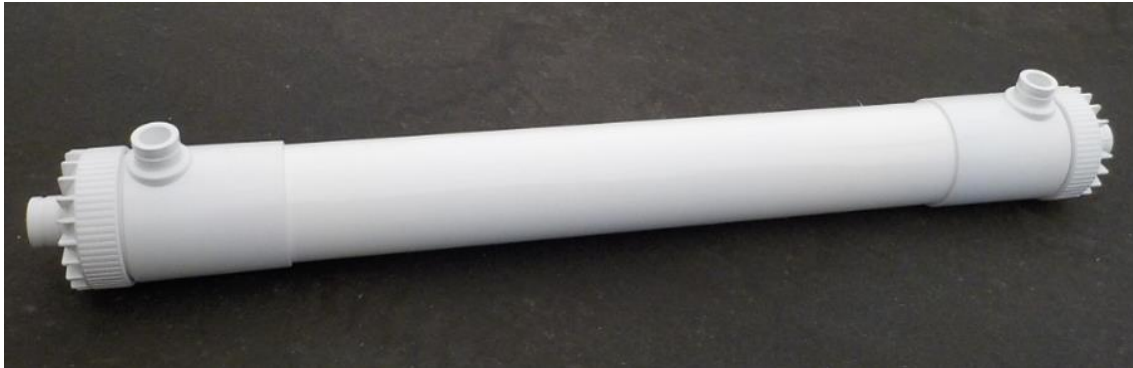


**TORAY Pressurized PVDF Hollow Fiber
Membrane Module "TORAYFIL™"
Instruction Manual**

Model: "HFU series" (type AN)



Issued by **Toray Industries, Inc.**

Water Treatment & Environment Division

2-1-1, Nihonbashi-Muromachi, Chuo-ku, Tokyo 103-8666 Japan

Tel: +81-3-3245-4552

Fax: +81-3-3245-4913

URL: www.toraywater.com

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I. Introduction

Toray PVDF Hollow Fiber Membrane Module "HFU series" is a pressurized hollow fiber UF (Ultra Filtration) membrane module developed with polymer science and membrane fabrication technologies accumulated over decades of successful membrane manufacturing at Toray Industries, Inc.

The membrane material is Polyvinylidene fluoride (PVDF). The nominal pore size of the membrane is 0.01 micron.

The module, which is permanently potted in its casing, is pressure-driven which provides equal filtrate quality to submerged modules, while offering greater TMP range for more flexible plant operation. Maximum operating pressure is 300 kPa (43.5 PSI). Flow direction is outside-in, which is more suitable for higher turbidity water treatment because of the air-scrubbing effectiveness. Additionally, outside-in modules are able to remove suspended solids more effectively at higher recovery rates compared to inside-out fibers.

1. Characteristics of Toray "HFU series" Membrane Modules

(1) High Filtration Flux

HFU series provides high filtration flux and stable operation for the filtration of various raw water sources. The membrane is made with a special spinning method, which enables high permeability and high fouling resistance.

(2) Excellent Water Quality

HFU series provides very good water quality for the filtrate, extremely low turbidity since the membrane has 0.01 micron nominal pore size. HFU series is recommended to be applied to the tertiary treatment of sewage water and RO pretreatment in seawater desalination.

(3) High Mechanical Strength

The membrane of HFU series has very high mechanical strength because it is made of PVDF with the special spinning method developed by Toray. HFU series provides high integrity and durability under recommended

operating conditions.

(4) High Chemical Durability

The membrane material of HFU series is PVDF, which allows you to clean the membrane with high concentrations of chlorine and with high concentrations of acid resulting in better cleaning and longer sustainable membrane flux rates.

2. About “type AN”




“Type AN” is a module type which has a slightly modified housing with new integrated cap, with improved sealing properties. All connecting ports of "Type AN" modules are identical to "Type N" modules, so "Type AN" modules can directly replace existing "Type N" modules.

3. Applications of Toray "HFU series" Membrane Module



- Drinking Water Production
- Tertiary Treatment of Sewage Water
- RO Pretreatment in Seawater Desalination
- Industrial Water Production
- Reuse of Industrial Waste Water

II. For Your Safety

- Please be sure to read and follow the instructions below before using HFU series. This manual should be retained for future reference.
- Follow the safety precautions as they are intended to protect operators and equipment from various risks such as physical harm and/or property damage. The following table shows a level of potential risk for each indicated symbol.

 DANGER	<p>This symbol indicates an imminent hazardous situation which will result in serious injury or death when the instruction is not observed.</p>
 WARNING	<p>This symbol indicates a potentially hazardous situation which will result in serious injury or death when the instruction is not observed.</p>
 CAUTION	<p>This symbol indicates a potentially hazardous situation which might result in injury or property damage when the instruction is not observed.</p>

- The following table explains the information to be noted.

 Prohibited	<p>“Prohibited”</p> <p>This symbol indicates a prohibited action or procedure.</p>
 Instruction	<p>“Instruction”</p> <p>This symbol indicates an important action or procedure which has to be taken without fail.</p>

1. Safety Instruction for Unpacking and Installation



Be sure to wear safety gear such as rubber gloves and safety glasses for unpacking. The membrane is packaged in sodium hypochlorite solution (100 mg/L). If the solution happens to splash onto the skin, wash the affected part with running water. If the solution happens to get in the eyes or mouth, wash the affected part with sufficient amounts of clean running water for more than 15 minutes and see the doctor immediately.



Be sure to wear safety gear such as a helmet and safety shoes to avoid injury.



The preservative solution should be drained out before using the modules. After that, keep clean water in the modules to prevent the hollow fiber membrane from drying out. Do not allow the modules to dry even for a few hours.



The membrane modules should not be frozen.



Be careful not to damage or dent the modules during handling.



Housing type joints are applied for connecting the modules of HFU-2020AN or HFU-1020AN to the piping. Follow the instruction of the Housing Type Joints Set-up Guide at the connection point. Wrong connections may damage the modules.



Keep the connection surface free of any dirt or oils.



Be sure to install the modules vertically for effective air scrubbing.

2. Safety Instruction for Filtration Operation



Flush all the piping out with clean water and make sure no debris is remaining in the piping prior to connecting the modules.



Confirm that the preservative chemical in the modules is completely drained out before starting the filtration operation. The preservative chemical is harmful to humans.



Flush the modules at low pressure, filling from the bottom, and vent to remove any air from the modules. Air left in the modules may cause water hammer and may result in damage to the membrane.



Prior to use, make certain modules are flushed. Filtrate water should be drained unless it meets the required quality.



