

KSS PURON®PSH

Submerged ultrafiltration technology

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Technical description



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1 Introduction

This report describes the intervention and operations to be carried out on the filtration section of the MBR (membrane bioreactor) module(s) installed in WWTP in Afula. The MBR plant consists of eight ultrafiltration trains with four PURON® PSH1800-38 submerged membrane modules in each train. The MBR plant has been in operation since July 2021.

Due to problems encountered in late 2021 with the fine screen installed (leaking and bypass) that allow wipes /hair and debris entering in the MBR WWTP, it was decided to proceed with an assessment of the proper operations necessary to restore the correct operating conditions of the MBR modules and trains.

The following paragraphs list a series of activities and steps that will guide you through to the specific situation.

N.B.: This document should be used in conjunction with the information already sent in the email dated July 17, 2025, regarding the detailed timing, personnel, and equipment/machinery REQUIRED for this activity, and with the PURON® operating manual (already shared with you since startup of the plant in 2021).

1.1 Operations to be performed on a PURON® PSH1800 module

- Stop the MBR train on SCADA or on touchscreen (press the OFF button to deactivate the train's specific utilities).
- Drain the tank from an activated sludge, clean the tank from debris and from residual sludge accumulate at the bottom of the tank with water hoses.
- Disconnect the first module from the permeate pipe and air supply pipe. See the equipment required to perform this operation on site.
- Remove the nuts, bolts, and washers that secure the module's traverse to the edges of the membrane tank. Check the equipment needed to do this on site.
- Position the crane on the floor at a distance sufficient to lift 5 tons (=5000 kg) of weight (module's weight once it's really chocked).

- Connect the 4 chains/slings to the 4 corners of the module's traverse as shown in the figure 1 below to lift the module from the membrane tank.



Fig.1 chains used to lift the module from the tank

- Remove any roof or obstacles before lifting the membrane module. Remove the cassette from the membrane tank and place it on a horizontal surface on the floor with sufficient space around it to facilitate operation by personnel.
- Disassembly of the module as described in chapter 10 of the PURON® PSH operating manual (**KSS will provide a PDF file for this specific operation step by step!**). All the equipment described in the file sent and listed below must be available



Equipment list for mechanical cleaning

DATE
KCTG ref.
CUSTOMER
SYSTEM

	Q.TY	ITEM DESCRIPTION				
	4	Water hoses (no pressure washers) for mechanically cleaning of individual membrane rows				
	2	Two ladders with platforms and safety railings (minimum height 2 meters)				
		Crane and its suspension supports – for lifting the membrane module. Capacity required 5000 Kg				
	4	Cables/chains for lifting the membrane module or four lifting harnesses or straps (one at each end of the hanging device). Capacity 5000 Kg				
		LOCTITE® : for all threaded stainless steel components				
	2	Ratchet screwdriver with 10 and 13 mm sockets				
	1	Torque wrench				
	2	Utility knife				
	2	PVC union pliers, 50-100 mm				
	2	Socket set with 10 and 13 mm sockets				
	2	10 mm extension socket				
	2	Set of 10 and 13 mm spanner				
	2	Containment buckets for the nozzles (to avoid losing them)				
	2	PURON® PSH1800 module air nozzle wrench			From Kovalus	
	1	Toolbox with M16 and M20 wrenches and sockets				
		Paper towels, waste bins, appropriate personal protective equipment: gloves, safety shoes, and safety glasses.				
	1	PURON® fiber repair kit			From Kovalus	

- After removing the plastic panels in front and on the back of the module start to open the PVC unions for permeate and air manifolds on top of the module. Once do that start to extract one row of membranes at a time. Please note that each row can weigh up to almost 100 kg. Extract the row with at least 2-3 people, handling it with care to avoid breaking the PVC or ABS pipes. See the following figure 2 or in the O&M.
Be careful of the rows still on the module's frame, as they are free to move when the air and permeate manifolds are removed and they could fall off on the ground and get damage.
- For the three remaining modules in the membrane tank please try to keep them wet with water from time to time or fill the tank with clean water (permeate water) via backwash (liquid level up to cover the membrane fibers).



Fig.2 removal of membrane rows from the module

- For the removed rows, mechanically clean the membrane using several cleaning positions (at least 3 or 4) with pressurized water pipes and/or hoses (no pressure washers) as shown in the following images (Figure 3). With more stations and personnel available, it will be possible to speed up the work. Pressure of water to be used not more than 1 bar.

You need to find an area where you can work (even producing a lot of water and sludge and garbage) and place the base of the membranes on a horizontal surface with a wall to keep the membrane in vertical position (as shown in the images below). Please check that such a position will not put too much pressure on PVC and ABS pipes (they could break if the weight is too much or the position of the row is not well done). Since wipes/ hair or other debris can be entrap between the fibers take kind way (by hand) to remove it in order to avoid any damage or to break the membrane fibers. Please, if this happens report and mark the position (integrity test will be done on rows at later stage).



