POLYMEX™

RO, NF & UF Membranes



UFC 160AL

User Manual

POLYMEX™

User Manual - Pressurized Hollow Fiber Ultrafiltration Membrane
Inside-out Membrane Module
MODEL - UFC 160AL

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Statement

Thank you for choosing ultrafiltration membrane product from POLYMEX , please read this manual carefully before use.

We hereby state that: the principles and data in this manual are proven correct and effective by our company. But we won't guarantee the ultimate performance of the product if it is used beyond our control, and we won't take responsibility for any problem caused by it. Users have responsibility to confirm the product applicability of special use.

POLYMEX reserves the right of final interpretation of this manual.

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Chapter 1 : Company Introduction

1.1 Company Introduction

POLYMEX is a national new & high-tech enterprise, specializing in the research & development of ultrafiltration technology and production & application of ultrafiltration products for more than 5 years. POLYMEX has a number of senior experts of membrane separation technology, experienced engineers, advanced production, research & development equipment and ultrafiltration membrane production technology with independent intellectual property rights.

POLYMEX main products are PVDF, PVC material pressurized ultrafiltration membrane modules and PVDF submerged MBR membrane modules. POLYMEX's ultrafiltration products are widely used in drinking water treatment, sewage treatment, gray water reuse, RO pretreatment, etc. Excellent performance of the products help customers develop wider engineering applications, such as purification of drinking water & feedwater, pretreatment of RO & NF to reduce SDI, treatment of oil field reinjection water, gray water reuse of electroplating, circuit board, tanning, paper making, glass grinding, mines, latex, printing & dyeing, etc., reuse of circulating wastewater, upgrade of domestic sewage & industrial wastewater, integrated treatment & reuse of domestic sewage of residential communities, clarification & filtration of wine & tea, etc. POLYMEX will continue to break into new areas and provide water resource solutions to more customers.

POLYMEX insists on quality first & diligent service, devoted in:

- Technical exchange and training of membrane product applications;
- One stop service, including model selection, equipment & frame drawing, electrical control instructions, chemical cleaning scheme and installation &debugging on site, etc.
- Formulate suitable schemes according to different wastewater conditions and customer requests to optimize economic benefit.

1.2 Quality Control

POLYMEX has advanced membrane production technology and precisely controlled automatic production equipment, every detail of membrane spinning & production process is strictly and precisely controlled to maximize product quality.

Chapter 2 : Ultrafiltration Technology Introduction

2.1 Ultrafiltration Technology Introduction

Ultrafiltration is a membrane separation technology to purify solutions, filtering pore size is 0.001-0.01 micron, MWCO is 1,000-300,000 Dalton. Ultrafiltration membrane allows solvents (such as water molecules, inorganic salts and small molecular organisms) to pass, and rejects suspended solids, colloids, proteins and microorganisms which are bigger than its pore size, so that the solutions are purified and separated.

Ultrafiltration membrane is widely used in water treatment projects, which is more and more important in RO pretreatment, drinking water purification, gray water reuse, etc. Besides, ultrafiltration technology also plays a pivotal role in bacteria & turbidity removal of wine and beverage, pyrogen removal of drugs, and concentration of food & medicine production.

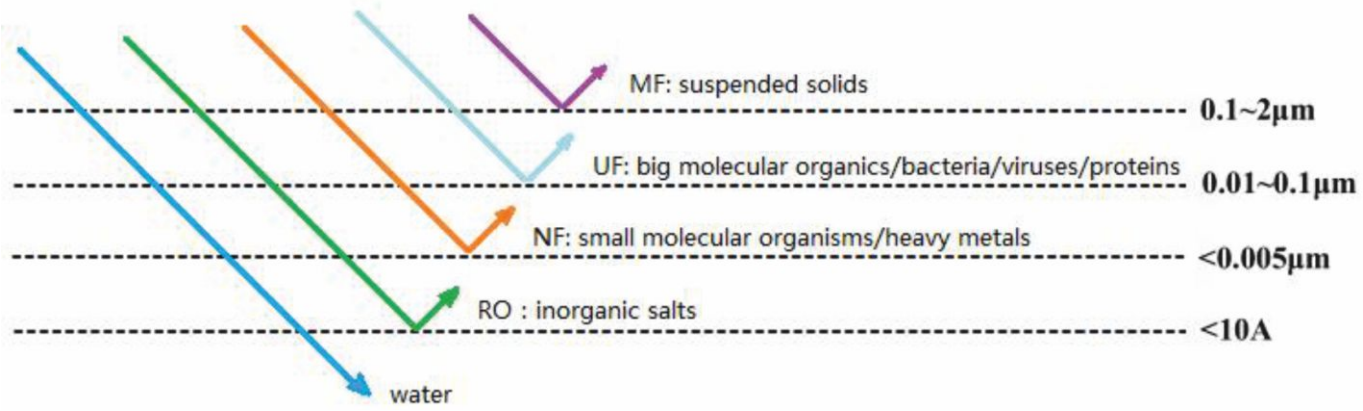


Figure 2-1 Membrane Separation Pore Size

2.2 Ultrafiltration Principle

Hollow fiber ultrafiltration takes pore sizes on the surface of hollow fiber membranes as filtering medium, pressure difference inside and outside membranes as driving force, filters substances with different physical diameters in liquid according to certain pore sizes, so that liquid is purified, separated, refined and concentrated.

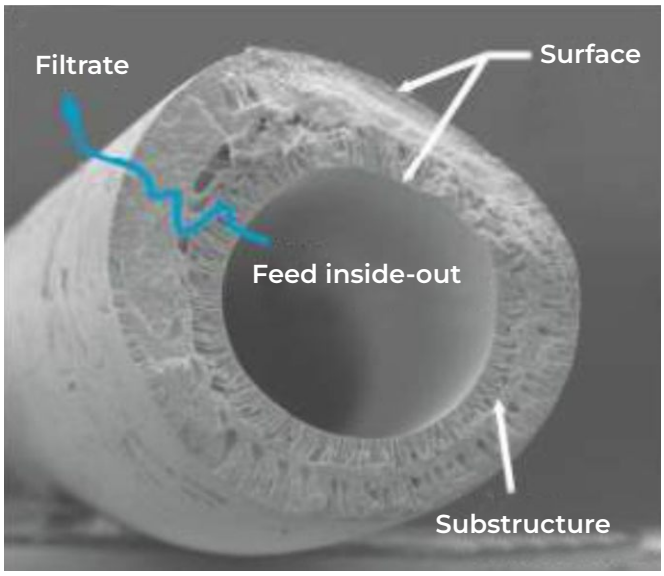


Figure 2-2 Inside-out Filtering Principle

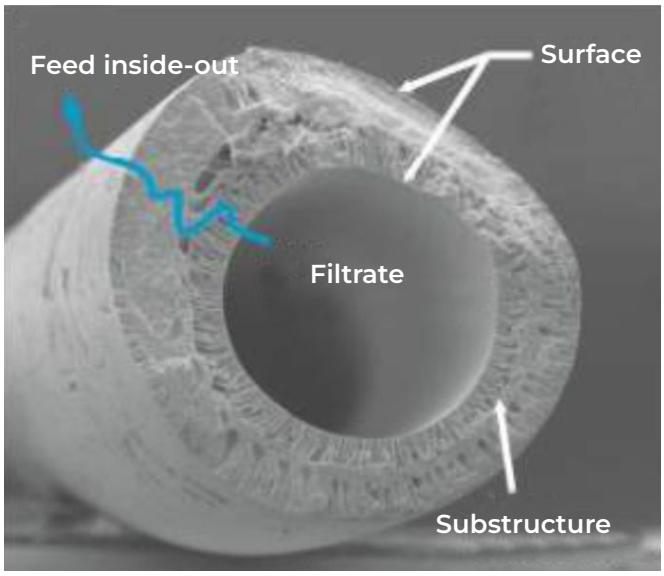


Figure 2-3 Outside-in Filtering Principle

2.3 Advantages of Ultrafiltration Technology

1) Ultrafiltration technology can be used for solution purification, separation and concentration, which is efficient, environmental and energy saving.

