Ecosoft CIPSEP4 Clean-In-Place Unit

for 4″ membrane Reverse Osmosis Systems

Product manual

2020/06

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ABBREVIATIONS

CIP	Clean-in-place (chemical cleaning)	GPM	Gallon per minute
RO	Reverse osmosis	LPM	Liter per minute
P&ID	Piping and instrumentation diagram	SMBS	Sodium metabisulfite

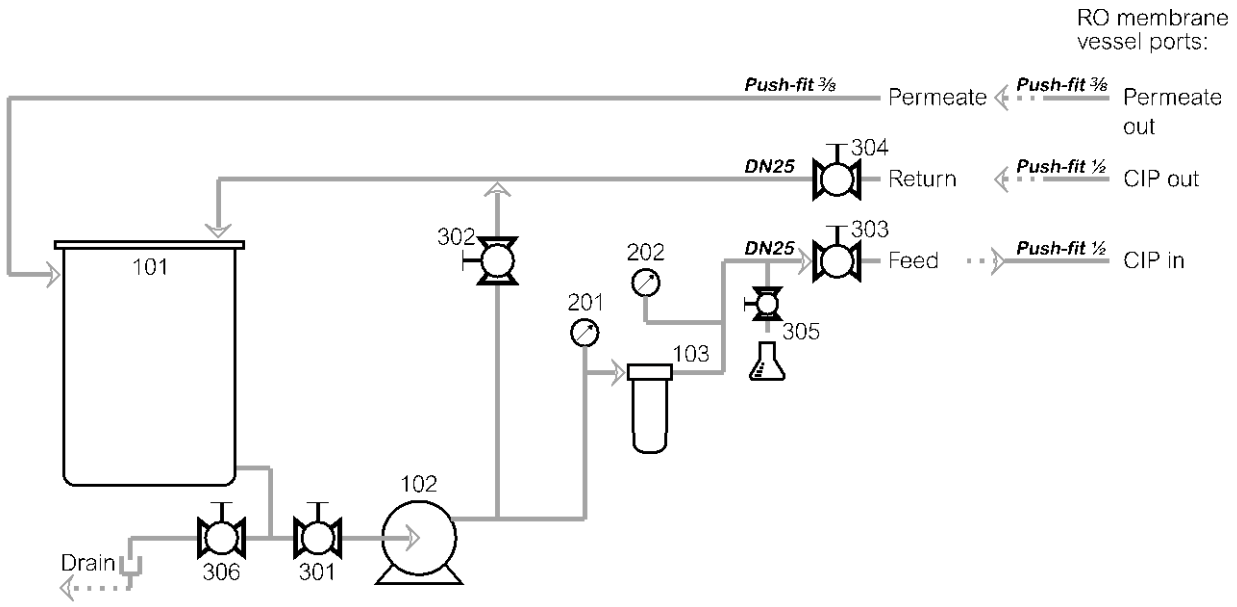
APPLICATIONS

During water treatment plant operation, reverse osmosis and nanofiltration membranes gradually become soiled with deposits of mineral, colloidal, organic, microbiological and other types of impurities. Chemical cleaning restores soiled reverse osmosis / nanofiltration membranes and reverses product water flux and the rate of purification. Another use is to rinse and soak RO/NF membranes with preservative solution for winterizing or long shutdown.

SPECIFICATIONS

Electrical requirements	230 V, 50 Hz (1 phase)
Installed power	0.5 kW
Skid dimensions (Width × Depth × Height)	0.5 × 0.95 × 1.5 m
Cleaning solution tank dimensions (Diameter × Height)	0.4 × 1.2 m
Connection port sizes	
cleaning solution feed	Push-fit ½″
cleaning solution return	Push-fit ½″
cleaning solution permeate	Push-fit ⅜″
Feed flow rate	2 m^3/h @ 3.0 bar
	3 m^3/h @ 2.5 bar
Weight (empty / operating)	45 kg / 150 kg

PROCESS DIAGRAM



Ref. #	Article	Specifications	Q-ty
101	CIP tank	100 L vertical poly tank	1 ea
102	Feed pump	Grundfos CM 3-4	1 ea
103	Sediment filters	Big Blue 20, 4.5 × 20″ filter	1 ea
201	Pressure & temperature gauge	0…10 bar, 0…+50 °C	1 ea
202	Pressure gauge	0…10 bar	1 ea
301	Tank valve	32 mm O.D. uPVC	1 ea
302	Bypass valve	32 mm O.D. uPVC	1 ea
303	Feed valve	32 mm O.D. uPVC	1 ea
304	Return valve	32 mm O.D. uPVC	1 ea
305	Sampling valve	¼″ quick-connect valve	1 ea
306	Drain valve	20 mm O.D. uPVC	1 ea

CLEANING PROCEDURE

Chemical cleaning of RO membranes must be carried out when product water flow capacity decreases 15%, permeate conductivity increases 15%, or normalized pressure increases 15% or more.