Protect modules from direct sunlight and ultraviolet light. Ultraviolet light can degrade module housing and membranes.



Constantly monitor filtrate water quality such as turbidity and/or the number of particles during filtration, and stop the operation if abnormal water quality is detected.



Prohibited

Do not exceed the maximum applicable pressure of 300 kPa (43.5 PSI). Higher pressures can damage the modules. Do not exceed the maximum temperature of 40 degree C (104 degree F). The higher temperature damages the modules.



Prohibited

Do not freeze the membrane modules.



Instruction

The operating conditions, including the filtration flux and the periodical physical cleaning, must be properly set-up otherwise the trans-membrane pressure may rise too quickly. The operation range is described in the latter section of this manual.



Instruction

Do not overfeed air to the modules. Excessive scrubbing air damages the membranes and/or shortens the membrane life.

The air flow rate should be within the range below for each module type.

HFU-2020AN: 4.8 – 9.0 Nm³/h (2.8 – 5.3 scfm)

HFU-1020AN: 4.8 – 9.0 Nm³/h (2.8 – 5.3 scfm)

The maximum required air pressure during the air-scrubbing for inside of the module will be 40 kPa (6 PSI).



Instruction

At the integrity tests, such as Pressure Decay Test (PDT) or Diffusive Air Flow (DAF) Test, keep the air pressure below 130 kPa (18.9 PSI). Keep the source air pressure lower than 200 kPa (29 PSI), to prevent excess air inflow. All the air used for air scrubbing and integrity testing must be dry oil-free air.

3. Safety Instruction for Chemical Cleaning



Instruction

Take special precautions when handling chemicals during chemical cleaning. Wear the safety gear such as safety glasses and protective gloves. If chemicals come in direct contact with your skin or your clothes, treat the contacted part appropriately based on the SDS.



Prohibited

Do not mix sodium hypochlorite with acid. Such mixture generates toxic chlorine gas.



Instruction

Stop operation whenever any anomaly occurs with the equipment or any signs of an anomaly are observed.



Instruction

In the chemical cleaning, strictly follow the procedure described in the latter section of this manual. Otherwise you may damage the modules or negatively affect the membrane performance.

4. Safety Instruction for Disposal



WARNING



Instruction

When dispose the modules, please apply a service of a qualified waste disposing company. When the module is to be incinerated, please apply the appropriate facilities in which hydrogen fluoride (HF) gas can be neutralized. HF gas is generated with the incineration of membrane.

III. Specifications of Toray "HFU series" Membrane Module

Table 1. Specifications of membrane *1)

Membrane Material		PVDF (Polyvinylidene fluoride)
Nominal Pore Size *2)		0.01 micron
Trans-Membrane Pressure	Maximum *3)	300 kPa (43.5 PSI)
	Normal Operation	Lower than 200 kPa (29.0 PSI)
Storage and Operating Temperature Range		0 – 40 degree C (32 – 104 degree F)
Operating pH Range		1 – 10

*1): Please note that the specifications are subject to changes from time to time.

*2): Estimation from removal of model particles.

*3): TMP (Trans-Membrane Pressure) should be below 300 kPa (43.5 PSI) at any time even during the filtration.

Table 2. Feed water limits *1), *4)

Turbidity	Intermittent Peak *5)	200 NTU
	Continuous Maximum	50 NTU
TSS	Intermittent Peak *5)	200 mg/L
	Continuous Maximum	50 mg/L
Ozone		Not detected
Pretreatment Filter Mesh Size		Smaller than 200 micron meter
Temperature Range		0 – 40 degree C (32 – 104 degree F)
pH Range		1 – 10
Maximum Feed Pressure		300 kPa (43.5 PSI)

*1): Please note that the specifications are subject to changes from time to time.

*4): In case of design, please contact us.

*5): The duration time should be less than 48 hours and the occurrence frequency should not exceed more than once a month.

Table 3. Cleaning limits *1)

Cleaning pH Range	0 – 12
Cleaning Temperature Range	0 – 40 degree C (32 – 104 degree F)
Maximum Concentration of NaClO as Cl ₂	3,000 mg/L (10 ≤ pH ≤ 12)
Maximum NaClO Exposure (lifetime contact time) as Cl ₂	1,000,000 mg/L hours
Maximum Acid Contact Time	1,000 hours (pH ≥ 0)

*1): Please note that the specifications are subject to changes from time to time.

Table 4. Specifications of modules *1)

Module Type		HFU-2020AN	HFU-1020AN
Membrane Surface Area (Outer Surface)		72 m ² (775 ft ²)	29 m ² (312 ft ²)
Dimensions	Diameter	216 mm (8.50 inches)	
	Length	2,160 mm (7.087 ft.)	1,120 mm (3.675 ft.)
Weight	Full of Water	92 kg (203 lbs)	51 kg (112 lbs)
	Drained	49 kg (108 lbs)	32 kg (71 lbs)
Materials	Housing	PVC and/or equivalent	
	Potting	Epoxy and/or equivalent	
Connections	Top	Housing type joint 80A	
	Bottom	Housing type joint 80A	
	Side	Housing type joint 65A	
Operating Conditions	Max. Feed Water Flow	12 m ³ /h (53 gpm)	4.8 m ³ /h (21 gpm)
	Max. Backwash Flow	13.5 m ³ /h (59 gpm)	5.4 m ³ /h (23 gpm)
	Max. Air Flow	9.0 Nm ³ /h (5.3 scfm)	
	Filtration Method	Outside to inside, dead end	
	Max. Inlet Pressure	300 kPa (43.5 psi)	
	Maximum Temperature	40 degree C (104 degree F)	

*1): Please note that the specifications are subject to changes from time to time.

**CAUTION**

- Handle and operate the modules within the ranges and the limits indicated in Table 1 to 4. Operation out of these ranges or limits may damage the modules, and affect filtration performance.

