OLTRE$_{CAP}$ P- SERIES

INSIDE – OUT

ULTRAFILTRATION MEMBRANES

CONTENTS

1. Company Profile

OLTREMARE is an Italian Company founded in 1989 as a chemical manufacturer and distributor for Reverse Osmosis membranes through its technical-oriented organization. Being involved since its first day in the reverse osmosis water treatment field, the company acquired major interest in being engaged in membrane research and development up to the point to start the production of spiral - wound Reverse Osmosis membranes.

Since 1999, all the efforts and the resources of the company are devoted to improve the manufacturing of a complete range of spiral-wound Reverse Osmosis membranes up to 8".

Today **OLTREMARE** has a complete line of products in all the filtration ranges from ultrafiltration to reverse osmosis.

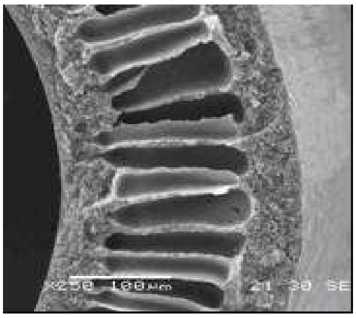
OLTREMARE elements are used in many different applications such as potable water, boiler feed-water, industrial process water, waste treatment reclamation, seawater desalination, electronic rinse water, agriculture and pharmaceutical.

2. Description of OLTRE$_{CAP}$ P ultrafiltration module

OLTRE$_{CAP}$ P series ultrafiltration (UF) is a pressurized UF introduced by Oltremare. OLTRE$_{CAP}$ P series membrane is an "Inside-out" hollow-fiber membrane that has a MWCO at 45,000 Dalton. OLTRE$_{CAP}$ P membrane offers superior properties on steady flux (steady production of filtered water), permeate quality, and membrane longer life time.

2.1 Features of OLTRE$_{CAP}$ P series inside-out UF module

OLTRE$_{CAP}$ P membrane modules are created with advanced membrane formation technologies and unique module structures that provide superior filtration efficiency and durability. The features are as follows.



SEM cross-section photograph

- **Permanent hydrophilicity (for steady flux)**

The hydrophilicity for all kinds of UF membranes is very important for the anti-fouling and stable flux properties. The OLTRE$_{CAP}$ P series membrane capillaries made with modified polysulfone, are intensively treated both chemically and thermally after the formation of the membrane yielding permanent hydrophilicity properties. Resulted from this permanent hydrophilicity, OLTRE$_{CAP}$ P membranes offer higher anti-fouling properties against organic pollutants, higher and stable operating flux.

- **Better permeate distribution for steady flux (patented technology)**

A large number of membrane capillaries are evenly distributed inside a pressure vessel by a so-called sub-grouping technology so that each membrane capillary works in very similar environments.

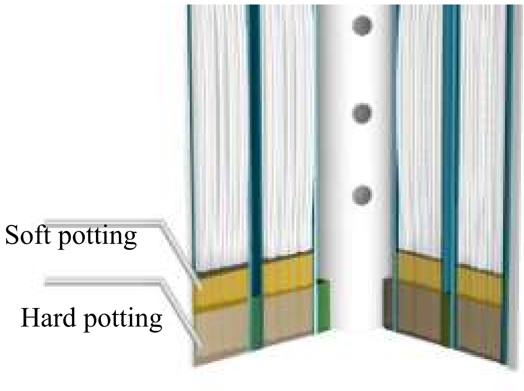
End-view of UF module

✧ **Larger capillary diameters (for steady flux)**

It is widely accepted that the larger the inner diameter of UF membrane capillaries are the better anti-fouling properties they have for the UF module. $OLTRE_{CAP}$ P UF membrane capillaries are made of relatively large inner diameters.

✧ **Soft potting (patented technology)**

The "roots" of the capillaries (hollow fibers) are the weakest portions in membrane modules, and may be broken during operation.
These portions of membranes in $OLTRE_{CAP}$ P UF modules are protected by a layer of soft potting material.



✧ **Lower molecular weight cut off**

$OLTRE_{CAP}$ P membrane offers very fine filtration at a MWCO at 45,000 Dalton, which is the very high end of UF filtration grade in water treatment.

2.2 Type and specifications of OLTRE$_{CAP}$ P series inside-out UF module

2.2.1 Membrane specification

Table 1: Membrane parameters of OLTRE$_{CAP}$ P series module

Module	Membrane area /m^2 (ft^2)	ID/OD / mm (inch)	Length / m (inch)	MWCO (Dalton)	Material
OLTRE$_{CAP}$-1030-P-B	23 (247.5)	1.0/1.5 (0.039/0.059″)	0.75(29.6)	45,000	mPS
OLTRE$_{CAP}$ -1060-P-B	50 (538.1)	1.0/1.5 (0.039/0.059″)	1.5(59.1)	45,000	mPS
OLTRE$_{CAP}$-1080-P-B	68 (731.9)	1.0/1.5 (0.039/0.059″)	2.0(78.7)	45,000	mPS

Note: Please customize in advance if you need other types of module.

Table 2: Performance of OLTRE$_{CAP}$ P series module

Performance	Index/value
SDI_{15}	<2
Permeate turbidity①	<0.1NTU
Removal of more than 0.2μm diameter particles	99.9999%
Removal of total coli forms	Not detected②
Removal of fecal coli forms	Not detected②
Removal of bacteria	Not detected③

Note：①Measured online ②Detected with 100ml UF permeate ③Detected with 1ml UF permeate.

