NANOH2O QuantumFlux™ Pressurized UF Membrane

Technical Service Bulletin 604

UF System Start-up / Operating Procedures

UF system commissioning should not occur until the plant is ready to start normal operations. If not, it is better to leave the UF modules in their shipping containers, stored according to TSB 601. Once the plant is ready to start normal operations, proceed in the following order:

1. Conduct pre-startup checks
2. System Integrity Test
3. Install UF modules on skid(s)
4. Perform start-up cleaning and module flush
5. Initial Flow Test
6. Integrity Test
7. Operating Sequence Test
8. Switch to auto mode

Startup Cleaning and Module Flush

Any remaining protective solution must be flushed before the system is started. If the system is shut down for a prolonged period, please refer to the module storage information in TSB 601.

1. Open the filtrate valve and concentrate valve.
2. Open the feed valve.
3. Start the feed pump slowly to get a low feed pressure, less than 0.1 MPa (14.5 psi).
4. Continue running clean water through the membrane modules until there is no foam in the discharge water.
5. Ensure the filtrate water meets the required quality.

Initial Flow/Permeability Test

To confirm that the module(s) and skid(s) permeability are within expected range, an Initial Flow/Permeability Test should be conducted, according to the following steps. This process will also allow the flux to stabilize. Observation of the flow rate and TMP will provide a useful reference point/baseline for long term operations.

Note

Control the valve opening and closing speed, such that the pressure increases no faster than 0.25 bar/second (~4 psi/second).

NANOH2O QuantumFlux™ Pressurized UF Membrane

Technical Service Bulletin 604

UF System Start-up / Operating Procedures

1. Open top drain valve and feed valve.
2. Start feed pump. When starting filtration, residual air may be present in the membrane modules, and skid. To prevent any damage to the membrane fibers due to water hammer, keep the feed and concentrate valves open while filling the membrane modules with feed water until all accumulated air is vented thoroughly through the concentrate port.
3. With the top drain valve open, slowly open the filtrate valve.
4. Once the filtrate valve is fully open, close the top drain valve.
5. Set the filtrate flow to 30% of the designed capacity.
   Record the filtrate flow rate, feed pressure, filtrate pressure, concentrate pressure and water temperature.
6. Increase the filtrate flow rate by 10% approximately every 4 to 6 hours until the designed value is reached.
   Record the filtrate flow rate, feed pressure, filtrate pressure, concentrate pressure and water temperature at each step.

Integrity Test

An integrity test with the modules installed should be conducted prior to starting normal operations. This test will identify any modules with bad connections or compromised fibers. It is not uncommon to find some modules with leaks at the connections to the skid or broken fibers. Please follow the procedure explained in TSB 606.

Control Sequence Test

Prior to starting normal operations, all automatic sequences (Filtration, Air Scour, Maintenance Clean, Recovery Clean, Integrity Test) need to be tested in auto mode to ensure that the pumps, blowers, and valves are operating at the correct time. Use the sequence tables in Table 2 to confirm the control sequence is correct. Please also refer to your project specific design calculation control sequence tables.

Adjust Operating Setpoints

Note

Feed water pressure should be less than 0.3 MPa (43.5 psi) during this adjustment.

Prior to switching to automatic operation, setpoints for key operating parameters should be made and verified. NANOH2O suggests that the operating parameters in the following table are adjustable.

NANOH2O QuantumFlux™ Pressurized UF Membrane

Technical Service Bulletin 604

UF System Start-up / Operating Procedures

Table 1: Adjustable Operating Parameter Table

Item	Description
1	Feed flow rate
2	Filtrate flow rate
3	Concentrate flow rate
4	Air scouring flow rate
5	Filtrate cycle time
6	Drain time
7	Fill time
8	MC interval
9	MC chemical dosing time
10	MC chemical soaking time
11	MC and RC drain time
12	RC interval
13	RC chemical dosing time
14	RC chemical soaking 1 time
15	RC chemical air scour time
16	RC chemical "top-off" time
17	RC chemical soaking 2 time

The initial set point for these parameters should be according to the system design recommendations provided by NANOH2O. Adjustments will likely be made over time depending on the actual feed water quality and the observed system performance.

