

HUBER Vacuum Rotation Membrane VRM® Bioreactor



Vacuum Rotation Membrane (VRM®) – Rotating plate membranes for MBR applications

The future-oriented solution designed for easy recovery of high quality service water (“ReUse”)

- Compliance with the latest legal standards (EC standards for bathing waters, California Title 22)
- The original – well-proven on more than 30 sites

►► The situation

Technical progress in the field of municipal wastewater treatment, including the removal of eutrophication pollution loads, has in the past few years significantly improved the process flow of sewage treatment plants.

Conversely however very little attention had been paid to the high number of germs and bacteria in the sewage treatment plant outlet. To prevent the risk, micro and ultrafiltration combined with the activated sludge process has proved in recent years to be a suitable method to minimise the effluent load whilst retaining at the same time pathogenic germs thus meeting the ever increasing and tightening discharge standards for sewage treatment effluents, without the need for the 'classic' aeration and secondary clarification tanks or filtration and disinfection plants.

Furthermore, the increasing drinking water shortage particularly in the conurbations of semi-arid and arid countries requires rethinking and consideration of at least the partial reuse of treated wastewater as service water. Membrane systems are able to meet all standards applicable for water to be used for field irrigation.

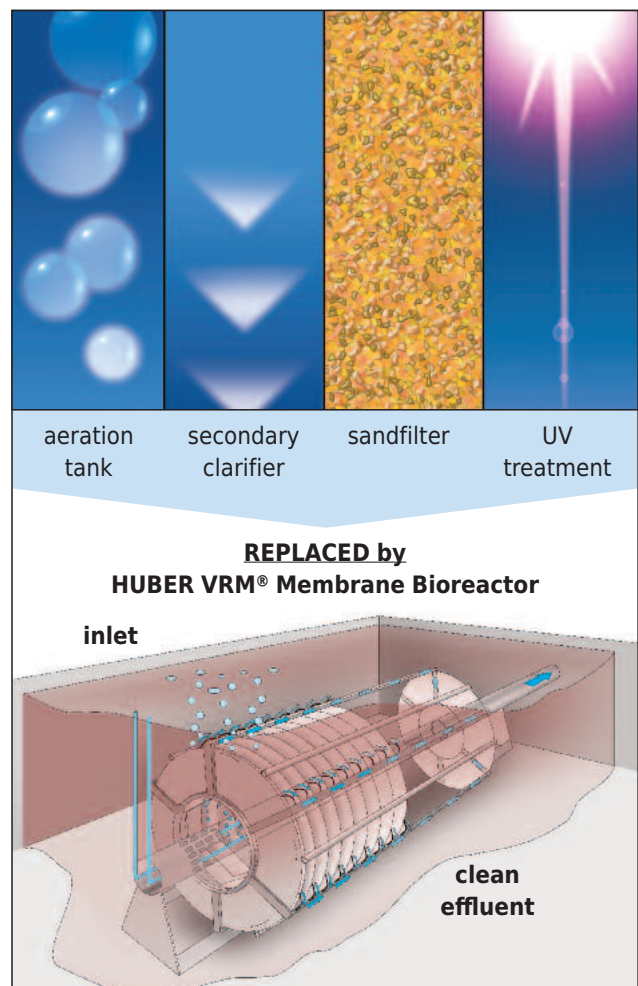
►► The solution

The HUBER VRM® process is a system of ultrafiltration membranes submerged within the aeration tank. The resultant high effluent quality meets the most stringent regulations whilst also allowing for the capacity to meet the increasing and higher disposal legislation anticipated in the future, with optimised investment and operating costs.

The HUBER VRM® system is a combination of biological wastewater treatment and high-efficient solids/liquid separation. The pre-screened wastewater is aerated, clarified biologically and all solids within the flow (particles, bacteria, viruses) removed by the ultrafiltration membrane in accordance with the low-pressure principle.

By increasing the concentration of the active biomass to 12 – 16 g/l we can improve the efficiency of a conventional wastewater treatment plant without the need to increase tank volumes.