2) Ultrafiltration separation works under room temperature, which has low energy consumption, no phase change and has good promotion & application value in the areas of food processing, medical industry, biological technology, etc.

3) The scale and capacity of ultrafiltration ensure wide range of applications, it's easy to be combined with other separation units with compact equipment structure and realize automatic control. For example, UF+RO has become the optimal combination of membrane desalination.

4) Ultrafiltration membrane has good resistance to oxidation and acid & alkaline, which can be used to treat a wide range of raw waters.

5) Ultrafiltration membrane has smooth inner & outer walls, which has good pollution resistance, flux attenuation rate will be low if it's washed reasonably.

Chapter 3 Specifications and Performance of Ultrafiltration Membrane Module

3.1 Product Overview

UFc250B ultrafiltration membrane is high polymer material capillary hollow fiber membrane, which will not have any phase change. The modified PVC material has good permeable rate, mechanical strength, chemical resistance and anti-pollution capacity, MWCO is 100K Dalton. Filtering direction is inside-out, that is water permeates outwards the membrane from interior, and bacteria, colloids, suspended substances and microorganisms are kept inside.

3.2 Product Applications

- Production of mineral water and mountain spring water.
- Drinking treatment of tap water, surface water, well water and river water.
- RO pretreatment.
- Treatment, recycle and reuse of industrial wastewater.

3.3 Filtration Performance

This product is proven to have below filtering effects according to its operating conditions with various water sources:

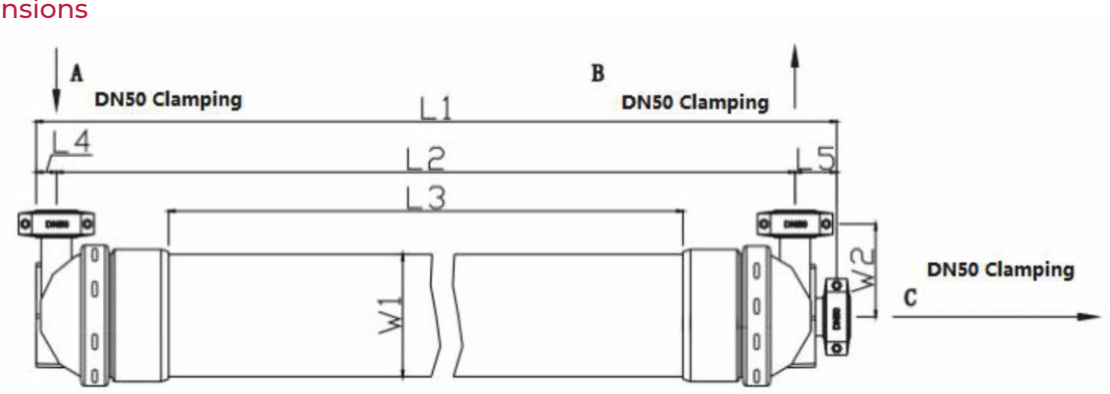
Component	Filtering Effect
Suspended substances, particles>1μm	Removal rate ≤ 99%
SDI	≤3
Turbidity	≤0.1NTU
TOC/COD	Removal rate: 0-30%
Bacteria, viruses	Removal rate > 4log
Attention: Bacterial & viruses removal rate is just an experimental datum, which cannot be the basis for sterile water production! When used for drinking water production or other conditions which have strict requirement for bacteria removal rate, ultrafiltrate still needs necessary sterilization!	

Table 3-1 Membrane Module Filtering Performance Parameters

Above data is obtained when feeding turbidity is < 15NTU.

3.4 Product Parameters

3.4.1 Product Dimensions



L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	W1 (mm)	W2 (mm)	A	B	C
1415	1595	1050	50	115	Φ160	173	Feed	Concentrate	Filtrate

3.4.2 Technical Parameters

Structure	Inside-out
Membrane Material	Modified PVC
Housing / Potting Material	UPVC / Epoxy Resins
MWCO	100K Dalton (0.01 micron)
Active Membrane Area	16m^2
Membrane ID/OD	1.0mm/1.8mm
Dimensions	Φ160mm ×1415mm
Connectors Size	DN50 Clamping

Table 3-2 Membrane Module Technical Parameters

3.4.3 Application Parameters

Designed Flux	35 – 100 L/m^2.hr (1.5Kg/cm^2, 25°C)
Operating Pressure	≤2.0Kg/cm^2
Backwashing Pressure	≤2.0Kg/cm^2
Max. Transmembrane Pressure	2.0Kg/cm^2
Operating Temperature	5-45°C
Operating PH Range	4-10
Washing PH Range	2-12
Operating Mode	Cross-flow or Dead-end

Table 3-3 Membrane Module Application Parameters

3.5 Feeding Water Requirements

A 50 micron bag filter should be set before feeding water to prevent blockage caused by large particles.

Turbidity	≤15NTU
Oil & Grease	≤2mg/L
Suspended Substances	≤20mg/L
Total Iron	≤1mg/L
Continuous Inlet Residual Chlorine	≤5ppm
COD	Suggested ≤ 500mg/L

Table 3-4 Membrane Module Feeding Water Parameters

Attention: Ultrafiltration membrane material is high polymer organic plastic, there must not be any organic solvents in raw water.

3.6 Membrane Module Design Guideline

Water Type	Requirement	Designed Flux	Backwashing Frequency	CEB	Recovery Rate
Surface Water	<15NTU	60-65L/m^2.hr	60-90min.	NaClO (50-100ppm) Every 3-7 days	<90%
Ground Water	<5NTU	70-75L/m^2.hr	60-90min.	NaClO (50-100ppm) Every 3-7 days	<95%
Tap Water	<3NTU	75-80L/m^2.hr	60-90min.	NaClO (50-100ppm) Every 1-2 weeks	<98%
Wastewater	<15NTU	40-45L/m^2.hr	30-45min.	NaClO (50-100ppm) Every day	<85%

Table 3-5 Membrane Module Design Guideline

Attention: Because of the complexity of operating conditions, above data is for reference only.

3.7 Washing Technical Parameters

Backwashing	Water Source	Ultrafiltrate or Pure Water
	Flux	100-150L/m^2.hr (twice or 3 times the designed flux)
	Frequency	20-60min. (depending on raw water quality)
	Duration	30-60s
	Pressure	≤2.0Kg/cm^2
Forward Washing	Water Source	Raw Water or Filtrate
	Flux	Raw Water Pump Flow
	Frequency	Before startup, before shutdown, after backwashing
	Duration	30-60s
	Pressure	≤2.0Kg/cm^2
CEB	Frequency & Chemicals	See Table 3-5 Membrane Module Design Guideline
	Chemical Injecting Duration	≥40s
	Soaking Duration	5-10min.
CIP	Frequency	Transmembrane pressure rises by 1 Kg/cm^2 (under same temperature), and cannot be recovered by backwashing, forward washing, gas washing and CEB
	Chemicals	Acid: 1-2% citric acid or 2000ppm HCl
		Alkaline: 1000ppm NaOH + 2000ppm NaClO
	Flow	1-1.5 times designed flux
	Circulating Duration	60-180min. (depending on blocking condition)
	Soaking Duration	60-180min. (depending on blocking condition)

Table 3-6 Washing Technical Parameters

Chapter 4 Design of Ultrafiltration System

4.1 Membrane Module Selection

1) Flux can be initially designed according to Table 3-5, then decide optimum flux by exact water source, water quality or pilot test.
2) What membrane area to select depends on project capacity, site limit, etc.

4.2 About Flux and Temperature

Viscosity of liquid will change with temperature, transmembrane resistance will also be different under different temperature, so flux changes a lot with temperature.