2.2.2 Module specification

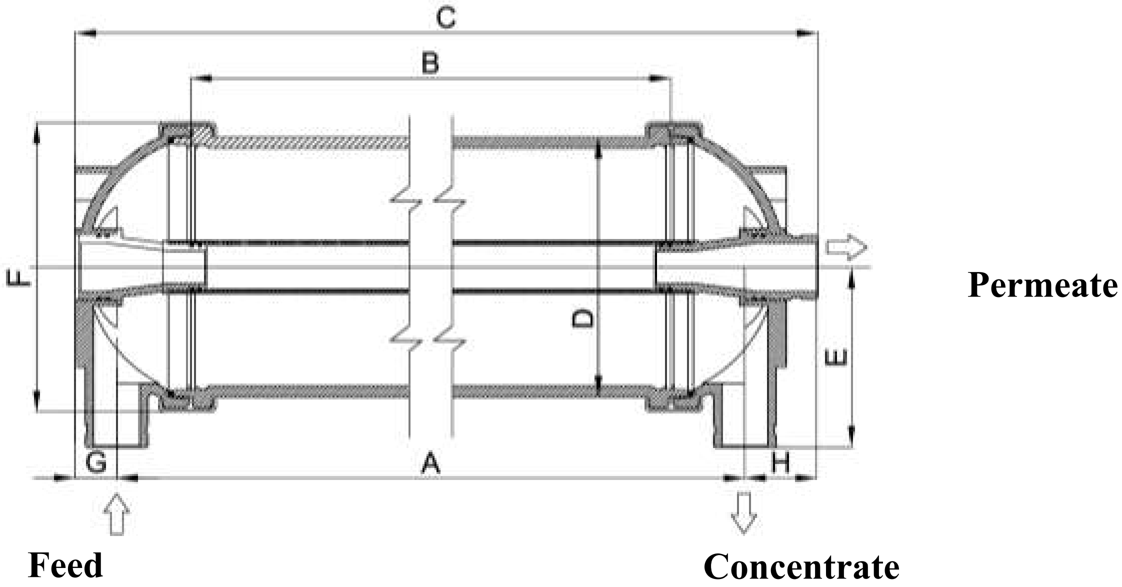


Table 3: Dimensions of OLTRE$_{CAP}$ P series module

	A	B	C	D	E	F	G	H
OLTRE$_{CAP}$ -1030-P **-B**	850mm (33.5″)	750mm (29.6″)	965mm (38.0″)	Φ250mm (Φ9.8″)	172mm (6.8″)	Φ277mm (Φ10.9″)	40mm (1.6″)	75mm (3.0″)
OLTRE$_{CAP}$ -1060-P **-B**	1600mm (63.0″)	1500mm (59.1″)	1715mm (67.5″)	Φ250mm (Φ9.8″)	172mm (6.8″)	Φ277mm (Φ10.9″)	40mm (1.6″)	75mm (3.0″)
OLTRE$_{CAP}$ -1080-P **-B**	2100mm (82.7″)	2000mm (78.7″)	2215mm (87.2″)	Φ250mm (Φ9.8″)	172mm (6.8″)	Φ277mm (Φ10.9″)	40mm (1.6″)	75mm (3.0″)

Table4: Housing material and OLTRE$_{CAP}$ P module connections

Module	OLTRE$_{CAP}$ -1030-P **-B**	OLTRE$_{CAP}$ -1060-P **-B**	OLTRE$_{CAP}$ -1080-P **-B**
Housing material	PVC/ABS		
potting material	Exposy		
Feed connections	VICTAULIC 2″		
Product connections	VICTAULIC 2″		
Concentrate connections	VICTAULIC 2″		

2.2.3 Application and typical process conditions

Table5: Application data and typical process conditions

Module	OLTRE$_{CAP}$ -1030-P **-B**	OLTRE$_{CAP}$ -1060-P **-B**	OLTRE$_{CAP}$ -1080-P **-B**
Operating temperature	45℃ (113℉)		
Operating pH range	1~13		
Operation mode	Dead-end or cross-flow		
Typical filtrate flux	60~120 L/m^2·h 35 ~70 GFD)		
Backwash flux	180~240 L/m^2·h (106 ~ 141 GFD)		
Maximum applied feed pressure	0.5 MPa (73 psi)		
Maximum TMP①	0.2 MPa (30 psi)		
Maximum backwash pressure	0.2 MPa (30 psi)		
Backwash frequency	15~60 minutes		
Backwash duration	30~120 seconds		
CEB frequency	0~24 times per day		
CEB duration	1~10 minutes		
CEB chemicals	NaClO(10 ~ 30ppm)，NaOH（pH：11 ~ 12），HCl（pH：2 ~ 3）		
CIP frequency	30-180 day		
CIP duration	60-180 min		
Cleaning chemicals	NaClO or H_2O_2, NaOH, HCl, citric acid or oxalic acid		
CIP flux	2.5 ~ 4 m^3/h		

Note: ①TMP is abbreviated formula of "trans-membrane pressure"
②CEB=chemical enhanced backwash
③CIP=cleaning in place

3. OLTRE$_{CAP}$ P ultrafiltration system design

This manual provides you information about our ultra filtration system design guideline. You can design the ultrafiltration system according to the water resource, customers' requirements and your experience. If you need help, please contact Oltremare personnel.

