

HUBER Vacuum Rotation Membrane VRM® Bioreactor



VRM® – The rotating plate membrane for clean water applications. The future-oriented solution designed for the ever increasing requirements in wastewater treatment

- Virtually free from solids, bacteria and germs
- Allows for the reuse of treated water
- Compliance with the latest legal EC standards for bathing waters



►► 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.



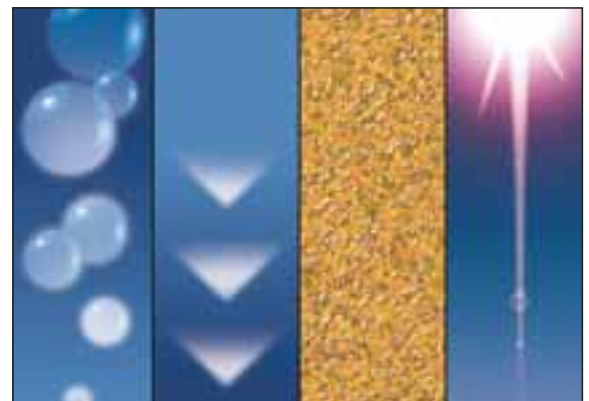
►► The solution

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.



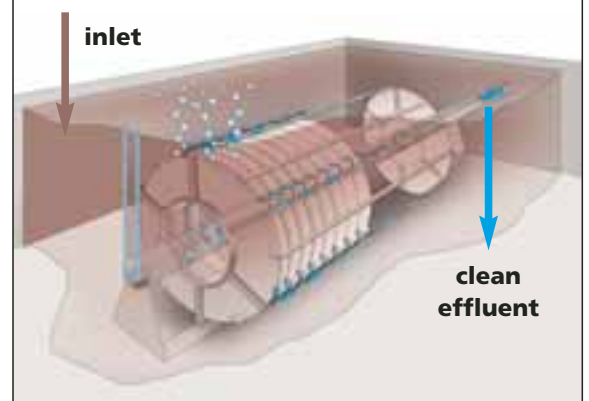
aeration tank

secondary clarifier

sandfilter

UV treatment

REPLACED by
HUBER VRM® Membrane Bioreactor

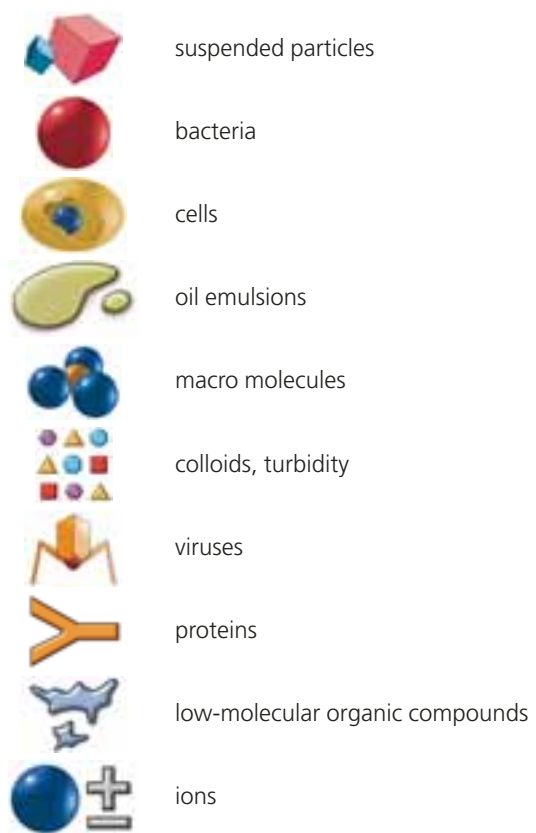
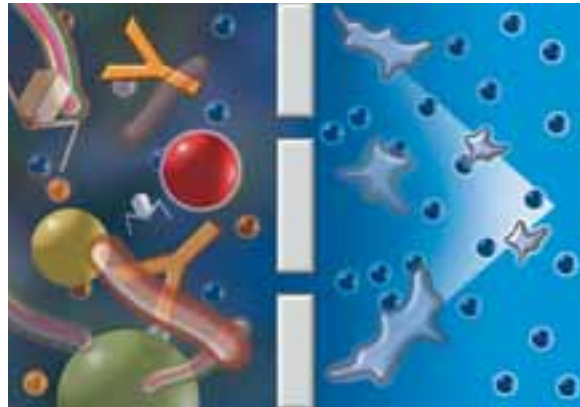