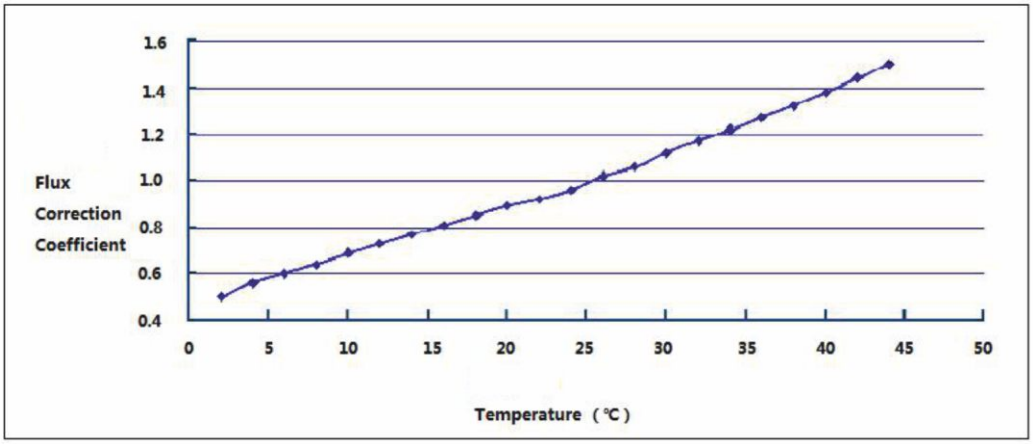


Figure 4-1 Temperature-flux Change Graph

Set correction coefficient as 1 on the basis of 25°C liquid temperature. Read the correction coefficient on the figure according to actual temperature when designing, and designed flux = standard flux under 25°C × correction coefficient.

4.3 Pretreatment – Pollution Prevention

4.3.1 Hardness

When water contains hardness contents such as Ca, Mg, etc. and is used as boiler water or cooling water, hardness contents will sediment on heat transfer surface or the inner side of pipeline. It can be softened by flocculation, sedimentation, filtration, chemical softening or ion exchange, etc.

1) Lime softening method reduce hardness by adding CaOH:

$Ca(HCO_3)_2+Ca(OH)_2 \rightarrow 2CaCO_3\downarrow+2H_2O$

$Mg(HCO_3)_2+Ca(OH)_2 \rightarrow CaCO_3\downarrow+Mg(OH)_2\cdot H_2O$

2) Non-carbonated hardness can be reduced by adding $NaCO_3$:

$CaCl_2+NaCO_3 \rightarrow 2Na_2CO_3+CaCO_3\downarrow$

4.3.2 Fe, Mn

Some ground water contains reduced Fe2+ and Mn2+, Fe2+ will turn to Fe3+ and become colloidal hydroxide after oxidation or when hydroxyl in the water is over 5mg/L.

$4Fe(HCO_3)_2+O_2+H_2O \rightarrow 4Fe(OH)_3+8CO_2$

Fe will cause pollution to membrane system more easily than Mn, when treating water with high Fe & Mn content, oxidize the water first, then filter it by filter to prevent pollution caused by Fe & Mn..

4.3.3 Colloids, Suspended Substances

Diameter of colloids is between 1nm and 1μm, which are usually negative charged, and will not polymerize because of electrostatic repulsion.

Flocculation means adding flocculating agent to neutralize the electric charges on the surface of colloid particles, weakening their repulsion, making it easier to gather. Flocculation works by below methods:

1) Attractive force & reactive force between colloids;
2)Contact & crash between particles;
3) Chemical action (produce metal hydroxide). Most common flocculating agents react with alkaline to form metal hydroxide, if excessive flocculating agents are added, hydroxide will separate out and cause pollution to membrane modules.

Apart from injection rate of flocculating agent, other conditions will also affect flocculation, such as PH value, stirring conditions and water temperature, etc. In actual design, these flocculating conditions must be predicted first.

4.3.4 Pressured Sand Filter

Pressured Sand filter can remove suspended substances and lower SDI value effectively. If particles cannot be effectively captured by flocculation and sand filter, flocculation-sedimentation& air flotation can be added. But adding auxiliary chemicals or flocculating agents may cause membrane pollution, so a small beaker experiment should be done to confirm if adding chemicals will cause pollution to membrane system.

Filtration rate is changeable according to different water qualities. Higher filtration rate can be selected for ground water, which contains less colloids and suspended substances; filtration rate cannot be too high for surface water or wastewater with bad quality, or it may cause pollution to membrane system.

4.3.5 Active Carbon

Active carbon filter uses the adsorption of active carbon porosity to remove organics, colloids and heavy metals, adsorption rate of free chlorine is over 98%, in the meantime effectively reduce water color and odor. Active carbon has been widely used as pretreatment of membrane systems.

4.3.6 Bag Filter

Bag filter of 50μm or below must be set before pretreated water enters into ultrafiltration system to prevent pollution from pipeline, pretreatment and medium water tank, and in the meantime remove suspended substances and turbidity. Please note that security filter may be the source of microorganism pollution, so security filter should be cleaned, sterilized and replaced regularly.

4.3.7 Biological Pollution Prevention

Microorganisms in feeding water will gather and grow, forming a biological membrane to block filtering channels and seriously affect membrane flux.

1) Chemical Sterilization

Chlorine sterilization has good effect and is easy to realize, confirmation of effect can be tested by residue or concentration of residual chlorine. But chlorine will react with some dissolved organic matters and form THM, which is harmful to human health, there are a lot of sanitizers now to replace chlorine. (The above mentioned chlorine is residual chlorine, which is free chlorine, valence +1, strong oxidizing property.)

ClO_2 Sterilization

ClO_2 is more and more widely used as sanitizer, it's formed by reaction on site and used directly because it cannot be stored due to its physical and chemical instability.

$2NaClO_3+H_2O_2+H_2SO_4 \rightarrow 2ClO_2+O_2+Na_2SO_4+2H_2O$

Generally the injection rate of ClO_2 is about 0.6-2mg/L, its sterilizing effect is 1/10-1/2 of chlorine.

Ozone Sterilization

O3 is a strong oxidant, which can kill vegetative forms of bacteria, spores, viruses and fungus, etc.

2) Ultraviolet Sterilization

Ultraviolet sterilization is different from chemical sterilization that it neither have chemical residues nor any outgrowth, sterilizing effect varies from different reacting objects. Sterilization works under the dosage of 1-21mj/cm^2 of UV253.7 (90% inactivation).

4.4 Ultrafiltration System Configuration

Ultrafiltration system consists of water supply system, backwashing system, CEB system (optional), air scouring system (optional), cleaning system, automatic control system and instruments.

