LG QuantumFlux™ Pressurized UF Membrane

# Technical Service Bulletin 605

## UF Membrane Cleaning

Air scouring will remove most fouling from the membranes, but not all. Over time, fouling will accumulate. Chemical cleanings are used to remove fouling that is not removed by air scouring. Chemicals should be selected based on the type of foulants present. The chemicals used should not damage the membrane module or create secondary pollution. LG Chem utilizes two types of chemical cleaning to recover membrane performance.

⚠ **DANGER:** If sodium hypochlorite and acid are mixed, poisonous chlorine gas will be formed. The skids should be thoroughly rinsed between chemical cleanings so that the chemicals do not mix.

⚠ **CAUTION**: Maintain cleaning solutions within allowable pH ranges and only use approved chemicals.

### Maintenance Clean (MC)

The maintenance clean is a shorter clean designed to maintain the membrane permeability. In general, a chemical solution is pumped into a drained skid from the feed or filtrate side of the membranes, usually the filtrate side. After a set soaking time is reached, low pressure air is used to scour the membrane. After air scouring, the skid is drained and rinsed, before resuming filtration. After maintenance cleaning, the Transmembrane Pressure (TMP) should be at least partially recovered.

### Recovery Clean (RC)

The recovery clean is similar to the maintenance clean but uses a higher concentration of the chemical and longer soak times. The recovery clean is designed to recover the membrane permeability to the original value. The steps of the RC are very similar to the MC, but with an extra soaking step. A recovery clean may be triggered by time (every 30-90 days), or when MC fails to restore membrane permeability and the TMP continues to rise a certain amount above the initial value. For example, more than 50KPa (7.3 psi) above the initial value.

### Chemical Cleaning Regime Design

The chemical cleaning regime (chemicals, frequencies, durations, and concentrations) should be uniquely selected for each site-specific condition. Contact LG Chem for assistance selecting the cleaning regime for your system. The following table is an indicative guide for various water types with typical quality. Variation from this table due to site-specific water quality is common.

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**Table 1: Chemical Cleaning Parameters**

| | Oxidant MC Frequency (# per skid/day) | Basic MC Frequency (# per skid/day) | Acid MC Frequency (# per skid/day) | Oxidant RC Frequency (Days between clean) | Basic RC Frequency (Days between clean) | Acid RC Frequency (Days between clean) |
|---|---|---|---|---|---|---|
| **Chemical & Concentration** | **200 ppm NaOCl** | **3500 ppm NaOH** | **1500 ppm $H_2SO_4$** | **500 ppm NaOCl** | **3500 ppm NaOH** | **2000 ppm Citric Acid + 1500 ppm $H_2SO_4$** |
| Ground Water | 0.5 | - | 0.14 | 90 | - | 90 |
| Seawater | 1 | - | 0.14 | 60 | - | 60 |
| Surface Water | 1 | 0.33 [2)] | 0.25 | 60 | 60 [2)] | 60 |
| Municipal WW - Clarifier Effluent | 1 | 1 [2)] | 0.14 | 45 | 45 [2)] | 45 |
| Industrial WW - Treated Effluent | 2 | 1 [2)] | 0.25 | 30 | 30 [2)] | 30 |

[1)] Please contact us for the cleaning formulation for special contaminants.
[2)] Only for TIPS products. pH would exceed limits of NIPS products.

### Method to Verify the Effectiveness of the Cleaning

Please record the following parameters before and after the cleaning:

1. Feed and filtrate flow rate
2. Feed, concentrate, and filtrate pressure
3. Water temperature

After the cleaning compare the data. If the filtrate flow rate, or TMP could not be recovered it means the cleaning is not effective, please contact our engineer to find a solution for this issue.

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### Cleaning Process Procedures

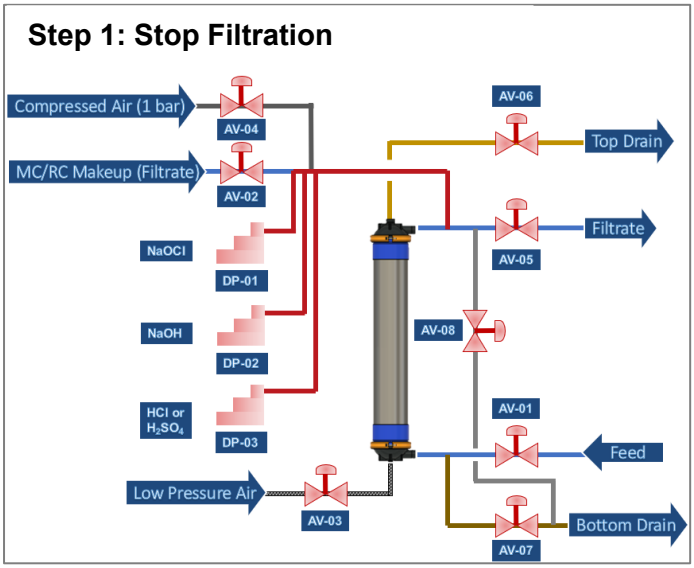
The cleaning process for both maintenance clean and recovery clean have been outlined. On the following pages, you can find step-by-step diagrams and detailed sequence tables.

