

SUN[®] MBR user's manual



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CONTENTS

01. RisingSun MBR product details.....	P3
1.1 The characteristics of MBR (Membrane Bio-Reactor)	
1.2 The introduction of RisingSun MBR membrane module	
02. Matters need attention.....	P6
2.1 Unpacking and installation	
2.2 Equipment operation and maintenance	
2.3 The chemical cleaning for MBR membrane module	
03. RisingSun MBR product technical specifications.....	P8
3.1 RisingSun MBR element specification	
3.2 RisingSun MBR module specification	
04. Related components for MBR design.....	P10
4.1 Periodic table of production water.	
4.2 System operation flow chart	
4.3 Configuration of MBR reaction tank	
4.4 Related pipe connection	
05. Installation settings.....	P17
5.1 Pre-installation preparation	
5.2 The removal of the membrane element	
5.3 The inspection of membrane element	
5.4 Manner of safe keeping	
5.5 The installation of membrane module	
06. Membrane module operation method.....	P21
6.1 Fresh water operation	
6.2 Seed sludge addition	
6.3 Operation starts	
07. MANEGEMENT OPERATION.....	P23
7.1 Operating condition	
7.2 Operating Parameter and Data Records	
7.3 Routing inspection on MBR	
08. MAINTENANCE AND MANAGEMENT.....	P26
8.1 regular maintenance items	
8.2 Aeration pipe cleaning method	
8.3 Chemical cleaning of the membrane element	
8.4 Agentia for cleaning	
8.5 Agentia using and operating guidance	
8.6 Membrane element cleaning method	
8.7 Remove the membrane module.	
09. FAULT HANDING.....	P33

01. RisingSun MBR product details

1.1 The characteristics of MBR (Membrane Bio-Reactor)

The Membrane Bioreactor (MBR) process is a combination of wastewater treatment and membrane filtration. This reactor possesses the advantages of membrane filtration and biological treatment technology. Membrane modules, which can replace the secondary sedimentation tank, are used to separate mud and water. The MBR process has obvious advantages compared with the traditional wastewater treatment technology. (as shown in figure 1-1, figure 1-2)

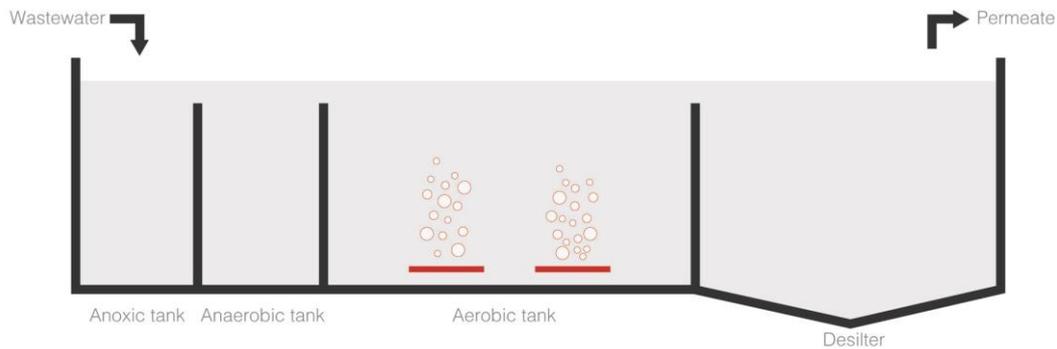


Figure 1-1 Traditional wastewater treatment process

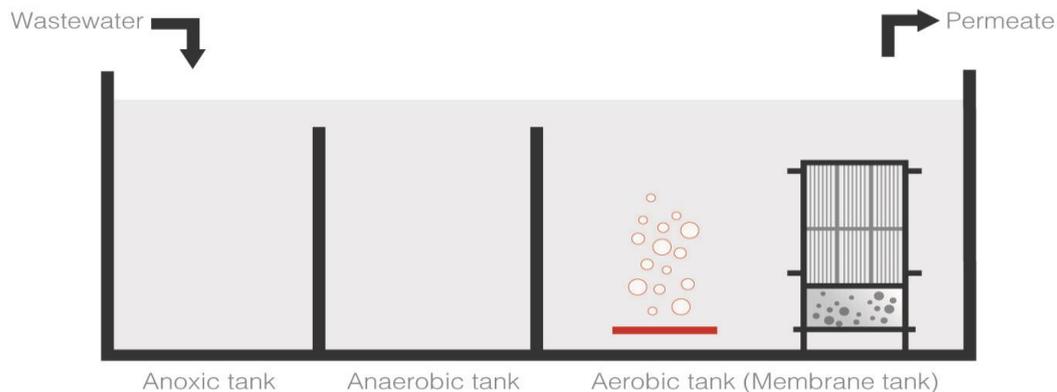


Figure 1-2 MBR Process

MBR Advantages

The quality of MBR produced water is much higher. and it will not be affected by the fluctuation of the feed water. The activated sludge age is longer, and its operation cost and used field area is less than that of conventional treatment process.

1.2 The introduction of RisingSun MBR membrane module

RisingSun immersion membrane module contains aeration and membrane element tank is equipped with a certain number of membrane and there is a specific interval between each membrane. Each piece of membrane is formed by seating flat sheet membrane on two sides of the support plate. The aeration tank includes the air supply aerator pipe. (as shown in figure 1-3) Membrane element is composed of flat sheet membrane which has the upright support plate as interlayer. The bubbles constantly enter into the aerator pipe at the end of the membrane

element and vertical with membrane permeate direction, and forms shear force. This makes it difficult for the activated sludge to sedimentate at the surface of membrane, thereby ensuring the stability of the filtration process.

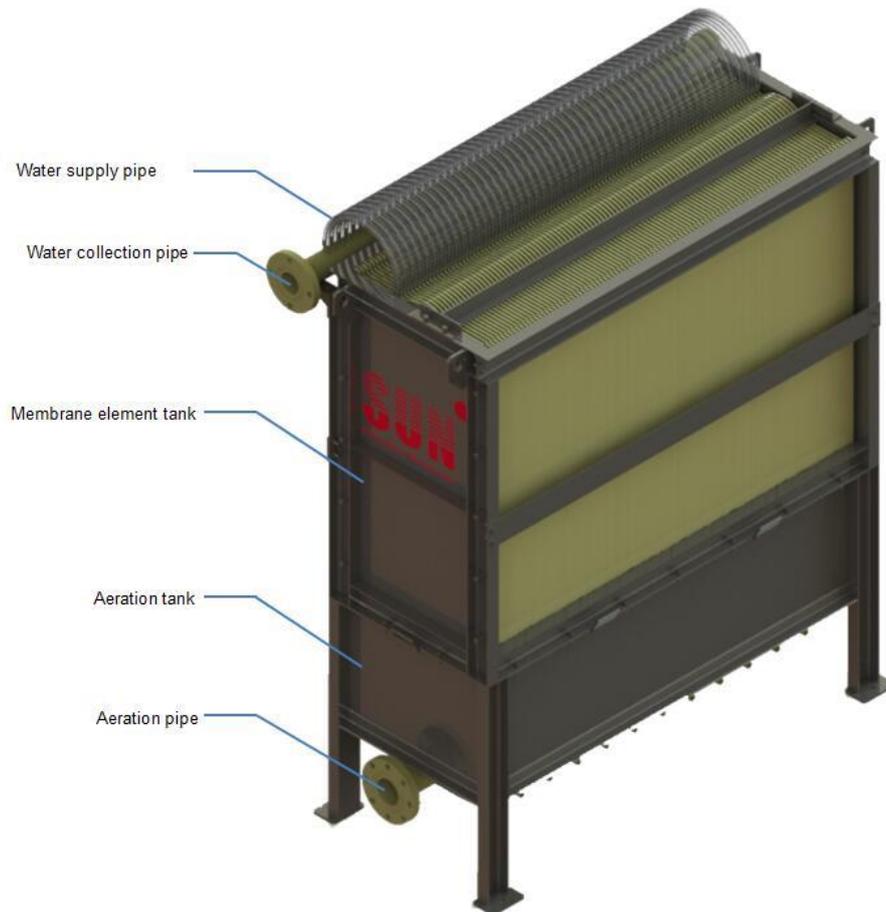


Figure 1-3 MBR module

① Membrane element configuration

Membrane element is comprised by a vertical support plate as a laminated plate and membrane sheet (as shown in figure 1-4). The air bubbles continuously come from aeration pipe cleaning membrane surface effectively. (as shown in figure 1-5). Because this mechanism makes active sludge does not deposit on the membrane surface easily, thus ensuring the stability of the filter.

② Membrane material

RisingSun use PVDF (polyvinylidene fluoride) as membrane material and PET non-woven fabrics as basic layer. This kind of composite structure can ensure the physical strength and chemical stability of the membrane.

③ Membrane structure

The filtration pore size of RisingSun PVDF membrane surface is small and well-distributed. RisingSun PVDF membrane not only can produce high-quality water and has excellent permeability performance, but also can effectively prevent the membrane fouling.