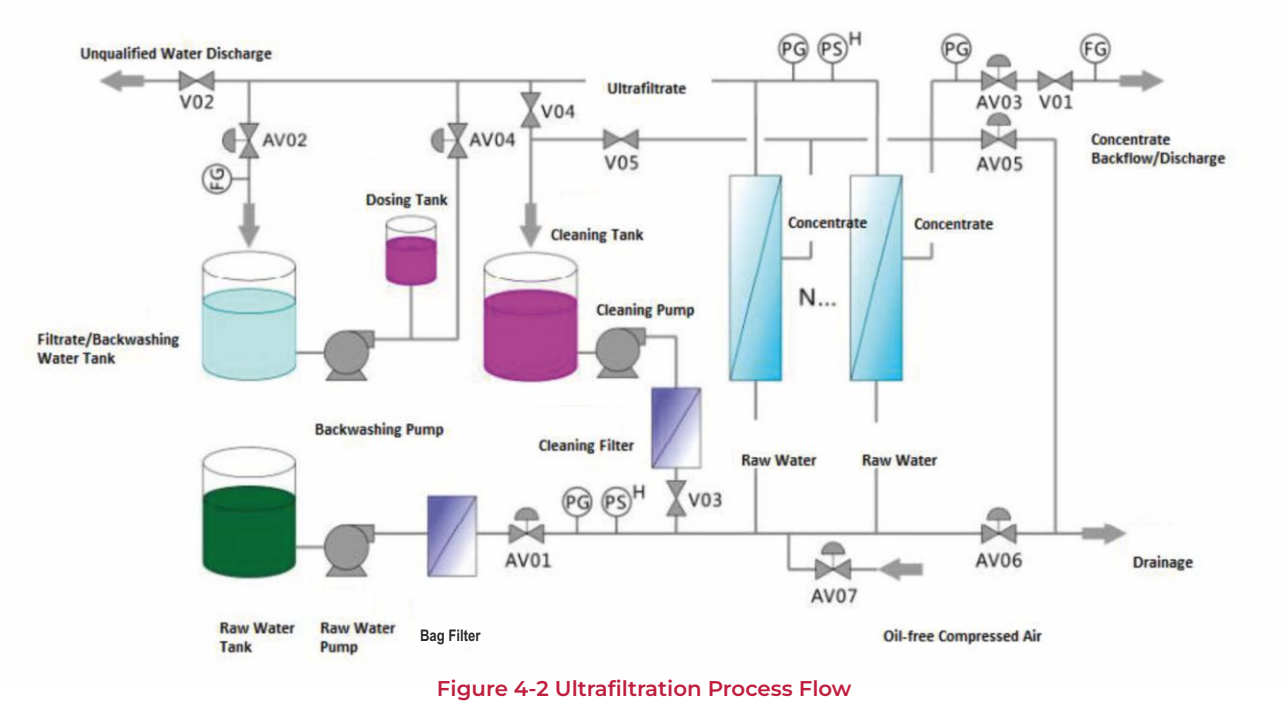


Figure 4-2 Ultrafiltration Process Flow

4.4.1 Water Supply System

Water supply system consists of prefilters and booster pump, prefilters selection see Section 4.3.

Booster Pump

Flow: Q = membrane system designed capacity ÷ recovery rate

Head: 25-30m (pressure drop should be considered and head should be raised properly when there are a number of prefilters)

MOC : Stainless Steel

4.4.2 Backwashing System

Backwashing system consists of backwashing water tank, backwashing pump and CEB dosing device.

1) Backwashing Water Tank

Ultrafiltration uses ultrafiltrate for backwashing, so there's no need to set a special backwashing water tank, just use the ultrafiltrate water tank as backwashing water tank. If a special backwashing water tank is needed, its volume must be sufficient for the backwashing flow of at least once.

2) Backwashing Pump

Flow: Q = number of membrane modules (N) × membrane area (S) × designed backwashing flux

Head : 20m

MOC : Stainless Steel

4.4.3 CEB Dosing Device

For raw water of bad quality, it is suggested that proper chemicals be added during backwashing to enhance backwashing effect. Acid or alkaline or both can be selected according to water quality conditions. When feeding water contains high valence metal colloids such as Fe, Al, etc. or suspended substances which cause inorganic pollution to membrane, acid wash can effectively remove inorganic impurities. And alkaline wash can effectively remove organic pollution.

Dosing device consists of dosing pump and dosing tank.

1) Dosing Pump (dosing pump flow depends on chemical concentration in backwashing water)

Flow: Q = backwashing flow (m^3/h) × 10-3 × use concentration ÷ chemical concentration (%)

Head : >40m

MOC : Stainless Steel

Example: If backwashing flow is $10m^3/h$, use concentration of NaClO is 100ppm, available chlorine concentration is 10%, then

Dosing Pump Flow Q = $10m^3/h \times 10\text{-}3 \times 100 \div 10\% = 10L/h$

2) Dosing Tank

Should be sufficient for chemicals of one day.

Set a low liquid level switch with the dosing tank, stop dosing pump when the switch alerts.

4.4.4 Chemical Cleaning System

Cleaning system includes cleaning solution tank, cleaning pump and cleaning filter.

1) Cleaning Solution Tank

Cleaning solution tank is used for cleaning solution preparation, its volume can be calculated as below: calculate the cleaning solution volume for one set according to volume and quantity of membrane module, plus volume for pipe washing and filter washing, plus some margin.

V = volume of membrane module V1 × quantity of membrane module N × 1.5 times

2) Cleaning Pump

Flow: Q = quantity of membrane module (N) × membrane area (S) × designed cleaning flux

Head: 15m

MOC : Stainless Steel

3) Cleaning Filter

Cleaning filter flow Q = cleaning pump flow, filtering precision ≤50μm, stainless steel material.

4.4.5 Control System

As ultrafiltration device needs frequent backwashing and forward washing, PLC control system is usually set.

4.4.6 Instruments

1) Flowmeter

Flowmeter should be set at ultrafiltrate & concentrate outlet to adjust recovery rate and observe flow change.

2) Pressure Gage

Pressure gage must be set at water inlet, ultrafiltrate outlet and concentrate outlet, it's better to choose 0-4 Kg / cm^2 or 0-6Kg / cm^2 range.

3) Pressure Controller

Pressure controller should be set at water inlet and backwashing water inlet to protect membrane modules from excessive pressure. Pressure control point should be set at 2.5 - 3.0 Kg/cm^2 for feeding water and 2.0Kg/cm^2 for backwashing.

4) Water Quality Monitoring Instrument

User can set turbidity meter and SDI tester at water inlet or ultrafiltrate outlet according to actual conditions to monitor if feeding water quality or ultrafiltrate quality reach the standards.

Remark: See Figure 4-2 for installation place of above instruments.

4.5 Ultrafiltration Working Status

4.5.1 Water Production

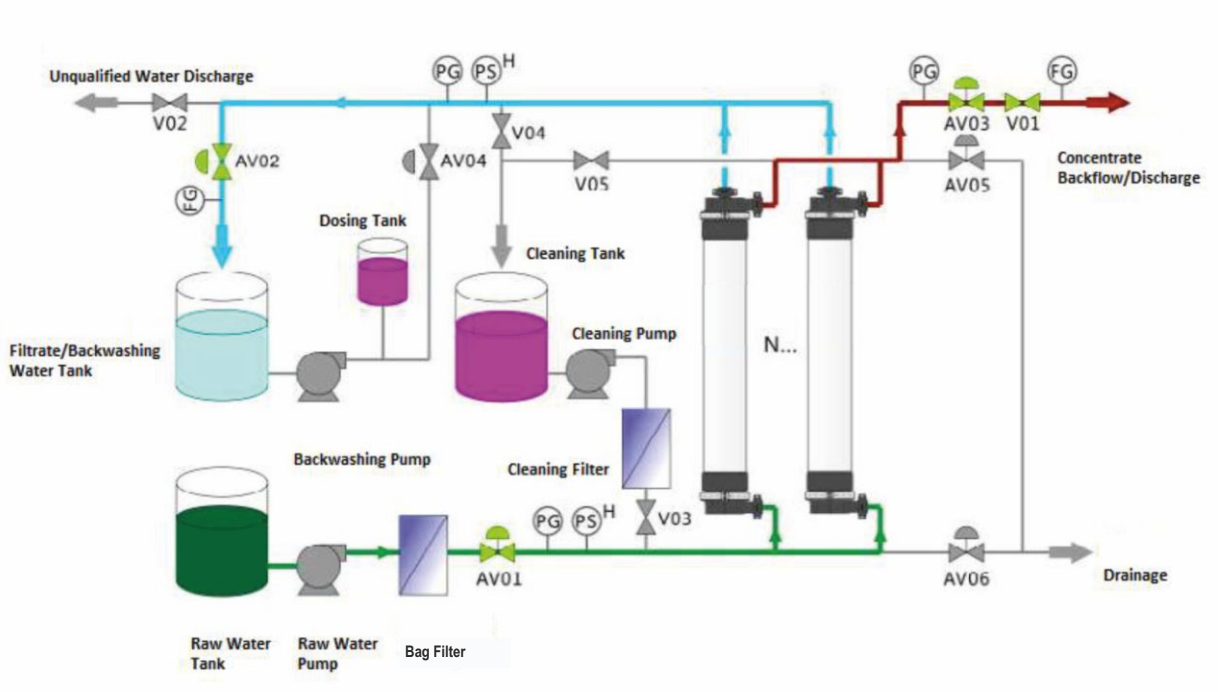


Figure 4-3 Water Production Status

Period of water production is generally set as 20-60min., first open feeding water automatic valve (AV01), water production valve (AV02), concentrate automatic valve (AV03) and concentrate regulating valve, then open raw water pump after 3-5s delay. In the mean time concentrate regulating valve can be adjusted to change system pressure, water capacity and recovery rate. After water production, close raw water pump first, then close automatic valves after 3-5s delay to prevent water hammer.