Chemical cleaning is done with the use of chemical cleaners such as Ecosoft Ecoclean 211 (caustic) and Ecoclean 203 (acid). In most cases, membranes should first be cleaned with caustic solution, then (after rinsing with pure water) acid solution. Every cleaning cycle must be followed by rinse with purified water.

Typical procedure for chemical cleaning is as follows:

1. Set up the CIP unit. Connect CIP unit's feed, return, and permeate ports to the RO membrane vessel ports with poly tube. Connect CIP drain outlet to gravity sewer. Connect the power plug to power mains.
2. Prepare cleaning solution with the necessary quantity of chemical cleaner.
3. Mix the solution for 3-5 minutes using the feed pump (via bypass valve).
4. Circulate cleaning solution through the membrane vessel for 15-60 minutes. Control pH, temperature, and color of the solution.
5. Stop the pump and let soak in the solution for 1-2 or more hours. Repeat circulation and soaking cycles multiple times when cleaning badly soiled membranes.
6. Discard used solution to drain.
7. Fill the tank with purified water and rinse the membranes until chemical cleaner residue is flushed and the rinsewater stops changing pH and color.
8. Discard rinsewater to drain. Dismantle the piping and unplug the electrical power from the CIP unit. Discard all permeate during the first 15-30 minutes of RO operation after chemical cleaning.

CLEANING INSTRUCTIONS

1 Setting up the CIP unit

Piping installation must be done by a plumber with the necessary skills and/or experience with pressurized water treatment systems.

All electrical works must be carried out by an electrician. Observe all applicable electrical code, building code, and plumbing code.

Shut down the RO system and switch off power supply before proceeding.

Connect the CIP unit's feed, return, and permeate ports to the RO membrane vessel ports as shown on the process diagram. Use regular polyethylene flexible tube.

Open the shutoff valves on CIP ports of the RO system.

Connect the power plug into an electrical socket. The circuit breaker inside the CIP unit's electrical panel must be switched off before powering up the system.

Install fresh filters in the sediment filter housings **103**.

2 Preparing cleaning solution

Chemical cleaning should only be performed by trained staff. Carefully read chemical cleaner instruction and material safety data sheet before handling the chemicals.

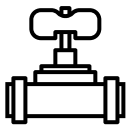
RO permeate should be used for preparing the cleaning solution. If unavailable, softened tap water is acceptable to use.

Ecoclean 211 and Ecoclean 203 require dilution to approximately 2% to obtain cleaning solution. This roughly amounts to 2 L of cleaner concentrate diluted to 100 L with purified water. Rule of thumb is to add small quantities of chemical cleaner to the required volume of water while thoroughly mixing it and monitoring the pH. Stop when target pH is obtained:

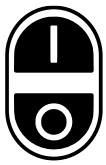
- pH 10.5…11.5 for caustic cleaning solution
- pH 2.0…3.0 for acid cleaning solution

Optimal temperature is 25 to 35 °C. **Higher than 40 °C may lead to membrane degradation**. If the temperature rises over 38 °C during cleaning, immediately stop the pump and let the solution cool.

3 Circulation mixing via internal bypass



Shut off feed valve **303** and return valve **304**.
Open tank valve **301** and bypass valve **302**.



Start the pump **102** using the On/Off push-button in the electrical cabinet door. Check that the pump has started, and the solution is running back into the tank via return pipe on the top. Do not start the pump before tank valve **301** and bypass valve **302** are open.

Let the solution mix for 3-5 minutes, then check if pH is in the recommended range. If necessary, lower or raise the pH by adding small quantity of acid or caustic cleaner. Sample pH multiple times while the pump is running to obtain an accurate reading.
If pH and temperature are good, begin circulation cleaning cycle.

4 Membrane circulation cleaning

Open delivery valve **303** and return valve **304**. Making sure that the tubes are properly connected to the membrane vessel and no leaks are visible.