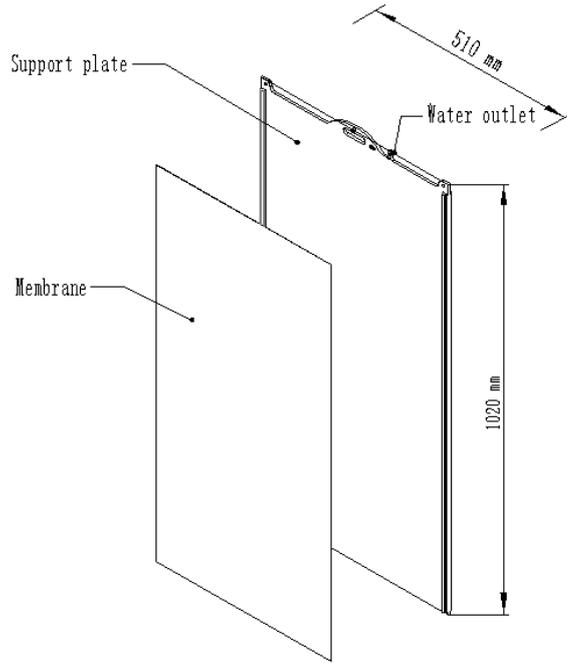


Figure 1-4 Membrane element configuration

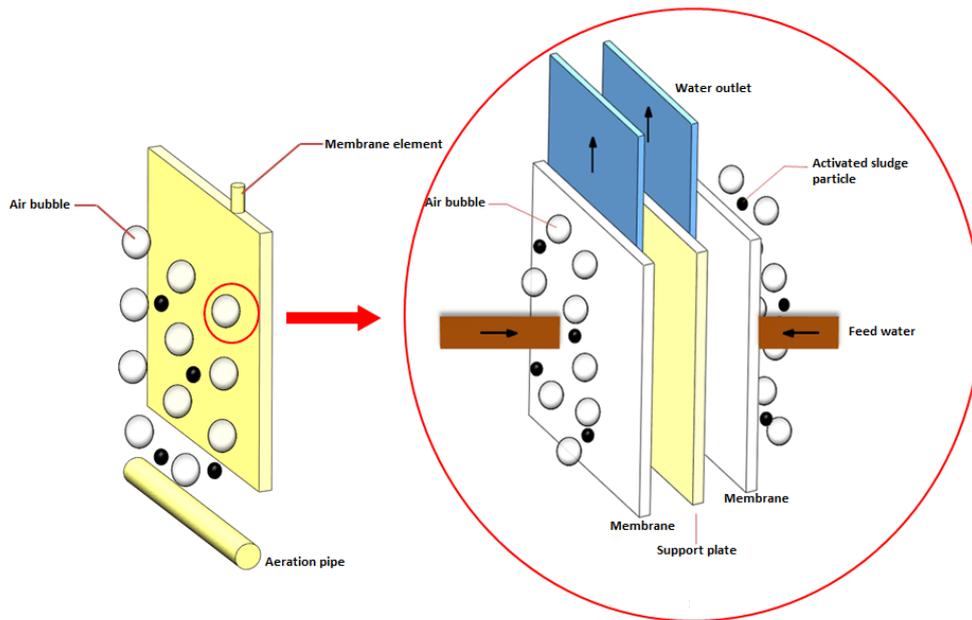


Figure 1-5 Activated sludge working principle

02. Matters need attention

Before using immersion flat membrane module, please read this manual. Matters in accordance with the instructions to operate, especially must observe the following safety matters. For details, please refer to the relevant section.

2.1 Unpacking and installation

Danger!

- When hoisting membrane module shell, should confirm the hook or chain hoist is connected with the shell, slowly to the upper part. Prevent the membrane module shell will shake. Prohibit any person under the membrane module.
- When hoisting membrane module shell, should use the hook or chain hoist matching the weight of membrane module.
- When installing a membrane module, should prepare the scaffold. Absolutely can not be allowed to climb on the shell. Adopt necessary protector to ensure the safety of construction persons.

Notice!

- During storage and use of membrane module, please take necessary measures to prevent the damage of membrane module, such as it is forbidden to place the component on the membrane module or prevent a collision with other objects.
- Avoid putting membrane module in 40°C or high temperature environment and staying out of the sun.
- From transport to begin the process of operation, it is strictly prohibited to weiding of fusing shear sparks in contract with the membrane module.
- To prevent membrane module from cold.
- Avoid pressure on the water production side.
- To protect the membrane module and prevent blockage, please use the screen size below 3 mm for raw water pre-treatment of membrane bioreactor.

2.2 Equipment operation and maintenance

Warning!

- Not drinking the permeate liquid.
- For recycling the treated water, should be used according to its purpose to analyze water quality of treated water.
- When burning the used membrane element, there will produce hydrogen gas (HF). Need the professional processing equipment to dispose the membrane element.

Notice!

- Open the exhaust valve to drain air from the membrane element before to add water into reaction pool. Close the exhaust valve after into the water.
- Suggest that do not use surface water contains a lot of iron, manganese, calcium and silicon.
- Do not make an excessive amount of water testing, which could cause blockage.

- Please keep the membrane moist after the water operation. It may result in low flux after drying.
- Please use the screen size below 5mm to process the pre-treatment for the sludge added to the reaction tank.
- When there is low aeration or irregular and stop the aeration, these will easily cause the membrane surface blocking. Absolutely do not filter.
- Do not add chemicals, drugs, oil or other substances which has a bad effect on activated sludge.
- Please avoid the sudden changes in temperature, PH, trans-membrane pressure, even in the normal range.
- Regular inspect and replace the widgets.
- To prevent membrane module from cold.
- After removing the membrane for maintenance, must make the membrane keep moist, then restart the process. It may result in low flux after drying.

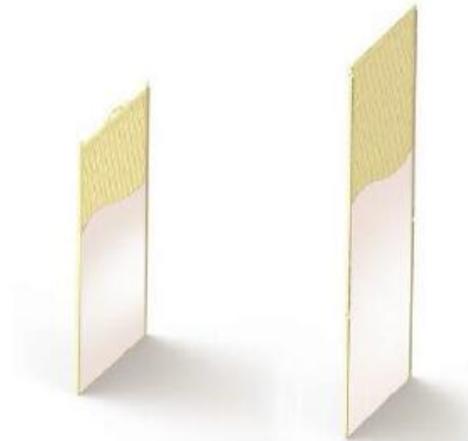
2.3 The chemical cleaning for MBR membrane module

Warning!

- When cleaning the drug which contain the harmful substance may hurt body. Using the drug, please make sure be very careful to wear protection glasses, gloves and other equipment. Please be sure to confirm the MSDS content of the drug.
- If chemicals touch the skin of clothes, please flush with large amount of water immediately.
- If chemicals into the eyes, please flush with large amount of water, and ask a doctor.
- In the chemical cleaning, if found any abnormal situation, please immediately stop cleaning.
- Direct injection drug with dosing pump, maybe affect the membrane element and sometimes can make the membrane internal pressure rise, causing damage. Must be with gravity (below 10 kpa) to add drug.
- Chemicals should be stored in shady and cool place and avoid direct sunlight.
- In order to avoid corrosion, please select the corresponding materials according to the nature of different drug to store the drugs.
- Sodium hypochlorite may not mix with heavy metal or acid. Please pay attention to when it mixes with acid can produce poisonous chlorine gas.
- Do not mix oxalic acid or citric and sodium hypochlorite. The mixing will produce a poisonous chlorine gas.

03. RisingSun MBR product technical specifications

3.1 RisingSun MBR element specification



Items	Standard type	Long type
Model	FMBR80	FMBR160
Size(L×W×T)(mm)	1020×510×14	1810x 512x14
Membrane effective area(m ²)	0.8	1.6
Weight(kg)	3	5
Permeate flux [l/(pc·d)]	320-550	640-1100
Membrane material	PVDF	PVDF
Membrane pore size(μm)	0.1	0.1
Plate material	ABS	ABS
Air flow rate [l/(min·pc)]	≥10	≥12
PH	3~12	3~12
Output turbidity (NTU)	<1.0	<1.0
Output SS(mg/L)	≤5	≤5
Chemical cleaning	~5,000mg/l NaClO	~5,000mg/l NaClO

Note: For different water quality, there will be a different water flow rate. So the user should fully test the membrane module. This parameter is tested at 25°C, -10KPa suction vacuum conditions based on municipal wastewater.

3.2 RisingSun MBR module specification



Items	FMBR80 standard			
Model	FMBR80-50	FMBR80-125	FMBR80-250	FMBR80-250-2
Permeate flux (m ³ /d)	16-26	38-65	75-130	150-260
Plate qty (pc)	50	125	250	500
Membrane effective area(m ²)	40	100	200	400
Size (mm) (L×W×H)	945×750×1750	1980×750×1750	3700×750×1750	3700×750×3100
Air flow rate (L/min)	500	1250	2500	3000
Weight(kg)	300	650	1200	2100

Items	FMBR160 standard			
Model	FMBR160-50	FMBR160-125	FMBR160-250	FMBR160-250-2
Permeate flux (m ³ /d)	32-50	75-130	150-260	300-500
Plate qty (pc)	50	125	250	500
Membrane effective area(m ²)	80	200	400	800
Size (mm) (L×W×H)	925×750×2550	1980×750×2550	3700×750×2550	3700×750×4500
Air flow rate (L/min)	600	1500	3000	3500
Weight(kg)	400	910	1910	3600

Note: We can provide a single membrane frame and any size MBR modules to make a free combination component, for example: FMBR80-175, FMBR80-200, FMBR80-200-2(double deck), FMBR160-200, FMBR160-200-2(double deck), etc.

04. Related components for MBR design

In order to use submerged MBR membrane component equipment more efficiently, we provide the following periodic table of production water, system operation flow chart, configuration of MBR reaction tank, pipe connection and so on.