IV. Configuration of Toray "HFU series" Membrane Module (type AN)

- (1): Filtrate Outlet / Inlet of Backwash Water
- (2): Air Outlet / Backwash Water Outlet
- (3): Feed Water Inlet / Air Inlet / Drain Outlet

Connections

	Pipe fitting outer diameter mm (in)	Connectors
(1)	89.1 (3 1/2")	Housing type joint 80A
(2)	76.3 (3")	Housing type joint 65A
(3)	89.1 (3 1/2")	Housing type joint 80A

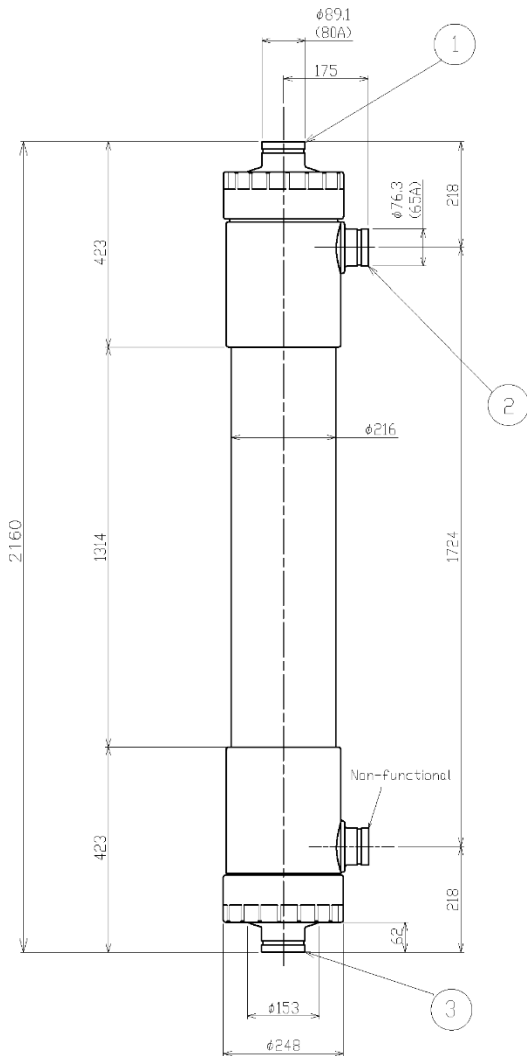


Fig. 1 Type: HFU-2020AN

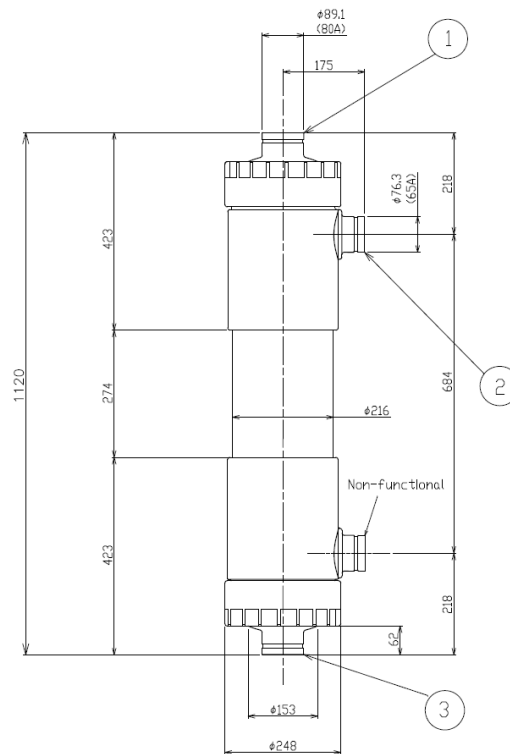


Fig. 2 Type: HFU-1020AN

V. Installation

The standard method to install the membrane modules is described below.

1. Unpack the membrane module from wooden box or corrugated box.
2. Remove plugging plate from each nozzle of the module.
3. Drain out the preservative solution from the module.



DANGER

- Wear rubber gloves and safety glasses when you drain the preservative chemical. Note that the preserving chemical is sodium hypochlorite solution (100 mg/L of chlorine). If this solution splashes onto your skin, wash the affected part with running water. If the solution gets in your eyes or mouth, wash the affected part with enough amounts of running water for over 15 minutes and see the doctor immediately.

4. Put the module vertically on the pedestal in the module rack. Fix the module upright with the hanging hook and/or the supporting belt (see Fig. 3).



WARNING

- Do not drop the module.
- Use equipment such as chain blocks, a crane or a forklift truck when you handle the module. The HFU-2020AN module is too heavy to handle by hand.



CAUTION

- Be careful not to install the module upside down. Confirm the module is installed in the right direction.
- Do not overtighten the module with the hanging hook and/or the supporting belt, or you may damage the module.
- Do not allow the hollow fiber membranes to dry even for a few hours, especially in summer.
- Do not freeze the module.

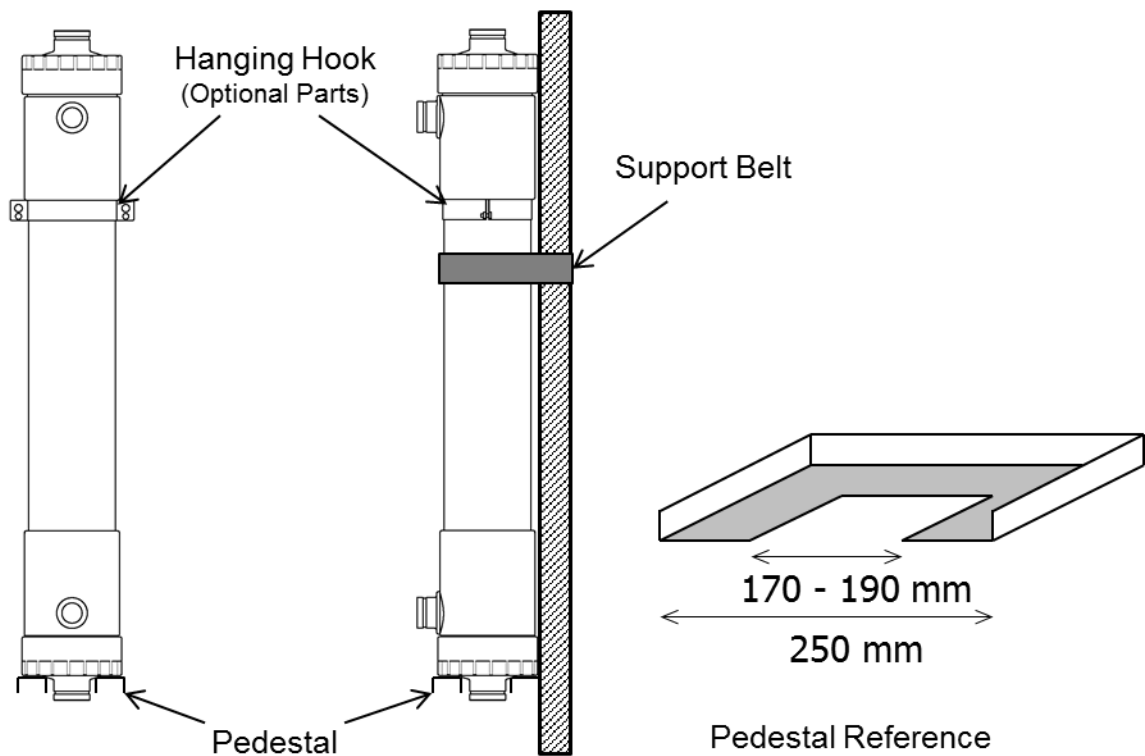


Fig. 3 Installation of the membrane module

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- Connect the piping to each connection point of the module with Housing type joints (HFU-2020AN, HFU-1020AN) (see Fig. 4). The maximum fastening power of the Housing type joints should not exceed 40 Nm. When you tighten or loosen the Housing type joints, make certain to maintain sufficient space prior to the work and be careful not to be wounded by swinging out or clipping your fingers.