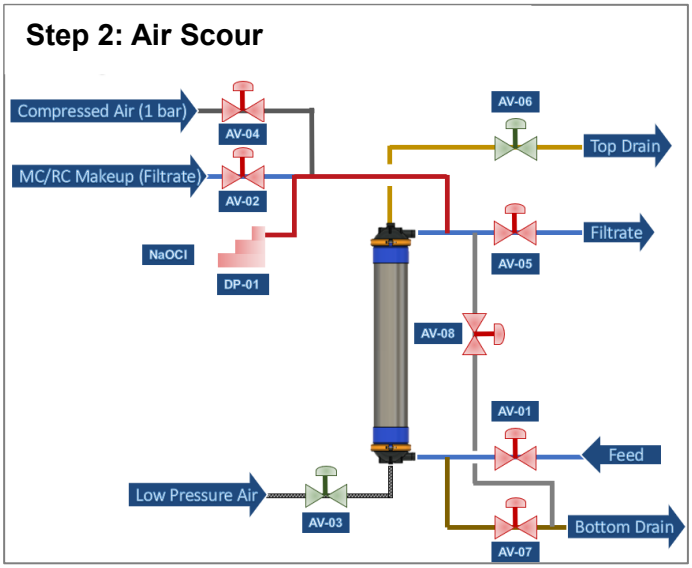
The maintenance clean and recovery clean procedures should be programmed into the control system. Maintenance cleans should occur automatically based on time or number of completed filtration cycles. Recovery Cleans should be manually initiated when an established number of days have passed (commonly, 30 days), or the TMP reaches 1.5 bar (22 psi). The procedure should be repeated for each chemical. Ensure rinsing is complete before introducing a new chemical. Typically, sodium hypochlorite is first, followed by sodium hydroxide. Finally, citric, hydrochloric, or sulfuric acid is used.

⚠ **CAUTION:** Ensure top drain valve is open during chemical soak step.

⚠ **CAUTION:** Check for potential exothermic reactions between cleaning solutions and foulants.

### Maintenance Cleaning Process Steps



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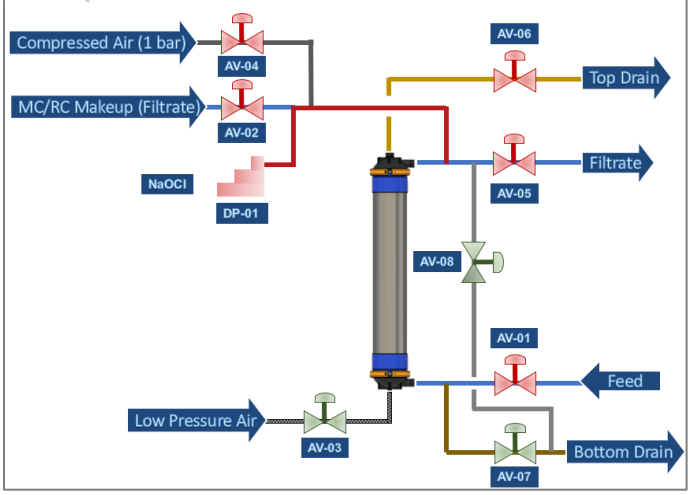
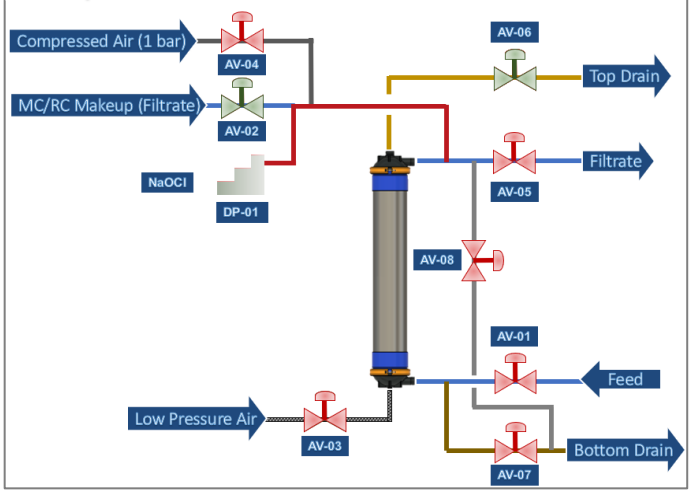
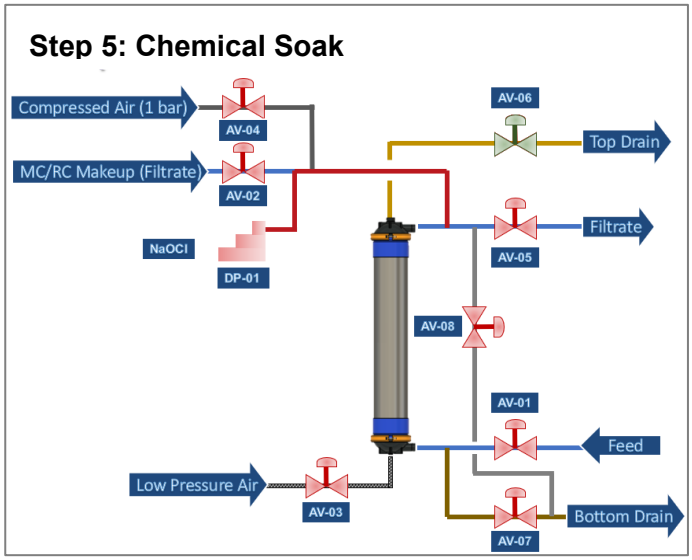
### Step 3: Air Scour and Drain



