BIO-CEL®-Modules

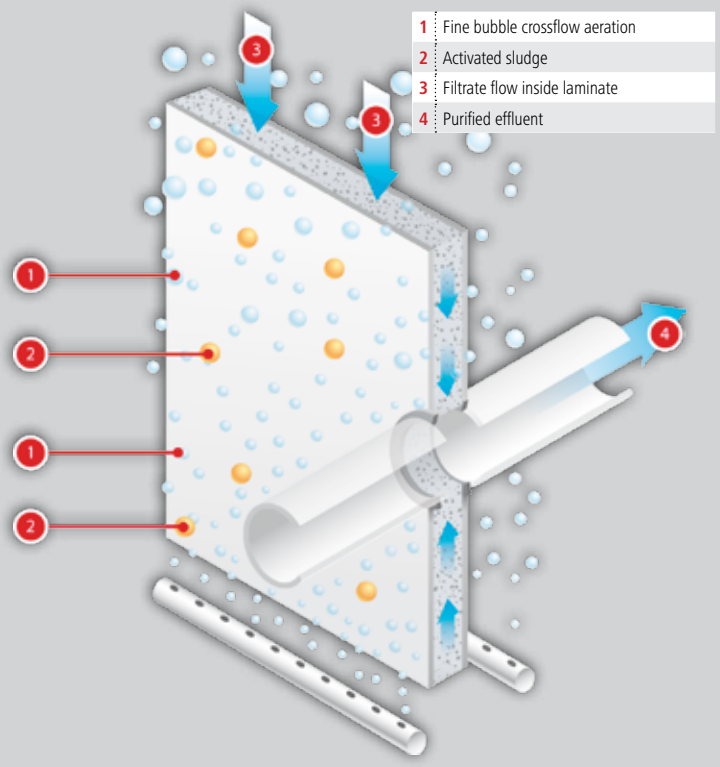
The Solution for state-of-the-art MBR-Technology

Backwashable - Self-Healing - Mechanically Cleanable

SELFHEALING MEMBRANE LAMINATE

MICRODYN NADIR

ADVANCED SEPARATION TECHNOLOGIES



BIO-CEL®

Submerged MBR Modules

Tighter discharge regulations, urbanization and the increase in water recycling have made Membrane-Biological-Reactors (MBR) the leading innovation in wastewater treatment through conventional activated sludge. Traditionally, activated sludge treatment relies upon solids settling in a secondary clarifier to separate the biomass from the treated wastewater. This process has the disadvantage of running at a lower MLSS (Mixed Liquor Suspended Solids), thus requiring more space and producing lower quality effluent. With MBR technology, the clarifier is replaced by a physical barrier – our BIO-CEL® membrane module. This physical barrier enables the MBR to operate at higher MLSS levels, thereby requiring a smaller overall footprint. The BIO-CEL® membrane separates within the ultrafiltration spectrum, producing high quantities of quality effluent at consistent flows. Efficiency, reliability and cost effectiveness, as well as long term viability, are just some of the characteristics of the BIO-CEL® module. The solids free effluent is suitable for recycling applications, such as irrigation or as feed for process water. BIO-CEL® combines the benefits of traditional hollow fiber and plate and frame configurations without any of their inherent disadvantages. The self-supporting membrane sheet is just 2 mm thick, resulting in an extremely high packing density and very low specific energy consumption.

The BIO-CEL® configuration is based on flat sheet technology, with crossflow eliminating clogging and reducing downtime. The module´s open top and bottom channels reliably prevent the deposition of sludge and fiber accumulation during the continuous crossflow process. The self-supporting structure of the membrane module enables frame-free installation, thus eliminating blockages around the external boundaries of each component.

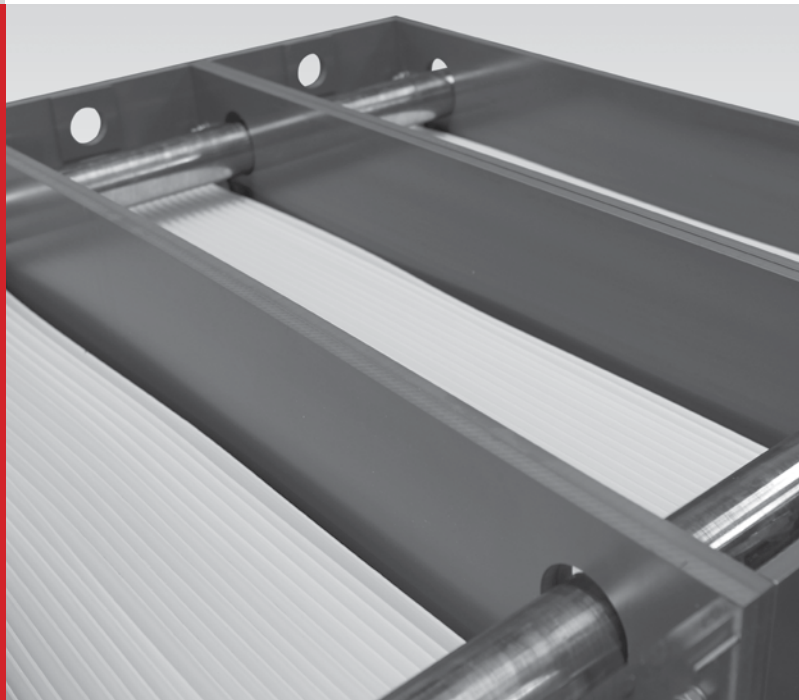
The membrane module is configured to allow for consistent permeate flow and a highly effective backflush over the entire membrane surface. In summary, the BIO-CEL® offers high packing density with optimal purification.