3.1 Inside-out ultrafiltration system design guideline

Table 6: OLTRE$_{CAP}$ P **system design guideline**

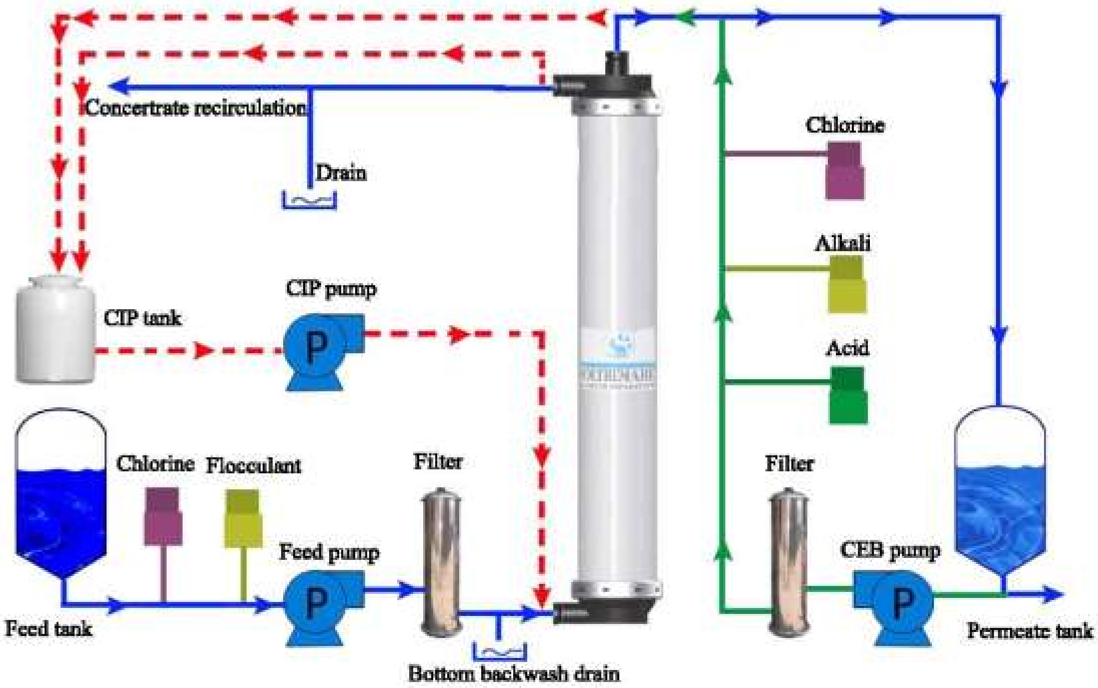
Parameter	Ground water	City water		Surface water		Treated industrial wastewater	Treated municipal wastewater	Sea water	
	NTU<5	NTU<3		NTU<25	NTU<5	NTU<5	NTU<20	NTU<50	NTU<5
Pretreatment	Optional	No	Yes	No	Yes	Yes	Yes	No	Yes
Filtrate flux	80-100	70-90	80-100	60-80	70-90	60-80	60-80	60-70	70-90
Particle size	<150								
Backwash frequency	30-60	30-45	30-60	20-40	25-50	20-50	20-50	20-45	30-50
Operation mode	Dead-end	Dead-end	Dead-end	Dead-end or Cross-flow	Dead-end	Dead-end or Cross-flow	Dead-end or Cross-flow	Cross-flow	Dead-end or Cross-flow
CEB frequency	1-4	2-6	1-4	2-8	2-6	3-12	3-12	2-8	2-6
CIP duration	60-90	30-60	45-90	20-60	45-90	20-90	20-90	20-60	30-90

Note: This guideline only provides the reference value.

3.2 OLTRE$_{CAP}$ P inside-out ultrafiltration system design

3.2.1 Components of UF system

Besides the ultrafiltration system, you should choose the pretreatment, dosing system of operational mode backwashing, dosing system of backwash, CIP and so on, based on your water resource.



Components of the UF system

1. Pre-filter

Pre-filter is always a key factor that determines the UF system to be successful or not. In order to prevent the UF membrane from being scratched, a screen of 100μm~150μm is required.

2. Dosing system of operational mode

You can dose the disinfectant and flocculent into the water flow before it flows into UF membrane based on feed-in water quality. Commonly, the flocculent will benefit the formation of a layer of contaminant on the membrane surface and prevent the surface and pore of the membrane from being polluted. The contaminants are easy to be removed. The quantities of disinfectant and flocculant are determined by the raw water quality, such as the turbidity, pH and so on. The disinfectant can prevent the membrane from being contaminated by microbe and organic substance. At the same time, the residue of disinfectant can inhibit from contaminating the pipeline and tank.