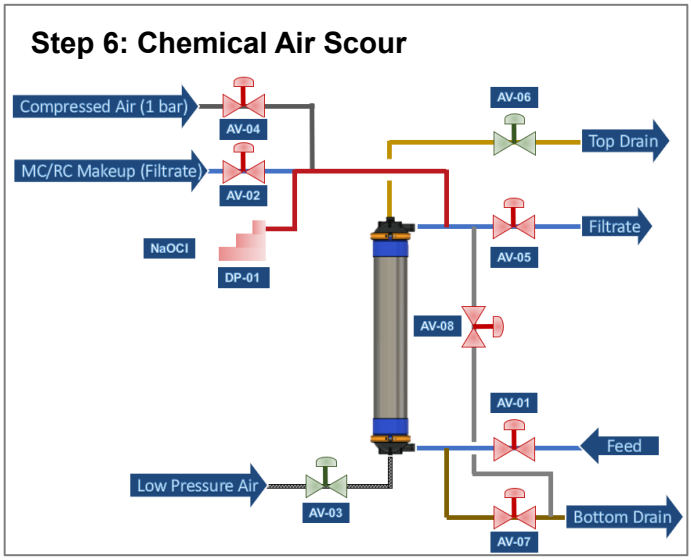

### Step 4: Fill with Chemical



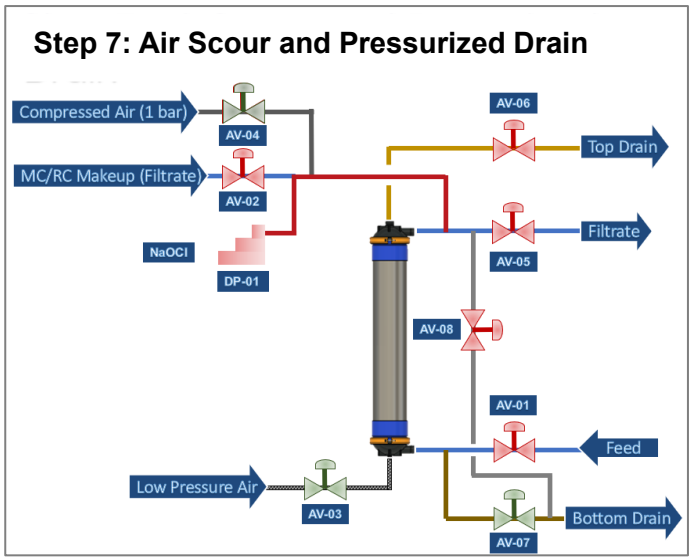

### Step 5: Chemical Soak



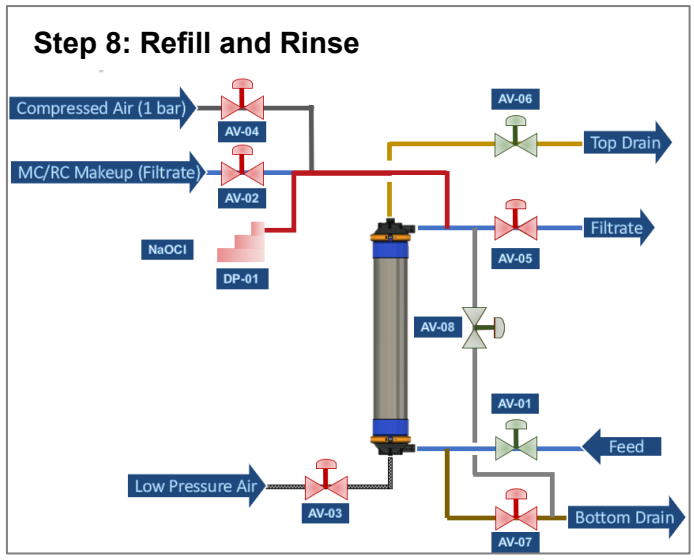

### Step 6: Chemical Air Scour




### Step 7: Air Scour and Pressurized Drain




### Step 8: Refill and Rinse



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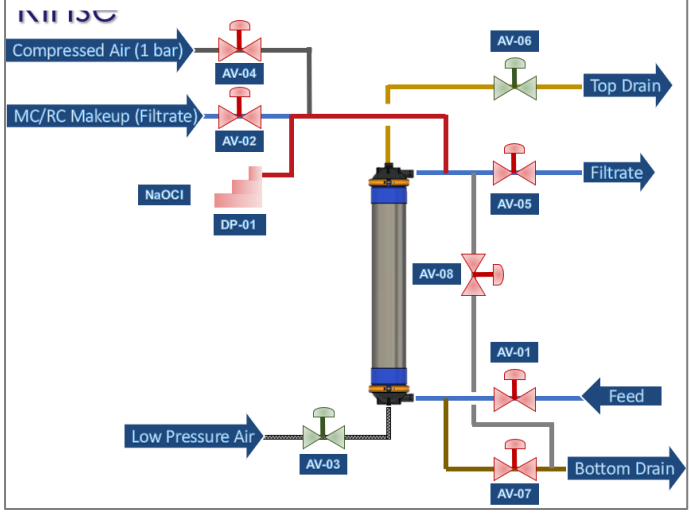
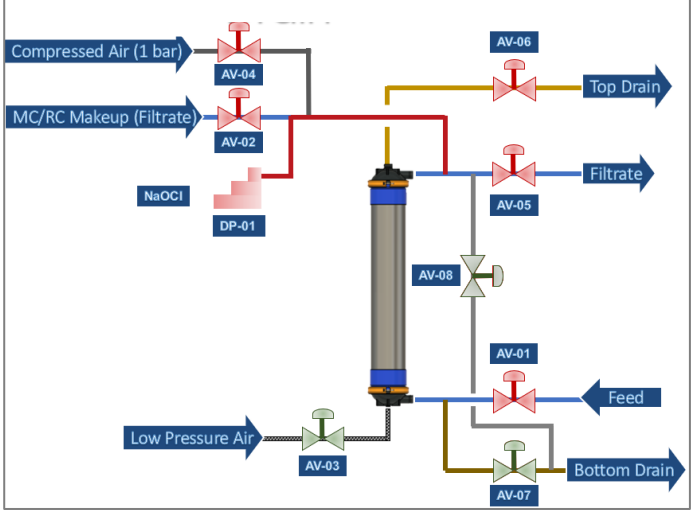
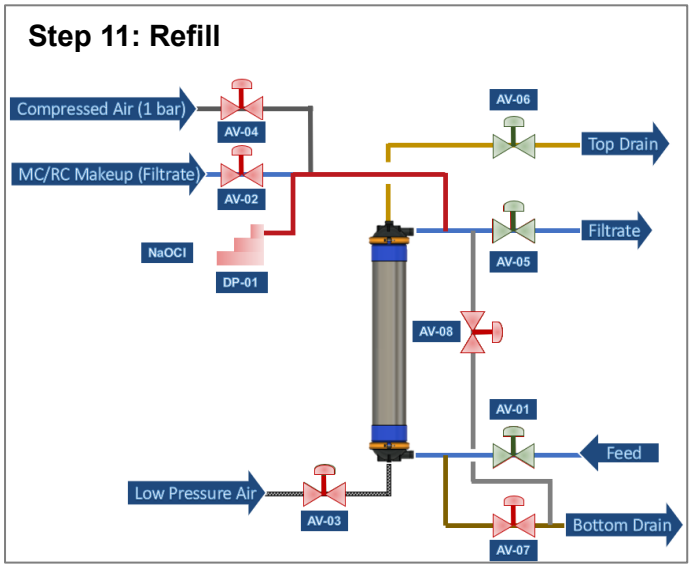
### Step 9: Chemical Air Scour