4.5.2 Forward Washing

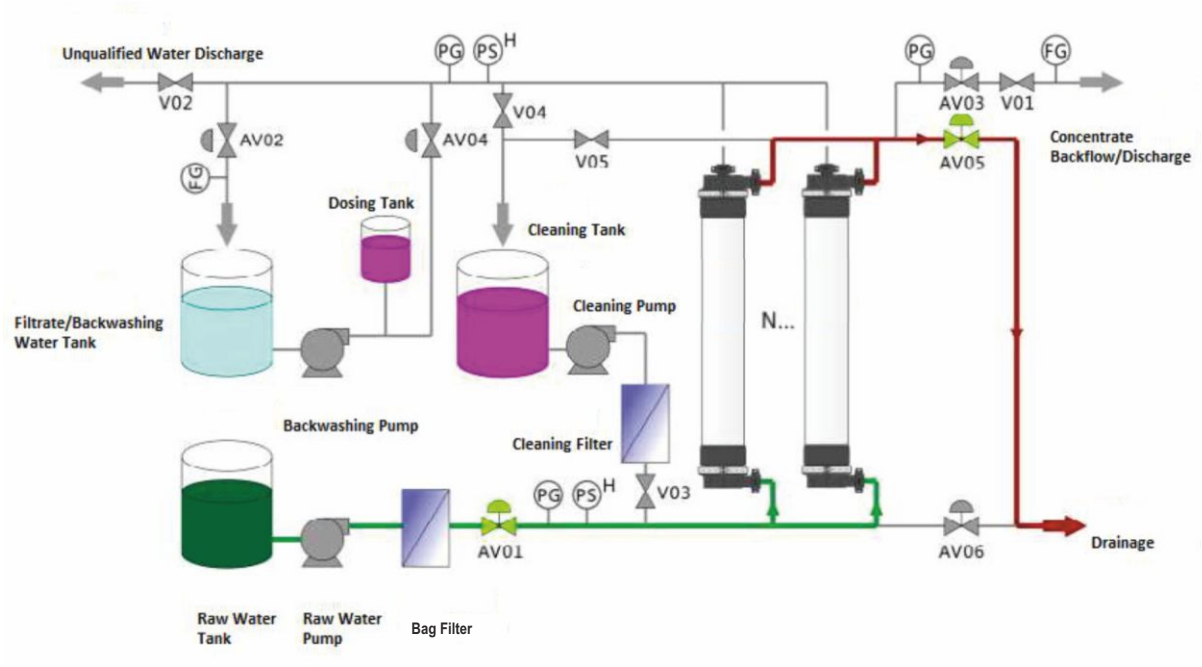


Figure 4-4 Forward Washing Status

Forward washing uses raw water or filtrate, which is transported from water inlet to concentrate outlet by raw water pump. Forward washing should be down every time before startup and shutdown of system and after backwashing, duration of which is usually 1min. When forward washing, first open feeding water automatic valve (AV01) and upward draining valve (AV05), then start raw water pump after 3-5s delay. After forward washing, close raw water pump first, then stop automatic valves after 3-5s delay to prevent water hammer.

4.5.3 Backwashing

Backwashing uses ultrafiltrate produced by ultrafiltration system or pure water, which is transported to concentrate outlet or water inlet by backwashing pump. It's called upward draining backwashing when it's transported to concentrate outlet and downward draining backwashing when it's transported to water inlet.

4.5.3.1 Upward Draining Backwashing

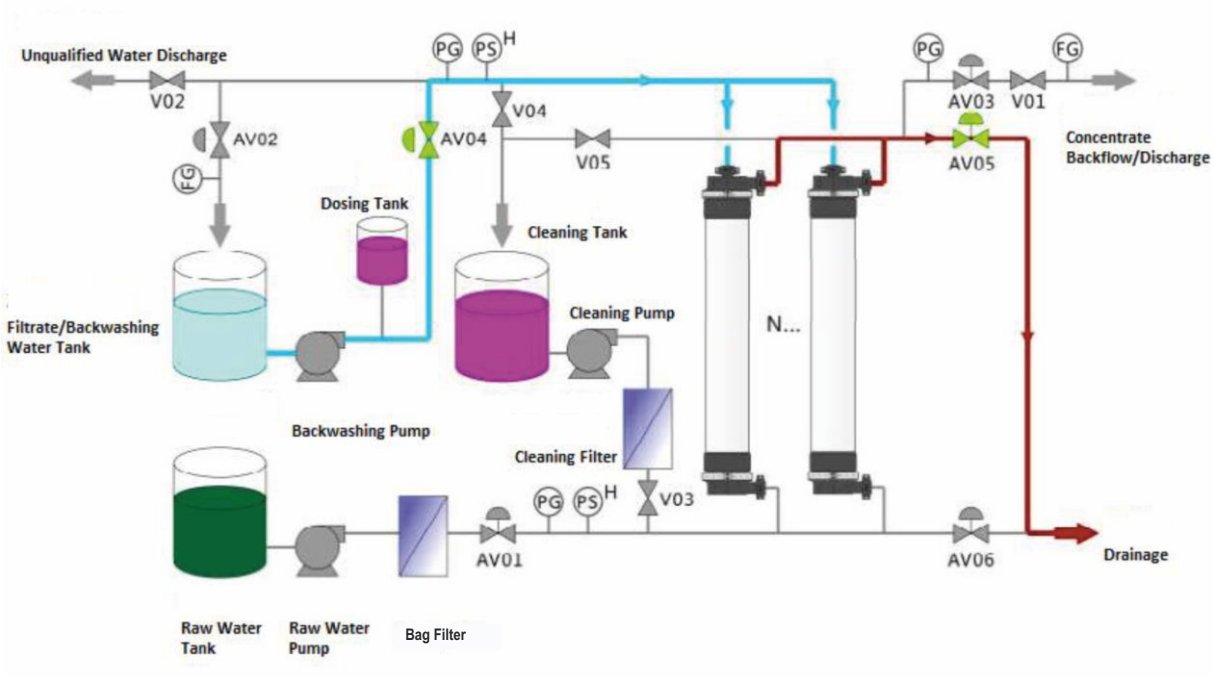


Figure 4-5 Upward Draining Backwashing Status

When upward draining backwashing, first open backwashing feeding water automatic valve (AV04) and upward draining valve (AV05), then start backwashing pump after 3-5s delay. After backwashing, stop backwashing pump first, then close automatic valves after 3-5s delay to prevent water hammer.