NANOH2O QuantumFlux™ Pressurized UF Membrane

Technical Service Bulletin 604

UF System Start-up / Operating Procedures

Many parameters can only be optimized on site. Use the following procedures to adjust these parameters to site specific conditions:

1. Concentrate flow rate adjustment – Open the auto concentrate valve and open the manual regulating valve slowly until the flow rate recommended by NANOH2O is obtained. Most systems are operated in dead-end mode, meaning the concentrate flow rate is zero.
2. Air scour flow rate adjustment – Open the auto air scouring valve. Turn on the blower. If using a positive displacement blower, adjust the blower speed slowly until the flow rate reaches the designed value. If using another type of blower, slowly adjust the manual regulating valve until the flow rate reaches the designed value.
    1) Air flow rate per 10″ module is 15 m^3/h (9 cfm).
    2) Air flow rate per 6″ module is 5 m^3/h (3 cfm).
3. Fill time adjustment - The fill time should be set on site by observing how long it takes for the skid to fill. This is critical to minimize water wastage and maximize recovery.
4. Drain time adjustment – The drain time should be set on site by observing how long it takes for the skid to be completely empty. This is critical to ensure foulants have been removed from the skids before refilling.
   Chemical dosing rate –
    1) Turn on the chemical cleaning pump. Measure the water flow rate. Turn off the chemical cleaning pump.
    2) Calculate the required chemical dosing rate to achieve the desired chemical concentration.
    3) Set the chemical dosing pump accordingly.
    4) Turn on the chemical cleaning pump and the chemical dosing pump.
    5) Take a sample of the chemical cleaning solution at the modules. Measure the concentration (for chlorine cleans) or pH (for caustic and acidic cleans).
    6) Adjust the chemical dosing rate up or down to achieve the desired target.
    7) Repeat 4. through 6. until the target is met.
5. RC chemical "top-off" time adjustment – During RC air scour, a portion of the water in the skid is displaced by air. Prior to RC soak, the skid should be topped off with chemical solution so that the entire length of membrane fibers will be exposed to chemical. The top-off time should be set by observing the amount of time it takes for chemical solution to start flowing out of the concentrate valve.

When all the parameters are set under manual mode, the system should be switched to auto mode.

NANOH2O QuantumFlux™ Pressurized UF Membrane

Technical Service Bulletin 604

UF System Start-up / Operating Procedures

Normal Operations

After completing the commissioning process above, normal operations should commence immediately. If there is a break between commissioning and normal operations, follow the instructions in TSB 601.

NANOH2O suggests the control system to be capable of being operated in Manual or Auto mode. In each mode, there are six working conditions. The working conditions are as follows:

- Standby - All the equipment and valves are closed. When power is on, the system will be in stand by condition.
- Filtration – The system is filtering water.
- Air scour – The filtration process is stopped, and the air scour process is started.
- Maintenance cleaning - The filtration process is stopped, and the maintenance cleaning process is started.
- Recovery cleaning - The filtration process is stopped, and the recovery cleaning process is started.
- Integrity testing - The filtration process is stopped, and the integrity testing process is started.

When the power is off, the system will be shut down. All the equipment and valves will be in the stop or closed state.

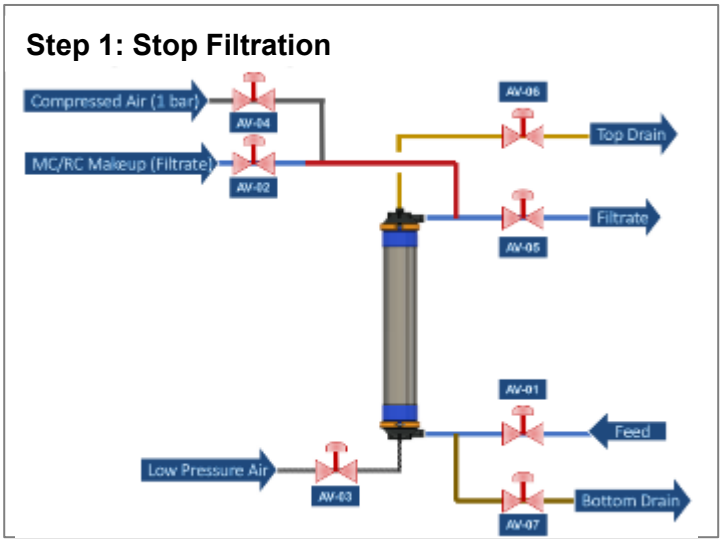
NANOH2O QuantumFlux™ Pressurized UF Membrane