4.1 Periodic table of production water

When the system is running, adopt the method of intermittent water production, like filtration-stop-filtration this pattern repeated operation, in this time aeration is still on working (as shown in figure 4-1)

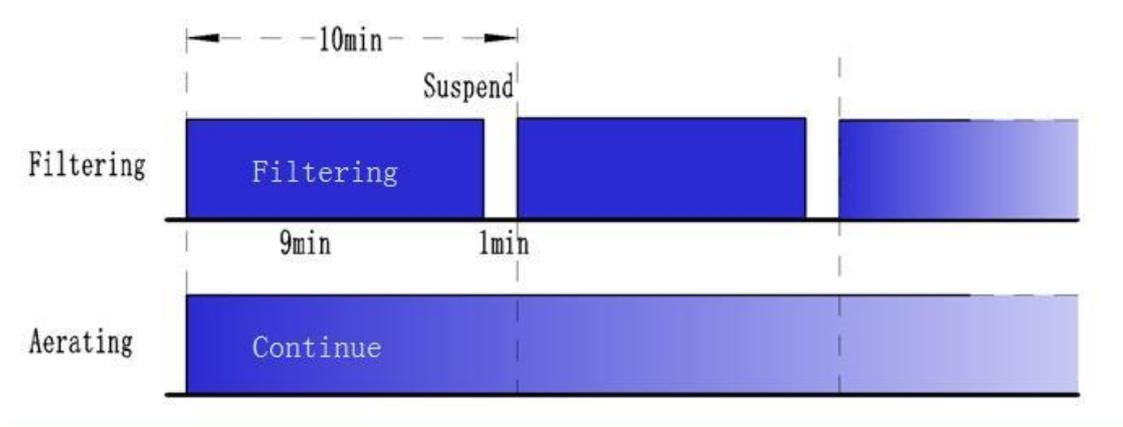


Figure 4-1 Operation time

When filtering suspended, aeration is still continuous. The aeration of this moment could realize the effective cleaning of membrane surface. Although the start and shutoff of the filtering need to be controlled by the equipment, when need to get high flux, we recommend and encourage you operation by intermittent filtration.

The recommended setting of the intermittent filtration is: operate 9minutes and shutoff 1 minute.

4.2 System operation flow chart

About membrane element of standardized operation flowchart (filter parts), natural head operation and pump suction operation as shown in ①, ②. The Accessory equipment show in ③

① Gravity flow operation

Gravity flow operation is using the driving force of height difference from liquid level of the reaction tank to the outlet of the filtration water (as shown in figure 4-2), In order to take advantage of the gravity flow, please set the filtration water outlet at the lower location relative to the liquid level of the membrane bioreactor (normally the calculation is based on the height of the bottom of the membrane)

We recommend you using this type of filtration water pipe, (as shown in figure 4-2), is the connection method which could cut-through the filtration water outlet of the membrane bioreactor. For the occasion that the pipe which could not cut-through the groove, but crossing the cell wall, using the equipment of siphon (Self-priming pump etc.) is very necessary.

In addition, we design the U type pipe unit at the outlet of the filtration water in order to water seal the pipe when the filtering stops.

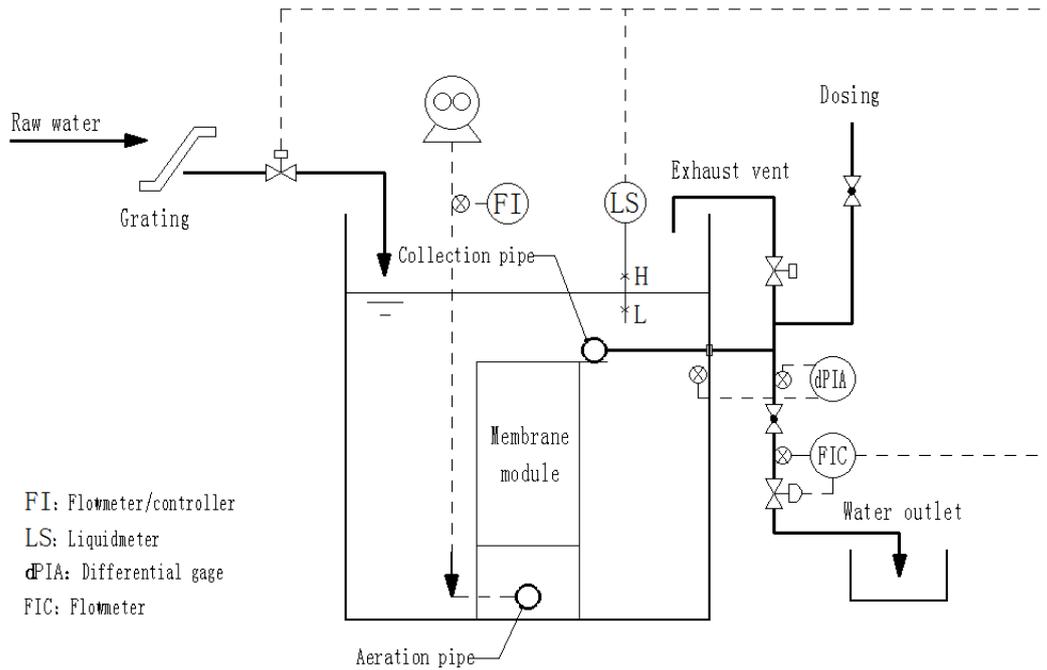


Figure 4-2 Gravity flow operation

The aperture of the water control valve is automatically controlled by flowmeter. Please stop filtering out of the water when the water level of the reaction tank is getting the lower liquid level; please stop feeding in the raw water when the water level is getting the upper liquid level. The fluctuation of the raw water flow is controlled by the adjusting pool (this is not showed in the figure). The capacity of the adjusting pool should satisfy the fluctuation control of the raw water. In order to gather the air in the pipe and efficiently reduce the loss of gravity flow. When the gravity flow is on operation, please pump the air 1 time/day.

For the occasion that the pipe is cut-through the filtration outlet, when the filtering stops, please open the exhaust valve to eliminate the air. We recommend you use automatic exhaust valve. For the occasion that the pipe is crossing the cell wall, please use one kind of equipment to eliminate the air to ensure the siphon.

② Pump suction operation

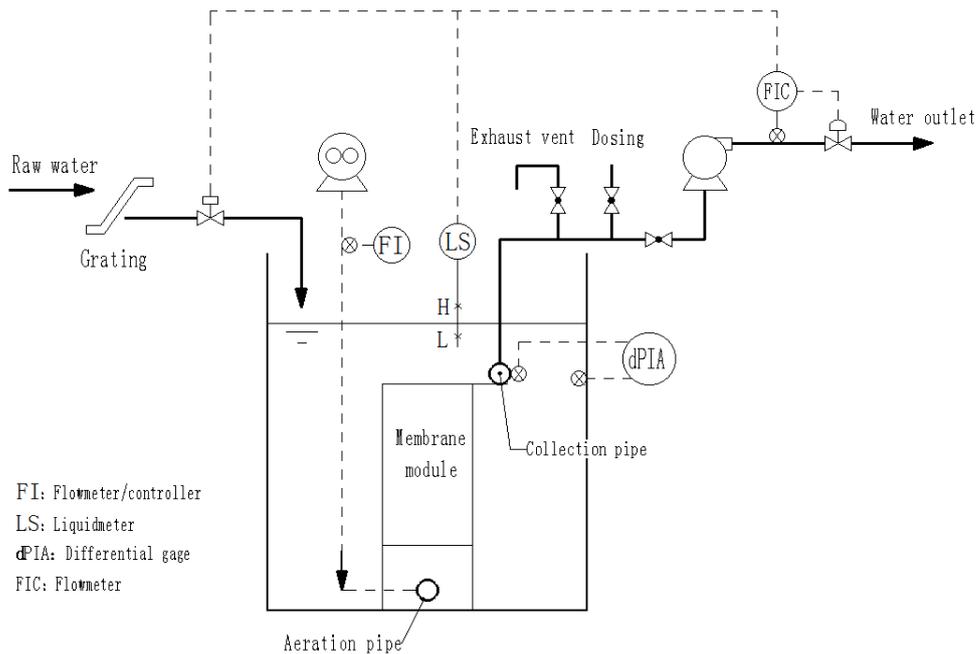


Figure 4-3 Pump suction operation

Pump suction operation is as shown in figure 4-3. The aperture of the water control valve is automatically controlled by flowmeter. Please stop filtering out of the water when the water level of the reaction tank is getting the lower liquid level; please stop feeding in the raw water when the water level is getting the upper liquid level. The fluctuation of the raw water flow is controlled by the adjusting pool (this is not showed in the figure). The capacity of the adjusting pool should satisfy the fluctuation control of the raw water.

③ Accessory equipment

The summary of the above mentioned equipment showed in the flowchart is as below. Except the mentioned items, there are still some necessary ones.

A: Grating

In order to protect the membrane, please use the grating which is less than 3mm to pretreat the raw water in the membrane bioreactor.

B: Flow-control device

Install flow-control device (flow control switch etc.) at the outlet pipe to control the output flow. For the occasion of several membrane modules on operation, we recommend you install flow control device for each series.

C: Differential pressure gauge

Install pressure gauge in the outlet pipe and bioreactor to measure the pressure difference between membrane (in order to measure the pressure difference accurately, please install the pressure at the same height.) for the occasion of several membrane modules on operation, we recommend you install pressure gauge for each module.

D: Air feeder device for aeration. (air blower, etc.)

Use the aeration pipe supply to aerate air. Please determine the air supply rate for each module according to the standard aeration rate.

E: Aeration air flow meter

Measure the air rate which is aerated by aeration pipe supply. For the occasion of several membrane modules on operation, we recommend you install aeration air flow meter for each series.

F: Filtration water suction pump

For the occasion of pump suction, using a filtration water suction pump is necessary. Please select the self suction pump which could match with lift and flux rate.

G: Liquid meter

Liquid meter is required to set in the submerged pool to control the liquid level.

Notice!

- In order to protect the membrane, please use the grating which is less than 3mm to pretreat the raw water in the membrane bioreactor.

4.3 Configuration of MBR reaction tank

The circuit of the spin reflux in the membrane reaction tank is shown in the figure by the arrow. The spin reflux is formed by the upwelling in the middle of the element and downwelling in the sides of the element generated by the air supply element start from aeration pipe.

In order to utilize the phenomenon of spin reflux and make the membrane surface clean, also let the sludge mix and stir well, it is very necessary to keep proper clearance when configuring in the groove of the membrane module.

