 3.5 % (0.5N) through the 3 compartment process.

Application Examples

Salt production from seawater

Electrodialysis

Composition (unit)	Seawater	Concentration
Na (g/L)	10.7	82.0
K (g/L)	0.4	4.0
Ca (g/L)	0.4	0.6
Mg (g/L)	1.3	1.4
Cl (g/L)	19.4	135.0
SO_4 (g/L)	2.6	0.5

POINT!

・It is possible to make the NaCl concentration 200g/L and more.

Desalination of soy sauce

Electrodialysis

Item (unit)	Feed solution	Desalinated solution		
Desalination rate (%)	-	32.1	57.1	75.1
Operation time (hour)	0	4	7	9
NaCl (g/L)	168	124	89	59
Solution amount (liter)	100	92	81	71
Nitrogen concentration (g/L)	15.3	16.1	17.2	18.0

POINT!

・It desalinates soy sauce without any loss of umami (flavour).
・Salt concentration is adjustable freely.

Desalination of oligosaccharide

Electrodialysis

Item (unit)	Feed solution	Desalinated solution		
Desalination rate (%)	-	90	95	99
NaCl (g/L)	58.50	5.85	2.92	0.58
Lactose (g/L)	1.00	1.00	1.00	1.00
Glucose (g/L)	1.00	0.96	0.94	0.93

POINT!

・It desalinates without losing much saccharide.

Production of gluconic acid

Bipolar Membrane Electrodialysis

Composition (unit)	Feed solution	Desalinated solution	Alkaline solution
Sodium gluconate (g/L)	201	13	-
Gluconic acid (g/L)	0	184	-
NaOH (g/L)	-	-	100
Flow rate (L/Hr)	100	92	34
Gluconic acid conversion rate (%)	94.0		-

POINT!

・Enable to produce gluconic acid from sodium gluconate at a high conversion rate.
・Enable to produce sodium hydroxide (NaOH) as a byproduct.

Desalination and removal of hardness from underground water

Electrodialysis reversal

Composition (unit)	Raw water	Produced water
Sodium ion (mg/L)	236	42
Chloride ion (mg/L)	587	40
Total hardness (mg/L)	567	60
TDS (mg/L)	1,500	180
SiO_2 (mg/L)	55	53
Conductivity (μS/cm)	2,340	307
Recovery rate (%)	85	
Desalination rate (%)	88	
Power consumption (KWH/m^3)	0.47	

POINT!

・Enable to produce drinking water by removing hardness component and salt with low power consumption.
・Enable to treat raw water with high SiO_2 concentration and achieve a high recovery rate.

Removal of nitrate nitrogen from underground water

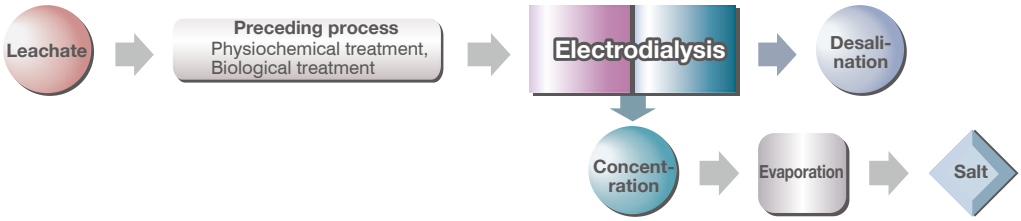
Electrodialysis reversal

Composition (unit)	Raw water	Produced water
Nitrate nitrogen (mg/L)	45	3
Total hardness (mg/L)	314	70
TDS (mg/L)	555	168
Conductivity (μS/cm)	770	240
Recovery rate (%)	80-85	
Desalination rate (%)	70	
Nitrate nitrogen removal rate (%)	93	
Power consumption (KWH/m^3)	0.4	

POINT!

・Nitrate nitrogen is removed efficiently.

Desalination/concentration of leachate from a landfill



Electrodialysis

Composition (unit)	Feed water	Desalinated solution	Concentrated solution
TDS (mg/L)	17,000	350	165,000
Cl (mg/L)	9,300	200	91,000
Ca (mg/L)	50	5	450

POINT!

・Enable to achieve high level of desalination and high concentration.

Application Examples

Desalination/concentration of waste solution from the manufacturing process of semiconductors

Electrodialysis

Item (unit)	Feed solution	Desalinated solution	Concentrated solution
$(NH_4)_2SO_4$ (g/L)	30.0	7.6	100.0
Flow rate (m^3/day)	1.10	0.84	0.26

POINT!