### Step 10: Chemical Air Scour Rinse and Drain




### Step 11: Refill




### Step 12: Resume Filtration

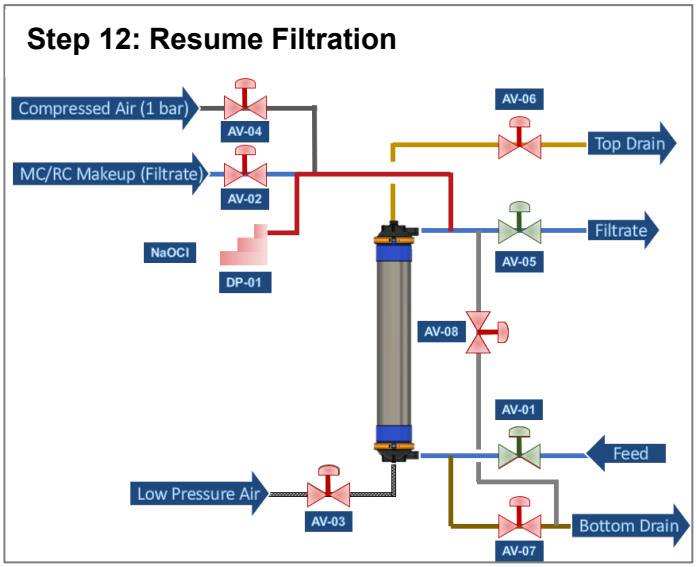


**Table 2: Control Sequence Table – Maintenance Clean**

| | | | | Valve Position | | | | | | | | | Pump Status | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Step Number | 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 → O | X | X | X | S | S | R | S |
| 3 | Air Scour and Drain | 60 | 140 | X | X | X | O | O | O | X | X | X | S | S | R | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 145 | X | X | X → O | O → X | O → X | O → X | X | X → O | O → X | S | S | R → S | S |
| | Step Transition - RC pump and chemical pump speed adjustment | 10 | 155 | X | X | O | X | X | X | X | O | O | S | S → R | S | S → R |
| 4 | Fill with cleaning solution | 60 | 215 | X | X | O | X | X | X | X | O | O | S | R | S | R |
| | Step Transition - RC pump and chemical pump speed adjustment | 10 | 225 | X | X | O | X | X | X | X | O | O | S | R → S | S | R → S |
| | Step Transition - Valve positioning | 5 | 230 | X | X | O | X | X | X | X | O → X | O → X | S | S | S | S |
| 5 | Chemical soak | 600 | 830 | X | X | O | X | X | X | X | X | X | S | S | S | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 835 | X | X | O | X | X → O | X | X | X | X | S | S | S → R | S |
| 6 | Chemical Air Scour | 300 | 1135 | X | X | O | X | O | X | X | X | X | S | S | R | S |
| | Step Transition - Valve positioning | 5 | 1140 | X | X | O → X | X → O | O | X | X → O | X | X | S | S | R | S |
| 7 | Air Scour and Pressurized Chemical Drain | 10 | 1150 | X | X | X | O | O | X | O | X | X | S | S | R | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 1155 | X → O | X | X → O | O → X | O → X | X → O | O → X | X | X | S | S | R → S | S |
| | Step Transition - Feed pump speed adjustment and valve positioning | 10 | 1165 | O | X | O | X | X | O | X | X | X | S → R | S | S | S |
| 8 | Refill | 30 | 1195 | O | X | O | X | X | O | X | X | X | R | S | S | S |
| | Step Transition - Valve positioning | 5 | 1200 | O | X | O → X | X | X | O | X | X | X | R | S | S → R | S |
| 9 | Chem Rinse Air Scour | 60 | 1260 | X | X | O | X | O | X | X | X | X | S | S | R | S |
| | Step Transition - Valve positioning | 5 | 1265 | X | X | O → X | X → O | O | X → O | X | X | X | S | S | R | S |
| 10 | Chemical Rince Air Scour and Drain | 60 | 1325 | X | X | X | O | O | O | X | X | X | S | S | R | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 1330 | X → O | O | X → O | O → X | O → X | O → X | X | X | X → O | S | S | R → S | S |
| 11 | Refill | 30 | 1230 | O | X | X | X | X | O | X | X | X | R | S | S | S |
| | Step Transition - Valve positioning | 5 | 1235 | O | X → O | X | X | X | O → X | X | X | X | R | S | S | S |
| | Step Transition - Feed pump speed adjustment | 10 | 1245 | O | O | X | X | X | X | X | X | X | R | S | S | S |
| 12 | Resume Filtration | 0 | 1245 | O | O | X | X | X | X | X | X | X | R | S | S | S |
| | Sequence duration (s) | | 1245 | Notes: O = Open valve | | | | | | | | | R = Run pump | | | |
| | Sequence duration (min) | | 21 | X = Closed valve | | | | | | | | | S = Stop pump | | | |