4.5.3.2 Downward Draining Backwashing

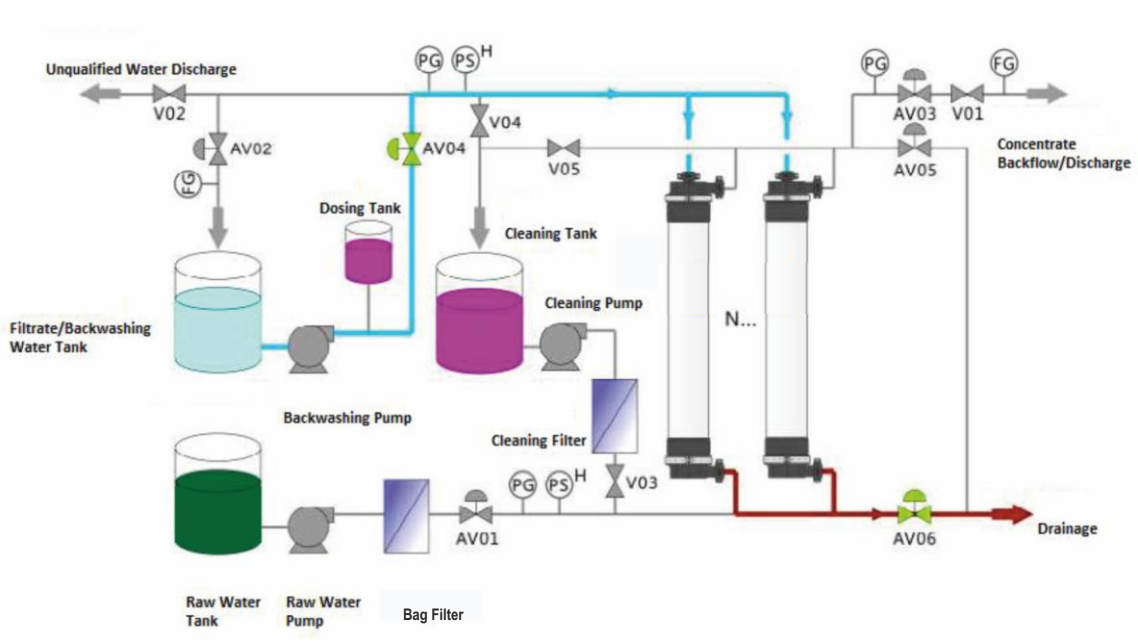


Figure 4-6 Downward Draining Backwashing Status

When downward draining backwashing, first open backwashing feeding water automatic valve (AV04) and downward draining valve (AV06), then start backwashing pump after 3-5s delay. After backwashing, stop backwashing pump first, then close automatic valves after 3-5s delay to prevent water hammer.

4.5.4 CEB

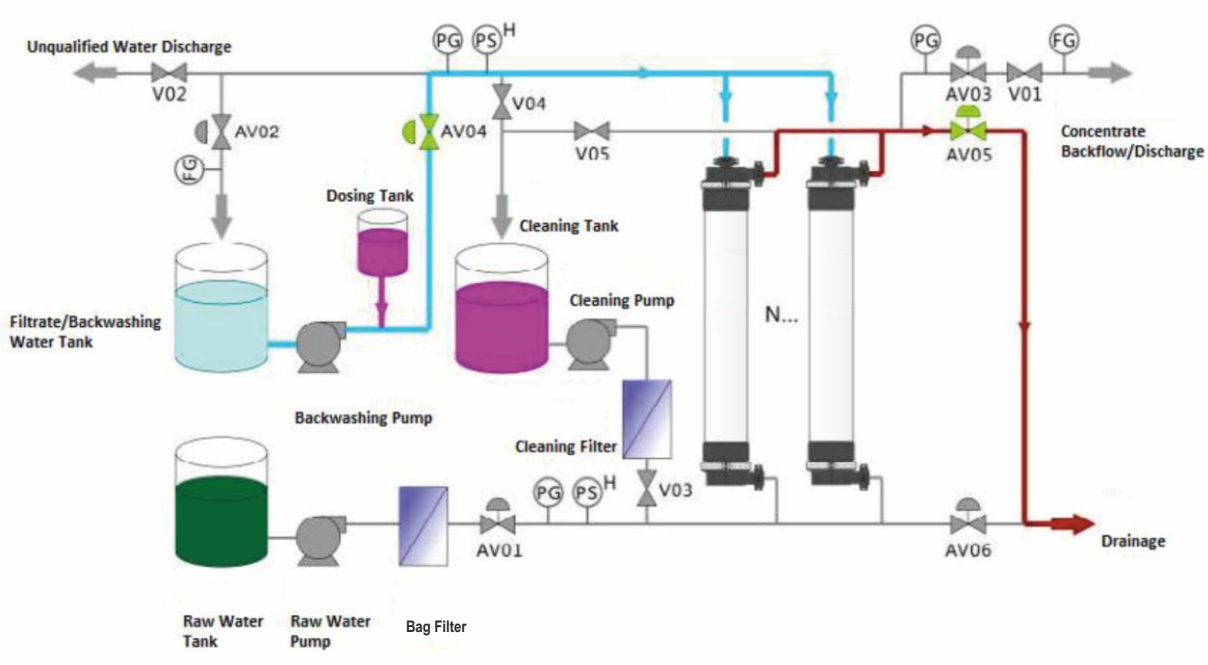


Figure 4-7 CEB Status

Add specific chemicals of certain concentrations when backwashing, clean the impurities on the surface of membrane by soaking. Chemicals & dosage please see Table 3-5 and Table 3-6.

CEB Steps:

a.Backwashing and forward washing must be done before CEB, duration of backwashing and forward washing is the same as normal operation.

b.Open backwashing feeding water valve (AV04) and upward draining valve (AV05), run the backwashing pump and dosing pump at the same time to dose, dosing duration ≥40s.

c. Close all valves to soak, soaking duration is 5-10min.

d. Upward draining backwashing (≥60s), downward draining backwashing (≥1m), forward washing (≥60s).

e. Use another chemical to soak or back to normal operation status.

4.5.5 Chemical Cleaning

Impurities in water will accumulate during long-time operation and affect membrane recovery performance, so chemical cleaning is needed regularly or irregularly to recovery membrane performance. Ultrafiltration system needs chemical cleaning when capacity of system drops by 10%-20% or transmembrane pressure rises by 0.8 - 1.0Kg/cm^2, and flux cannot be recovered by backwashing.

Use specific chemicals of certain concentrations to circulate and soak in membrane system to clean the impurities on membrane surface. Chemicals should be selected according to water quality type and membrane pollution property.

Chemical Selection

Alkaline Washing: Sodium Hypochlorite (2000ppm) + Sodium Hydroxide (1000ppm)

Applicable scope: when organic content of feeding water is high and may cause organic pollution, and living condition is good for biology, some bacteria and algae will grow in ultrafiltration membrane modules and cause biological pollution.

Acid washing: 1-2% citric acid solution or hydrochloric acid solution (2000ppm)

Applicable scope: When content of Fe, Mn, or other metal in feeding water exceeds design standards, or content of suspended substances is very high, which cause inorganic pollution to membrane water inlet.

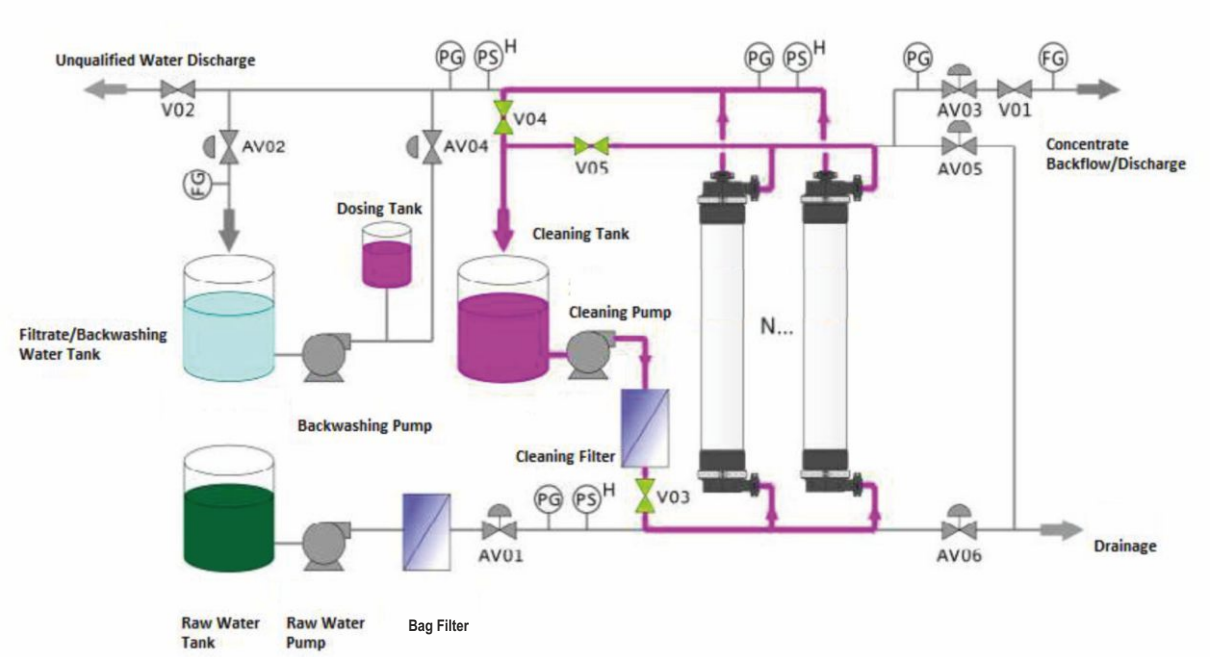


Figure 4-8 Chemical Cleaning Status

Cleaning Steps:

a. Shut down ultrafiltration system as per shutdown procedure, close all valves.

