Flexible Technology Creates Beautiful Water

Nitto high-polymer separation membrane technology significantly contributes to securing water resources and the separation, refining and concentration of water and chemicals. Nitto combines various technologies including molecular design, polymer synthesis and membrane manufacturing to provide a wide range of applications to create beautiful water, including ultrapure water production for semiconductor manufacturing, seawater desalination, wastewater processing and water reuse. Nitto membrane products are used in a wide range of ways to give a constant supply of beautiful water and to make people’s lives around the world more healthy and abundant.

Various Membrane Separation Methods and Their Applications

Separation membranes enable the user to filter, separate, refine and concentrate substances contained in water and solutions; fresh water can be produced by removing salt from seawater. According to the size of the particles of the substance separation membranes are classified into microfiltration (MF) membranes, ultrafiltration (UF) membranes, nanofiltration (NF) membranes and reverse osmosis (RO) membranes. Separation membranes operate in two modalities: cross-flow filtration and dead-end filtration. Nitto’s separation membrane elements are mostly based on cross-flow filtration.

<table>
<thead>
<tr>
<th>Applicable Size Ranges and Target Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size Ranges (m)</td>
</tr>
<tr>
<td>Dimensions (μm)</td>
</tr>
<tr>
<td>Separation Membranes</td>
</tr>
<tr>
<td>Example Substances</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Principles of Membrane Permeation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-flow Filtration</td>
</tr>
<tr>
<td>Dead-end Filtration</td>
</tr>
</tbody>
</table>

Applications for Separation Membranes

- UF Membranes
  - Use for food processing and paper processing
  - Water purification
  - Wastewater treatment

- NF Membranes
  - Use for removes the impurities larger than 0.001 μm
  - Water purification
  - Wastewater treatment

CONTENTS

Various Membrane Separation Methods and Their Applications
Principle of Action of Various Membranes
Separation Membranes: Elements RO/UF/MF
Product Applications
Product Applications: Seawater Desalination System Flow
Membrane Separation Technology that Supports the Future of the Earth (Shiga Plant)
Nitto Group R&D and Production System for Membrane Products
Hydraulics—A World Brand of RO Membranes
Global Network
Ultrafiltration (UF)

Ultrafiltration (UF) is a method of membrane separation for high-molecular substances with molecular weights of about 1,000 to 300,000. Consisting of an asymmetrical skin layer and sponge layer, the UF membrane allows water, ionized molecules and low-molecular substances to pass through with a particularly high water permeability, while rejecting the passage of high-molecular substances.

Microfiltration (MF)

Microfiltration (MF) is a method of membrane separation occupying a position between ordinary filtration and ultrafiltration. A MF membrane has larger pores than an UF membrane, separating fine particles of 0.05-10 μm in diameter contained in liquids.
A spiral membrane element consists of spirally wound multiple flat sheet membranes. It is inserted in a pressure-resistant vessel, and this assembly is used as a spiral membrane module.

**Membrane Materials and Their Features**
- Aromatic polyamide: High rejection at low operating pressures
- Polyvinyl alcohol derivative: High permeability
- Sulfonated polyether sulfone: Chargeable skin layer (NF membranes)

**Module Features**
- A large membrane area per unit volume ensures a compact design and high permeability.
- Low operating pressures contribute to saving energy for RO systems.
- Membrane materials, element structures and component members are optimized for a wide variety of applications, including seawater desalination, ultrapure water production and food processing (ingredient separation and concentration).
- Membrane elements are exchangeable.

**Examples of Applications**
- Seawater desalination (potable water, industrial water, etc.)
- Brackish water desalination (potable water, industrial water, etc.)
- Production of boiler feed water
- Production of ultrapure water for semiconductor manufacturing etc. in the electronics industry (primary, polishing and reclamation systems)
- Production of sterile water for the medical and pharmaceutical industries
- Wastewater reuse (tertiary treatment of municipal sewage and treatment of general industrial wastewater)
- Separation, refinement and concentration of active ingredients in the pharmaceutical, food and chemical industries
- Removal of harmful substances (baron, arsenic, etc.)

**Available Sizes of Spiral Membrane Elements**
- 2-inch element (for various tests) 61 mm dia. x 1,016 mm length
- 4-inch element 99.5 mm dia. x 1,016 mm length
- 8-inch element 201 mm dia. x 1,016 mm length

**Examples of Applications**
- Production of ultrapure water for semiconductor manufacturing etc. in the electronics industry
- Production of sterile water for the medical and pharmaceutical industries
- Separation, refinement and concentration of active ingredients in the pharmaceutical, food and chemical industries

**Module Features**
- The membrane material is physicochemically tough polysulfone resin, offering sharp fractionation and high permeate flow.
- The asymmetric double-skin structure of the membrane ensures a high degree of cast resin impregnation and makes the membrane unlikely to detach.
- The unique structure with a hydrodynamically optimized design keeps out the retention of liquids and bubbles, thus prevents bacteria and suspended solids (SS) from entering the porous membrane.