Technical Service Bulletin 604

UF System Start-up / Operating Procedures

Filtration Mode

Most systems using NANOH2O UF modules are designed to operate in dead end mode. In dead end mode, all feed water is converted to filtrate water. During dead end filtration, the feed water valve (AV-01), the filtrate valve (AV-05), and the feed pump (P-1) are all on. In certain situations, where the solids concentration in the feed water is high, a small concentrate bleed (5-10% of the feed flow rate) will be utilized to control the solids accumulations rate in the modules. During filtration, suspended solids are deposited on the membrane surface. The filtration cycle duration is usually based on a set time interval but may also be set by meeting a certain processing volume.



Operating Pressures

- Feed water pressure: The maximum pressure for the membrane module is 0.3 MPa (43.5 psi).
- TMP: The maximum TMP is 0.15 MPa (22 psi).

Air Scour Mode

To remove the suspended solids accumulated during filtration, the system should automatically go into the air scouring process after completion of the set filtration cycle time. During air scour, air is pumped by the blower (B-1) to the bottom of the membrane modules while the air scour valve (AV-03) and top drain valve (AV-06) are open. Hollow fibers swing and vibrate in rising air bubbles and the contaminants are stripped away from membrane surfaces, as a result of the frictional impact from the fiber movements and shearing from localized eddies formed around rising bubbles. Air scour pressure is equal to the water head above the bottom of the membrane modules plus some minor losses in the module and piping losses.

Note

Make sure the module(s) are full of water throughout the air scour step to gain maximum cleaning effect.

Technical Service Bulletin 604

UF System Start-up / Operating Procedures

After reaching the preset air scour time, the skid should be drained by closing the concentrate valve and opening the drain valve (AV-07). The air scour valve (AV-03) should remain open while the skid is drained. This will keep solids in suspension and expedite the drain pressure slightly.