➤➤ The HUBER membrane principle

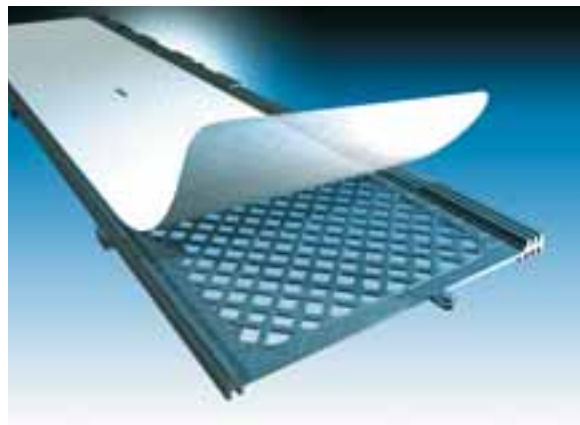
The principle of membrane filtration is based upon the separation of solids suspended in a watery solution by means of a pressure differential. While the liquid solution (in most cases water) permeates through the membrane, the solids are retained on the concentrate side on the membrane surface where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

HUBER utilises for all membrane systems a high performance hydrophilic membrane which has very good wetting 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.

The overflows required for constant operation of the ultrafiltration membranes are achieved through a special and effective air flow located on the concentrate side.