Subsequent secondary clarification tanks, sand filters or a disinfection plant for advanced wastewater treatment are deemed unnecessary, with the improvement in the effluent quality produced. Existing secondary clarification tanks however can alternatively be used to allow for process optimisation.

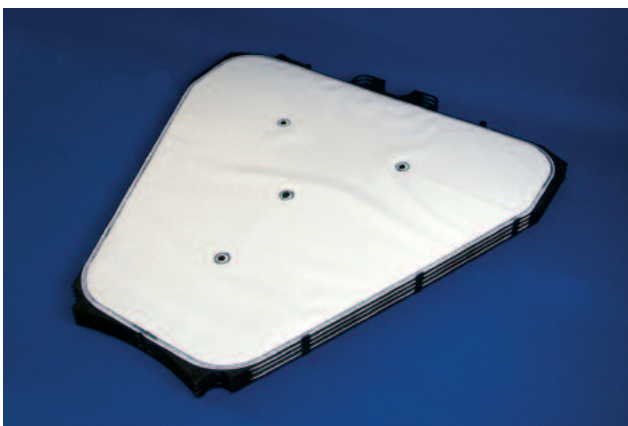
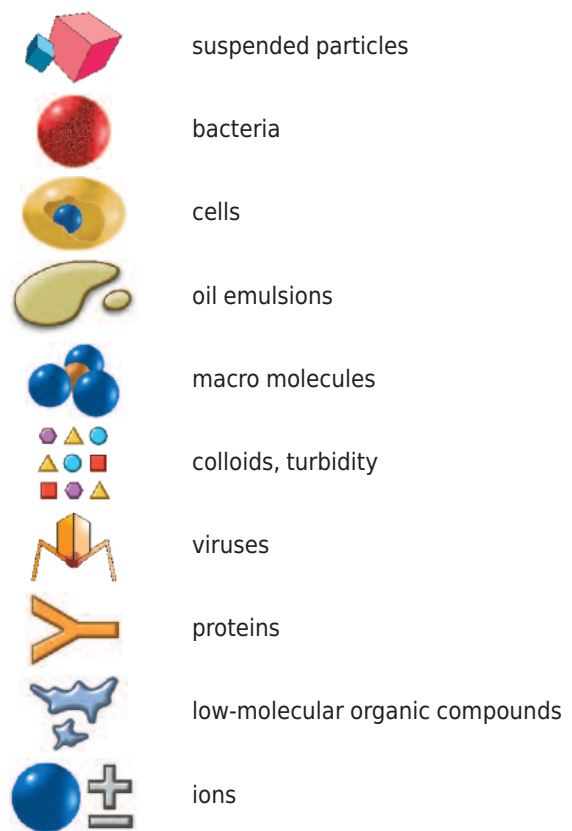
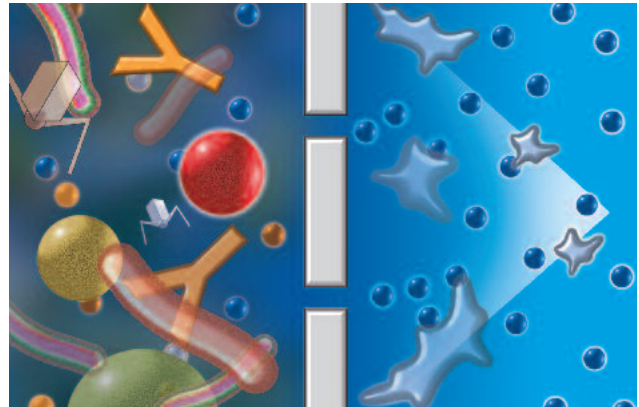


