



Combining the best of both worlds

New Hollow Sheet technology for membrane bioreactors

The filtration membranes used in membrane bioreactors (MBRs) are only one part of the overall set-up – but they are vital for achieving the best results. A reliable supply of effective membranes of a consistently high quality is crucial for maximizing the commercial success of MBR solutions.

Leveraging two technologies into one new

Two distinct membrane technologies – hollow fiber (HF) and flat sheet (FS) – currently widely used in the MBRs installed in wastewater treatment facilities.

Hollow fiber membranes make it possible to achieve

- backflushing
- high packing density

Flat sheet membranes have the advantage of

- less fouling/clogging
- gravity-based operation without pumps and other ancillary equipment
- Lower screening requirements
- operation at relatively low trans-membrane pressure (TMP)

The ground-breaking Alfa Laval membrane solution combines the best from each of these technologies into one membrane configuration with a completely new designation – “Hollow Sheet”.

The MFM unit

The Alfa Laval Membrane Filtration Module (MFM) consists of standardized packages of Hollow Sheet elements placed inside a stainless steel frame fitted with the appropriate connections. These Hollow Sheet elements are both taller and wider than anything else currently on the market.

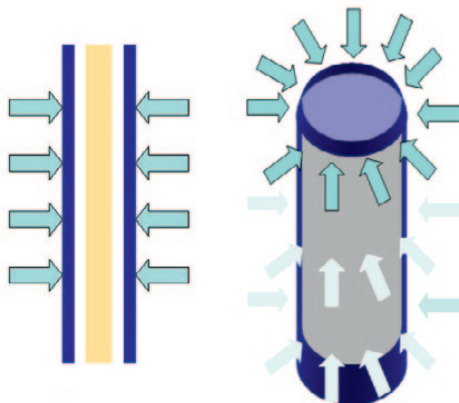


Fig. 1 Traditional FS and HF membranes



By providing an extremely compact, stackable design, the MFM unit enables you to achieve an unprecedentedly high packing density within any MBR tank.

This in turn makes it possible to reduce operating costs and ensure better quality effluent than ever before.

With the Alfa Laval Membrane Filtration Module, you benefit from

- fouling being virtually eliminated, which means extended membrane lifetime with hardly any cleaning
- exceptionally large membrane area in relation to the footprint enable compact design.
- special polyvinylidene fluoride (PVDF) membrane elements that are highly resistant to acids, caustic and oxidation processes
- substantially longer service life, with all-round savings on operating costs.

Alfa Laval and membrane filtration

Alfa Laval is Europe's largest developer and manufacturer of flat sheet membranes. You benefit in full because we also manufacture the actual membranes used in our filtration units. This means we retain full control over quality standards and are able to supervise them end-to-end.

As a result, our customers know exactly what they are buying – a top-notch, extremely reliable product with consistent quality in every delivery.

Experience counts

Alfa Laval's experience with membrane filtration dates back almost as far as the technology itself, covering reverse osmosis, nanofiltration, ultrafiltration and micro-filtration, in order of increasing pore size.

We provide the full range of membrane filtration equipment, including spirals, hollow sheet, plate-and-frame units, etc.

The MFM impact

The new Alfa Laval Membrane Filtration Module (MFM) is designed to boost efficiency and reduce operating costs for the filtration of biologically treated wastewater of both industrial and municipal origin.

The unique feature of the MFM design is that it operates with an exceptionally low TMP across the entire surface of the membrane. This means that mixed liquor is not squeezed against the membrane surface and significantly reduces fouling, which is one of the major constraints on the effective implementation of MBR technology.

The low TMP results in a considerable reduction of the need for cleaning, thus reducing both costs and downtime.

How it works

Mixed liquor flows upwards between the membrane elements while the permeate passes through the membrane sheet. To make sure this mixed liquor circulates effectively, air bubbles are used to create a cross-flow velocity. This also provides a scouring effect on the membrane surface. Regardless of configuration, air is added via one single aerator at the bottom.

A unique Alfa Laval design ensures that the permeate (cleaned effluent) is drained from the entire surface of the membrane and emerges all the way round the edges, exiting through connectors at the top of the unit.

This means the pressure drop over the membrane is close to zero and there are no dead spots on the membrane itself. This extremely low TMP means the membranes are significantly less prone to fouling, resulting in a longer lifetime and extended operating periods between cleaning.

And when cleaning is eventually needed, it is easy to deal with the entire membrane surface effectively using cleaning sequences that include relaxation, back pulse, Cleaning In Place (CIP) by circulation.

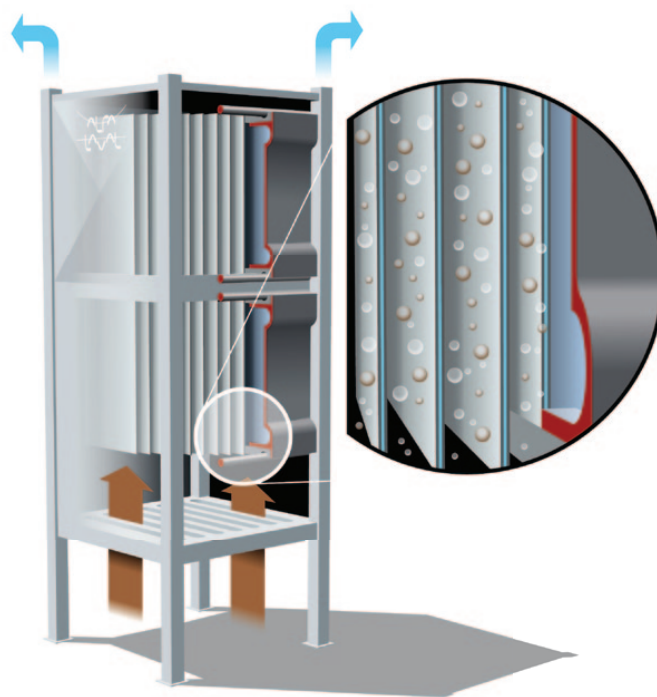
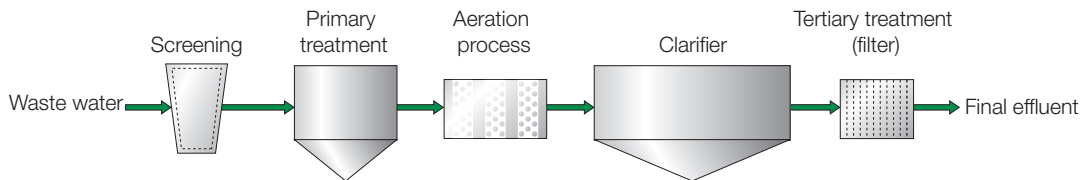