・Enable to reduce waste solution.

Waste solution from pickling process

Electrodialysis

Item (unit)	Feed solution	Desalinated solution	Concentrated solution
Na_2SO_4 (g/L)	10.1	2.0	141.0
$NaNO_3$ (g/L)	4.4	1.9	44.1
Flow rate (m^3/day)	32.0	30.1	1.9

POINT!

・Enable to reduce waste solution.
・Enable to further concentrate RO (Reverse Osmosis) concentrated solution.

Production of acid and alkali from waste solution with salt

Bipolar Membrane Electrodialysis

Item (unit)	Waste solution	Acid solution	Alkaline solution	Desalinated waste solution
Na_2SO_4 (g/L)	150	-	-	10
H_2SO_4 (g/L)	-	98	-	-
NaOH (g/L)	-	-	80	-
Solution amount (m^3)	100	99	99	67
Recovery rate (%)	95			

POINT!

・Enable to produce acid and alkali from waste solution containing salt at a high recovery rate.
・Enable to reduce the amount of waste solution.

Acid recovery of stainless pickling process

Diffusion dialysis

Item (unit)	Waste acid	Recovered acid solution	Deacidified solution
HNO_3 (g/L)	150.0	131.0	15.0
HF (g/L)	24.0	14.0	9.9
Fe (g/L)	20.0	1.6	19.0
HNO_3 recovery rate (%)	90		
HF recovery rate (%)	60		
Fe leakage rate (%)	8		

POINT!

・Enable to achieve high acid recovery rate.

Acid recovery of aluminum plate pickling process

Electrodialysis

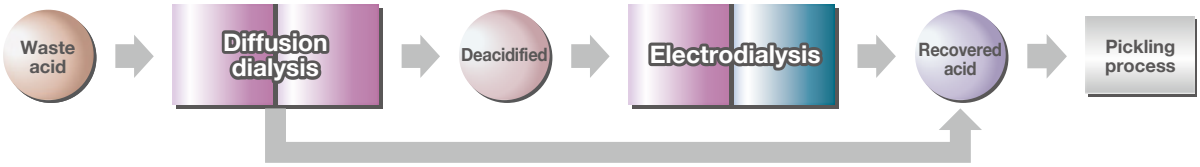
Item (unit)	Waste acid	Recovered acid solution	Deacidified solution
H_2SO_4 (g/L)	175	176	20
Al (g/L)	17.0	1.5	20.2
Acidrecovery rate (%)	91		
Al leakage rate (%)	8		

POINT!

・Enable to achieve high acid recovery rate.
・Enable to recover acid keeping concentration.

Application Examples

Acid recovery of aluminum foil pickling process



Diffusion dialysis

Item (unit)	Waste acid	Recovered acid solution	Deacidified solution
H_2SO_4 (g/L)	350	278	70
HCl (g/L)	30	27	3
Al (g/L)	10	0.3	9
Solution amount (m^3)	50	48	52
Al leakage rate (%)	3		

Electrodialysis

Item (unit)	Deacidfied solution by diffusion dialysis	Recovered acid solution	Ultimate Deacidified solution
H_2SO_4 (g/L)	70	147	7
HCl (g/L)	3	2	1
Al (g/L)	9	0.6	9
Solution amount (m^3)	52	23	46
Al leakage rate (%)	3		

POINT!

・Enable to achieve high acid recovery rate.

Recovery of alkali waste solution

Electrodialysis

Item (unit)	Alkali waste solution	Recovered alkaline solution	Dealkalized solution
NaOH (g/L)	40	146	4
Solution amount (L)	1,000	250	880
Alkali recovery rate (%)	91		

POINT!

・A high alkali recovery rate can be accomplished.
・Concentrated alkali recovery can be accomplished.

- The contents of this catalogue are effective as of April, 2022.
- Refer the operating manual of each product to use.
- Specifications in this catalogue are subject to change without any notice, and the information in this catalogue is based on test that we believe reliable, but not guaranteed values.
- Customers are requested to consult with ASTOM prior to any applications different from those described above or diversion of use from original one.

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Astom Corporation was established by consolidating the hydrocarbon-based ion exchange membranes and electrodialysis equipment divisions of two chemical manufacturing companies, Tokuyama Corporation and Asahi Kasei Corporation.

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