3. Backwash system

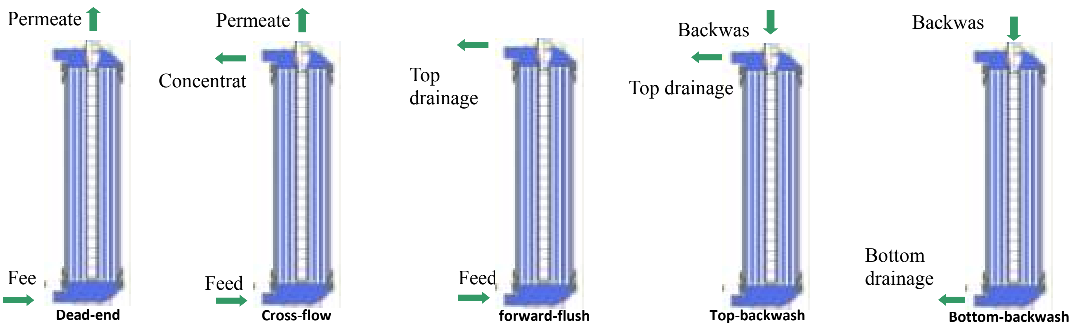
A Backwash system is very necessary. Backwash can remove the contaminants and recover the performance of the membrane. A Backwash system consists of a permeate tank, a backwash pump, a pipeline and a valve and dosing system. The Backwash system is controlled by an automatic controller. The backwash is divided into water backwash and chemical enhanced backwash. During the chemical enhanced backwash, you can choose between the low concentration disinfectant, acid and alkali. The optimized process is based on water quality. Regularly, chemical enhanced backwash is a key solution to recover the performance of membrane. It can prolong the duration of CIP.

4. CIP system

The CIP system consists of a cleaning tank, a cleaning pump a filter and heater. When the membrane is heavily contaminated or the TMP is beyond the permission, and the performance of membrane can not be recovered after chemical enhanced backwash, you should carry out CIP.

3.2.2 UF operation process

UF operation process consists of filtration, flush (with water) and CIP. The following is the filtration and flush process. CIP will be introduced in detail in the following chapters.



Operation process of the UF system

1. UF filtration model

There are dead-end and cross-flow operation models during the UF operation. Dead-end operation model means that all of the feed water permeates through the membrane and most of the suspended solid and colloid are barred at the feed water side of the membrane. After the setting time, the backwash mode starts automatically and contaminants barred by the membrane will be flushed away. If the suspended solid, turbidity and COD are low, you can choose the dead-end operation model. Cross-flow means most of the water permeates through the membrane and the other water called concentrate is drained out of the membrane. The cross-flow can enhance the velocity of flow and reduce the contamination, but the energy consumption is higher. The concentrate flow depends on the feed water quality. We suggest the concentrate flow accounts for 15~35% of all the feed flow. All or part of the concentrate flow back to the UF feed tank or pump back to the UF membrane.

2. Flush process

The suspended solid, colloid and bacteria are barred by the membrane. All the impurity will contaminate the membrane after operating sometimes. In order to maintain the UF performances, the backwash activates every 30~60 minutes.

The Flush process consists of forward flush, backwash and air scour. The backwash consists of top backwash, bottom backwash and both washes together. You can choose between a different combination process based on the quality of the water and operation model. Please refer to table 7.

Table 7: Design guide of the UF system

Operational mode	Backwash mode	Step 1	Step 2	Step 3	Step 4	Step 5
Dead-end	Backwash	Flush	Top backwash	Bottom backwash	—	—
	CEB	Flush	Both	soak	Top backwash	Bottom backwash
Cross-flow	Backwash	Top backwash	Bottom backwash	—	—	—
	CEB	Both	soak	Top backwash	Bottom backwash	—

The specific process of the washing procedure is described as follows.

Forward flush: You can choose UF feed water or permeate water to flush the membrane. The forward flush can remove most of the contaminations to reduce the backwash resistance and water consumption. The forward flush flow is drained through the concentration pipeline but does not permeate through the membrane. The duration of the forward flush is 10~15 seconds.

Top backwash: We suggest users choose the permeate water as the backwash water. The water is pumped through the permeate pipeline and drained out through the concentration pipeline. The Backwash can remove the contaminant on the surface and in the pore of the membrane. The Top backwash makes the recovery of the top of the membrane more efficient. The suggested duration of the top backwash is 15~30 seconds.

Bottom backwash: The purpose is the same as the top backwash, but the backwash water is drained out through the bottom of the membrane. The Bottom backwash makes the recovery of the bottom of membrane more efficient. The suggested duration of the bottom backwash is 15~30 seconds.

Both top and bottom backwash (combined with CEB): In order to distribute the chemicals evenly and quickly, the water is pumped into the permeate pipeline and drained out through the concentration pipeline and feed pipeline. The suggested duration of this step is 20~50 seconds.

Soak: In order to enhance the effect of CEB, we need to soak the membrane. The duration of soak is 60~120 seconds.

A Backwash that uses low concentration chemical solutions is called chemical enhanced backwash (CEB). If most of the contaminant is organic substance, you should choose sodium hypochlorite or alkali. Moreover if the contaminant is metallic ion, you should choose acid. The Operator can choose the duration of backwash, top backwash, bottom backwash and frequency of CEB according to the quality of the water.

3.2.3 Key point of design

Reasonable and efficient pretreatment is the key point of a UF system. Most of sewage water must be treated before flowing into the UF system. Flocculation deposition and filtration are all necessary. All of UF systems must install a filter which has a pore size to be a lot finer than 150μm as pretreatment to prevent the membrane from being scratched.

