Cleaning of Silica-based Membranes

When handling CIP chemicals always wear gloves, apron and eye protection. Dissolve the chemicals in filtrated or RO water.

When performance indicates the membrane is suffering from fouling, determine at first the cause of the fouling. Use the cleaning method for the specific fouling.

For testing of cleaning procedures it is recommended to run these tests first at small scale to ascertain proper function and performance, before applying any procedure onto the whole plant.

Several brands of membrane cleaning agents are on the market, such as Ecolab and Johnson Diversey.

For a general approach follow the following procedure:
- flush the module with a clean solvent at 40 – 50 °C
- one can use either an one cleaning agent treatment or follow a sequence of treatments with neutral and slightly acidic cleaning agents, flushing with clean solvent in between, followed by sterilizing the system.

Operation and chemicals to be used (Henkel Ecolab, Johnson Diversey)
It should be noted that the use of any cleaning agent is not guaranteed, nor in function nor in compatibility of the membrane.
This is a general approach; compatibility has to be ascertained at small scale beforehand.

Pervatech is not responsible for any results from testing, our service is just to support you to the best of our knowledge to help you keeping the equipment operational.

Processing during cleaning
Operation parameters during cleaning:

Pressure	atmospheric
max pressure drop	0,5 bar (between in-out feed side)
temperature (max):	50 °C (limited by the enzymes)
pH tolerance	3 to 7,5

Cleaning
At the end of the standard dehydration process flush the element with clean solvent (max 50 °C). Continue flushing until "clean" solvent is coming out of the system. After flushing the element, CIP the element with appropriate means. This is either with its own solvent or with typically 0,5% to 1% enzymatic neutral non-ionic detergent. Flush out thoroughly the element with clean solvent of the application. Sterilize with Formaldehyde (1%) or Sodium Azide(<0.01%) or equivalent (mind the safety instructions and use protective clothing).

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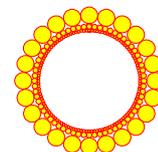
Performance check after cleaning cycle with pure solvent

It might be helpful to flush the membrane with warm clean solvent, temperature 40 – 50 °C.
To check the function after flushing with solvent, you can run a functional test with vacuum applied to determine any effectiveness of the flush or cleaning step.

If not sufficient heat is supplied the vapour water can freeze inside the membrane structure, destroying the membrane layer by ice formation expansion.

Be sure to maintain a flow of at least Reynolds >13.000.

Executing a cleaning protocol

Before starting a cleaning procedure be sure to switch off all power of the plant, since the cleaning pump is independent from running the plant.
As cleaning pump you can use preferably an air-driven centrifugal pump (Ex area.)
Capacity of the pump should be around 100 - 150 ltr/h, with max head 0,5 bar.

Prepare the cleaning solution of choice.
Connect the cleaning system to the module/membranes, through 3-way valves HV14 and HV61
**Do not apply vacuum during flushing and cleaning.**
Flush the internal hold up of the modules with clean solvent of choice, depending upon your cleaning protocol.
Pump the cleaning solution through the module according to the below schedule

Mode	CIP chemical	Function	Concentration	Temperature	Time
Rinse	Solvent			40 – 50°C	15 min
Cleaning	Ecolab, or Diversey	Enzymatic	1 % (pH < 7,5)	Max 45°C	45 min.
Rinse	Solvent			-	15 min.
Acidic cleaning	Acidic flush (org acid)	Acid	0,1 % (pH >3,0)	50°C	25 min.
Rinse				-	15 min.
Disinfection	Formaldehyde, or	Disinfectant	1%	RT	15 min.
	Sodium Azide		0,01%		
Rinse	Solvent				20 min.

The type of cleaning agent depends upon the characteristic of the fouling and will be recommended upon consultation of Ecolab or Diversey
Please notice the type of cleaning agent determines also the process parameters during cleaning, which can be different for any brand.

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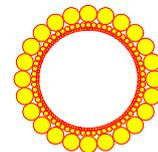
Cleaning steps

1	Fill the properly rinsed cleaning tank with clean solvent* , use in total at least 5 litres for flushing and 3 litres for recirculation
2	Check cleaning solvent for suspended solids
3	Check if the feed tubing is below the level in the feed tank, preventing suction in air to avoid foaming
4	Open HV14 and AV61, such that only the module is connected with the cleaning pump
5	Be sure the retentate (hold up) is disposed of, for flushing dispose of the retentate. For recirculation connect retentate tubing to the cleaning tank
6	Check if the flow of cleaning liquid is not restricted in any way
7	Switch on the cleaning pump
8	Take measures that the pressure drop over the module is < 0,5 bar, still maintaining sufficient flow to ensure intense contact of the membrane surface with the cleaning liquid
9	Monitor or control the temperature during cleaning, not to go over 50°C, but also not < 30°C, in order to prevent freezing of water vapour in the membrane structure
10	Check feed supply to be < 0,5 bar absolute when running, i.e. the absolute pressure on the membrane should be not over 0,5 bar
11	After sufficient cleaning time, rinse out the cleaning agent according to the above schedule and follow with the next step in the cleaning cycle
12	After all cleaning cycles and flushing, in processes were bacterial growth is an issue, be sure the membrane module is sanitised with the appropriate means for the specific application.

* use appropriate cleaning solvent, i.e. always use one that is completely miscible with the solvent that is present in the setup

Schematic set up for cleaning cycle