CAUTION

- Keep the connection surface free of any dirt or oils.
- Follow the instruction of the Housing Type Joints Set-up Guide when using Housing Type Joints. A wrong use may cause the damage to the module.

- Air inject should be located just beneath the bottom nozzle of the module to inlet air completely to the module. Please refer to the below photos. Also, a check valve is necessary to the air piping to avoid water reverse flow.



Good location for air inject



Poor location for air inject

Good location for check valve

- Make sure that the module is installed vertically.



CAUTION

- If the module is not installed vertically, the effect of the air scrubbing would be reduced and an effective filtration will be impaired.

VI. Operation

1. Filtration

- (1) Check that all piping is connected appropriately and flushed out prior to the operation. Fig. 4 shows a typical example of piping.

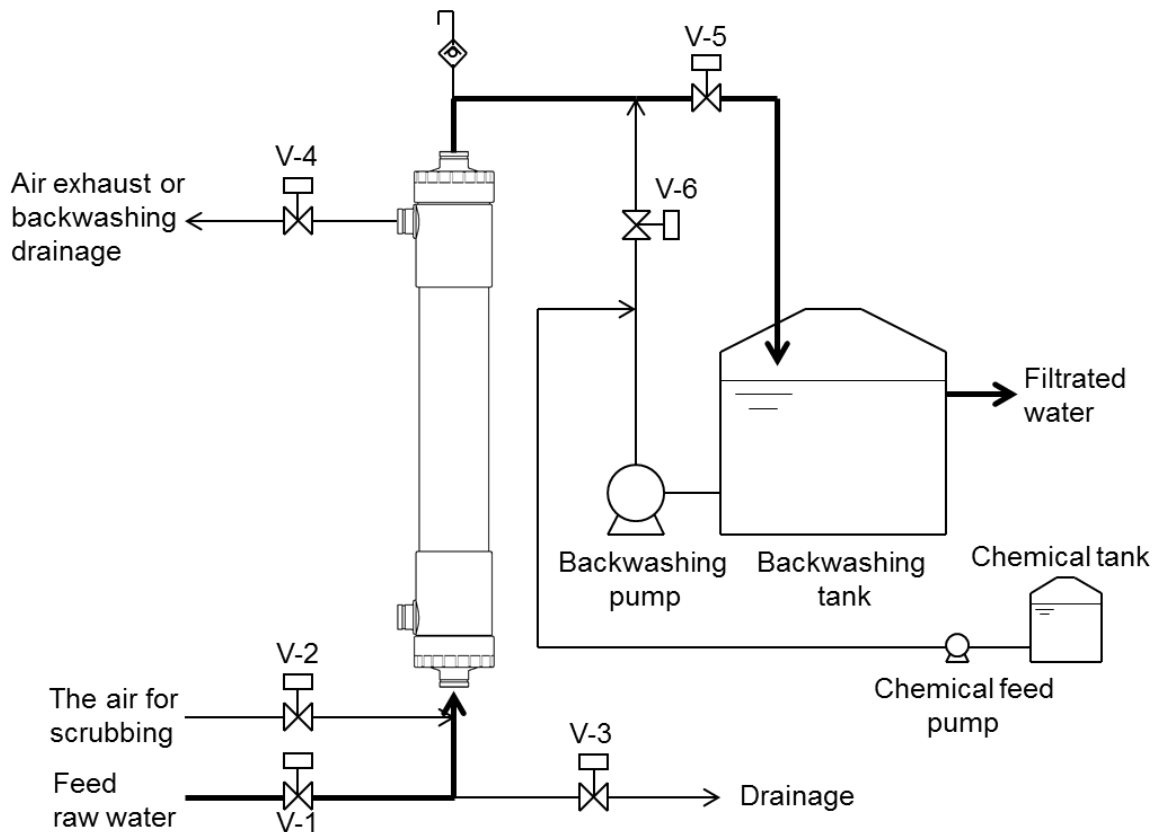


Fig. 4 Typical example of piping

- (2) Make sure the feed water valve (V-1), the drainage valve (V-3) and the valve for the scrubbing air (V-2) are “closed”.
- (3) Make sure the filtrate water line is open. Open the air exhaust valve (V-4).
- (4) Gradually open the feed water valve (V-1) and charge the feed water to the module to purge any air out.

**CAUTION**

- Do not open the feed water valve (V-1) quickly, or water-hammer may occur and the module could be damaged.

(5) Confirm that the air is out of the module, and then close the air exhaust valve (V-4).

(6) Set appropriate volume of filtrate water flow.

**CAUTION**

- Do not exceed 300 kPa (43.5 PSI) to avoid damage to the module.
- Operating conditions including the filtration flux and the physical cleaning should be properly set up, observing the rise of trans-membrane pressure (Details are described in the next session.). Please contact us if you need technical support.

(7) When stopping operation, gradually close the feed water valve (V-1).

2. Backwash and Air-scrubbing

The physical cleaning with backwash followed by air-scrubbing should be carried out periodically and automatically for the continuous filtration. The frequency of the physical cleaning mainly depends on the raw water quality (Typical frequency is once every 30 minutes normally for surface water filtration. Please contact us if you need technical support.). Fig. 5 shows a typical example of the flow diagram for backwash and air-scrubbing. Do not carry out the backwash and the air-scrubbing simultaneously since it may damage the membrane.