The design should be completed by professional training and experienced engineers. As a small design mistake is likely to make the overall system fail the engineers should conduct adequate research and analysis at the design stage in order to avoid design defects. The following are the common steps of the design.

1. Collection of feed water information

The information about the feed water is very important for the system design. The type of water resource, turbidity, suspended solids, COD and BOD all have to be considered. Also, the designer has to gain enough knowledge about the variation of the feed water. Some other data, such as colloidal mater content, the types of organic pollutants and the contents of bacteria and their debris, are hard to determine but still important. The designer should investigate the case and gain also indirect information. As above mentioned, some information is difficult to collect usually but still important for system design. The designer may estimate these data and design accordingly.

2. Selection of operation mode and the flux rate

Users can confirm the operation mode referring to the design guideline. The flux rate is determined by the feed water quality and by the membrane properties. For $OLTRE_{CAP}$ P UF membrane modules, the flux rates are all suggested at 40-90 L/m2·hr in ordinary conditions when the membrane modules are selected according to the feed water qualities as described in the design guideline. The flux rates higher than 90 L/m^2·hr are usually not suggested.

Designer should determine the flux, duration of operation, backwash, etc. according to the quality of the feed water. If you encounter a special water, it is recommended to carry out a pilot test to gain the parameters.

3. Confirmation of number of modules

To determine the number of modules of a system needs, another factor that must be considered is the idle time when the membrane is under backwashing and the amount of water needed for back washing.

For example for a system of a 100 m3/hr with a flux rate of 80 L/ m2·hr we select OLTRECAP 1060 P-B membranes.

(1) Confirmation of parameters

The backwash program is designed as water washing every 30 min, as top backwash every 15 seconds and bottom backwash every 15 seconds. So the total washing time is 30 seconds.

The CEB program is designed as every 20 times backwash as both top and bottom backwash and dosing chemical 30 seconds, soak 60 seconds, top backwash 15 seconds, bottom backwash 15 seconds. Then the total CEB time is 120 seconds.

(2) Calculation of service efficiency

The time efficiency is [operation time]/[operation time + washing time + CEB time]. Then the time efficiency is:

$$(30\times20)/(30\times20+30/60\times19+120/60)= 98.12\%$$

(3) Calculation of production efficiency (Supposing the backwash flow is 3times of filtration)

The water production efficiency is: (total production – backwash water consumption – CEB water consumption)/ total production.

Then the water production efficiency is:

$$[20*30\times3.2-19\times(15+15)/60\times3\times3.2-(30+15+15)/60\times3\times3.2]/20\times30\times3.2=94.75\%$$

(4) Confirmation of the number of modules

The module number is: (required production)/ (production efficiency× service efficiency × production of each module). Then the number of modules is:

$$100/ (98.12\% \times 94.75\% \times 3.2) \approx 34$$

4. Backwash system design

A Backwash occurs separately for each system according to the setting time. If it is a small scale system, the flow rate of the backwash pump is chosen by the flow of the UF unit backwash, and the backwash pump should be backed-up.

If it is a big scale system, we should choose two pumps as backwash pump. Each system should design a CEB system. We should avoid the water hammer during the changing to other operation mode.

5. CEB chemicals

Chemicals may be added into the backwashing water in order to enhance the back wash effects. The following formulas are often used:

(1) Injection of HCl to make up the backwash water pH at 2-3.

HCl is often used when the hardness of the feed water is high or when there is a coagulant- related fouling of the membrane.