After the valves **303** and **304** are opened, and the pump is running, gently close the internal bypass valve **302**.

Monitor the pressure gauge **201** carefully. If pressure rises sharply and reject solution is not running back into the tank, stop the pump and look for possible obstructions:

- CIP unit's ports not properly connected to membrane housing ports
- Sediment filter in the filter housing **103** not freshly installed or not stripped of its plastic wrap
- RO membrane clogged to zero passage

Run circulation for 15-60 minutes. The duration depends on type and severity of membrane soiling and will be more easily gauged with enough experience. **Monitor the solution's pH, color, and temperature throughout the cycle**.

If the solution becomes turbid, discolored, pH < 10 (for caustic cleaning) or pH > 4 (for acid cleaning), proceed as follows:

— stop the cleaning cycle

— drain the solution (step 6)

— rinse the membranes with purified water (step 7)

— prepare fresh cleaning solution (steps 2-3)

— start a new cleaning cycle (step 4)

5 Membrane soaking

Stop the pump. Do not close any valves.

Let the system stand for 1-2 hours (in cases of severe membrane soiling the interval can be extended up to 12 hours). Then, resume circulation for 3-5 minutes by switching on the pump. Pay attention to solution pH, temperature and color after resuming circulation.

If the solution becomes turbid, discolored, pH < 10 (for caustic cleaning) or pH > 4 (for acid cleaning), proceed as follows:

— stop the cleaning cycle

— drain the solution (step 6)

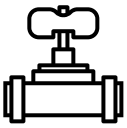
— rinse the membranes with purified water (step 7)

— prepare fresh cleaning solution (steps 2-3)

— start a new cleaning cycle (step 4)

If the solution's pH and color have not changed appreciably after cleaning and soaking, finalize the cleaning procedure. Drain the solution and rinse the membranes as described in the following steps. Otherwise, repeat steps 2 to 5 until solution quality stops deteriorating.

6 Draining used solution



Switch off the pump before proceeding.

Open drain valve **306** without closing any valves.

Let the solution run down the drain completely. Then close the drain valve 306.

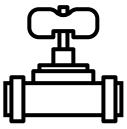
7 Membrane rinsing

Fill the tank **101** with purified water.

Start the pump and check that the rinsewater is running back into the tank via return pipe on the top.

Circulate for 5-15 minutes, then check rinsewater pH. If it has not reached the neutral range of 5.5…8.5, or become dirty/discolored, repeat steps 6-7 until clean rinsate is obtained.

Stop the pump and drain rinsewater.



Switch off the pump before proceeding.

Open drain valve **306** without closing any valves.

Let the water run down the drain completely. Then close the drain valve **306**.

If your cleaning protocol requires cleaning with different chemicals, proceed with the next cleaner steps 2-7.

Most cleaning protocols require first cleaning with caustic, then with acid cleaner.

8 Dismantling the CIP unit

Remove electrical power from the CIP unit. Remove the flexible hoses connecting the CIP unit to the RO system and sewerage.

The RO system is ready for resuming operation.

Discard all permeate produced during the first 15-30 minutes of operation after membrane cleaning as it may contain residue of chemical cleaners.

PRESERVATIVE TREATMENT

The CIP unit can be used for preservative treatment of RO membranes prior to an extended downtime. Most commonly used preservatives are sodium sulfites, non-oxidizing biocides and propylene glycol.

Typical concentrations are 1-2% solution sodium metabisulfite or 20% or higher polypropylene glycol diluted with purified water. It is critical to account for water in pipes and membrane vessels when calculating the required dosage of concentrated preservative.

Typical procedure for preservative treatment is as follows:

1. Set up the CIP unit. Connect CIP unit's delivery, return, and permeate ports to the RO membrane housing ports with hoses. Connect CIP drain outlet to gravity sewer. Connect electrical power matching the unit's specifications.
2. Prepare preservative solution with the necessary quantity of preservative concentrate.
3. Mix the solution for 3-5 minutes using the feed pump via bypass valve.
4. Circulate cleaning solution through the membrane vessel for 10-20 minutes.
5. Disconnect the CIP unit from the RO membrane housing and plumb the housing back into the RO machine. Then discard the remainder of the solution to the drain.
6. Dismantle the piping and remove the electrical power from the CIP unit.
7. When resuming RO operation after chemical cleaning, discard all permeate during the first 15-30 minutes of operation as it will contain preservative residue.