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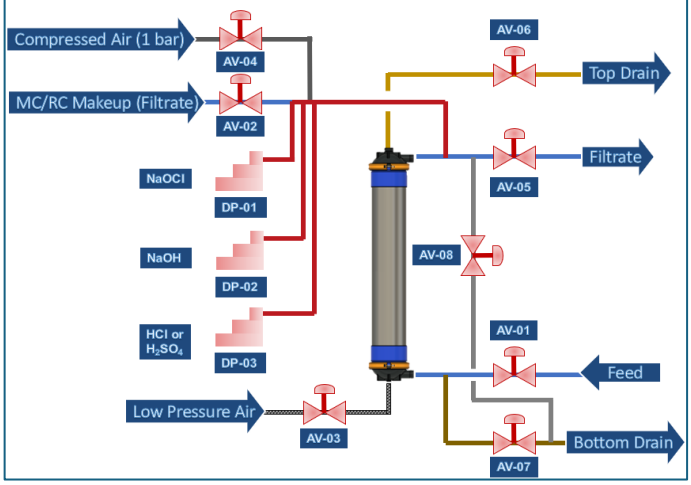
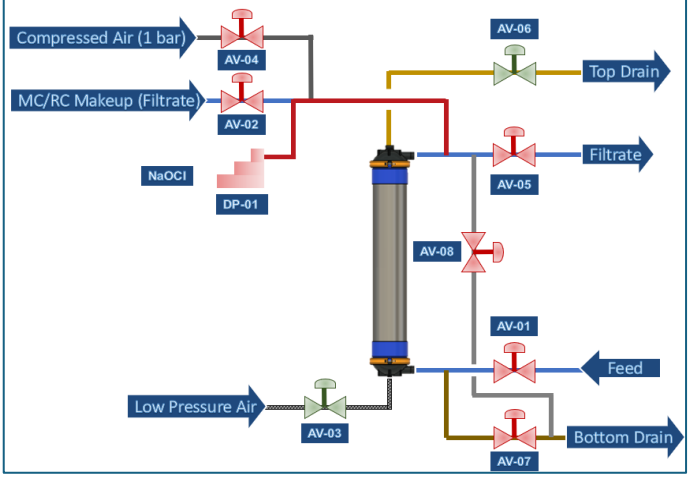
### Recovery Cleaning Process