➤ The HUBER membrane principle

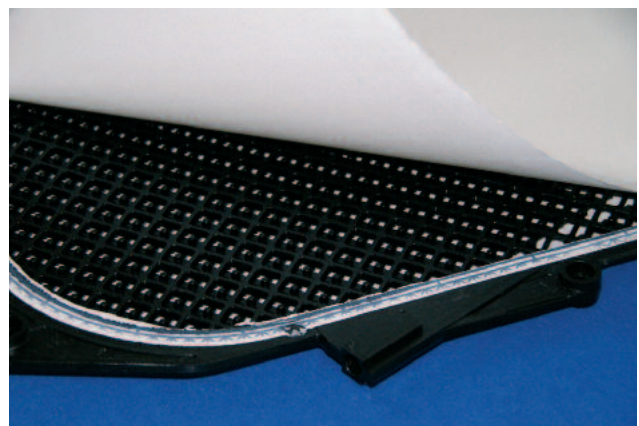
The principle of membrane filtration is based upon the separation of solids suspended in a watery solution by means of a pressure difference. While the water permeates through the membrane, the solids, bacteria and even most viruses are retained on the concentrate side on the membrane surface where they are removed by relative movement. The pressure differential necessary to pass the liquid through the membrane depends on the membrane pore size and membrane quality.

HUBER uses for all membrane systems high performance hydrophilic PES membranes which have very good filtration properties with a low affinity to fouling and covering layer forming material contained within the wastewater. The membrane pore size of approx. 38 nm lies within the ultrafiltration range. This allows high flow rates (up to 60 l/m²h) at a low transmembrane pressure (< 100 mbar) whilst retaining all solids, bacteria and the majority of germs. In addition to the liquid phase only ions and low-molecular dissolved substances pass through the membrane. Typical surface-related flux: up to 35 l/(m²h) at peak load.

The overflows required for a constant operation of the ultrafiltration membranes are achieved through a highly effective air flow on the concentrate side with only one sixth or eights of the installed membrane surface being intensively scoured at a time. Furthermore, intermittent scouring at low throughputs minimises energy costs.