The below figure 4-4 and 4-5 shows the lateral figure and plane figure of the configuration in the membrane bioreactor on the occasion of the 3D view of the membrane module. Please check and set the scope of the configuration parameters W1、W2、W3、a and b in the membrane bioreactor.

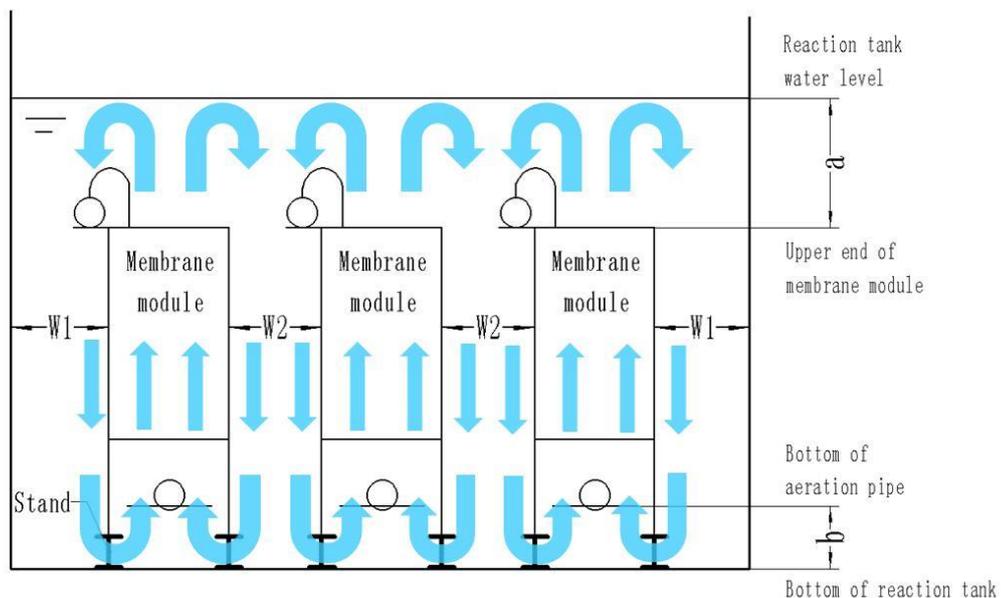


Figure 4-4 Configuration of water depth direction

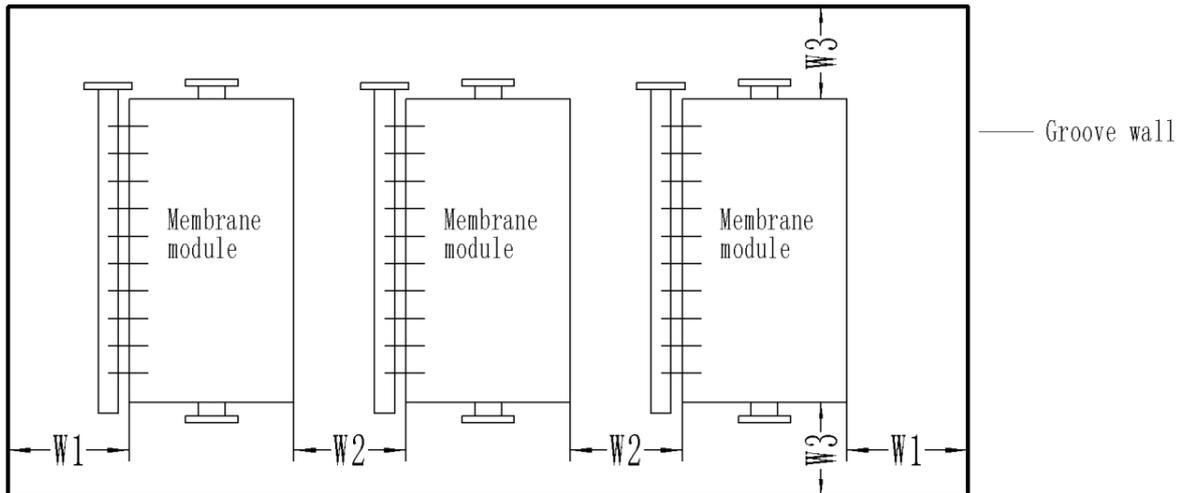


Figure 4-5 The plane layout of membrane module in reaction tank

W1: 380-680mm

W2: 430-730mm

W3: On the basis of considering the pipe connection and maintenance, etc. Please set up with no gaps between the tank wall (usually 400 mm intervals)

- a: Please operate when the water level distance from the top of the element to the bioreactor is above 500mm
- b: When setting the trestle and etc., the distance from the bottom of the membrane bioreactor to the lower surface of the aerator pipe should be less than 400mm

**Questions about the activated sludge tank and the above configuration, please contact with RisingSun Membrane.*

4.4 Related pipe connection

① Aerator pipe accessories

Connect the aerator pipe accessories, use flange to connect aerator equipment and aeration tank (as shown in the figure 4-6). In order to remove the piping when the pipeline jams, please connect with flange at the pipeline above the liquid level.

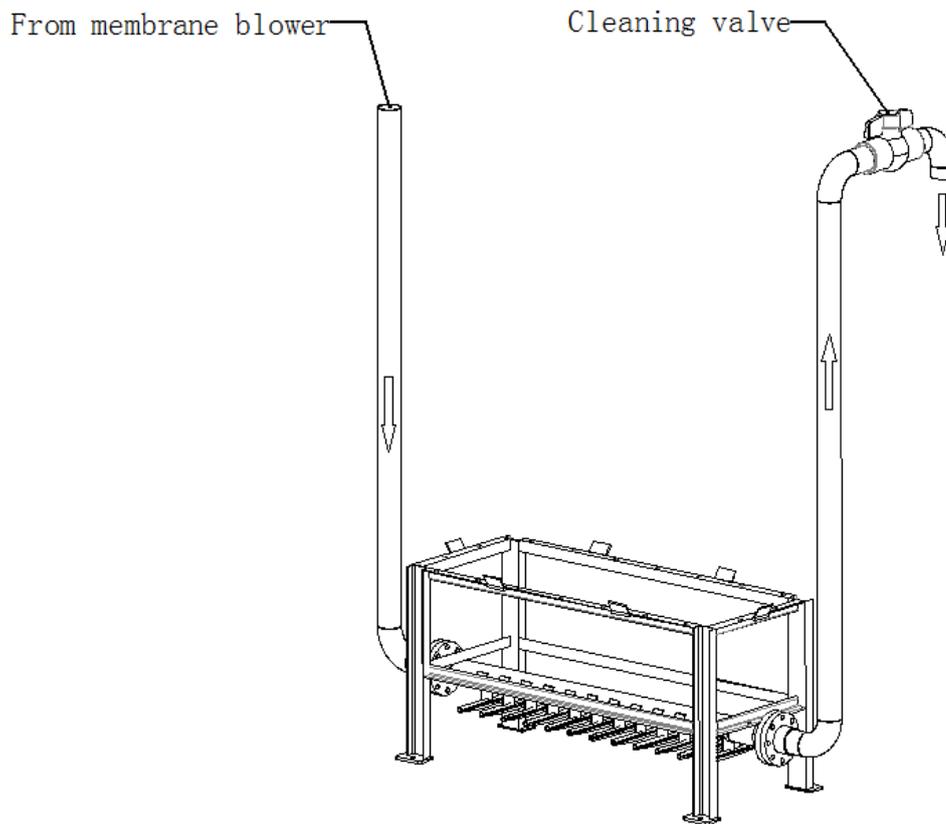


Figure 4-6 Aerator pipe accessories

② Collector pipe

Concerning the collector pipe connection, the example of getting the filtered water downward from the membrane bioreactor (as shown in figure 4-7); the example of getting the filtered water upward from the membrane bioreactor (as shown in figure 4-8).

On the occasion of gravity flow operation, we recommend you using the pipe connection method of getting the filtered water downward from the membrane bioreactor.

On the occasion of pump suction operation and when the set position of the pump is higher than membrane bioreactor, we recommend you using the pipe connection method of getting the filtered water upward from the membrane bioreactor; when the set position of the pump is lower than membrane bioreactor, we recommend you using the pipe connection method of getting the filtered water downward from the membrane bioreactor.

Whether using the method of getting the filtered water upward or downward from the membrane bioreactor, we should install branch pipes between vacuum valve and collector pipe and install vacuum valve used for injecting solutions and pumping out air.