Fig. 2 The Alfa Laval Membrane Filtration Module with Hollow Sheet membranes visible

Features and benefits

- Less fouling thanks to even utilization of the full membrane surface
- Ultra low TMP - up to 10 times lower than hollow fibre and flat sheet membranes
- Robust module design for long module lifetime
- Simple system (fewer pumps and simpler control system needed) due to gravity-operated MBR
- Stackable design - better utilization of scouring air - making it energy-efficient
- Multiple cleaning methods - back flush, circulation and soaking
- Strong PVDF membrane suitable for multiple applications
- Compact design resulting in a high packing density.

Typical wastewater treatment process using conventional activated sludge



Typical wastewater treatment process using membrane bioreactor technology

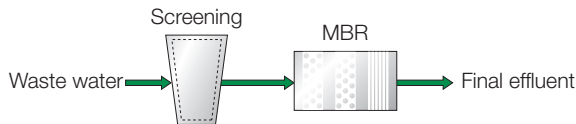
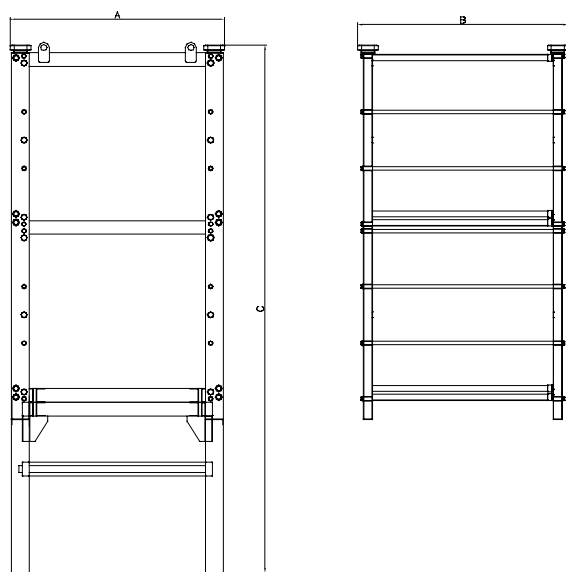


Fig. 3 Conventional vs. MBR wastewater treatment



Alfa Laval MFM advantages and benefits

- Extremely effective exploitation of the entire surface of the Hollow Sheet membrane
- Exceptionally high packing density, resulting in high filtration effect with small footprint
- Much less prone to fouling than conventional HF and FS filtration configurations
- Easy to clean, and with long intervals between any cleaning being necessary
- Membrane materials that are highly resistant to acids, caustic substances and oxidation, for extended service life
- Very low energy consumption – especially in double and triple MFM configurations
- Operation via gravity or vacuum, depending on specific MBR hydraulic configurations and requirements

Alfa Laval Membrane Filtration Modules for membrane bioreactors are available in the following standard sizes:

Module designation	MFM 100	MFM 200	MFM 300
Membrane area m ² /ft ²	154/1658	308/3315	462/4973
Number of stacked sections	1	2	3
Liquid capacity (volume displacement) l/gallons	311/89	606/178	900/266
Weight (dry) kg/lbs	379/836	721/1590	1053/2320
Packing density ratio m ² membrane/m ² footprint – (ft ² /ft ²)	129	258	388

Dimensions

	MFM 100	MFM 200	MFM 300
Width, A mm/inches	1122/44.2	1122/44.2	1122/44.2
Depth, B mm/inches	1062/41.8	1062/41.8	1062/41.8
Height, C mm/inches	1600/63	2878/113	3900/154

Scouring Air requirements NI/m ² /min.	MFM 100	MFM 200	MFM300
	8-9	4-5	3-4

Other standard modules of 25 or 50 and 100 m² are available for smaller flows.

Module data

Membrane type	MFP2
Membrane pore size	0.20 µm

Operating data

Typical TMP during operation	0.01-0.04 bar / 0.15-0.58 psig
Typical net flux range	10-30 LMH*/6-18 gfd*
Maximum temperature	50°C / 122 °F
pH range	1-11

*Depending on actual wastewater conditions and composition

Materials data

Module frame	AISI 316 stainless steel
Permeate and aerator piping	AISI 316 stainless steel
Membrane element and spacer	Polypropylene (PP)
Membrane	Polyvinylidene fluoride (PVDF)
Aerator type	Stainless steel piping – diffuser of the coarse bubble type
Connection at air inlet	2 inch BSP/NPT
Connection at permeate outlet	2 inch BSP/NPT

How to contact Alfa Laval

Contact details for all countries are continually updated on our website. Please visit www.alfalaval.com to access the information direct.