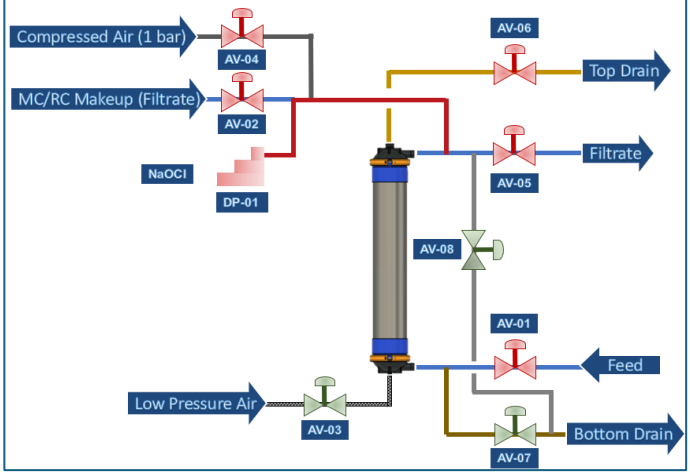
#### Step 1: Stop Filtration



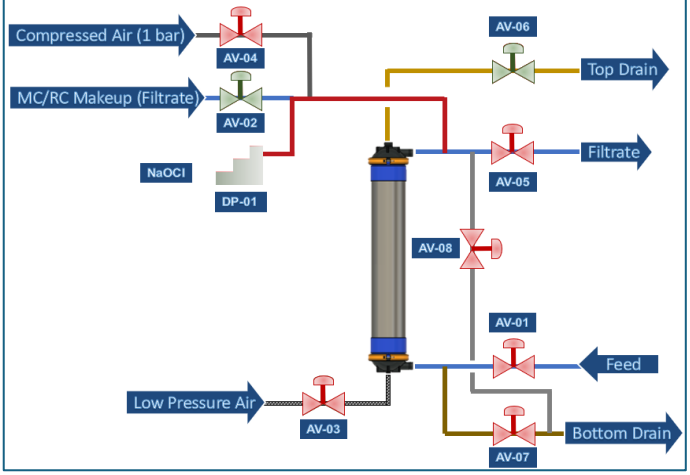

#### Step 2: Air Scour



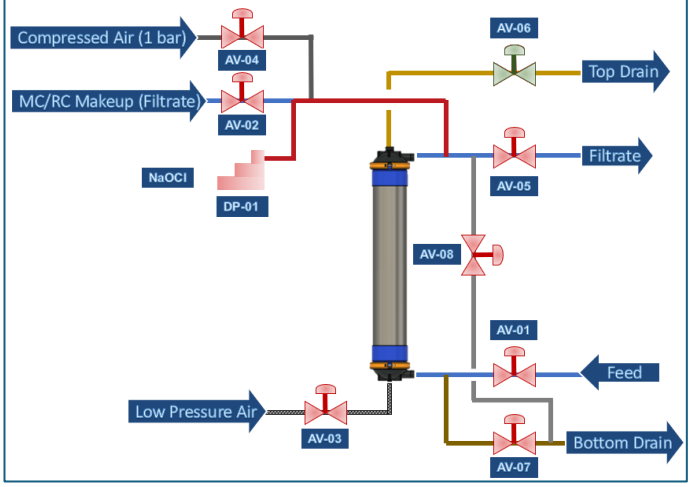

#### Step 3: Air Scour and Drain



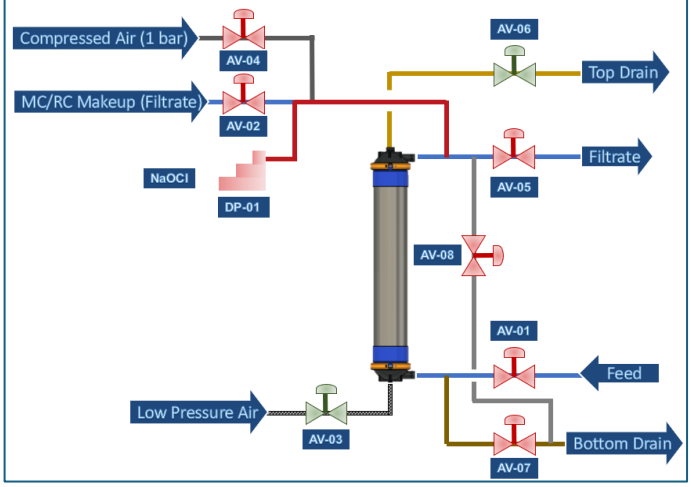

#### Step 4: Fill with Chemical




#### Step 5: Chemical Soak




#### Step 6: Chemical Air Scour



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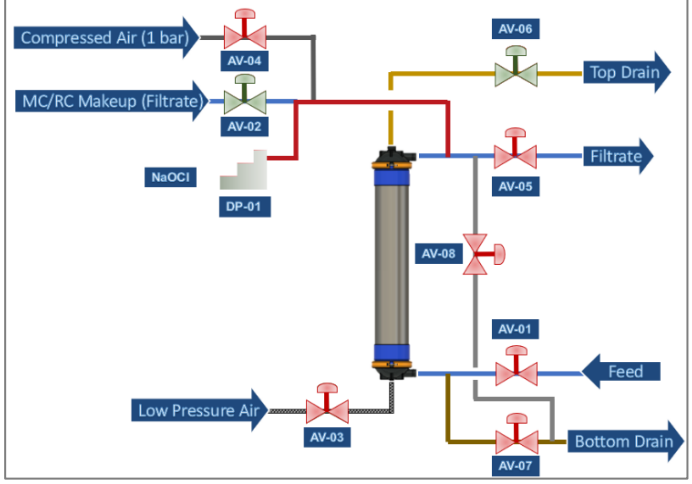
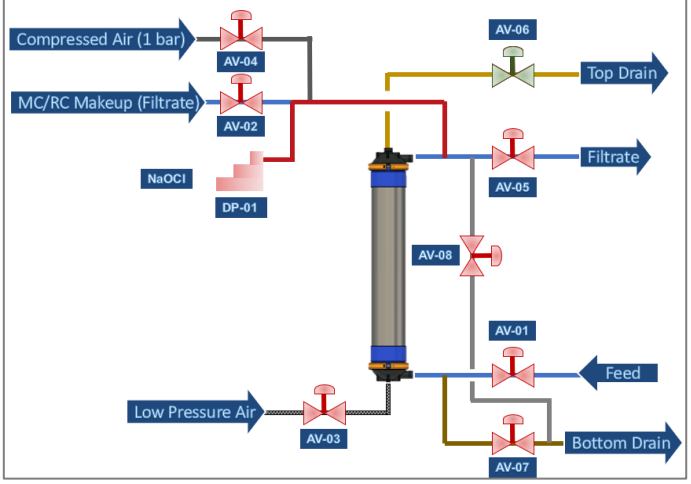
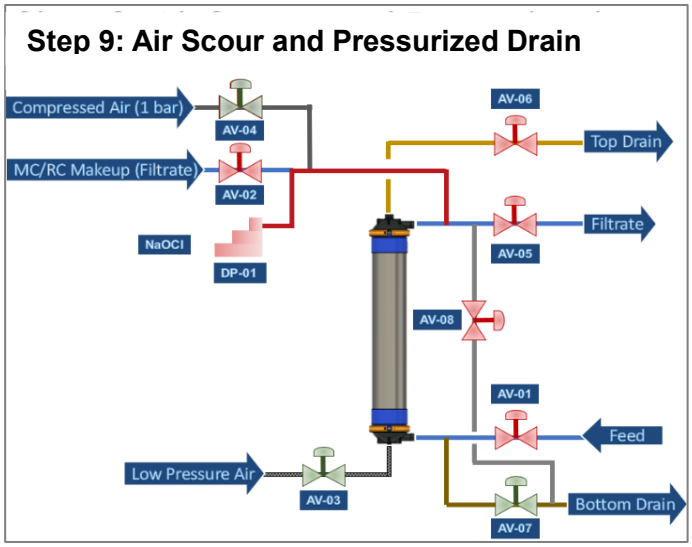
### Step 7: Chemical "Top-Off"