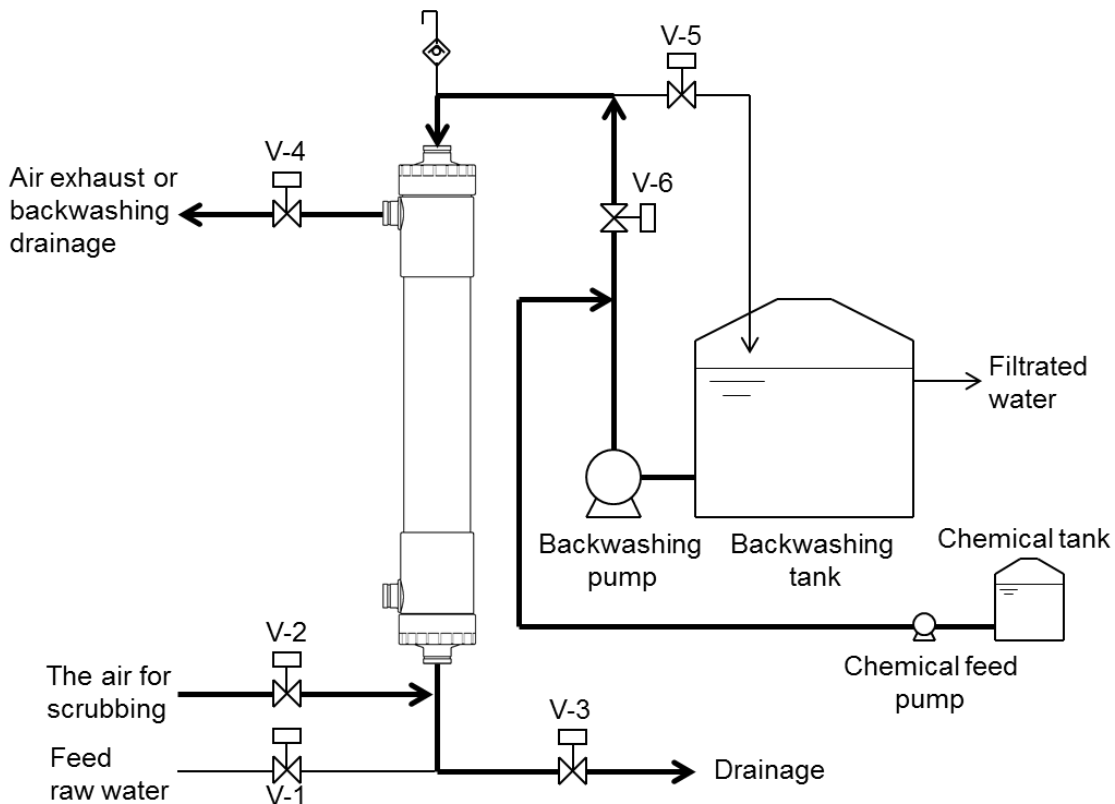



Fig. 5 Flow diagram for backwash and air-scrubbing

- (1) Close the feed water valve (V-1) and stop the feed water pump.
 - (2) Open the air exhaust valve (V-4).
 - (3) Close the filtrate water valve (V-5) and open the backwashing valve (V-6) to feed back the filtrate water from the backwashing tank to the membrane
-

module. During backwash, chemical feed pump can be operated to dose chemical to the backwash water. The dosing chemical is usually sodium hypochlorite and the dosing ratio should be up to 50 mg/L as Cl₂.

The flow rate of backwash water is set up in advance for 1.0 to 1.5 times filtrate water flow rate (Do not exceed Max. Backwash Flow described in Table 4).

- (4) After backwashing for a fixed time (normally 30 seconds, up to 60 seconds), close the backwashing valve (V-6) and stop the backwashing pump.
- (5) Open the air exhaust valve (V-4) and the air-scrubbing valve (V-2) for air-scrubbing for a fixed time (normally 30 seconds, up to 60 seconds).



CAUTION

- The air flow rate for air-scrubbing should be within the range below. Excessive air flow rate may damage the hollow fiber membrane.

HFU-2020AN: 4.8 – 9.0 Nm³/h, normally 6.0 Nm³/h
(2.8 – 5.3 scfm, normally 3.5 scfm)

HFU-1020AN: 4.8 – 9.0 Nm³/h, normally 6.0 Nm³/h
(2.8 – 5.3 scfm, normally 3.5 scfm)

The maximum required air pressure during the air-scrubbing for inside of the module will be 40 kPa (6 PSI).

- (6) Close the air-scrubbing valve (V-2) and open the drainage valve (V-3).
- (7) Close the drainage valve (V-3) after the water is all drained out.
- (8) Run the feed water pump and open the feed water valve (V-1).
- (9) Close the air exhaust valve (V-4) after the air is purged from the module.



CAUTION

- Constantly monitor filtrate water quality during filtration, and stop the operation if abnormal water quality is detected. If abnormal water quality is detected, check the integrity of the element with PDT (Pressure Decay Test) or DAF (Diffusive Air Flow) Test. The test procedure is provided as the technical information by Toray.

3. Toray Maintenance Cleaning

Instead of chemical dosing for every backwash, soaking the membrane to chemical solution several tens of minutes a day is also effective for membrane performance retention. This process is called Toray Maintenance Cleaning (TMC). The TMC is usually held following the backwash and air-scrubbing which does not contain the chemical dosing. The frequency and soaking time of the TMC mainly depends on the raw water quality (Normally once a day and each soaking time are 20 minutes. Please contact us if you need technical support.). Fig. 6 shows a typical example of flow diagram for the TMC.