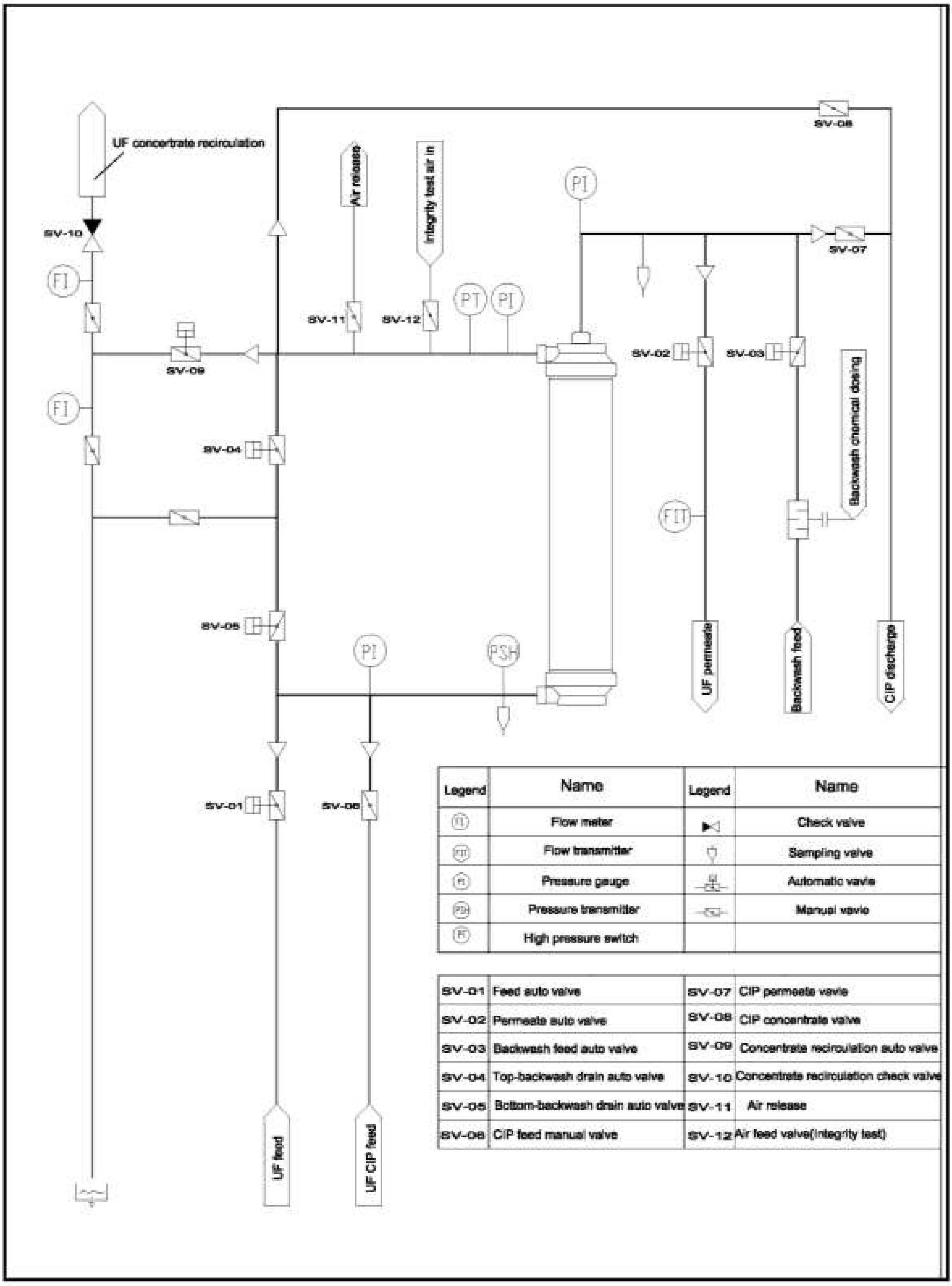
(2) Injection of NaOH to make up the backwash water pH at 10-13.

NaOH addition is often effective when the feed water has organic pollutants.

(3) Injection of NaClO to make up the backwash water at residue chlorine of 10-30 ppm.

NaClO is often used when the feed water is polluted by organics and bacteria.

3.3 P&I diagram of a typical UF system



Legend	Name	Legend	Name
FI	Flow meter		Check valve
FIT	Flow transmitter		Sampling valve
PI	Pressure gauge		Automatic vavle
PSH	Pressure transmitter		Manual vavle
PT	High pressure switch		

SV-01	Feed auto valve	SV-07	CIP permeate vavle
SV-02	Permeate auto valve	SV-08	CIP concentrate valve
SV-03	Backwash feed auto valve	SV-09	Concentrate recirculation auto valve
SV-04	Top-backwash drain auto valve	SV-10	Concentrate recirculation check valve
SV-05	Bottom-backwash drain auto valve	SV-11	Air release
SV-06	CIP feed manual valve	SV-12	Air feed valve(integrity test)

P&I diagram of a typical UF system

Table 8: Valve activities of the typical UF system

	SV-01	SV-02	SV-03	SV-04	SV-05	SV-06	SV-07	SV-08	SV-09	SV-10	SV-11	SV-12
Stand-by	0	0	0	0	0	0	0	0	0	1	1	0
Operation （dead-end/cross-flow）	1	1	0	0	0	0	0	0	0/1*	0/1*	1	0
Flush	1	0	0	0	0	0	0	0	1	0	1	0
Top-backwash	0	0	1	1	0	0	0	0	0	1	1	0
Bottom- backwash	0	0	1	0	1	0	0	0	0	1	1	0
Soaking	0	0	0	0	0	0	0	0	0	1	1	0
Both Top and bottom backwash	0	0	1	1	1	0	0	0	0	1	1	0
Integrity Test	0	0	0	0	0	0	0	0	0	0	0	1
CIP	0	0	0	0	0	1	1	1	0	1	1	0

NOTE：1=open 0=close

"*" means the valve is optional.

4. $OLTRE_{CAP}$ P module installation, operation and maintenance

4.1 $OLTRE_{CAP}$ P module installation

Please pay attention to the following guidelines before module installation and adjustment:

1. Before installation, flush feed the pipeline thoroughly with water to make sure no rigid particle is present, such as iron filings, plastic filings or sands, etc.

2. Unpack the module carefully.

3. In order to prevent the damage caused by drying out, install the module as quickly as possible after unpacking.

4. Keep concentrate and permeate valves fully open and feed valve half open to remove the air before the UF module starts up.

5. Flush the module until all of the preservative solution is out of the membrane totally.

4.2 System adjustment, running and maintenance

You can adjust the system after installation. Firstly, check the auto-valves, the switches and the alarm system to make sure that all of them are working normally. In addition, keep detailed records as reference for ultrafiltration normalization in future, including feed conditions, permeate quality, operation parameters, and so on.

Start up after adjustment. Please pay attention to the following points during operation:

1. Check the meters, pumps and permeate quality regularly.

If there is something abnormal, stop the system immediately and eliminate the abnormal phenomenon.

