



## **Company profile**

Singapore Century Water Systems & Technologies Pte. Ltd. is an innovator of industrial and commercial water and environmental solutions. The company is a founding member of the Singapore Membrane Innovation Alliance, and its business model and innovation capabilities have been highly recognized internationally.

The company has the core technology and large-scale production capacity to manufacture silicon carbide ceramic membranes. Its main flat membrane, tubular membrane and column membrane products have been widely used in petroleum, chemical, electric power, metallurgy, coal, food, medicine, printing and dyeing, Environmental protection and other industries, and received unanimous praise from customers.

In 2019, Century Water won the world-renowned Zayed Sustainability Award, becoming the first water company in the world to receive the award.

## **Silicon carbide ceramic membrane introduction**

Silicon carbide ceramic membrane refers to an inorganic ceramic membrane made of silicon carbide materials. It mainly includes several structural forms such as flat membranes, tubular membranes and multi-channel column membranes. It has high strength, good thermal shock stability, large flux, the comprehensive advantages of low operating cost and long service life are a new generation of ceramic membrane products facing the future.

Silicon carbide ceramic membrane has the following characteristics:

Good hydrophilicity, high porosity, and large flux;

Good chemical stability, resistance to acids, alkalis, organic solvents and various oxidants;

Good thermal stability, high temperature resistance up to 800 degrees Celsius;

High strength, good wear resistance, long service life;

Good membrane regeneration and stable flux;



MOISANITE series silicon carbide ceramic ultrafiltration membrane uses silicon carbide ceramic membrane as the filter unit, adopts the "inside-out" flow method, and filters through a ceramic membrane with a nominal pore size of 0.05 microns. This tiny pore size can remove almost all suspended or colloidal particles in the water, including Giardia and cryptosporidium. MOISANITE silicon carbide ceramic ultrafiltration membrane can even remove a considerable part of the virus that is freely suspended and attached to particles.

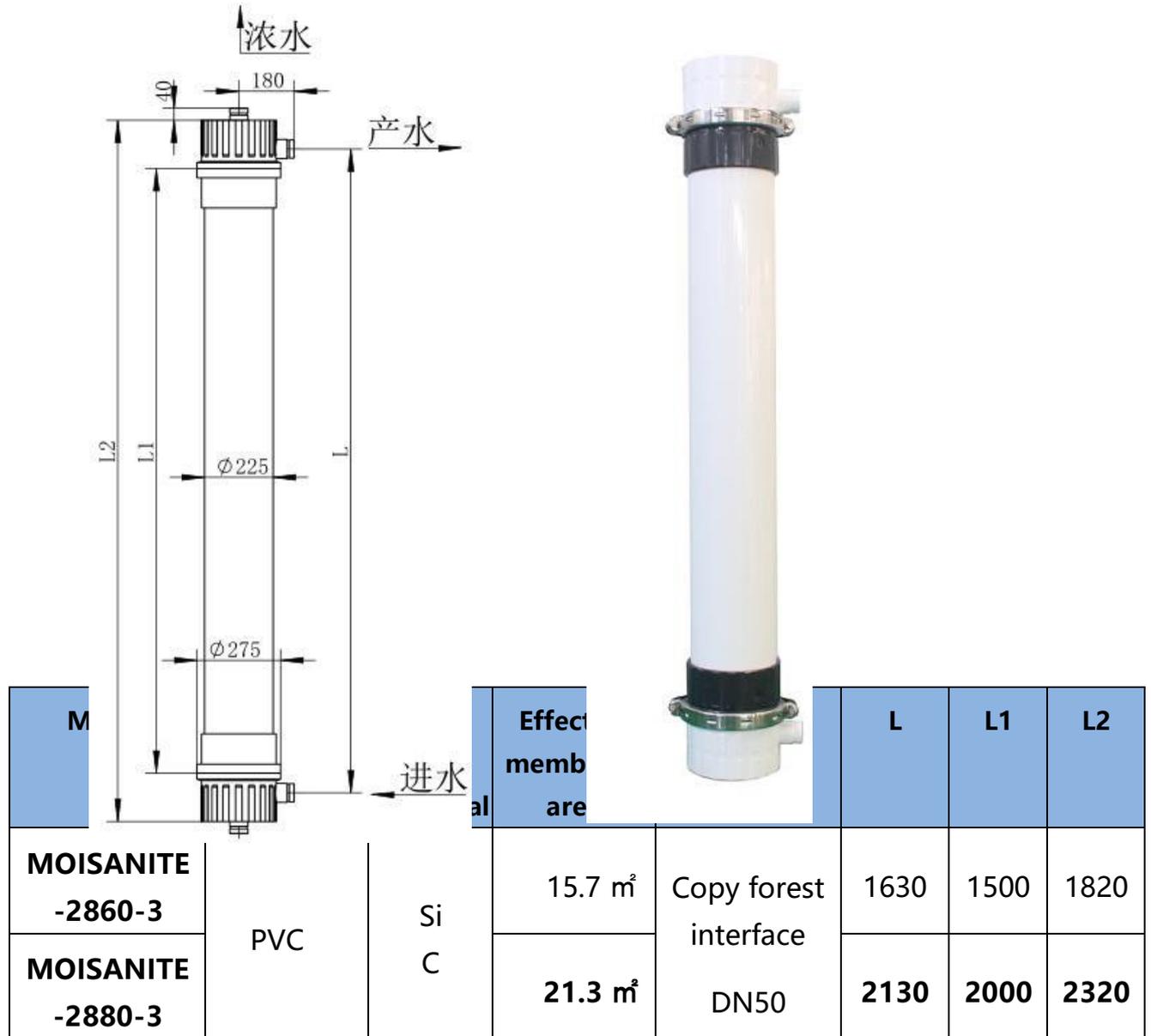
Advantages of MOISANITE series silicon carbide ceramic ultrafiltration system:

- SiC membrane material has low pollution characteristics, even if it is polluted, it can adapt to harsh cleaning methods.
- Adopting the "inside to outside" filtration method to evenly distribute the water flow and solid load without clogging the membrane elements.
- Form a real ultrafiltration barrier, provide high-quality effluent, meet and exceed user water treatment requirements.
- It can tolerate high solid content and can treat wastewater with high turbidity and high coagulant dosage.
- The design of the membrane frame is simple and compact. It not only has the whole machine system, but also can be customized design, which can transform the ultrafiltration and microfiltration "from outside to inside".
- High degree of operation automation, simple operation and maintenance.

#### **How the ultrafiltration component works**

The operation of ultrafiltration has two modes: full flow filtration (dead end filtration) and cross flow filtration. In full-flow filtration, all the influent water passes through the surface to become product water; while in cross-flow filtration, part of the influent water passes through the membrane surface to become product water, and the other part is discharged with impurities and becomes concentrated water. Full-flow filtration has low energy consumption and low operating pressure, resulting in lower operating costs; while cross-flow filtration can handle fluids with higher suspended solids content. The specific operation form should be determined according to the suspended solids content in the water.

**MOISANITE series silicon carbide ceramic ultrafiltration membrane module**



## **Features of membrane modules:**

### **1. Wide range of applicable raw water**

Since silicon carbide (SiC), which is highly chemically resistant, is used as the raw material, the water quality has a very wide range of applications, and can be used for purification of various water quality such as water purification, sewage, and seawater.

### **2. Low cost and small size**

- The unit filtration area of the membrane module is at most 21.3m<sup>2</sup>, and a small amount of membrane module can be used for large water treatment.
- Capable of high recovery rate operation.
- The membrane can be operated at high flow rate under low pressure, so that the processing capacity per unit membrane area becomes larger.
- The operation of the pressure type full-volume filtration or the cross-flow filtration method is simple and easy to operate, and it can also operate under low pressure, so it can save electricity and reduce costs.

### **3. High anti-fouling ability**

- Use silicon carbide (SiC) material with strong chemical resistance as the membrane material to make the membrane components resistant to acid, alkali, oxidant and other chemical cleaning agents
- Membrane elements have strong mechanical properties, even if repeated physical cleaning (air surface flushing) using airflow has good durability.

### **4. Reliable turbidity removal performance**

Due to the uniform distribution of very fine pores on the membrane surface, stable and good filtered water quality can be obtained.

## 5. High product water safety

- The components are highly safe and can be used as pretreatment equipment for large-scale reverse osmosis systems.
- Can be used for advanced treatment of drinking water.
- Suitable for tap water quality and water supply treatment.