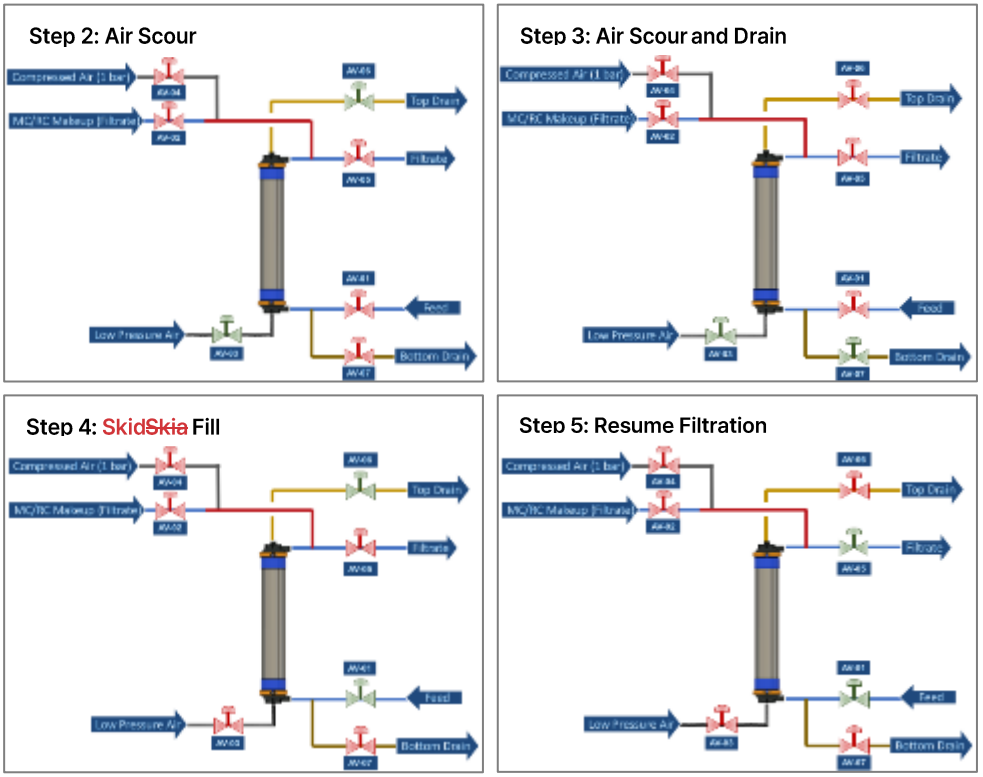
Note

Make sure the module(s) are completely drained. Failure to do so will result in accelerated fouling of the membrane.

Note

The air scouring pressure should be less than 0.05 MPa (7.3 psi).

Once the skid is empty, turn off the air scour valve (AV-03) and the drain valve (AV-07). Open the feed valve (AV-01) and top drain valve (AV-06). Slowly start the feed pump (AV-01). Once the skid is full of water, and all air has been evacuated, open the filtrate valve (AV-05) and close the top drain valve (AV-06).



The use of this product in and of itself does not necessarily guarantee the removal of cysts and pathogens from water. Effective cyst and pathogen reduction is dependent on the complete system design and on the operation and maintenance of the system. No freedom from any patent owned NanoH2O Co., Ltd. or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time. Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. NanoH2O assumes no obligation or liability for the information in this document. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED. All trademarks stated herein are properties of their respective companies. © NanoH2O Co., Ltd.

Air Scour: 1 Sequence

Table 2: Control Sequence Table – Air Scour

				Valve Position									Pump Status			
Step	**Step Description**	**Typical Step Duration (s)**	**Typical Cumulative Sequence Duration (s)**	**Feed (AV-01)**	**Filtrate (AV-05)**	**Top Drain (AV-06)**	**Drain (AV-07)**	**Air Scour (AV-03)**	**Filtrate to Drain (AV-08)**	**Air for MIT (AV-04)**	**MC/RC Feed (AV-02)**	**Chemical Injection**	**Feed Pump (P-1)**	**MC/RC Pump (P-2)**	**Air Blower (B-1)**	**Chemcal Dosing Pump (DP-1/2/3)**
1	Stop Filtration	0		O	O	X	X	X	X	X	X	X	R	S	S	S
	Step Transition - Feed pump speed adjustment	10	10	O	O	X	X	X	X	X	X	X	R → S	S	S	S
	Step Transition - Valve positioning and blower speed adjustment	5	15	O → X	O → X	X → O	X	X → O	X	X	X	X	S	S	S → R	S
2	Air Scour	60	75	X	X	O	X	O	X	X	X	X	S	S	R	S
	Step Transition - Valve positioning	5	80	X	X	O → X	X → O	O	X	X	X	X	S	S	R	S
3	Air Scour and Drain	80	160	X	X	X	O	O	O	X	X	X	S	S	R	S
	Step Transition - Valve positioning and blower speed adjustment	5	165	X → O	X	X → O	O → X	O → X	X	X	X	X	S	S	R → S	S
	Step Transition - RC pump and chemical pump speed adjustmen	10	175	O	X	O	X	X	X	X	X	X	S	S → R	S	S → R
7	Skid Fill	30	205	X	X	O	X	X	X	X	X	X	S	R	S	R
	Step Transition - Valve positioning	5	210	X	X → O	O → X	X	X	X	X	X	X	R	S	S	S
14	Resume Filtration	0	210	O	O	X	X	X	X	X	X	X	R	S	S	S
	Sequence duration (s)		210	Notes: O = Open valve X = Closed valve									R = Run pump S = Stop pump			
	Sequence duration (min)		3.5													