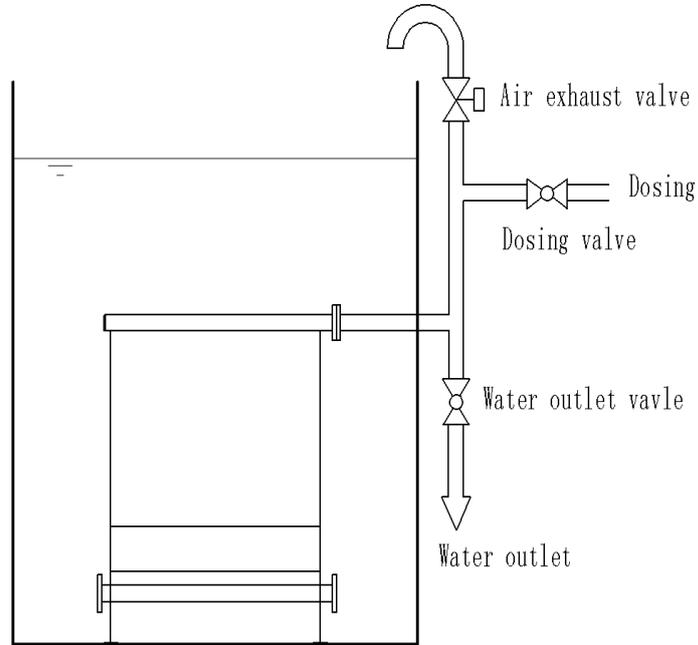


Figure 4-7 collecting water from downward

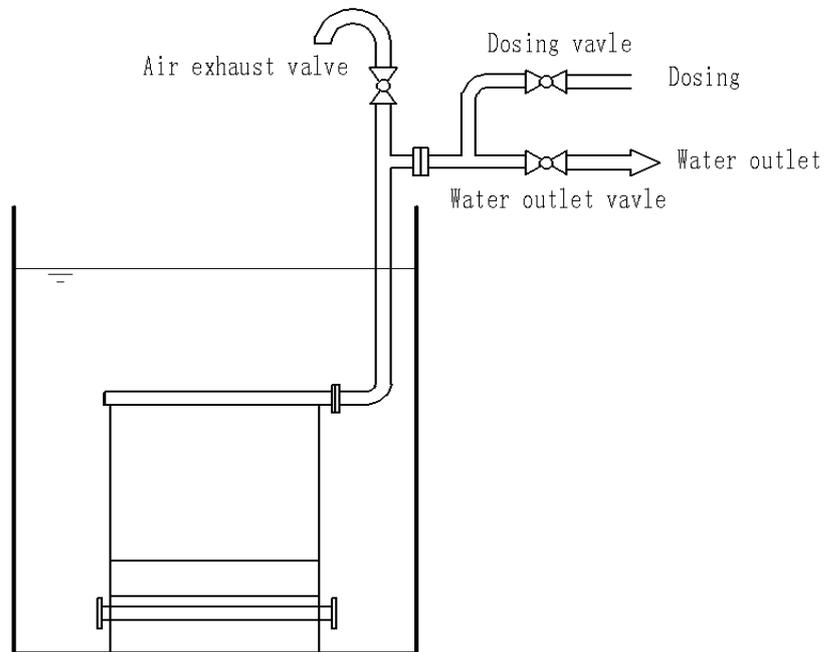


Figure 4-8 collecting water from upward

05. Installation settings

5.1 Pre-installation preparation

- ① Make sure the transportation for the membrane installed into the biological reactor, such as transport routes.
- ② Get appliance the ready to unload the membrane from the truck (fork lift trucks, cranes, trailers, ect.)
- ③ Before installation, the reaction in the pool should have been completed, and check the cleaning work. Big chunks (concrete blocks, cutting crumbs, fragmentary material) and son on which can not be left in the tank, must be sure to remove it.

5.2 The removal of the membrane element

When the membrane element is removed from the truck, please use a forklift, crane or trailer and other appliance.

Packing styles and samples lifting method is as follows:

- ① When shipping parts, the membrane, aeration and collecting pipe were packaged respectively.
- ② When lifting the membrane elements, the hook completely hung up the rings then hanging horizontally.

Danger!

- When setting up and installing membrane module and membrane element, must consider setting up scaffolding, protection equipment and other operations staff security measures. Do not allow to directly climb the membrane housing.
- When lifting the membrane and membrane module, must use dedicated lifting equipment.

5.3 The inspection of membrane element

After moving out the membrane, please check again the following matters:

- ① Shipper described in the article has been moved out.
- ② There is not damaged in transportation.
- ③ The protective layer does not release.

5.4 Manner of safe keeping

Please keep flat to avoid exposure and direct sunlight, temperature in the range of 5-40 °C.

The whole process from beginning to run up, in order to prevent the membrane elements from damage, please be very careful for custody. Especially in soldering, welding, fusing, grinders and other sparking occasion, please cover fire protection layer, so as not encounter sparks.

In addition, during the construction had to be stored outdoors, try to control in the short time, and follow the below items for good storage.

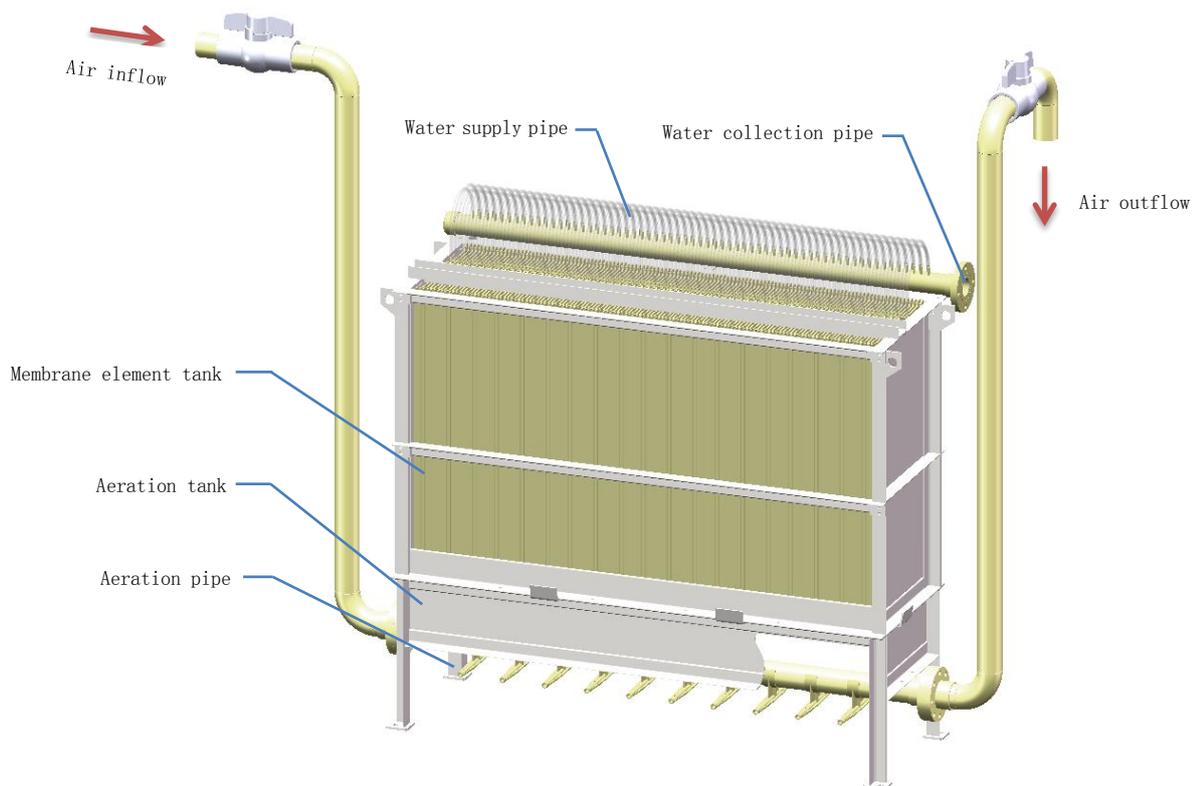
- ① The range of 5-40°C
- ② Freeze clause
- ③ Prevent rain water
- ④ Not flooded
- ⑤ Avoid direct sunlight

Notice!

- Don't leave standing at more than 40 °C or direct sunlight conditions.
- To prevent membrane module from cold
- The whole process from beginning to run up, please stay away from welding, fusing, grinders and other issued sparks.
- To prevent the membrane elements from damage, please pay attention to avoid the heavy pressure and collisions with other objects.

5.5 The installation of membrane module

When installing the membrane module, please according to the following ① to ④ as the order. Before installation, the construction in the tank should have been completed, and check the cleaning work. Big chunks (concrete blocks, cutting crumbs, fragmentary material) and son on which can not be left in the tank, which must be sure to remove it. About the installation position, please refer RisingSun module assembly diagram. Hope to get special installation methods, please consult RisingSun.

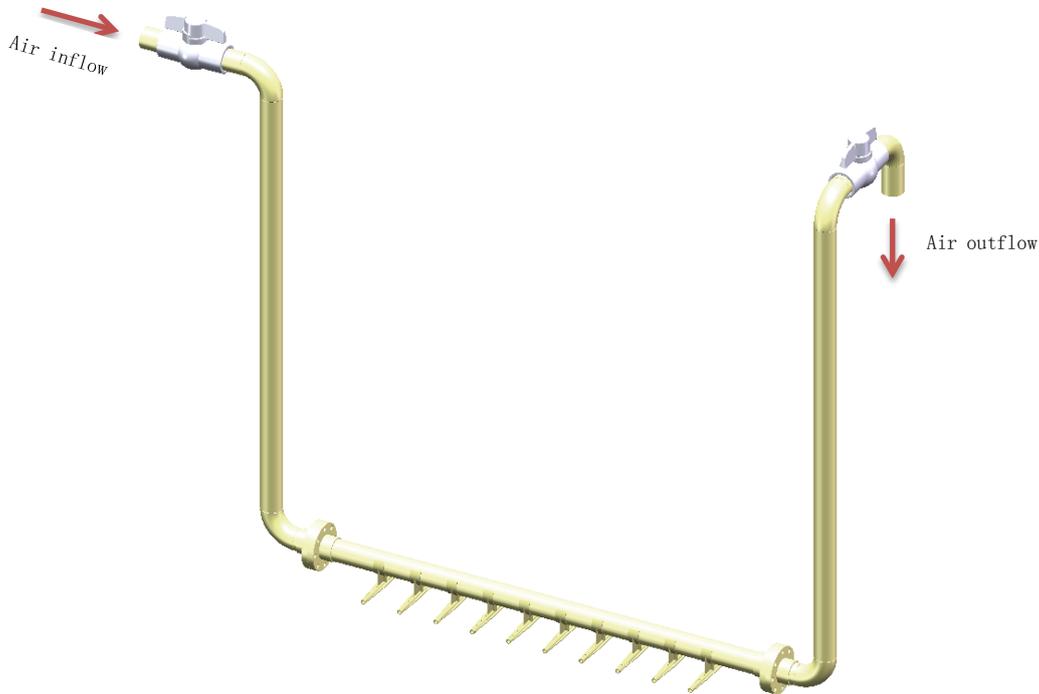


① Installation of aeration portion (bottom-mounted case)

Please use the anchor fix the aeration on the biological reactor. During the installation, the level of aeration tube is very important. In order to supply uniformly rotating flow to each membrane element surface, please keep the level of aeration tube and try to make each aeration holes emit the same air volume. Therefore, the upper part of the aeration should be fixed in longitudinal and transverse level of 3/1000 or less.