### **The main purpose of the membrane module:**

- Purification treatment of tap water, aseptic purification water supply system
- Deturbidity and sterilization treatment of groundwater, surface water and well water
- Replace traditional filtration methods such as sand filtration and activated carbon
- Pretreatment of large-scale reverse osmosis membrane device
- Can be used to remove particles and suspended matter that cannot be removed by ion exchange resin treatment
- Deturbidity, sterilization and purification of processing water in the food and medical fields
- Reuse of secondary wastewater in GB8978-1996 and reuse of reclaimed water for secondary treatment of domestic sewage
- Advanced treatment of general engineering drainage
- Purification treatment of oilfield reinjection water
- Refining fruit juice drinks and clarifying wine
- Refining and removing turbidity of Chinese medicine extract
- Filtration of water supply purification device for residential area or residential unit
- Pretreatment of seawater desalination project

Performance parameters of membrane modules:

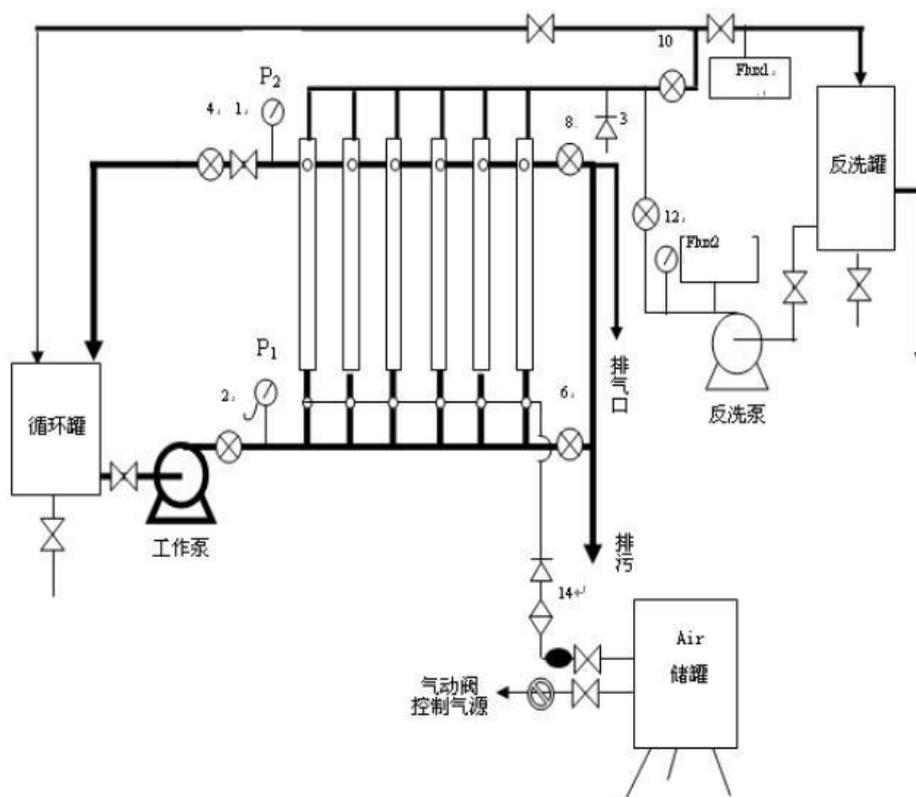
Performance parameters of membrane modules				
Performance			MOISANITE-2860-3	MOISANITE-2880-3
	Pure water initial flux (25°C 0.1MPa)		7000~8000L/h	10000~11000L/h
	Product water turbidity		≤0.2NTU	
	Suspended matter (SS)	Raw Water GB8978-1996 qualified secondary sewage	≤1mg/L	
	Escherichia coli		Not detected	
Specification	Membrane filtration form		内压式	
	Membrane material		碳化硅 (SiC)	
	Water channel		3mm	
	Fiber bonding material		环氧树脂	
	Shell material		UPVC	
	Membrane surface area		15.7 m <sup>2</sup>	21.3 m <sup>2</sup>
	Cutting molecular weight / cut-off pore size		50nm	
Conditions of use	Standard design, design throughput (20°C, 0.1MPa)		1600 ~ 2400L/h	2200 ~ 3200L/h
	Maximum water inlet pressure		1MPa	
	Maximum transmembrane pressure difference		0.15MPa	
	Operating temperature range		5 ~ 60°C	
	PH range		pH 2 ~ 12	
	Operation mode		Full or cross-flow filtration	
	Maximum backwash water flow		11000L/h	
Typical Process Conditions	Way to control		Constant flow	
	Air wash flow		2.5 ~ 5.0m <sup>3</sup> /h·支	
	Air washing inlet pressure		≤0.03MPa	
	Backwash water pressure		0.03 ~ 0.05MPa	
	Backwash water flow	Air and water double washing	0.3 ~ 1.0m <sup>3</sup> /h·支	
		When backwashing only with water	2.0 ~ 3.0m <sup>3</sup> /h·支	
	Backwash time	Air and water double washing	20 ~ 60 sec	
		When backwashing only with water	20 ~ 60 sec	
	Forward flow		2.0 ~ 3.0 m <sup>3</sup> /h·支	
	Forward time		20 ~ 60 sec	
use pressure		0.03 ~ 0.2 MPa		