**Examples of Applications**
- Production of ultrapure water for semiconductor manufacturing etc. in the electronics industry (primary, polishing and reclamation systems)
- Production of sterile water for the medical and pharmaceutical industries
- Wastewater reuse (tertiary treatment of municipal sewage and treatment of general industrial wastewater)
- Separation, refinement and concentration of active ingredients in the pharmaceutical, food and chemical industries
- Removal of harmful substances (boron, arsenic, etc.)
Product Applications

Membrane Separation Technology that Supports the Future of the Earth (Shiga Plant)

Nitto Shiga Plant was Japan’s first manufacturing facility dedicated to the production of polymer separation membranes. Surrounded by a bountiful natural environment, and furnished with the latest R&D equipment, production and quality management departments, the plant supplies a broad range of membrane products that can meet diverse needs today.

Rapidly entering the membrane technology field, the plant has been working on developing membrane separation techniques by fusing molecular design technology, polymer synthesis technology, membrane manufacturing technology, membrane modularization technology, system design technology and analytical technology.

Currently the Shiga Plant is working on producing reverse osmosis (RO) membranes for separating ions, ultrafiltration (UF) membranes for separating high-molecular substances, and other products. These separation membranes are supplied in the form of a spiral (roll), capillary (hollow fiber) and other modules. Many products that make the best use of the functions of these membranes are contributing to people’s lives across the world in terms of seawater desalination and other various applications.

Nitto membrane products are used in a broad range of separation and refining processes in seawater desalination plants, municipal sewage recycling plants, pharmaceutical production and food processing.

Product Applications:
Seawater Desalination System Flow

Nitto membrane products are used in a broad range of separation and refining processes in seawater desalination plants, municipal sewage recycling plants, pharmaceutical production and food processing.

Nitto Shiga Plant was Japan’s first manufacturing facility dedicated to the production of polymer separation membranes. Surrounded by a bountiful natural environment, and furnished with the latest R&D equipment, production and quality management departments, the plant supplies a broad range of membrane products that can meet diverse needs today.

Rapidly entering the membrane technology field, the plant has been working on developing membrane separation techniques by fusing molecular design technology, polymer synthesis technology, membrane manufacturing technology, membrane modularization technology, system design technology and analytical technology.

Currently the Shiga Plant is working on producing reverse osmosis (RO) membranes for separating ions, ultrafiltration (UF) membranes for separating high-molecular substances, and other products. These separation membranes are supplied in the form of a spiral (roll), capillary (hollow fiber) and other modules. Many products that make the best use of the functions of these membranes are contributing to people’s lives across the world in terms of seawater desalination and other various applications.

Nitto membrane products are used in a broad range of separation and refining processes in seawater desalination plants, municipal sewage recycling plants, pharmaceutical production and food processing.

Product Applications:
Seawater Desalination System Flow

Nitto membrane products are used in a broad range of separation and refining processes in seawater desalination plants, municipal sewage recycling plants, pharmaceutical production and food processing.
Nitto Group R&D and Production System for Membrane Products

The Nitto Group membrane business is implemented at three major production sites (Shiga plant in Japan, a 100% owned subsidiary Hydranautics in the US, and Shanghai plant in China), with more than 20 sales/technical service centers and two R&D centers. With its headquarters located in the United States, the membrane business moves forward through group-wide global management based on speedy decision-making.

Hydranautics–A World Brand of RO Membranes

Hydranautics is Nitto Denko Corporation wholly owned overseas subsidiary founded in 1963, and based in Oceanside, California. Hydranautics entered the reverse osmosis (RO) water treatment field in 1970, and joined the Nitto Group in 1987. Today, Hydranautics is a key production site for supplying membrane products under the Hydranautics brand to overseas markets, mainly in Europe and the United States. The company also serves as a R&D center which is developing spiral RO membrane modules and application technologies for seawater and brackish water desalination. In 1996, Hydranautics acquired ISO 9001 certification, and all group companies are now involved in development and production, and utilizing the same quality control system.

Hydranautics products are now in use on seven continents, achieving a world-leading market share in reverse osmosis membranes for seawater desalination and wastewater reuse.

Global Network

Be sure to visit Nitto’s website at www.nitto.com/jp/en/ for more information.

- The information in this brochure is effective as of September 2019.
- This brochure features products sold in Japan. Please visit Nitto’s website for information on sales of products in other countries.
- The contents of this brochure are subject to change without notice.
- The figures given in the brochure are observed values only and are not guaranteed.
- The applications given herein are suggested examples. Make sure the product is capable of the application before actually attempting to put it to use.
- The contents of this brochure (including text, graphics, data and other content) are the intellectual property of Nitto Denko Corporation.
- All logos, product names and other relative names are trademarks and registered trademarks of the Company and their respective companies in Japan or other countries.
- This document may not be copied or reprinted. We ask that you contact us through our website before using the contents for any purpose other than for which they are intended.