② Aeration pipe connecting

Aeration pipe supplied with flange at shipment. Install flanges on each pipe in advance. After connected the aeration pipe, the aeration portion submerged in clean water, start to supply air. Confirm aeration without deviation, adjust the levelness.



③ Installation of membrane element

Install membrane element according to membrane type as the following order:

(a) FMBR80-125

Membrane element parts mounted on the aeration part, connected by the bolts.

(b) FMBR80-125-2

FMBR80-125-2 has two membrane element tank and two aeration tank, each membrane element tank has a water collection pipe, which has flange type connection.

(c) FMBR150-100

Install the membrane elements at the central of aeration part and connected by the supplied bolt. Just install a membrane element at right above the aeration part, connected by the supplied bolt.

④ Connecting the collection pipe

Collecting pipe supplied with flange at shipment. According to the membrane module type, install the membrane in the following order. Also, try to make the height with bracket at both ends of the collecting pipe can be adjusted slightly. To facilitate the air inside the collection pipe run out easily, please adjust the bracket up and down to form the side height higher slope for filter water flow out. In addition, please check the filter pipe by flushing and leakage testing before connecting the collecting pipe. It may cause damage to membrane module if force pressure from membrane permeates side.

(a) FMBR80-125

Please connect one end of the collecting pipe to the filtering water pipe flange. Close the other end.

(b) FMBR80-125-2

(1) Unilateral connection

Please slightly loose the U-bolts fixed on the collecting pipe, connect with the same collecting pipe on the two side of membrane module portion. After collecting pipe connected, check the collecting pipe join U-bolt has been fixed well. Then, connect one end of the collecting pipe to the filtering water pipe.

(2) Bilateral connection

Please slightly loose the U-bolts fixed on the collecting pipe, connect with the same collecting pipe on the two side of membrane module portion. After collecting pipe connected, check the collecting pipe join U-bolt has been fixed well. Then, connect two end of the collecting pipe to the filtering water pipe.

(c) FMBR150-100

Please connect one end of the collecting pipe to the filtering water pipe flange. Close the other end.

Danger!

- When lifting the membrane module, must fix the hanging chain or hook with the housing, rise slowly and vertically, do not shake the housing. Stand clear of the membrane module.
- When lifting the membrane module, must use hanging chain or hook match the weight of the membrane module.
- When setting up and installing membrane module and membrane element, must consider setting up scaffolding, protecting equipment and other operation staffs.
- Do not allow to directly climb the membrane housing.

Notice!

- Do not allow to force pressure from membrane permeates side.
- Must keep the aeration tubes be horizontal.

06. Membrane module operation method

6.1 Fresh water operation

① Checking and setting

Before fresh water operation, please make the following preparations for inspection.

- (a) Make sure the air pipes and sewage pipes are right connected.
- (b) Make sure the membrane element tank is fixed tightly on the aeration tank.
- (c) Make sure the reaction tank is already clean. If not, when we open the protection cap, the dirt and dust may damage the membrane module.
- (d) Please open the air exhaust valve before putting fresh water into the tank in order to exhaust the air in membrane element.
- (e) Put the fresh water (tap water or filtered water) to operating level.
- (f) Turnoff the air exhaust valve after putting the fresh water to the operating level.

Notice!

- Please open the air exhaust valve before putting fresh water into the tank in order to exhaust the air in membrane element and turnoff the air exhaust valve after putting the fresh water to the operating level.
- Do not use surface water to replace fresh water. If the surface water contains a lot of iron, manganese, calcium and silicon, this may cause blocking of the membrane.

② Fresh water operation

Please do the fresh water operation according to the instructions below:

- (a) Please confirm the aeration rate and the homogeneity of aeration after aeration blower starts. Foam may be generated during operation. This phenomenon may be caused by the insoluble biochemical hydrophilic substance in the membrane and operation can be continuing regardless of this phenomenon.
- (b) When a blower supply wind for more than one membrane module. Please make sure the air supply rate of each membrane module is the same. If there is a big difference, please check the pipeline construction (eg. the thickness of connection pipe) and the situation of each air pipe.
- (c) Please check the performance of the control equipment.
- (d) Please measure and record the transmembrane pressure and temperature between each element.
- (e) Please stop filtering and aerating immediately after the performance test is finished.

Notice!

- Do not make excessive fresh water operation because fresh water may lead to blockages of the membrane.
- Please keep moist of the membrane after fresh water operation. It may result in the decline of the permeable capacity if the membrane is getting wet after fresh water operation.

6.2 Seed sludge addition

Seed sludge addition must be done, because if we use the membrane to separate the raw water directly, it may cause membrane blockages earlier.

Please do the seed sludge addition according to the instructions below:

- (1) Please prepare the seed sludge which could deal with the same kind of waste water. We recommend you use the seed sludge of which the MLSS concentration is around 20000mg/L.
- (2) Immediately adding raw water after seed sludge addition. Please add through superfine grating (the gap is less than 5mm) in order to remove the mixed substance.
- (3) The amount of seed sludge should enable the MLSS concentration of the membrane immersion tank to be more than 8000mg/L.

** Please do not use inoculants.*

Notice!

- Please add the seed sludge through superfine grating(the gap is less than 5mm) in order to remove the mixed substance.

6.3 Operation starts

After seed sludge addition were completed, firstly start aeration, then start filtering operation and at the same time start raw water supply. Please measure and record the pressure difference and temperature between membranes in practical operation when the filtered water is stable. The related matters of operation management will be described later.

07. MANEGEMENT OPERATION

7.1 Operating condition

Ensure the MLSS, viscosity, DO (Dissolved Oxygen), PH and other conditions must be appropriate to maintain good processing capacity.

When the raw water contained more inclusions or coarse grain of SS (suspended material), and grease composition for the larger proportion, there must have properly pretreatment. When must add defoamer to remove the bubble in the tank, please use alcohol defoamer which is not easy to fouling.

Item	Unit	Operating condition
MLSS	mg/L	7000-18000
Viscosity	MPa * s	<250
DO	mg/L	>1.0
PH	-	6-8
Temperature	°C	15-40
Flux	m3/m2/d	<0.75

Table 7-1 Standard operating conditions

Shown in the table 7-1 is for the standard operating conditions, there may be different with different environment.

Warning!

- No drinking the permeate liquid.
- Should analyze the water quality based on the intended use, before recycling the treated water.

Notice!

- Do not add chemicals, drugs, oil or other substances which has a bad effect on activated sludge.
- Please avoid the sudden changes in temperature, PH, trans-membrane pressure, even in the normal range.
- Regular inspect and replace the widgets.
- To prevent membrane module from cold

7.2 Operating Parameter and Data Records

The performance of membrane module changes with the water quality and operating conditions. For maintaining the system's stable working, recommend you record the management project data to grasp the membrane performance and characteristics.

The following example for operation and management project:

- (1) Aeration quantity
- (2) Outlet air pressure
- (3) Filter flux
- (4) Trans membrane pressure (TMP)
- (5) Permeate water quality (BOD, COD, turbidity, T-N, T-P etc.)
- (6) Reaction tank temperature

- (7) Raw water quality (BOD, COD, turbidity, T-N, T-P etc.)
- (8) Excess sludge quantity
- (9) DO (Dissolved Oxygen)
- (10) Immersion tank PH
- (11) MLSS
- (12) Viscosity
- (13) Sludge settle-ability (SV60/SVI120)

7.3 Routing inspection on MBR

In order to the stable operation of the membrane module, aeration condition and the stability of the biological treatment are particularly important. Please practice the following inspection.

① Trans-membrane pressure difference

Check the stability of the trans-membrane pressure difference. Sudden rise of trans-membrane pressure difference show that membrane congestion occurs. This perhaps, caused by the abnormal state of aeration or the deterioration of sludge properties. When this happens, check the following parameters and take the necessary action, such as chemical cleaning of membrane module.

② Aeration status

Check for the standard air aeration quantity, and whether it is uniform aeration. When the air aeration quantity and aeration are abnormal, please make the necessary measures: such as removing of fouling of the trachea, check the installation, check the blower, and adjusting the aeration, etc.

Notice!

When there is low aeration or irregular and stop the aeration, these will easily cause the membrane surface blocking. Absolutely do not filter.

③ The color and smell of activated sludge

Normal activated sludge is tan color and is agglutinative, not unpleasant smell. If the appearance and smell are not this state, please properly inspect the MLSS. Mud viscosity, DO, pH, temperature and BOD load numerical etc.

④ MLSS

The normal MLSS is about 7000-8000mg/L. It maybe can not reach the establish performance with the ill-conditions, please adjust the range of MLSS properly: at low MLSS, adding the seed sludge or stopping the sludge discharge: at high MLSS, increasing the sludge emissions to stay sludge concentration pool, etc.

⑤ Viscosity

Normal sludge should be under 250 MPa * s. it maybe can not reach the establish performance with the ill-conditions, please adjust to the normal range of viscosity: if it's too high, can update sludge, increase the sludge emissions stay in sludge concentration pool and other measures.

⑥ **DO**

The normal DO is more than 1mg/L within membrane bio-reactor. If it is not more than the maximum air aeration quantity, can take the necessary measures to meet the requirements such as adjusting the aeration conditions.

⑦ **pH**

A normal PH is 6-8. It maybe can not reach the establish performance with the ill-conditions, please add the acid or alkali to adjust PH.

⑧ **temperature**

The normal water temperature is 15~40°C. It maybe can not reach the establish performance with the ill-conditions, please take necessary measures such as cooling and heat preservation if possible.