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<b>Chemically enhanced backwash cycle</b>	3 ~ 72 h (Depends on water quality)
<b>Chemical washing cycle</b>	3 ~ 12 week (Depends on water quality)
<b>Chemical positive washing cycle online water washing cycle</b>	50 ~ 90s/20 ~ 60min

Operation of membrane module:



## 1. Water production

Open the automatic valves 2, 4, and 10 of the ultrafiltration system, and close the automatic valves 6, 8, 12, and 14; the working time of membrane filtration is 20-60 minutes. In this state, according to the requirements of raw water quality or product water quality, the oxidizing bactericide can be directly added to the membrane filtration raw liquid system through the metering pump, that is, added to the circulating water tank. The oxidant can be chlorine, ozone, chlorine dioxide, sodium hypochlorite, etc., with a concentration of 0.5-10ppm.

**When passing water, air may remain in the membrane module. In order to prevent damage to the membrane module caused by water hammer, please enter the water slowly and fully exhaust the air.**

## 2. Backwash

- Air and water backwash: close automatic valves 2, 4, 6, 10, open automatic valves 8, 12, 14, and open the backwash pump to adjust the flow of backwash liquid to 0.3t/h • branch, and the flow of cleaning gas to 2.5~ 5.0 m<sup>3</sup>/ • stick, cleaning time is 20-60 seconds. The purpose of backwashing is to loosen the deposits on the membrane surface and keep the membrane module filled with liquid, so as to maximize the effect of air oscillation. In this state, backwashing can be added to the backwashing liquid through the one-way valve 3 according to the water quality requirements.
  - (1) Oxidizing cleaning agent. The oxidant can be chlorine, ozone, chlorine dioxide, sodium hypochlorite, etc. The concentration is 2~1000ppm
  - (2) Acid scale inhibitor, such as hydrochloric acid, etc.
  - (3) Alkaline degreaser, such as sodium hydroxide, etc. According to water quality needs, one or two agents can be added at the same time
- Water backwash: close valves 2, 4, 10, and 14, open valves 6, 8, and 12, adjust the backwash flow to 2.3t/h • piece, and the cleaning time is 10-60 seconds. The purpose of this cleaning process is to flush out the contaminants on the membrane pores and membrane surface through a large flow of backwashing, and discharge the concentrated sewage through the lowest valve 6.

## 3. Sewage discharge or positive impact

- Sewage:

Close valve 12, the rest of the valve status is the same as cleaning status 2, and drain the concentrated sewage remaining in the membrane module and membrane device pipeline through the lowest valve 6.

- Positive impact:

Open the automatic valves 2, 8 and close the other automatic valves. In this state, use raw water to drain the residual contaminants in the membrane module from the return port of the membrane module.

## 4. The water permeability of membrane modules varies with water temperature. Operating temperature is 5~60°C



### **Washing of newly installed membrane modules**

Due to factors such as the production and storage process of the membrane module, the modules are cleaned according to the purpose of the produced water before the official water production starts to achieve the required water production index.

1. Run the connected components according to normal use procedures;
2. After running for ten minutes, perform air and water backwash for 40 seconds, and then perform water backwash for 20 seconds;
3. Discharge sewage, discharge the dirt in the module;
4. Repeat the above steps until the pH value of the inlet water and the discharged sewage are the same.