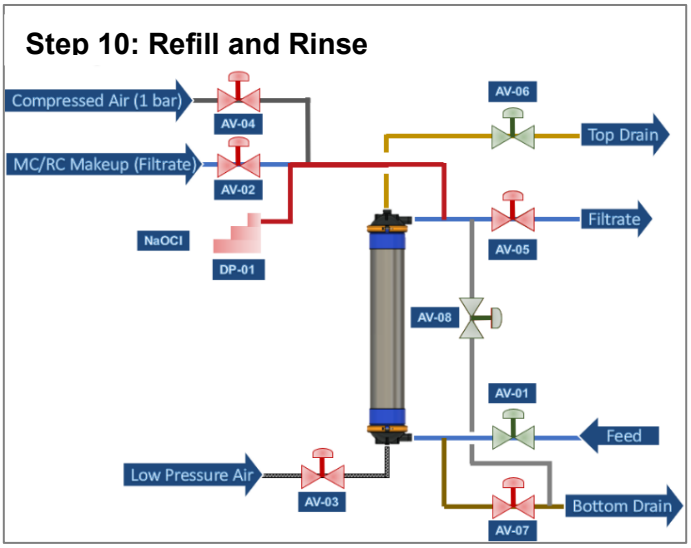

### Step 8: Chemical Soak



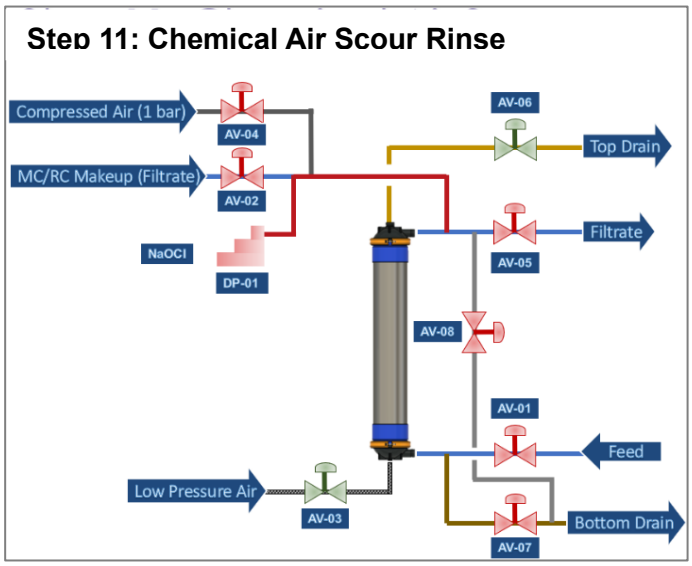

### Step 9: Air Scour and Pressurized Drain



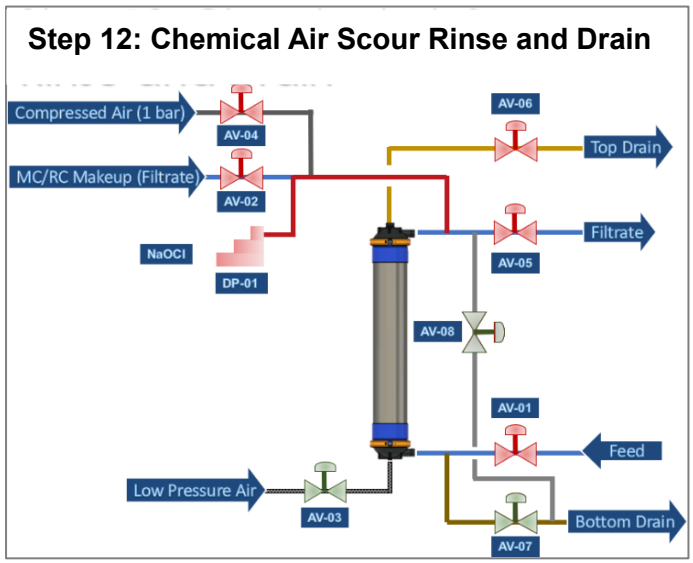

### Step 10: Refill and Rinse




### Step 11: Chemical Air Scour Rinse




### Step 12: Chemical Air Scour Rinse and Drain



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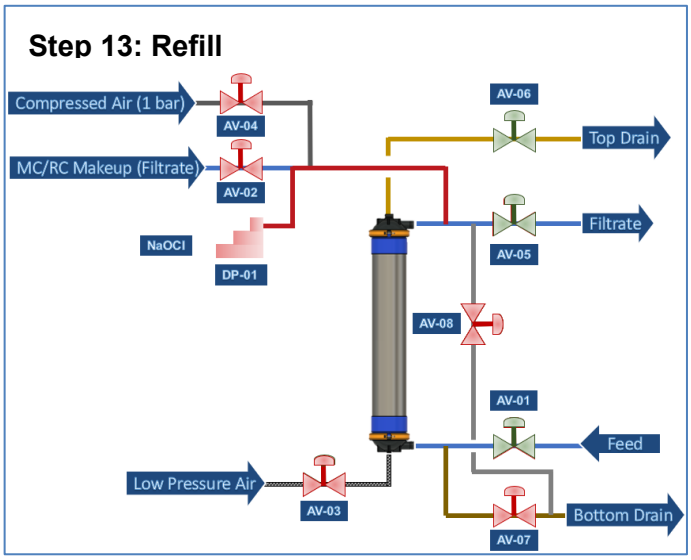