⑨ **Water level**

Please check whether the water level of membrane bio-reactor in the normal range. When an exception occurs, please make the following checks:

- a. Liquid level gauge
- b. Through the pump
- c. Pressure difference between membrane elements

08. MAINTENANCE AND MANAGEMENT

8.1 regular maintenance items

In order to maintain the membrane module performance, maintenance and management items and its implementation frequency should be carried out as following:

- ① Aeration pipe cleaning (frequency: once a day)
- ② Membrane elements chemical cleaning (frequency: when the transmembrane pressure under the same filtration flow is 5KPa higher than the early stable operation or once half a year). Please choose between the two which is shorter to do the chemical cleaning.
- ③ The outlet pipe replacement (frequency: about once every three years, but due to different use condition.)

- * When replacing the outlet pipe, please use the specified type.
- * The detailed specifications and gaining method of the replacement parts, please contact RisingSun.
- * When replacing the outlet pipe, please insert the outlet pipe firmly to the roots of water outlet.
- * When replacing the outlet pipe, please do not overpower the membrane element and collector pipe inlet to prevent damage.

8.2 Aeration pipe cleaning method

The scale inhibition of membrane aeration hole may lead to nonuniform aeration and membrane blockage. In order to prevent membrane blockage, please do aeration pipe cleaning once a day, 1-5min/time. (we suggest you install automatic valve to proceed auto cleaning).

When cleaning, in order to let the sludge reflux into the aeration pipe, please release the pressure in aeration pipe by open the cleaning valve. (as shown in figure 8-1)

Aeration tube cleaning process is as below:

- ① Stop suction pump, stop filtration.
- ② Open cleaning valve, let the sludge liquid comes through the aeration holes into aeration pipe, and it discharged together with the air.
- ③ Close cleaning valve.
- ④ Restart suction pump for filtration.

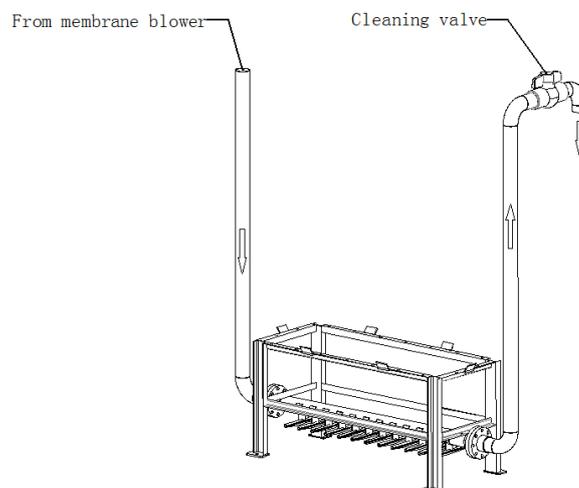


Figure 8-1

8.3 Chemical cleaning of the membrane element

When the transmembrane pressure rises too high, chemical cleaning will be proceeded. The phenomenon will occur when the pore in membrane surface blocked. The chemical cleaning circle is as follows.

- ① When the transmembrane pressure under the same filtration flow is 5kPa higher than the early stable operation or once half a year, please choose between the two which is shorter to do the chemical cleaning.
- ② When the transmembrane pressure rises quickly, please carry out chemical cleaning as soon as possible. The timely chemical cleaning can effectively eliminate pore blockage.
- ③ Observe how long it will take for the transmembrane pressure to be higher than 5kPa. The routinized chemical cleaning can effectively extend the life of the membrane.

8.4 Agentia for cleaning

The agentia used and the standard using condition is as shown in the table 8-1. Please select the agentia which can correspond to the fouling material.

Fouling material	Agentia name	Chemical liquid concentration	Injection quantity of chemical liquid	Cleaning time	Soak time
Organics	NaClO & NaOH	2000-5000mg/l NaClO & 1000mg/l NaOH solution (effective chlorine density)	5L/membrane element	1 to 3 hours	1 hour
Inorganic	Oxalic acid	1000mg/l	5L/membrane element	1 to 3 hours	1 hour
Inorganic	Citric acid	2500mg/l	5L/membrane element	1 to 3 hours	1 hour

Table 8-1

- * Due to different inlet water quality, depending on the situation to decide whether to use acid cleaning after alkaline cleaning.
- * The used volume chemical and the concentration of the cleaning media will pass through the membrane and out in the MBR tank. Please be aware of eventual influence from the cleaning media in the biology of the waste water plant.

8.5 Agentia using and operating guidance

The agentia used for cleaning may contain the substance which will do harm to human body when touched. Therefore on the basis of reading the material safety data sheet (MSDS) carefully, protection appliance such as protection glasses, gloves must be equipped. When the agentia touches the skin, please deal with according to the corresponding solutions on MSDS.

① Sodium hypochlorite solution / (NaClO)

A: Instructions on operation.

- (a) Avoid inadequate ventilation. Avoid high temperature objects, sparks and acid.
- (b) Do not do rough operation, such as bottom up the vessel, dropping out, striking or excessive pulling the vessel.
- (c) Do not attempt to create dusts or vapors in order to avoid incidents such as leakage, overflow and sprinkle and so on.
- (d) Please airtight the container after using.



- (e) Please carefully wash hands, face etc. and rinse mouth after operation.
- (f) No eating & drinking and smoking outside the designated places.
- (g) Do not take the gloves and other contaminated protective tools into rest area.
- (h) No admittance in operation places.
- (i) Please wear appropriate protective devices, so as not to absorb agentia and avoid eyes, skin and clothes contacting with agentia.
- (j) Please use local exhaust equipment when operate indoors.

B: Instructions on storage

- (a) Please avoid direct sunlight and keep in the shadows; Please airtight and avoid contacting with air.
- (b) Please select a corrosion-resistant container as reservoir.

② Oxalic acid / (COOH)₂

A: Instructions on operation.

- (a) Avoid inadequate ventilation. Avoid high temperature objects, sparks and acid.
- (b) Do not do rough operations, such as bottom up the vessel, dropping out, striking or excessive pulling the vessel.
- (c) Do not attempt to create dusts or vapors in order to avoid incidents such as leakage, overflow and sprinkle and so on.
- (d) Please airtight the container after using.
- (e) Please carefully wash hands, face etc. and rinse mouth after operation.
- (f) No eating & drinking and smoking outside the designated places.
- (g) Do not take the gloves and other contaminated protective tools into rest area.
- (h) No admittance in operation places.
- (i) Please wear appropriate protective devices, so as not to absorb agentia and avoid eyes, skin and clothes contacting with agentia.
- (j) Please use local exhaust equipment when operate indoors.

B: Instructions on storage

- (a) Please avoid direct sunlight and keep in the shadows; please airtight and avoid contacting with air.
- (b) Please select a corrosion-resistant container as reservoir.

③ Citric acid / HOOCCH₂C(OH)(COOH)CH₂COOH

A: Instructions on operation

- (a) Stay away from strong oxidant and strong alkali.
- (b) Do not do rough operations such as bottom up the vessel, dropping out, striking or excessive pulling the vessel.
- (c) Do not attempt to create dusts or vapors in order to avoid incidents such as leakage, overflow and sprinkle and so on.
- (d) Please airtight the container after using.
- (e) Please carefully wash hands, face etc. and rinse mouth after operation.
- (f) No eating & drinking and smoking outside the designated places.
- (g) Do not take the gloves and other contaminated protective tools into rest area.

- (h) No admittance in operation places.
- (i) Please wear appropriate protective devices, so as not to absorb agentia and avoid eyes, skin and clothes contacting with agentia.
- (j) Please use local exhaust equipment when operate indoors.

B: Instructions on storage

- (a) Please avoid direct sunlight and keep in the shadows; Please airtight and avoid contacting with air.
- (b) Please select a corrosion-resistant container as reservoir.

Warning!

- The agentia used for cleaning may contain the substance which will do harm to human body when touched. Therefore on the basis of reading the material safety data sheet (MSDS) carefully, protection appliance such as protection glasses, gloves must be equipped. When the agentia touches the skin, please deal with according to the corresponding solutions on MSDS.
- If the chemical touches the skin or clothing, please immediately wash with large amount of water.
- If the chemical touches the eyes, please immediately wash with large amount of water and seek medical advice.
- Chemicals should be stored in a shadow place and keep away from direct sunlight.
- In order to avoid corrosion, please choose appropriate storage tank to store the chemicals according to different nature of each chemicals.
- Sodium hypochlorite should not be mixed with heavy metals or acids. Please pay special attention that when it is mixed with acid, poisonous chlorine can be produced.
- Do not mix oxalic acid or citric acid with sodium hypochlorite, because poisonous chlorine can be produced after mixture.