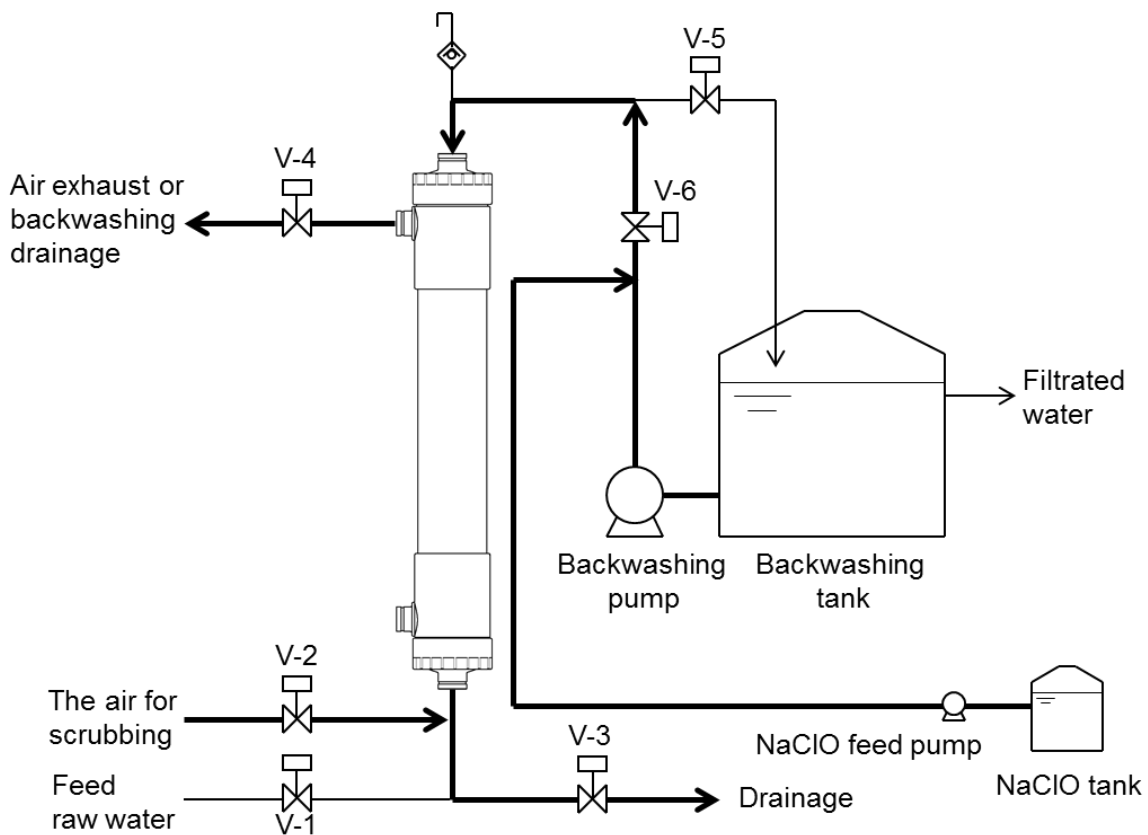



Fig. 6 Flow diagram for the TMC

- (1) Open the air exhaust valve (V-4) and the drainage valve (V-3).
- (2) Open the backwashing valve (V-6), run the NaClO feed pump and the backwashing pump to feed the chemical enhanced backwash water to the membrane module.

The flow rate of backwash water is set up in advance for 1.0 to 1.5 times

filtrate water flow rate (Do not exceed Max. Backwash Flow described in Table 4).

- (3) As soon as the NaClO is detected in the drainage water, close the drainage valve (V-3).
- (4) After making sure water comes out from upper part of the side nozzle of the membrane module, stop the NaClO feed pump, close the backwashing valve (V-6) and stop the backwashing pump.
- (5) Soak the membrane in the chemical for a fixed time (normally 20 minutes). And then, open the air-scrubbing valve (V-2) for a fixed time (normally 60 seconds).



CAUTION

- The air flow rate for air-scrubbing should be within the range below. Excessive air flow rate may damage the hollow fiber membrane.

HFU-2020AN: 4.8 – 9.0 Nm³/h, normally 6.0 Nm³/h
(2.8 – 5.3 scfm, normally 3.5 scfm)

HFU-1020AN: 4.8 – 9.0 Nm³/h, normally 6.0 Nm³/h
(2.8 – 5.3 scfm, normally 3.5 scfm)

The maximum required air pressure during the air-scrubbing for inside of the module will be 40 kPa (6 PSI).

- (6) Close the air-scrubbing valve (V-2), open the drainage valve (V-3) to drain the chemical from the membrane module.
- (7) Close the drainage valve (V-3), and then open the backwashing valve (V-6) and run the backwashing pump (normally 30 seconds). Stop the backwashing pump and close the backwashing valve (V-6), and then open the air-scrubbing valve (V-2) (normally 30 seconds). Repeat this procedure

until the overflow water meets the required water quality.

- (8) Repeat the process of (6) to (7) until the overflow water meets the required water quality.
- (9) Make sure the air-scrubbing valve (V-2) and the backwashing valve (V-6) are “closed” and the backwashing pump is “stopped”.



CAUTION

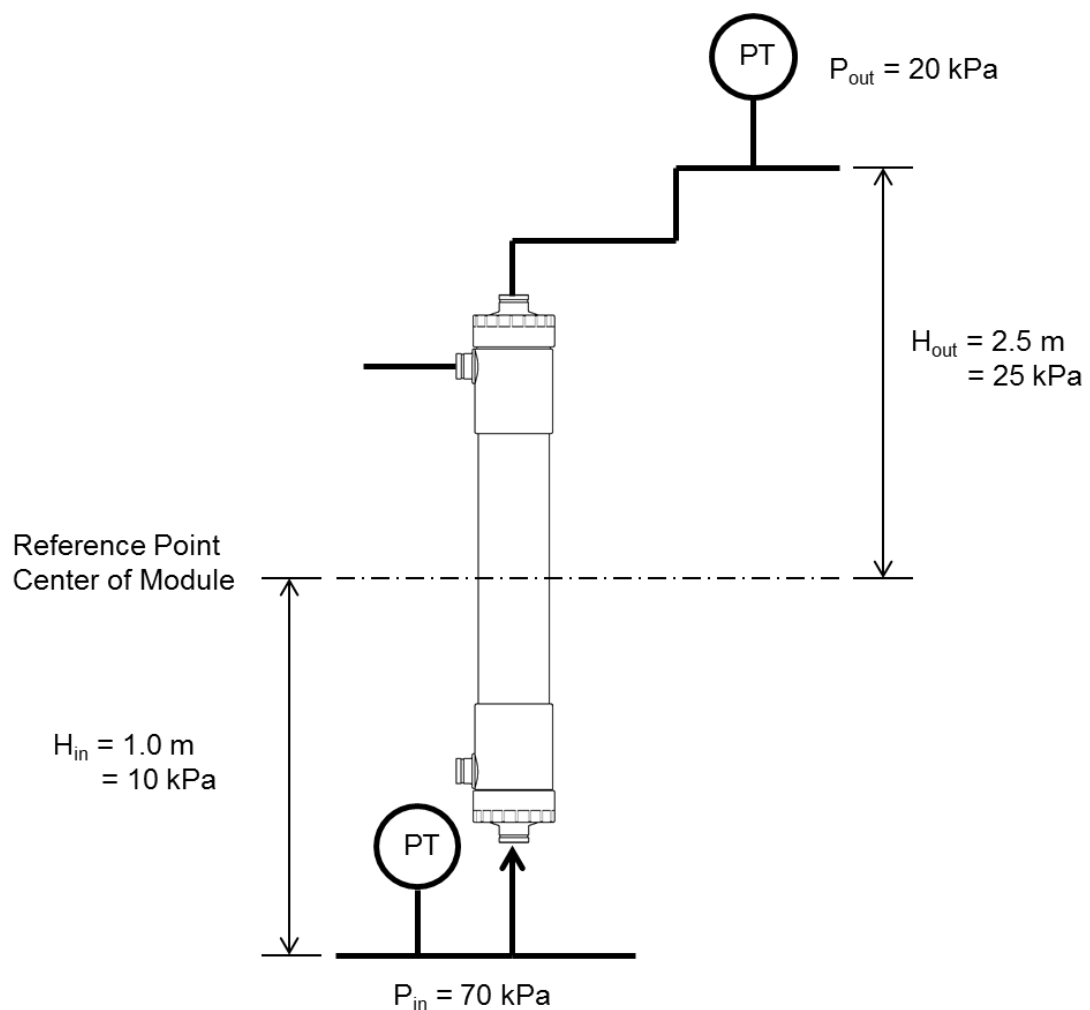
- Constantly monitor filtrate water quality during filtration, and stop the operation if abnormal water quality is detected. If abnormal water quality is detected, check the integrity of the element with PDT (Pressure Decay Test) or DAF (Diffusive Air Flow) Test. The test procedure is provided as the technical information by Toray.