2. Monitor the equipments and record the operation parameters.

We suggest the users to monitor the parameters including the quality of the

Feed water (temperature, turbidity, COD, etc.), operation conditions (pressures and flows of feed, permeate, concentrate, flush and backwash, CEB chemicals, pH value, duration of CEB), and permeate quality (turbidity, SDI etc).

3. Clean and sterilize the UF system regularly.

4. Check the automatic air vent regularly to make sure the air has exhausted.

4.3 Clean in place - chemical cleaning

Periodically backwashing the membrane can remove most of the fouling matters, but sooner or later, the membrane may need a chemical cleaning. At designed flow rate, when trans-membrane pressure (TMP) is higher than 0.15 MPa, and cannot be reduced by CEB, a chemical cleaning is necessary. A Clean-In-Place (CIP) system should be installed with the UF system to facilitate chemical cleaning process.

The cleaning formulation may be selected according to the fouling matters and the operation experience. The following may be considered:

1) A HCl solution at pH=2;

2) A caustic mixture solution of 0.4% NaOH with 2000ppm NaClO at pH≤13;

3) Choose surfactant based on the feed water quality.

Notes:

1) Check the pH value with meter and avoid big error caused by the test paper.

2) Avoid the HCl and NaClO to contact each other during cleaning.

	Warning HCl, NaOH, NaClO are corrosive, please respect the related regulations.

The procedures are as following:

1) Record the operating parameters before CIP chemical cleaning.

2) Open the CIP feed valve and the CIP concentrate recycle valve, circulate the chemical solution for 30minutes by turning the circulation pump on.

3) Check the pH of the solution, if there is a significant change, add appropriate chemical to resume the chemical concentration. Circulate the solution for another 30 minutes.

4) Repeat step 2 until there is no significant pH change. Change the cleaning solution if it gets too dirty or too much chemical is added.

5) Stop the circulation pump and let the membrane soak in the solution for 30 minutes.

6) Close the CIP concentrate recycle valve and open the CIP permeate recycle valve, circulate the chemical solution for 30minutes by turning the circulation pump on.

7) Repeat steps 2-4.

8) Drain the solution tank. And run the system by directing permeate to drain until the pH of permeate is neutral.

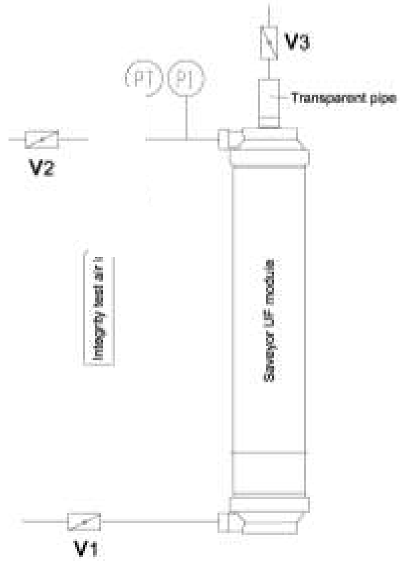
9) Record the operating parameters after chemical cleaning.

Compare the parameters before and after chemical cleaning, if the system is not resumed to its normal operation conditions, consider using another cleaning formulation, or call membrane factory for further solutions. Make sure the feed pressure of CIP is lower than 0.08Mpa.

Note

Treat the solution according to the standard of discharge

4.4 Integrity test



During operating, the membrane may be broken because of pollution, pressure variation and water hammer, as result, the integrity of the module is destroyed. Impurities will diffuse to the permeate by passing the break in the membrane. To ensure the system to be in proper operating conditions, integrity tests should be run periodically to identify the problematic module(s).

The integrity test instruments includes oil-free pressurized air (>0.1 Mpa), air adjusting valve and a transparent pipe (>10cm) installed in the concentrate out-let pipeline on top of each module.

Auto integrity test system can test the module system periodically. Integrity test includes the following steps:

1) Stop system. Close all valves.
2) Inflation air. Open the air adjust valve (V_4) slowly to let the air flow into the module from the permeate water pipe, close the air valve (V_4) when the pressure increase is up to 0.10Mpa.
3) Pressure holds or decays. The pressure change will record and analyze thanks to the monitoring system (PLC). The pressure decay is less than 5% in 2 minutes if there is no leakage and the membrane is complete as normal.
4) Check if there is bubble in concentrate pipe. Mark the module if there is continuous bubble, and repair the module off-line.

   The integrity test is needed every day for the drinking water system.

4.5 Module repair

Contact the contractor to get membrane repair training, tools and plug etc.

5. OLTRE$_{CAP}$ P module storage and ship

To control bacterial growth and prevent damage caused by drying out, the module must be stored with preservative solution.

5.1 Module storage

5.1.1 New module

1. Prior to shipment, the module has passed the flux test and integrity test and has been stored in the preservative solution with sodium bisulfite, glycerin, water at a certain ratio.

2. The Module must keep wet. The new module should keep in its original package until installation.

3. The Module should be placed indoors at 5-40℃ horizontally and avoid direct sun exposure.

4. Keep modules at an adequate temperature to prevent freezing.

5.1.2 Used module

1. Wash out the module before storage and add above sodium bisulfite preservative solution into the module.

2. Update the preservative timely.

3. Keep the module wet in any case.

The storage guidelines for new module are fit for the used module. Wash out the preservative before reuse.