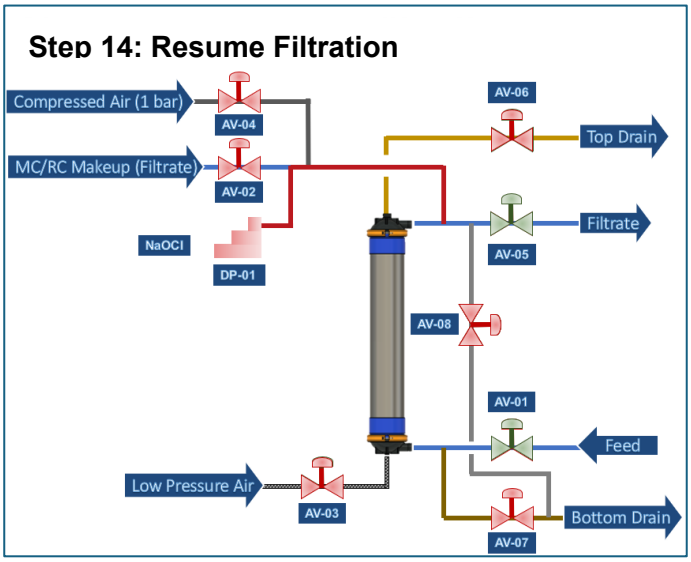

**Table 3: Control Sequence Table – Recovery Clean**

| | | | | Valve Position | | | | | | | | Pump Status | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Step Number | 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) | 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 | R | S | S | S |
| | Step Transition - Feed pump speed adjustment | 10 | 10 | O | O | 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 | S | S | S → R | S |
| 2 | Air Scour | 60 | 75 | X | X | O | X | O | X | X | X | S | S | R | S |
| | Step Transition - Valve positioning | 5 | 80 | X | X | O → X | X → O | O | X → O | X | X | S | S | R | S |
| 3 | Air Scour and Drain | 60 | 140 | X | X | X | O | O | O | X | X | S | S | R | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 145 | X | X | X → O | O → X | O → X | O → X | X | X → O | S | S | R → S | S |
| | Step Transition - RC pump and chemical pump speed adjustmen | 10 | 155 | X | X | O | X | X | X | X | O | S | S → R | S | S → R |
| 4 | Fill with cleaning solution | 600 | 755 | X | X | O | X | X | X | X | O | S | R | S | R |
| | Step Transition - RC pump and chemical pump speed adjustmen | 10 | 765 | X | X | O | X | X | X | X | O | S | R → S | S | R → S |
| | Step Transition - Valve positioning | 5 | 770 | X | X | O | X | X | X | X | O → X | S | S | S | S |
| 5 | Chemical soak | 2700 | 3470 | X | X | O | X | X | X | X | X | S | S | S | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 3475 | X | X | O | X | X → O | X | X | X | S | S | S → R | S |
| 6 | Chemical Air Scour | 300 | 3775 | X | X | O | X | O | X | X | X | S | S | R | S |
| | Step Transition - Valve positioning | 5 | 3780 | X | X | O | X | O | X | X | X → O | S | S → R | R → S | S → R |
| 7 | Skid Topoff | 10 | 3790 | X | X | O | X | X | X | X | O | S | R | S | R |
| | Step Transition - Valve positioning | 5 | 3795 | X | X | O | X | X | X | X | O → X | S | R → S | S → R | R → S |
| 8 | Chemical soak | 2700 | 6480 | X | X | O | X | X | X | X | X | S | S | S | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 6485 | X | X | O → X | X → O | X → O | X | X → O | X | S | S | S → R | S |
| 9 | Air Scour and Pressurized Chemical Drain | 10 | 6495 | X | X | X | O | O | X | O | X | S | S | R | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 6500 | X → O | X | X → O | O → X | O → X | X → O | O → X | X | S | S | R → S | S |
| | Step Transition - Feed pump speed adjustment and valve positioning | 10 | 6510 | O | X | O | X | X | O | X | X | S → R | S | S | S |
| 10 | Refill | 30 | 6540 | O | X | O | X | X | O | X | X | R | S | S | S |
| | Step Transition - Valve positioning | 5 | 6545 | O | X | O → X | X | X | O | X | X | R | S | S → R | S |
| 11 | Chem Rinse Air Scour | 60 | 6605 | X | X | O | X | O | X | X | X | S | S | R | S |
| | Step Transition - Valve positioning | 5 | 6610 | X | X | O → X | X → O | O | X → O | X | X | S | S | R | S |
| 12 | Chemical Rince Air Scour and Drain | 60 | 6670 | X | X | X | O | O | O | X | X | S | S | R | S |
| | Step Transition - Valve positioning and blower speed adjustment | 5 | 6675 | X → O | O | X → O | O → X | O → X | O → X | X | X | S | S | R → S | S |
| 13 | Refill | 30 | 6575 | O | X | X | X | X | O | X | X | R | S | S | S |
| | Step Transition - Valve positioning | 5 | 6580 | O | X → O | X | X | X | O → X | X | X | R | S | S | S |
| | Step Transition - Feed pump speed adjustment | 10 | 6590 | O | O | X | X | X | X | X | X | R | S | S | S |
| 14 | Resume Filtration | 0 | 6590 | O | O | X | X | X | X | X | X | R | S | S | S |
| | Sequence duration (s) | | 6590 | Notes: O = Open valve X = Closed valve | | | | | | | | R = Run pump S = Stop pump | | | |
| | Sequence duration (min) | | 110 | | | | | | | | | | | | |