4. Basic Trans-Membrane Pressure Calculation

To calculate accurate Trans-Membrane Pressure (TMP), it is necessary to involve the height difference of inlet and outlet pressure gauges.

Example calculation of TMP

$$\begin{aligned} \text{TMP} &= (P_{\text{in}} - H_{\text{in}}) - (P_{\text{out}} + H_{\text{out}}) \\ &= (70 - 10) - (20 + 25) \\ &= 60 - 45 \\ &= 15 \text{ kPa} \end{aligned}$$



Note, the following formula may also be used:

$$\begin{aligned} \text{TMP} &= P_{\text{in}} - P_{\text{out}} - \text{total delta H} \\ &= 70 - 20 - (10 + 25) = 15 \text{ kPa} \end{aligned}$$

5. Temperature Correction Factor

The permeability of the membrane is influenced by temperature mainly because the water viscosity changes with temperature. When you evaluate the permeability correctly, you need to eliminate the temperature effect with the temperature correction factor (TCF) shown in Fig. 7.

A Trans-Membrane Pressure (TMP) measured at some real temperature can be converted to 25 degree C corrected TMP with multiplying by TCF at real temperature shown in Fig. 7.

A filtrate flow rate measured at some real temperature can be converted to 25 degree C corrected filtrate flow rate with divided by TCF at real temperature shown in Fig. 7.

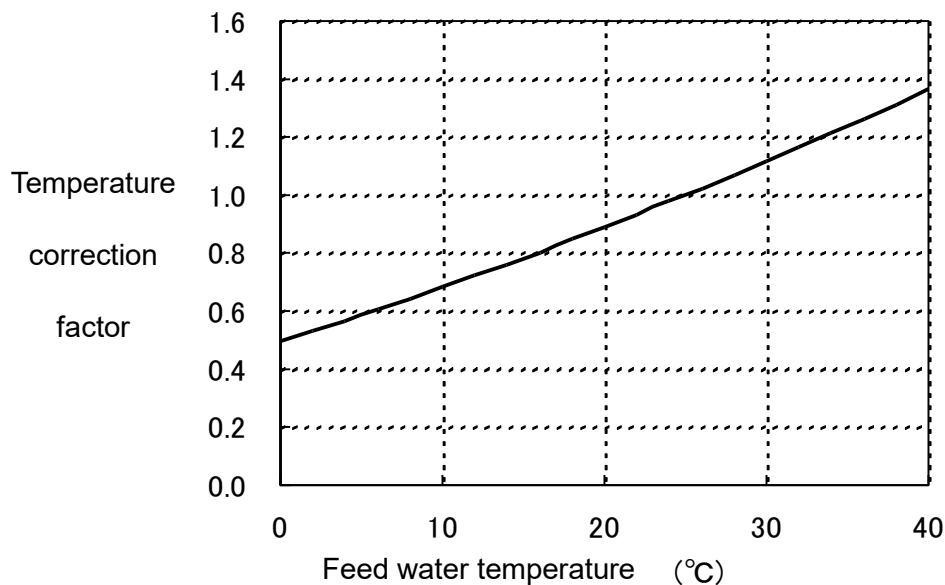


Fig. 7 Temperature correction factor (TCF)

The equation for calculating TCF at a temperature (T degree C) is as follows.

$$\text{TCF} = 0.0008902 / (0.01257187 \times \text{EXP}((1 - 0.005806436 \times (273.15 + T)) / (0.001130911 \times (273.15 + T) - 0.000005723952 \times (273.15 + T) \times (273.15 + T))) / 1000)$$

VII. Chemical Cleaning

The chemical cleaning should be carried out to remove foulants accumulated in the membrane pores or sticking to the membrane surface.



CAUTION

- Carry out the chemical cleaning before the trans-membrane pressure rises up to 200 kPa (29.0 PSI), or the module filtration performance could be reduced significantly.
- Follow the instruction described in this manual when you carry out the chemical cleaning. If you use the unacceptable chemicals or perform the cleaning altered from the recommended procedure, the membrane could be seriously damaged.



DANGER

- Pay full attention when handling chemicals and be sure to wear the safety gear such as glasses and gloves. The chemicals used for the chemical cleaning are harmful to people. If chemicals directly contact your skin, your eyes or other body parts, take the appropriate treatment as stated in its SDS.
- Do not mix sodium hypochlorite with acid. Such mixture generates toxic chlorine gas.
- Stop operations when any instrumental anomalies occur or any sign of anomalies are observed.