### **Testing of newly installed membrane modules**

1. Run the cleaned components according to the program;
2. Sampling and testing of self-produced water sampling port;
3. If the test result exceeds the standard, analyze the reason;
4. If the components are not clean, continue to wash the components;
5. For other reasons, reinspect after elimination;
6. Repeat until the test result is qualified.

## System maintenance and failure analysis

### 1. Daily maintenance of the system

- Pressure gauge

Calibrate regularly and adjust in time if necessary.

- Centrifugal pump

Regularly check the temperature of the pump, at the same time check the pump gasket and the structure to prevent pump leakage.

- Flow meter

Correction every three months.

- Automatic valve

Check once a month and check the valve body for leaks.

- Ultrafiltration system

Check the water quality, flow rate, and operating pressure of the inlet and outlet water according to routine; whether the valve action is sensitive and conforms to the operating procedures.

### 2. System failure analysis:

Phenomenon	Possible Reasons	Corrective measures
Ultrafiltration membrane transmembrane pressure difference is too high	The ultrafiltration membrane module is contaminated	Find out the cause of contamination and adopt corresponding cleaning methods
	Product water flow is too high	Adjust the flow rate according to the requirements in the operating instructions.
	Inlet water temperature is too low	Increase inlet water temperature

Poor water quality	Influent water quality exceeds the allowable range	Check the quality of incoming and outgoing water, SS, turbidity, COD.
	The membrane module is damaged	Find the cause of damage, replace or repair the membrane module.
Small water flow	The ultrafiltration membrane module is contaminated	Find out the cause of contamination and adopt corresponding cleaning methods.
	Incorrect valve opening setting	Check the opening state of the valve and adjust the opening.
	Problem with flow meter	Check and proofread the flow meter.
	Water supply pressure is too low	Increase the pressure and adjust the parameters.
	Inlet water temperature is too low	Increase the inlet water temperature.
The system cannot run in the automatic state	The water supply pump does not start	Find if the wiring is wrong Restart in manual state and switch to automatic control after normal;
	High inlet pressure	Check the water supply pump. Pressure switch setting problem.
	High water back pressure	The product water outlet valve is not open. The subsequent system did not start in time. Pressure switch setting problem.
	PLC program is wrong	Check the program.

## Membrane module cleaning

Due to the wide range of membrane applications and the complex processing media, there will be varying degrees of pollution on the membrane surface during the process of processing the liquid. In principle, the shorter the cleaning cycle, the better the recovery of membrane performance and the longer the service life. Users can according to your own process, choose the appropriate cleaning agent and cleaning cycle.

**Cleaning methods are mainly divided into physical cleaning and chemical cleaning:**

### Physical cleaning

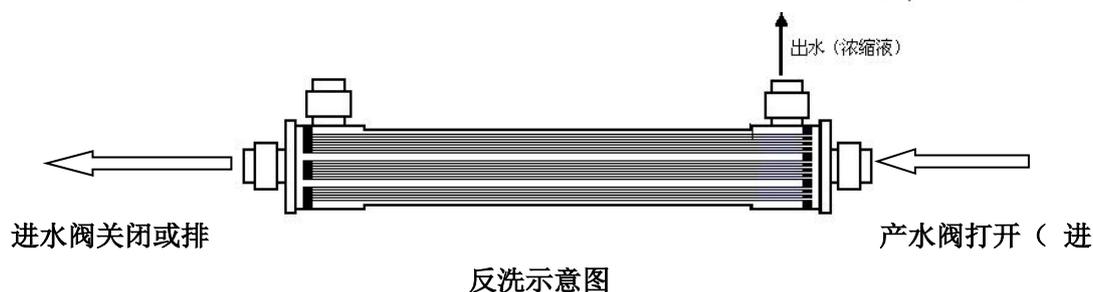
- Positive washing, that is, use clean water to clean the remaining material liquid in the module, and use clean water to pass through the original liquid side of the membrane at a certain flow rate to wash out the contaminants. It can be recycled or washed while draining. At this time, the concentrated water valve is fully opened (equal pressure cleaning), and the water outlet valve is fully closed. The cleaning time depends on the specific situation, generally 10-30 minutes (Off-line cleaning time).