b. Prepare acid/alkaline solution in cleaning tank and stir well.

c. Open cleaning feeding water valve (V03) and cleaning backflow valve (V04, V05), then start cleaning pump. Let cleaning solution enter into membrane modules and flow back to cleaning tank. Circular cleaning duration is 60-120min.

d. Shut cleaning pump, stand and soak for over 60min (depending on pollution conditions).

e. Circular wash again for 10-20min.

f. Alternate backwashing and forward washing until PH of drainage is neutral.

g. Use another chemical to clean or back to normal operation status.

4.6 Sequence Design

As feeding water quality differs, specific operation, washing parameters and sequence are based on actual flux and pressure change. General principle is, when water quality is bad, increase the frequency of backwashing, CEB, air wash and chemical cleaning.

Chapter 5 Operation

5.1 Overview

Basic Steps:
a. Examination before startup
b. Wash membrane modules
c. Adjust capacity of water inlet, water production and concentration, adjust feeding water pressure.
d. Adjust backwashing pressure
e. Adjust air inlet pressure
f. Adjust sequence time interval
g. System automatic operation

5.2 Examination before Startup

Check examination contents before startup
Check every examination content in Annexed List 1.

5.3 Wash Membrane Modules

Wash out the protective solution inside the membrane modules before startup of ultrafiltration system.
Steps:
a. Open feeding water valve (AV01), upward draining valve (AV05) and unqualified water discharge valve (V02).
b. Start water supply pump, adjust the water supply flow and make feeding water pressure ≤1.5 Kg/cm^2.
c. Wash for over 30min until there's on foam of drainage.

5.4 Adjustment of Flow/Pressure

5.4.1 Adjustment of Feeding Water Flow, Concentrate Flow, Water Production Flow and Feeding Water Pressure

a. Open feeding water valve (AV01), water production valve (AV02), concentrate valve (AV03) and fully open concentrate draining valve (V01).
b. Start water supply pump.
c. Adjust the water supply capacity of pump and opening of concentrate draining valve to reach expected water production capacity and concentrate drainage. Under the condition that water production capacity is met, the lower feeding water pressure the better, ideal operating pressure is under 1.5 Kg/cm^2

5.4.2 Adjustment of Backwashing Pressure

a. Open backwashing feeding water valve (AV04) and upward draining valve (AV05).
b. Start backwashing pump.
c. Adjust water supply capacity of backwashing pump and make backwashing pressure under 2Kg/cm^2.

5.4.3 Adjustment of Air Washing Pressure

a. Open upward draining valve (AV05).
b. Open air inlet valve (AV07).
c. Slowly adjust air inlet regulating valve to proper air input, air inlet pressure ≤ 1Kg/cm^2

5.4.4 Adjustment of Sequence Time Interval

Set status sequence and operating time interval according to Table 3-5 and Table 3-6.

5.4.5 Automatic Control

When pressure and flow of system are set manually, shut down the system and restart it as automatic mode. First turn off all switches, change manual switch to automatic, and then start the system and let it operate automatically.

Notes
a. Open water production valve before feeding water valve when testing water.
b. Install pressure control switch on feeding water pipe, set control point to 2.5Kg/cm^2
c. Install pressure control switch on backwashing pipe, set control point to 2.5Kg/cm^2
d. Control the air pressure under 1Kg/cm^2 if membrane needs air washing, excessive air washing pressure will cause membrane breakage.
e. When membrane system first put into operation, initial capacity should be set to 50% of designed capacity. Increase to designed capacity after 24 hours, it's good for stable flux.

Chapter 6 Installation, Storage and Maintenance

6.1 Installation and Storage

6.1.1 Installation

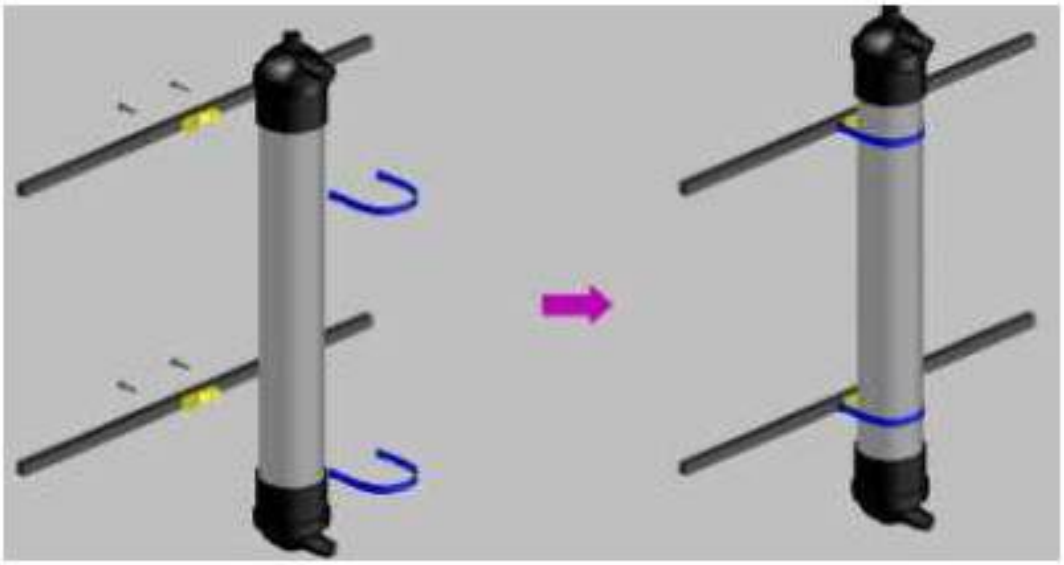


Figure 6-1 Banding Installation

When banding install, fix the rubber cushion block on the rack, then use band and screws to fix the membrane module on the rack. Don't use membrane module as supporting stuff, don't hit membrane housing and end caps with tools, don't expose membrane modules to sunlight.

Item#	Punching Size	Punching Center Space	Membrane Module Center Space
UFC 160AL	Φ8mm	260mm	≥370mm

Table 6-1 Membrane Module Installation Parameters

Item#	Connector		Fixing Components		Screw	
	Specifications	QTY	Name	QTY	Specifications	QTY
UFC 160AL	DN50	3 sets	Band / Rubber Cushion Block	2 sets	M8×90 inner hexangular set screw	4pcs

Table 6-2 Membrane Module Component Parameters

6.1.2 Storage

1) Membrane modules, which are not used temporarily, should be filled with protective solution and sealed, and stacked on flat and clean floor indoor without corrosive and pollutant around, and kept away from cold/heat source and sunlight. Storing temperature should be 5-40°C.

2) Protective solution formula: 1% sodium hydrogen sulfite solution, which should be renewed every 6 months. 10-30% glycerine should be added whnder low temperature to prevent freezing.

Note: Power must be off during long time shutdown. Besides, ultrafiltration membrane should kept wet at anytime, once it's dehydrated and dried, it will be irreversible damage to membrane modules.

6.2 Maintenance

6.2.1 Operation Data Recording

Data recording is necessary during operation to follow operating conditions and search for reason when system break down. See Annexed List 2 for recording sample.