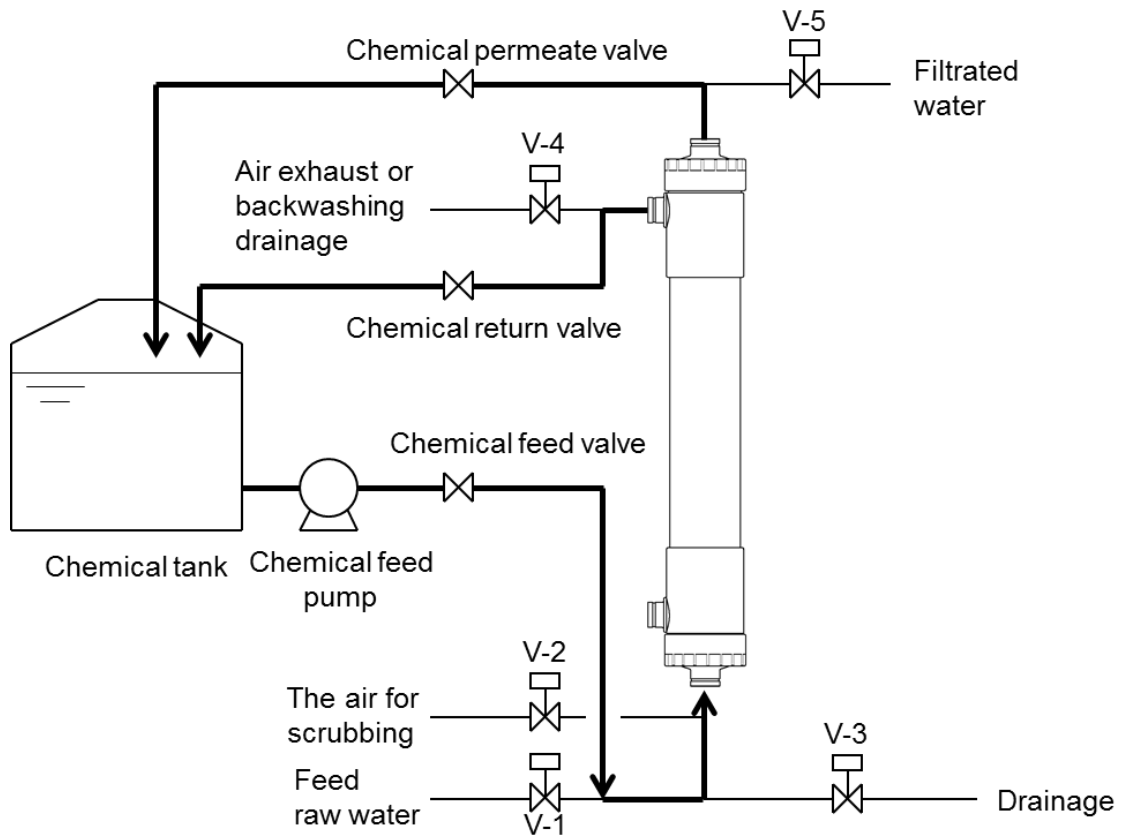


Fig. 8 Flow diagram for chemical cleaning

- (1) The flow diagram for cleaning simultaneously both outer surface and inside of hollow fiber membranes is shown in Fig. 8. The flow diagram can be changed case by case. Please contact us if you need the information in detail.
- (2) Open the chemical return valve and then open the chemical feed valve.
- (3) Run the chemical feed pump to start the circulation of chemical and then open the chemical permeate valve to have the chemical permeate through the

membrane.

- (4) Circulate the chemical for a fixed time.
- (5) Stop the chemical feed pump.
- (6) Drain the chemical and rinse the cleaning line and the module thoroughly with product water.



CAUTION

- Take appropriate measures to prevent the mis-operation or accidents that could cause the chemicals to get into the product water. Check the piping and correctly position of each valve before starting the chemical cleaning.

- (7) The standard conditions for chemical cleaning are shown in Table 5.
 - The concentration and the circulation time shown in Table 5 should be observed. Otherwise the membrane module may get damaged and/or the life of membrane may be shortened.
 - The cleaning temperature should be 20 to 40 degree C.
 - The circulation flow rate for each type of the module is as follows.

HFU-2020AN: 50 L/min (13 gpm)

HFU-1020AN: 20 L/min (5.3 gpm)

Table 5. Standard conditions for chemical cleaning

Pollutants	Chemicals	Maximum Concentration	Circulation Time (hr)
Inorganic substances	Citric acid *6)	3.0 wt%	1 - 3
Organic substances	Sodium hypochlorite	3,000 mg/L as chlorine (10 ≤ pH ≤ 12)	1 - 3

*6): Besides citric acid, hydrochloric acid (with the maximum concentration of 1.0 mol/L), oxalic acid (with the maximum concentration of 1.0 wt%), sulfuric acid (with the maximum concentration of 0.05 mol/L) and nitric acid (with the maximum concentration of 0.1 mol/L) are acceptable.



CAUTION

- In the case of cleaning with acid and with sodium hypochlorite alternately, rinse the cleaning line and the module with clean water thoroughly after each cleaning. Use product water for rinsing and make sure that pH of the water in the module is in the range between pH 6.5 and 7.5 after rinsing.



DANGER

- Do not use any other chemicals than those indicated above.
- Do not mix sodium hypochlorite with acid. Such mixture generates toxic chlorine gas.



Instruction

The chemical cleaning should be done at least once a year. Otherwise the module filtration performance could be reduced.

VIII. Storage of Membrane Module

Follow the instruction below when you store the modules.



CAUTION

- Be careful not to freeze the modules.

1. Storage of New Membrane Modules

Keep the modules in the original packing in a dark and cool place (0 to 40 degree C).

Avoid direct sunlight and moisture.

2. Storage of Membrane Modules after use

(1) Short term, or temporary, shutdown or storage

In the case of the suspension of operation for less than four days, stop the feed water and keep modules full of water. Keep the modules at 0 to 40 degree C.

If the suspension lasts for four days to less than eight days, fill the module with the chemical described in Table 6. Use filtrate quality water. Keep the modules at 0 to 40 degree C.

Table 6 Conditions for storing membrane modules for less than eight days

Maximum Storage Period	Chemical	Concentration of the Chemical
7 days	Sodium hypochlorite	20 mg/L as chlorine

(2) Long term storage

First carry out a chemical cleaning with sodium hypochlorite. Fill the module with the chemical described in Table 7. Use filtrate quality water. Follow the instructions shown in Table 7.

Keep the modules sealed with the aqueous chemical solution shown in Table 6 or Table 7. If removing modules from the system, seal them and store out of direct sunlight. Keep the modules at 0 to 40 degree C.

Table 7 Conditions for storing membrane modules for more than seven days

Storage Period	Preservative Chemical	Concentration of the Chemical
More than 7 days	Sodium bisulfite	1,000 mg/L



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- Rinse the module thoroughly with clean water after the chemical cleaning with sodium hypochlorite, and fill the module with sodium bisulfite solution. Toxic chlorine gas is generated in the case of mixing sodium hypochlorite with sodium bisulfite without first flushing with water.

3. Replace Preservative Chemical

Check the pH value of sodium bisulfite solution as the preservative and replace the chemical if the pH is below three (3.0). Sodium bisulfite solution with a pH of 3 - 6 is active for the preservation. Sodium bisulfite reacts with oxygen and forms sulfuric acid which results in a lower pH.

This Instruction Manual does not intend to guarantee the results of application of the information provided herein or the safety and the compatibility of this product. Before using this product, the user is asked to check for its safety and compatibility with the intended purpose.

The content of this Instruction Manual is subject to revision from time to time. Unauthorized use or reproduction of this manual is forbidden.