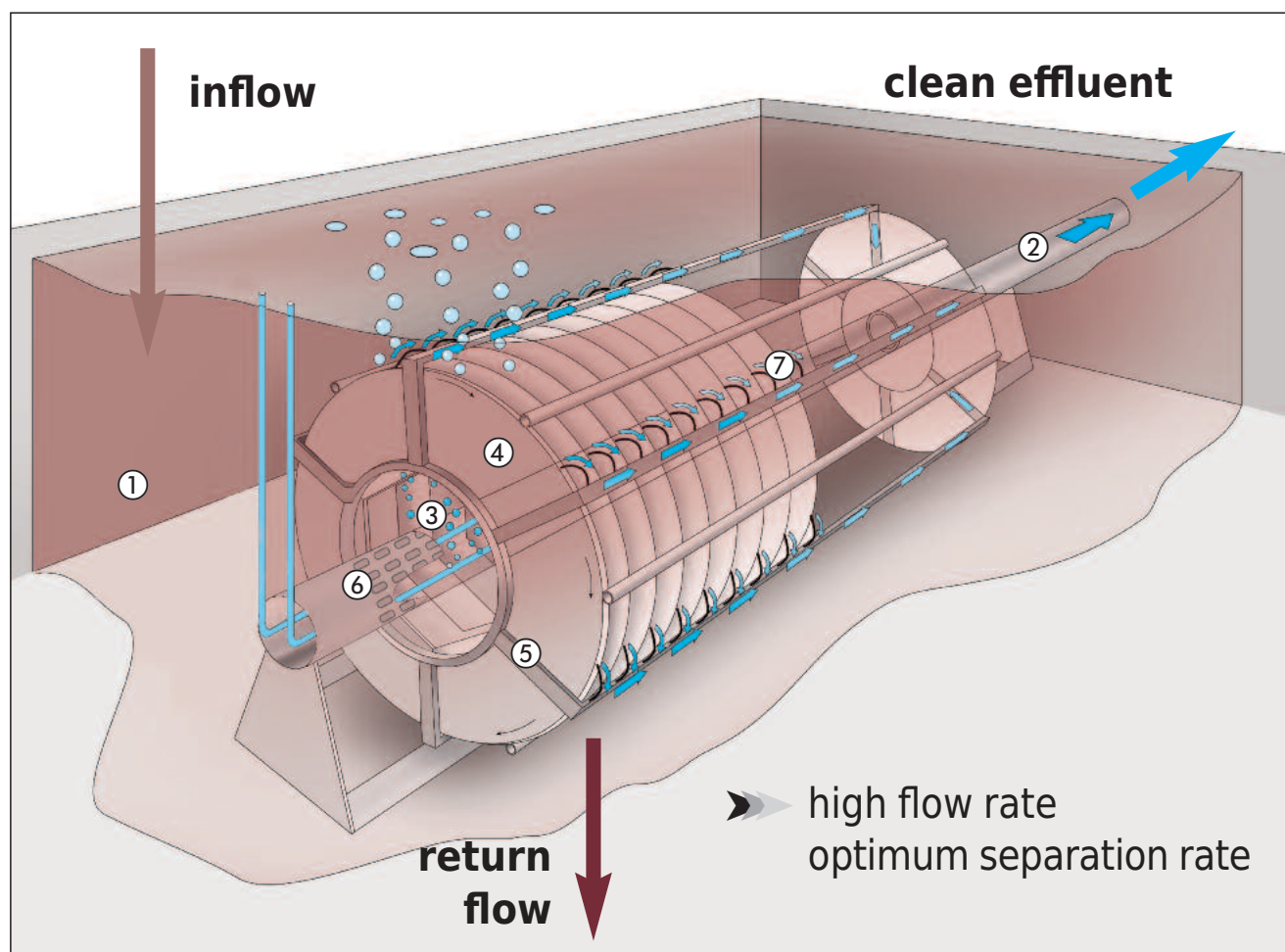


VRM® 30 module with 6 m² filter surface



Membrane carrier plate

➤➤ Flow diagram HUBER VRM®



- | | |
|--|----------------------------|
| ① aeration tank or filtration chamber | ④ membrane module |
| ② permeate discharge
(by hydrostatic difference or pumps) | ⑤ membrane segment |
| ③ scouring air inlet | ⑥ hollow shaft |
| | ⑦ permeate collecting pipe |

➤➤ Functional description

The complete VRM® unit is integrated in a support frame and submerged directly in an aeration tank ① or alternatively installed within a separate filtration chamber.

The system consists of a rotating hollow shaft ⑥ around which 6 or 8 UF modules are installed with pre-defined clearances between the modules.

The biologically clarified wastewater is sucked through the membranes due to the transmembrane pressure difference, the molecular separation size lying at 150 kDa, prior to being discharged ② via the permeate collecting pipes ⑦.

To prevent production of a covering layer and thus a decreasing flow rate as the liquid component of the activated sludge mixture is passing through the membrane, a **cross flow** is generated on the membrane surfaces through the introduction of air.

The innovation of the HUBER VRM® System is its efficient scouring system for covering layer control which eliminates the need for periodic backwashing.

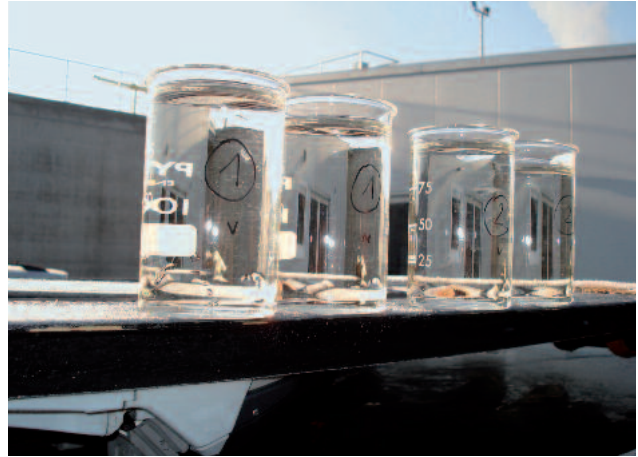
The principle of membrane cleaning consists in the generation of directed air flows whilst at the same time causing radial acceleration along the rotating membranes within the reactor. Only one individual membrane segment requires high-intensity cleaning, which consequently demands only a minimum energy requirement.

The HUBER VRM® unit can be installed into existing or new concrete tanks, or alternatively into stainless steel or steel tanks.

Chemical purification is dependent on system throughput capacity and required two to four times a year.