- Backwashing, applying low pressure, so that clean water (tap water or membrane filtered water) permeates from the membrane filtrate side to the membrane original solution side, and the pollutants on the membrane original solution side and the obstructions that penetrate into the micropores are washed out. During the washing process, do not return the permeate to the washing tank to prevent pollution on the water purification side of the membrane. The washing time depends on the specific conditions, generally 10~20 minutes (off-line cleaning time).



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- Soaking. After the membrane is washed and backwashed, if the effect is not good, it can be soaked in clean water or chemical solution to loosen the contaminants. Soaking for a certain period of time is often an effective way to remove pollution.
- Air and water double washing, while the membrane module is backwashed, a certain amount of compressed air is introduced from the water inlet, and the air bubbles rise and oscillate in the module to cause the pollutants to fall off and discharge from the sewage outlet. This method can realize the automation and continuity of the technological process.

### Chemical cleaning

Because SiC has excellent pollution resistance, generally physical cleaning can achieve better results. If physical cleaning is not ideal, chemical cleaning can be performed

- In the continuous membrane filtration equipment system, chemical cleaning is generally carried out once in 3-12 weeks to remove organic pollution and restore membrane flux. For chemical cleaning, common water treatment agents with excellent bactericidal properties such as sodium hypochlorite and chlorine dioxide can be used for system sterilization; NaOH solution is used to remove organic pollution in the membrane system; use HCL or EDTA sodium salt solution to remove the inorganic salt fouling pollution of the membrane system.
- Sodium hypochlorite cleaning, with 500-3000ppm sodium hypochlorite aqueous solution, low pressure inside the membrane system (<0.1MPa) Circulate for 20 minutes, after soaking for 20 to 120 minutes, circulate for 20 to 120 minutes, and wash with water until it is neutral. This cleaning agent is suitable for microbial contamination. (General industrial product sodium hypochlorite is 10wt% available chlorine).
- Acid cleaning, using hydrochloric acid aqueous solution with a concentration of 3000~10000ppm, low pressure inside the membrane system (<0.1MPa) Circulate for 20 minutes, after soaking for 20 to 120 minutes, circulate for 20 to 120 minutes, and wash with water until it is neutral. This cleaning agent is suitable for inorganic pollution, such as high hardness water. (Generally based on the concentration of 30wt% hydrochloric acid product).



- In addition to hydrochloric acid, oxalic acid (0.3%), citric acid (2%), nitric acid can also be used (0.3%) wait for cleaning.
- Surfactant cleaning can use sodium dodecyl sulfonate, sodium dodecyl sulfate, sodium dodecyl benzene sulfonate, etc. The general concentration is 200-1000 ppm.
- It varies according to the concentration of the medicines sold in the market. In addition, the concentration changes with the season. It is recommended to use experiments and other methods to confirm before using the drug.
- The standard chemical liquid temperature is 25-35°C.

**When using an acidic agent and an alkaline agent in combination, clean water must be performed after the cleaning of the former agent is completed, and then the next agent cleaning. Use membrane filtered water or better water as the flushing water, and confirm that the inside of the membrane module has reached a neutral state (pH value of 7) before proceeding to the next step of cleaning or returning to normal use.**

## Cleaning steps

### 1) Choice of cleaning plan

- Use acidic solution to clean the ultrafiltration device

Because the Fe or Mn content in the influent water exceeds the design standard, or the suspended solids in the influent water are extremely high, non-organic pollution on the water inlet side of the membrane is caused.

- Use alkali or oxidant to clean the ultrafiltration device

When the content of organic matter in the influent is high, it may cause the filter membrane to be polluted by organic matter. And when conditions are conducive to the survival of organisms, some bacteria and algae multiply in the module, thereby causing biological pollution.

#### ❖ **Matters needing attention:**

- All cleaning agents must enter the module from the water inlet side of the ultrafiltration to prevent possible impurities in the cleaning agent from entering the membrane from the back of the dense filter layer.
- Carry out sufficient backwashing before chemical cleaning of the ultrafiltration device.
- The entire chemical cleaning process takes 2 to 4 hours.
- After cleaning, the ultrafiltration device will be shut down for more than 3 days and must be maintained.
- The cleaning fluid must use ultrafiltration produced water or better water configuration.
- The cleaning agent must remove possible contaminants before circulating into the membrane.
- The temperature of the cleaning fluid can generally be controlled between 25°C and 35°C. Increasing the temperature of the cleaning fluid can improve the cleaning efficiency.
- If necessary, a variety of cleaning agents can be used for cleaning, but the cleaning agents and bactericides cannot damage the membrane and components. And after each cleaning, the cleaning agent should be drained, and the system should be rinsed with ultrafiltration or RO water before cleaning with another cleaning agent.