8.6 Membrane element cleaning method

① Chemical cleaning process of membrane element

Please inject chemical liquid slowly into membrane element through water diversion pipe and let the chemical liquid seep from inside of the membrane to outside. Please utilize gravity flow when injecting the chemical liquid. The cleaning method will be described one by one according to the design-in location of the liquid tank

A: Chemical cleaning process when chemical liquid tank is in a lower position. Please refer to figure 8-2

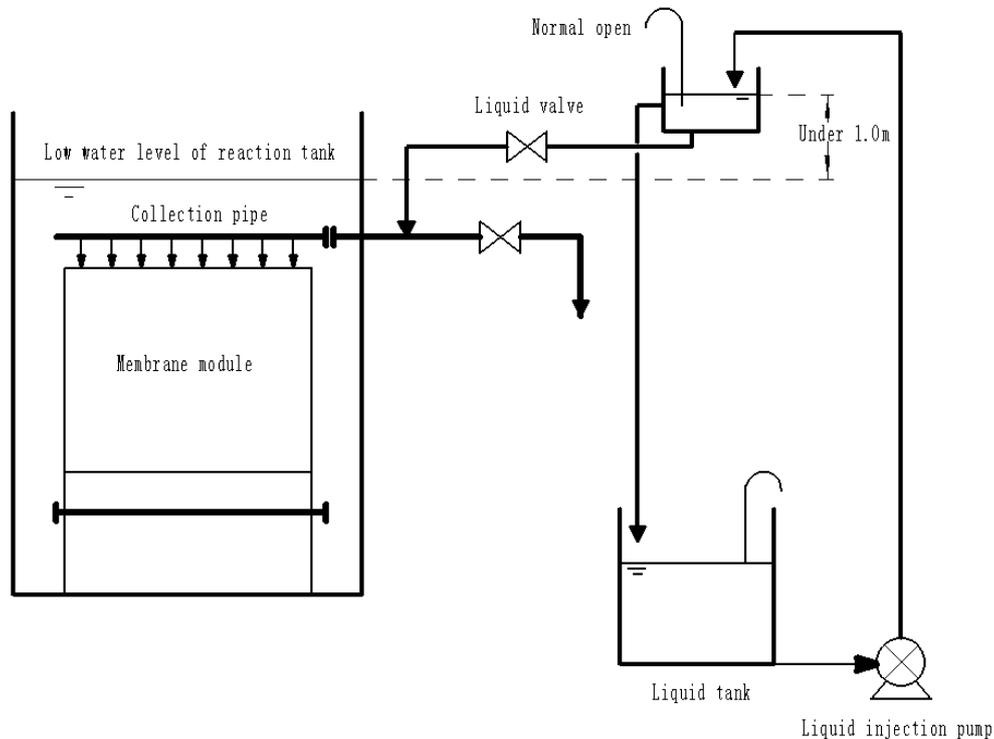


Figure 8-2 Chemical liquid tank is in a lower position

- (a) Make sure the liquid valve is closed and the liquid pump is stopped.
- (b) Adjust the liquid in liquid tank to a given state.
- (c) Stop filtration and close the permeate water valve (aeration continues).
- (d) Confirm having opened the liquid pump and confirm the circulation of liquid.
- (e) Slowly open the liquid valve and start injecting the liquid.
- (f) Inject quantitative liquid and close the liquid pump after injection finished.
- (g) The setting given time (1-3 hours).
- (h) Close the liquid valve, open the permeate valve and restart filtering operation.

* At the early stage of operation, there will be liquid residue in permeate water. Please return it back to raw water tank. If can not return, please deal with the waste water according to the environment of the operation place.

B: Chemical cleaning process when chemical liquid tank is in a higher position. Please refer to figure 8-3

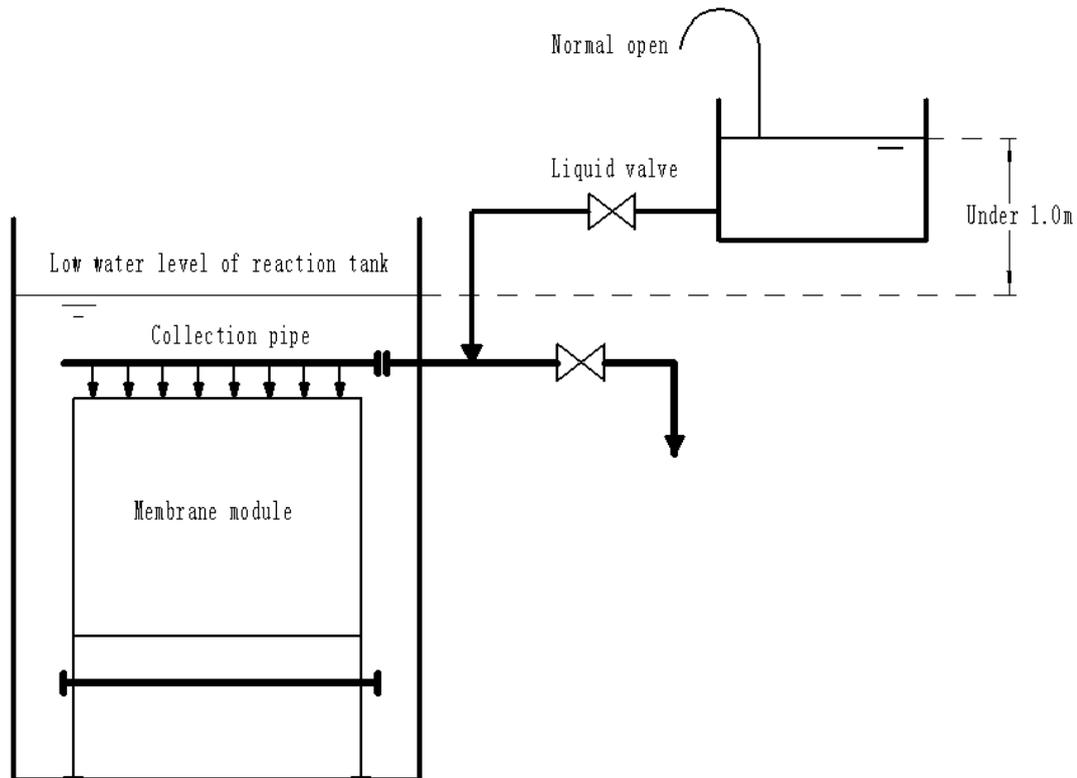


Figure 8-3 Chemical liquid tank is in a higher position

Express in turn according to the figure.

- (a) Make sure the liquid valve is closed.
- (b) Adjust the liquid in liquid tank to a given state.
- (c) Stop filtering operation and shut down the permeate water valve (aeration continues).
- (d) Slowly open the liquid valve and start injecting a given amount of liquid.
- (e) After injection, place a given time (1-3 hours).
- (f) Close the liquid valve, open the permeate valve and restart filtering operation.

* At the early stage of operation, there will be liquid residue in permeate water. Please return it back to raw water tank. If can not return, please deal with the waste water according to the environment of the operation place.

② **The do's and don'ts during the process of chemical cleaning of membrane elements.**

- (a) Please make liquid injection through gravity way and control the pressure to be within 10kPa. If injecting directly by pump, the pressure may be higher than 10kPa, and this will lead to damage of membrane element. Therefore please absolutely do not operate in this way.
- (b) Please do liquid injection when the membrane element is in a state of immersion. In order to ensure the safety of operator, please make sure the depth from water surface to the top of membrane element is more than 500mm.
- (c) When doing chemical cleaning, aeration and agitation should be continued. But the

influence of different of different kinds of chemicals and etc may lead to generation of foams in immersion tank, at this time, please reduce the aeration rate.

(d) The higher the temperature of the liquid, the better the effect of cleaning . But the temperature should not surpass 40°C. On the other hand, if the temperature is too low, the effect of cleaning can not be reached and the performance of membrane may not renew. Therefore please keep the temperature of membrane immersion tank at a higher level.

(e) When the chemical cleaning is finished, it will have some residual liquid in membrane element and also the pipe in permeate side. When filter operation starts again, please return the filtered water back to raw water or treat the liquid as waste water before the effect of chemical liquid to the filtered water disappears.

Warning!

- When chemical cleaning equipment has abnormal, please stop cleaning immediately.
- If the liquid directly inject through the liquid pump, the pressure rises inside the membrane element, which could lead to the membrane element damage; so be sure to use gravity mode injection (supply pressure 10kPa or less).
- When do the chemical cleaning, please make the fluid levels in the immersion tank to the upper portion of the membrane element more than 500mm, then inject the chemical liquid at the membrane element be submerged.

8.7 Remove the membrane module

When removing the membrane, proceed in the following order.

- ① Discharge the activated sludge from membrane bioreactor.
- ② When only removing the membrane elements, remove the collecting pipe. If need to remove the aeration portion , please also remove the aeration pipe.
- ③ When only removing the membrane elements, remove connecting bolts in the aeration. For longer type membrane element, if the collecting pipe connected to two membrane element tanks, take off the bolts to remove the collecting pipe.
- ④ If need to remove the aeration portion, discharge the anchors firstly.

Danger!

- When lifting the membrane module housing, must fix the hanging chain or hook with the housing, rise slowly and vertically, do not shake the housing. Stand clear of the membrane.
- When lifting the membrane module, must use hanging chain or hook match the weight of the membrane.

Warning!

- After removing the membrane for maintenance, must make the membrane keep moist, then restart the process. It may result in low flux after drying.

09. FAULT HANDING

Membrane element fault generally include: abnormal aeration, membrane pressure differential between the rising and the loss by water flow, the through water quality deterioration.

As shown in the following for all kinds of situation and problems, causes and treatment methods.

Problems	Causes	Treatment methods
Substandard aeration air quantity	Blower fault	Checking the blower
	Obstruction of aeration pipe	Cleaning the membrane aeration pipe
Unstable aeration condition within the membrane module	The membrane aeration pipe blockage	Cleaning the membrane aeration pipe
The through water reduction or membrane pressure differential rising	Membrane blockage	Medicated wash
	Abnormal aeration result on the membrane surface rinsed badly	Improve aeration situation
	Abnormal shape sludge result on deteriorated sludge filtration performance	Improve sludge characters Adjust the amount of sludge discharge prevent abnormal component inflow (oil classification) adjustment of BOD load Adjust the raw water (Addition of nitrogen, phosphorus, etc.)
Suspended component increased in the through water	Membrane element or hose damage	Seal the membrane Diversion pipe of element or collecting pipe
	Through water pipeline leakage	Survey and repair defective parts
	Bacterial growth at through side	Inject available chlorine concentration 100-200 mg/L of sodium hypochlorite into the through water pipe to clean

- ① Even if the problem from the hose, may also have defaced inside the membrane element, therefore also need to seal the membrane elements.
- ② When pressurized operation for checking the pipe connecting portion and welded parts for leaks, do not change the pressure of membrane element.