Below parameters are suggested to be recorded every 2 hours:

- Inlet/outlet pressure of security filter
- Water inlet pressure, temperature and PH of membrane system
- Concentrate pressure and concentrate drainage of membrane system
- Water production pressure and capacity of membrane system
- Alarm record

Below parameters are suggested to be recorded once a week:

- Turbidity of water inlet (NTU)
- Turbidity of water production (NTU)
- SDI value of water production

6.2.2 Shutdown Maintenance

1) If system is shut down for a short time (less than 1 week), operate it 30-60min every day to prevent bacteria growth.
2) If system is shut down for a long time (more than 7 days), clean the membrane modules thoroughly, and inject protective solution. Protective solution should be renewed every 3 months. See 6.1.2 Storage for protective solution formula.
3) When system is put into operation again after a long time shutdown, protective solution should be washed out until there's no foam of drainage.

Note: Power must be off during long time shutdown. Besides, ultrafiltration membrane should kept wet at anytime, once it's dehydrated and dried, it will be irreversible damage to membrane modules.

6.3 Leakage Checkce

Leakage check should be done when quality of UF filtrate turns bad after a period of operation, find out & repair the leakage point or replace the membrane module which is seriously leaking.



Figure 6-2 Leaking Point Check

Open the end cap and connect the ultrafiltrate outlet with 1Kg/cm^2 compressed air, in the meantime flush on the end surface of membrane module. Where there are bubbles coming out continuously and rapidly, there is leakage point (See Figure 6-2).

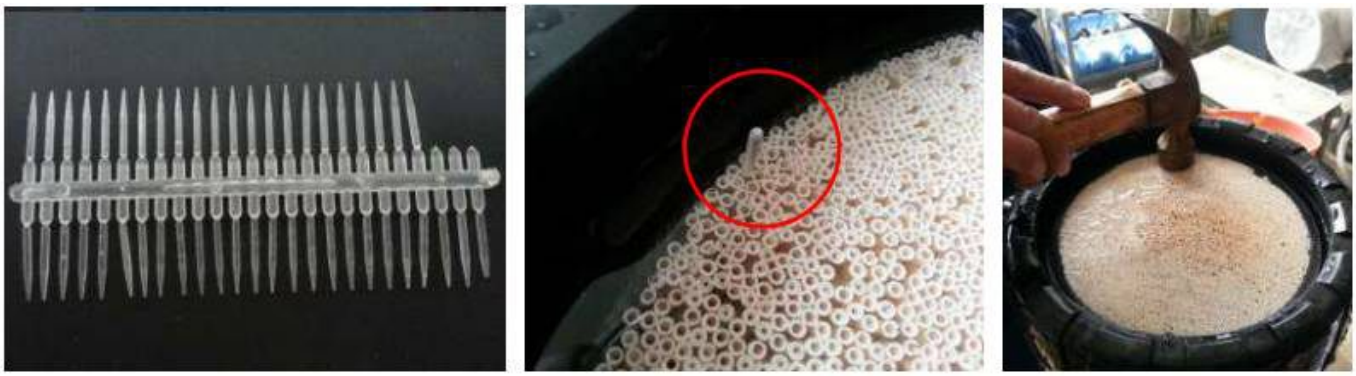


Figure 6-2 Leaking Point Check

Plug up the leaking point with specific plastic nail.

6.4 Calibration of Instrument/Equipment

6.4.1 Pressure Gage : Calibrate on time and adjust timely when necessary.
6.4.2 Booster Pump : Check pump temperature and sealing regularly.
6.4.3 Flowmeter: Calibrate every 3 months.
6.4.4 Automatic Valve : Check once a month about valve leakage.

6.5 Troubleshooting

Failure	Reason	Solutions
Excessive transmembrane pressure	Membrane Module Pollution	Find out pollution reason, take proper cleaning method.
	Excessive water production flow	Adjust flow according to operation instructions
	Temperature of water inlet is too low	Raise temperature of water inlet.
Low water production flow	Membrane Module Pollution	Find out pollution reason, take proper cleaning method.
	Valve opening is not correctly set	Check and make sure all valves, which should be opened, are opened, and adjust valve opening.
	Flowmeter breakdown	Check and replace Flowmeter.
	Filter blockage or water supply pump breakdown, causing low water supply pressure	Replace filter cartridge or filter bag, repair water supply pump.
	Temperature of water inlet is too low	Raise temperature of water inlet.
Bad water production quality	Feeding water quality does not reach standards	Check feeding water quality, mainly turbidity and suspended solids.
	Membrane leakage	Find out leaking reason, repair or replace membrane module.
System cannot work under automatic mode	Water supply pump does not work	Rule out the possibility of wiring mistake, restart the pump on manual mode and turn to automatic control when it works normally.
	High feeding water pressure	Check water supply pump; pressure switch setting problem.
	High water production backpressure	Water production outlet valve is not opened; follow-up system is not started in time; pressure switch setting problem.
	Programming error of PLC	Check program.

Table 6-3 Common Troubleshooting List

Annexed List 1 – Checklist before Debugging

No.	Content	Standards	Verification	Remark
1	Whether water inlet meets requirements	Make sure water inlet meets requirement before entering into UF (turbidity≤15NTU).		
2	Whether below are prepared: Debugging chemicals (oxidant), debugging tools (beaker, measuring cylinder, stopwatch, common ironware and electric tools), analytical instruments (PH meter, SDI tester, etc.).	Testing chemicals are prepared and meet design requirements, debugging tools and analytical instruments are prepared.		
3	Whether water, electricity, gas system for debugging use has continuous supply capacity, whether drainage ditch is qualified for drainage.	Water, electricity, gas system have continuous supply capacity. Drainage ditch is qualified for drainage and drains smoothly, meeting design requirements.		
4	Whether ultrafiltration related water tanks are cleaned up and measured sectional area (raw water tank, water production tank, backwashing water tank).	Water tanks are cleaned up without debris; sectional area of each water tank is measured and correct.		
5	Whether all pipes are connected according to design drawing, whether piping rack is installed stably.	Meet requirements of design drawing, piping rack is installed stably.		
6	Whether quantities of pressure gage, liquid level switch, Flowmeter, SDI tester, thermometer, etc. on pipes and device are compliance with design.	Compliance with design drawing.		
7	Whether connection of MCC cabinet, PLC cabinet and local control cabinet are checked and calibrated and powered on.	Compliance with design drawing, instruments display normally.		
8	Whether air supply pipeline of instrument control cabinet is purged clean.	Put a clean napkin 5cm from purging outlet and no dirt on its surface.		
9	Whether gas wash pipeline is purged.	Gas wash pipeline is purged and no debris.		
10	Whether all electrical machineries are test run (raw water pump, backwashing pump).	No noise of test run, electricity and temperature rise are normal.		
11	Whether pipes of dosing device are connected as per design requirements and rack is installed stably.	Compliance with design drawing, rack is installed stably.		
12	Whether dosing tank is purged and no debris; whether dosing pump is calibrated and normal.	Dosing pump works well and meets design requirements, there's no leakage of dosing pipeline.		
13	Whether all pneumatic valves can be turned on/off normally, whether on-off speed is adjusted.	Pneumatic valves can be turned on/off normally, on/off speed meets technical requirements.		
14	Whether process pipes are pressure tested and no leakage.	Compliance with design requirements, no leakage of pipes.		
Check Person		Date		

Note: Tick (v) when normal and cross (×) when abnormal, mark reason and settle the problem or report to company.

Table 6-3 Common Troubleshooting List

Annexed List 2 – Ultrafiltration System Operation Records

Item Date/Time	Inlet pressure of bag filter	Outlet pressure of bag filter	Feeding water pressure	Concentrate pressure	Water production pressure	Feeding water PH	Feeding water temperature	Feeding water flow	Concentrate flow	Water production flow	Water production SDI	Water production NTU	Alarm record	Remark
	Unit: Kg/cm^2	Unit: Kg/cm^2	Unit: Kg/cm^2	Unit: Kg/cm^2	Unit: Kg/cm^2		°C	m^3/h	m^3/h	m^3/h				