5.2 Module reservation

When the system is turned off for less than 7 days, the module can be protected just by flushing the system for 10~30 minutes every day

When the system is turned off for a longer period, run the chemical cleaning and sterilizing procedure first, and then seal all of the out-lets to keep the module wet to prevent bacteria and algae growth. The formulation of preservative solution is the water and sodium bisulfite at ratio of 99 to 1.

Check the pH value of the preservative every three months. Replace the solution if pH value is lower than 4.

Module will irreversibly lose flux if the module is dried out, so bear in mind that a module must be kept wet to prevent bacterial and mould growth.

5.3 Module shipping

The module is shipped with special cartons or wooden boxes. Avoid collision, sun exposure, rain and mechanical damage. Please pay attention to prevent freezing in cold regions.

Appendix 1 OLTRE$_{CAP}$ P UF membrane parameters

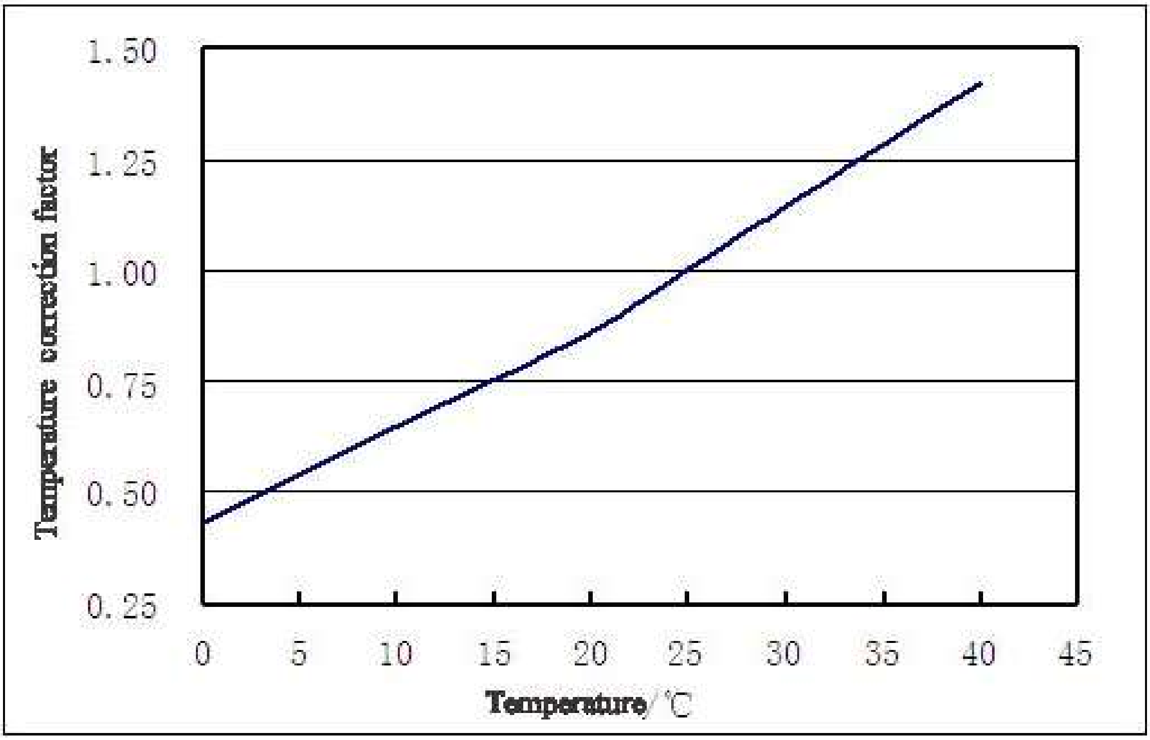
Parameters / Specifications	Dry weight (kg/lb)	Packing size (Length × width × height) mm (inch)
OLTRE$_{CAP}$-1030-P-B	32/71	1070×330×340 (42.1×13.0×13.4)
OLTRE$_{CAP}$-1060-P-B	52/115	1820×330×340 (71.7×13.0×13.4)
OLTRE$_{CAP}$-1080-P-B	69/152	2320×330×340 (91.3×13.0×13.4)

Notes: Dry weight of membrane means weight of membrane without preservative.
Wet weight of membrane means weight of membrane filled with water.

Appendix 2 Temperature calibration curve

The correction factor is 1, when the temperature is 25 ℃. Get the correction factor from the table based on the actual temperature.

Actual flux = correction factor × design flux under 25 ℃.



Temperature – flux correction factor curve

Appendix 3 Ultrafiltration system running data sheet

Content \ Time		1	2	3	4	5	6	7	8	9
Feed temperature	℃									
Feed pH value										
Feed turbidity	NTU									
Feed COD	ppm									
Feed flow	m^3/h									
Concentrate flow	m^3/h									
Feed pressure	MPa									
Permeate pressure	MPa									
Concentrate pressure	MPa									
Permeate turbidity	NTU									
Permeate SDI										
Permeate COD	ppm									
Permeate ORP	ORP									
Backwashing flow	m^3/h									
Backwashing pressure	MPa									
Back washing cycle	minute									
Back washing duration	second									
CEB dosing	ppm									
CEB frequency	minute									
CED duration	second									
CIP frequency										
CIP temperature	℃									
CIP pH value										
CIP flow	m^3/h									
CIP pressure	MPa									
CIP chemical 1										
CIP chemical 2										
Others										