➤➤ The benefits

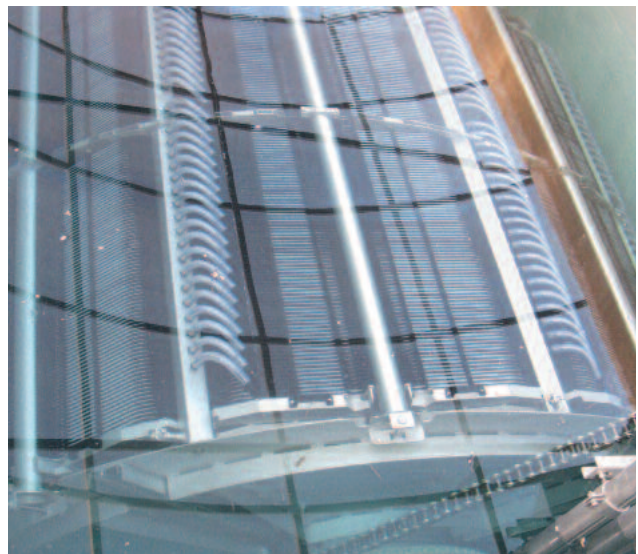
- Maximum effluent quality due to the complete particle separation => direct effluent reuse
- Compliance with hygienic standards due to the high bacteria and virus separation achieved by the UF membranes (37 nm, 150 kDa).
- High concentrations of active biomass allow for a reduction in the aeration tank volume by up to 70%.
- Membrane covering layer control with minimum energy consumption through sequential cleaning of the rotating membranes.
- Low operating costs due to minimum scouring air requirements.
- Reduced energy consumption for scouring air due to the centrally positioned air intake and low pressure.
- No periodic permeate back washing during filtration, no permeate loss and no continuous chemicals consumption.
- The transmembrane pressures are low and tranquil due to the high membrane permeability and subsequently have a positive effect upon the membrane life and minimise energy consumption.
- Innovative permeate discharge system prevents contamination on the permeate side.
- Complete stainless steel design for long life
- Easy identification and replacement of individual defective membrane modules (3 m² or 6 m²).
- HUBER provides its extensive experience gained over more than 8 years and proven by more than 30 installations.



Crystal clear water – the result of state-of-the-art wastewater treatment



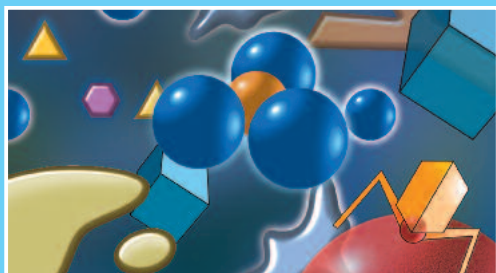
VRM® 20/300 – membrane unit installed on the industrial wastewater treatment plant GZM Lyss, Switzerland



VRM® 30/320 filtration unit in clear water at Jana, Croatia

➤➤ Standard designs of HUBER VRM® Bioreactors

- Up to approx. 4,000 m² membrane surface per VRM® unit
- Multiple unit installation in parallel allows suitability for any flow rate
- Applicable for both industrial and municipal wastewater
- More than 8 years experience, more than 30 installations
- Expertise in industrial wastewater treatment (e.g. textile industry, meat processing industry, etc.)

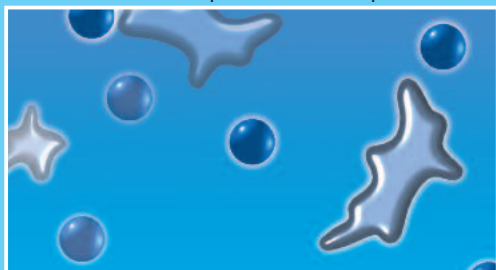


Raw wastewater / sludge



Microfiltration:

Particle separation > 0.1 µm



Ultrafiltration:

Particle separation 0.1 - 0.01 µm



Nanofiltration:

Particle separation 0.01 - 0.001 µm



4 VRM® 30/448 units installed on the municipal WWTP Arenas de Iguna, Spain



3 VRM® 30/544 membrane units installed on WWTP Hutthurm, Germany



Industrial WWTP, three VRM® 30/400 units with 7,200 m² installed at Hans Kupfer & Sohn GmbH, Germany

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