Fig.3 manual cleaning of membrane rows with water hoses

- After manual cleaning of the membrane fibers, the air nozzles of each individual row will be removed and manually cleaned as shown in the following pictures (Figure 4) and in chapter 10.4.1 of the PURON® PSH manual. **Please, before removing, observe the original position of the air nozzles in order to reinstall them in the proper direction.** There are 9 nozzles installed in each row, 1 nozzle per membrane bundle.

For such an operation, the row will be placed on table in a horizontal position. Such a job will require two people that would be responsible for removing and mechanically cleaning the nozzles. To remove the air nozzles in proper and safe way use a special “nozzle removal tool” (a wrench supplied by KSS = Kovalus).



Fig. 1 Nozzle removal set



Fig. 2 KSS nozzle wrenches



Fig.4 removal of air nozzles for one membrane row

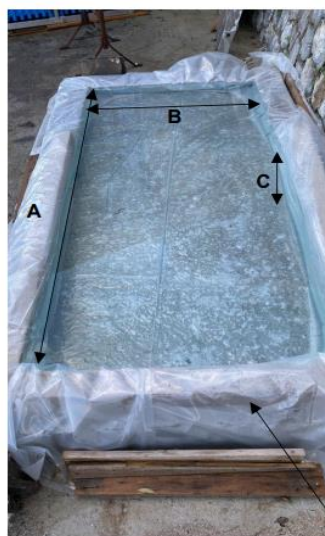
Once the air nozzles have been manually cleaned and the PVC air pipe has been rinsed, the nozzles could be reinstalled in their original position.

- As a final step for each membrane row, after everything has been completely cleaned (membranes and aeration system), an integrity test will be performed on each row using compressed air from a small portable compressor.

The membrane will be immersed in a tank specially prepared for this test to identify any potential breaks and/or mechanical damage that may have developed over time and due to mechanical cleaning of the row.



Dimensioni vasca per test di integrità



A - Lunghezza utile (interna): mm 2.600
B - Larghezza utile (interna): mm 1.200
C - Profondità (utile): mm 300-400

Telo impermeabile

Fig.5 integrity test tank

The test consists of pressurizing the permeate side (with air pressure need to be reduced to ~50 mbar) of each individual row to detect breaks (with the production of “big air bubbles”).

Each row has 2 PVC pipes. One pipe will bring air to the 9 nozzles, and one pipe collects permeate from the membrane fibers.

The “pressurization line” needs to be connected with the PVC union permeate pipe (not with the air). See figure 6



Fig.6 integrity test tank

If leak(s) is identified with the production of large air bubbles coming from the membrane fibers (see chapter 9 of the PURON® PSH operating manual), the necessary repairs will be carried out (with silicone or by making a knot below the damage) to try to restore the integrity of the membrane.

This operation will be carried out by one person, possibly with the help of a second person to move the row while they perform other tasks (cleaning the membranes or nozzles).

Of course having more than 1 person dedicated to this job it will speed up the work.

- Once the integrity test has been successfully completed, the row will be ready to be reinstalled on the module frame (see chapter 10 of the PURON® PSH operating manual and the new document shared by KSS).
- Once all membrane rows have been returned to their place on the frame, the plastic panels and manifolds will be reassembled as the last operation.

It is estimated that for one PURON® PSH1800 module with 38 membrane rows to be mechanically cleaned, it will take 3-4 working days to complete the above operations.

- Once the operations have been completed and the module has been reassembled, the crane will be free to reposition it inside the tank. “Dry” installation (tank empty) of the module as per chapter 6.3.12 of the operating manual.
- Once repositioned, tighten the nuts, washers, and bolts at each corner of the traverse to secure the module in the tank (to avoid floating).
- Reconnect the air and permeate pipes with the appropriate clamps to the general manifolds.

We need to repeat all the steps described above for all the remaining modules in one tank / train.

Once complete the mechanical cleaning of each module and the installation of the last module has been completed.

- Fill the membrane tank (via backwash with flowrate of 100 m³/hr = 15 LMH) with permeate water until the fibers are covered by liquid with 10-15 cm.
- Perform the integrity test with compressed air at 0.25 bar (250 mbar) on the permeate line. Use the same compressor used for integrity test of the row as described above. The injection point in the permeate line must be agreed on site (it is possible to use a sample tap or valve already present on the permeate pipe located between the pump and the membrane). Integrity test could take some time (even 1 hour).
- Once the integrity test on the permeate side has been successful, proceed in doing the "leak test" of the air-line.
- Turn on the blower at different frequencies (30 Hz-40 Hz) to check the tightness of all connections of the four modules. During aeration of the train, visually analyze the air distribution on the membrane modules and note the value discharge pressure on the nozzles (as a post-cleaning reference value).
- At the end of all these activities, depending on the urgency of putting the train back into service, a decision will be made on whether or not to perform a chemical recovery cleaning (with chemicals such as 12.5% sodium hypochlorite and 50% citric acid) as described in chapter 7.3.7 of the PURON® PSH operating manual. When this operation is performed, the train will be kept out of service for at least another 24 hours.
- Unlike the previous point, the train will be put back into service while carefully monitoring the first few cycles of operation.



Therefore, a minimum of 12-15 working days (excluding Recovery Cleaning operation) are required to completely restore one train with 4 PURON® PSH1800 module.