### 2) Safety precautions

- Avoid direct contact with agents such as NaOH and NaClO, which are corrosive to varying degrees.
- The pipeline pressure should be controlled during cleaning to avoid excessive pressure causing chemical splashing.

### 3) Cleaning program



- Shut down the program to shut down the system.
- Close all valves in the system.
- Prepare the cleaning solution in the cleaning solution tank and stir it thoroughly to make it evenly mixed.
- Start the cleaning water pump, slowly open the outlet valve of the cleaning water pump and the cleaning fluid inlet and outlet valves of the ultrafiltration device to control the flow of each membrane module to allow the cleaning solution to enter the membrane module and return to the cleaning solution tank. Cycle cleaning.
- Turn off the cleaning pump and let it stand for soaking.
- Empty the cleaning solution tank and cleaning filter, and rinse them with clean water.
- Open the concentrated water discharge valve and product water discharge valve of the ultrafiltration device.
- The pH value of the inlet and outlet water of the flushing ultrafiltration device is neutral.
- Return to production running status.

### **Precautions for the use of membrane modules**

In order to maximize the performance of the membrane module, please pay attention to the following:

- 1) In cold areas, prevent the membrane module from freezing.
- 2) The membrane module container is made of plastic, please be careful not to drop it and cause it to break when using it.
- 3) The junction between the membrane module and the outside is a UPVC union. When connecting with piping, pay attention to the installation method to protect the membrane module from damage.
- 4) At the joint, please do not get any oil or dirt except adhesive.
- 5) Please note: Install the membrane module vertically. Otherwise, the cleaning efficiency will be reduced during air cleaning.
- 6) Before passing water through the membrane module, be sure to flush the piping and other parts, and confirm that there are no particles or dirt.



- 7) When water is supplied, air may remain in the membrane module. In order to prevent damage to the membrane module caused by water hammer, please enter the water slowly and fully exhaust the air.
- 8) When performing filtration operation, please do not over pressurize the membrane module and pay attention to the temperature of the water supply. The maximum transmembrane pressure difference of the membrane module is less than 0.15MPa. If it is used with excessive pressure, the membrane module will be damaged. The operating temperature is 5°C~60°C.
- 9) Set proper operating conditions according to the raw water quality. Because filtration water flow, physical cleaning and other operations will affect the service life of the membrane and the cleaning frequency of the agent. The best backwash flow is 1 to 2 times the filtered water flow.
- 10) When air cleaning, please set the appropriate air flow. Excessive airflow can cause damage to the membrane. The recommended flow rate of compressed air is:  $Q=2.5\sim 5\text{m}^3/\text{h}$ .
- 11) Please perform chemical cleaning under suitable conditions. Under different conditions, if the medicine is used incorrectly, the performance of the membrane module will decrease.
- 12) When the membrane module is used, the inlet water should be gradually increased in pressure, and the time for the pressure to be increased to a normal state should not be less than 10 ~30 seconds.
- 13) When the membrane module is used, the inlet water flow rate should be gradually increased, and the time for the flow rate to increase to a normal state should be no less than 10-30 seconds.
- 14) In order to prevent the growth of microorganisms, we recommend to put 10-100ppm of sodium hypochlorite in the membrane module after the system is shut down for 1-7 days; for 7-30 days, put 1% NaHSO<sub>3</sub> solution; for more than 30 days, 1% NaHSO<sub>3</sub> solution should be replaced regularly (Depending on the pH value of the protection solution).
- 15) It is strictly prohibited to use incompatible chemicals and lubricants, otherwise it will affect the service life of the membrane module.
- 16) It is strictly forbidden to run the membrane module overpressure at any time.
- 17) Please strictly abide by the technical parameters and operating conditions of the membrane module, otherwise the service life of the membrane module will be affected.