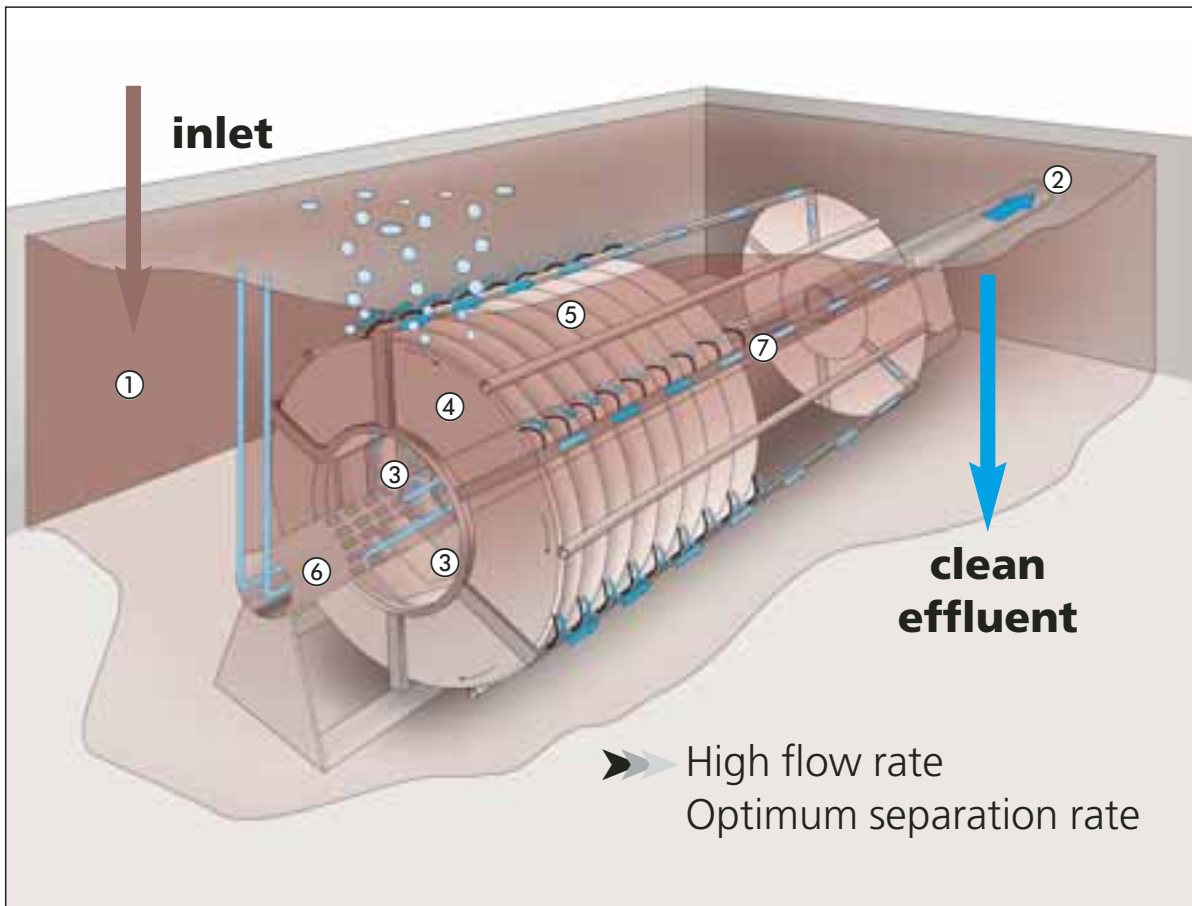


VRM[®] 20 module with 3 m² filter surface



Schematic of a membrane carrier plate

➤➤ Flow diagram HUBER VRM®



- | | |
|---------------------------------------|----------------------------|
| ① aeration tank or filtration chamber | ⑤ membrane segment |
| ② permeate discharge | ⑥ hollow shaft |
| ③ scouring air inlet | ⑦ permeate collecting pipe |
| ④ membrane | |

➤➤ Functional description

The complete HUBER VRM® Unit is housed within an integral support frame and submerged directly into the 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 predefined clearances between each module. The biologically clarified wastewater is then sucked through the membranes by the action of 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 reduction in the flow rate as the liquid component of the activated sludge mixture passes through the membrane, a cross flow is generated on the membrane surface through the introduction of air.

The innovation of the HUBER VRM® System is that the new, efficient and variable cleaning system ③ makes periodic backwashing completely unnecessary. The principle of membrane cleaning consists in the generation of directed air and medium flows whilst at the same time causing radial acceleration along the rotating membranes ④ within the reactor. Only one individual membrane segment ⑤ 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 our stainless steel "BioMem®" tanks.

►► The benefits

- Maximum effluent quality due to the complete particle separation from the liquid phase.
- Compliance with hygienic standards are met 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 removal with minimum energy consumption through sequential cleaning of the rotating membranes.
- Reduced energy consumption for scouring air due to the centrally positioned air intake.
- No periodic permeate back washing during filtration.
- Periodic disinfection of the permeate system prevents contamination on the permeate side.
- Fully automatic filtration, depending on the transmembrane pressure with automatic operation initiating the intensive cleaning cycle when differential pressures are exceeded. After return to normal pressure differential, filtration returns to its normal automatic operational sequence.
- The transmembrane pressures are low and tranquil due to the high membrane permeability and subsequently have a positive effect upon the membrane life.
- The rotating motion of the filtration module produces intensive turbulences within the reactor tank, such that no additional circulating units are necessary.
- The variable use of the scouring air allows a wide field of application (industrial wastewater, e.g. from laundries, with a high detergent content).
- Complete stainless steel design
- Modular construction allowing easy detection and replacement of individual defective modules (3 m² or 6 m² membrane).
- Removal of individual or complete membrane segments.



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



►► Standard designs of HUBER VRM® Bioreactors

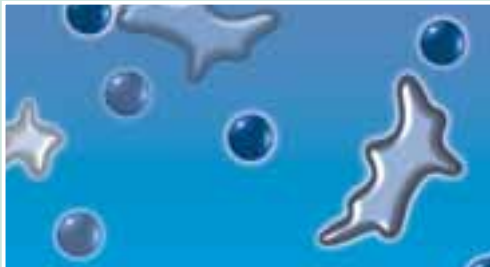
- VRM® size 20: 180 - 900 m² membrane surface
- VRM® size 30: 960 - 2880 m² membrane surface
- The maximum flow rate depends on the individual application conditions.
- Multiple unit installation in parallel allows suitability for any flow rate
- Applicable for both industrial and municipal wastewater
- Subject to technical modification.



Microfiltration: particle > 0,1 µm



Ultrafiltration: particle 0,1 - 0,01 µm



Nanofiltration: particle 0,01 - 0,001 µm



Reverse osmosis: particle < 0,001 µm



Industrial WWTP Raisio Chemicals with 2 VRM® 20/198 units, extendable to 2 VRM®20/252 units, with 1512 m² total membrane surface

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Subject to technical modification

**HUBER Vacuum
Rotation Membrane
VRM® Bioreactor**