For large scale applications with a total inflow to the MBR plant of > 2,000 m^3/d of wastewater to be treated, the BIO-CEL® XL with a total membrane area of 1,900 m^2 has been developed.

ADVANTAGES

- » physical barrier for the retention of solids and bacteria
- » module design is unsusceptible to braiding/sludge deposits
- » backwashable with filtrate or with chemicals if required
- » high packing density
- » low energy demand
- » reliable performance
- » self-healing membrane laminate
- » fine bubble aeration

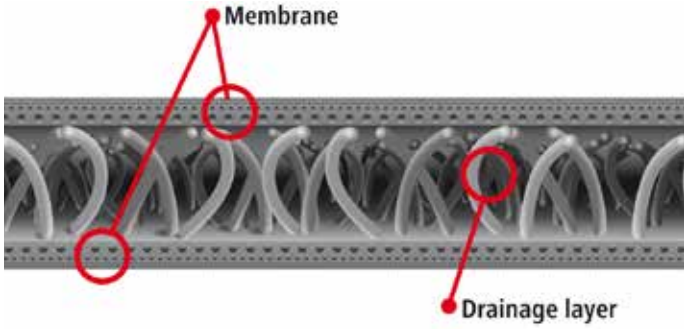
W W W . M I C R O D Y N - N A D I R . C O M



BIO-CEL®

For MBR-Systems
Innovative Membrane Laminate with Self-Healing Effect

Separation processes which are based on membrane technology are being applied more and more frequently. As membranes do not seem to be very robust per se, the question if membranes could be a suitable solution for "rough" applications arises.



Especially when considering wastewater treatment using MBRs the integrity of the membrane plays a significant role. The actual cleaning of the wastewater in the MBR process is being performed by the biomass in the system. The membrane used must now ensure the safe separation of the biomass from the cleaned wastewater. Superficial damages to the membrane should therefore not compromise this.

If membranes are being installed in a wastewater treatment plant for many years possible damages to the membrane cannot be avoided – may they be caused by a screwdriver or any other debris falling into the filtration chamber. Indeed membranes are "vulnerable" but when using the appropriate module construction superficial damages to the membrane will not result in a serious problem.

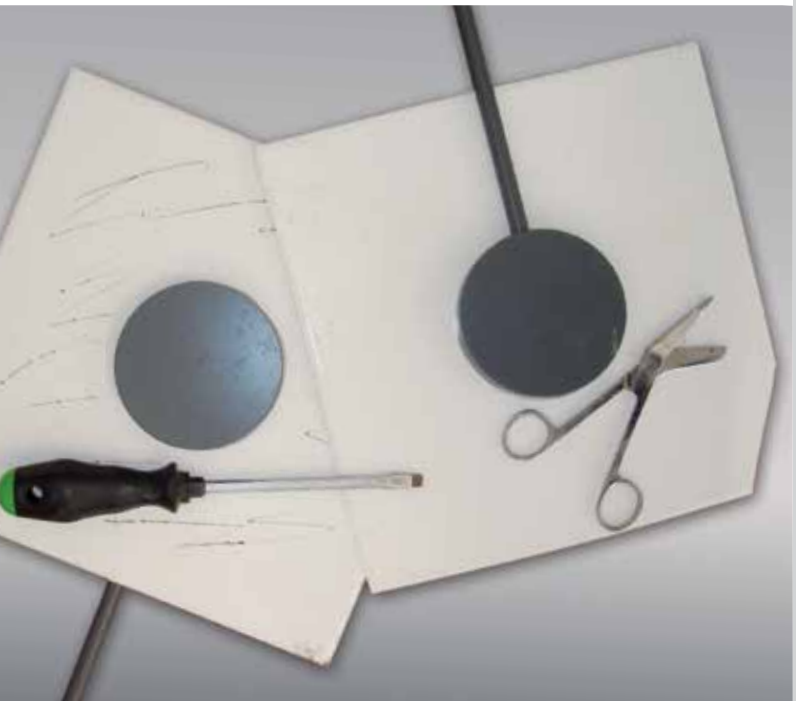
In conventional plate and frame modules the membranes are mounted on a plastic plate and then glued or welded onto the frames. A hole in the membrane will then inevitably lead to a by-pass of unfiltered wastewater from the plant.

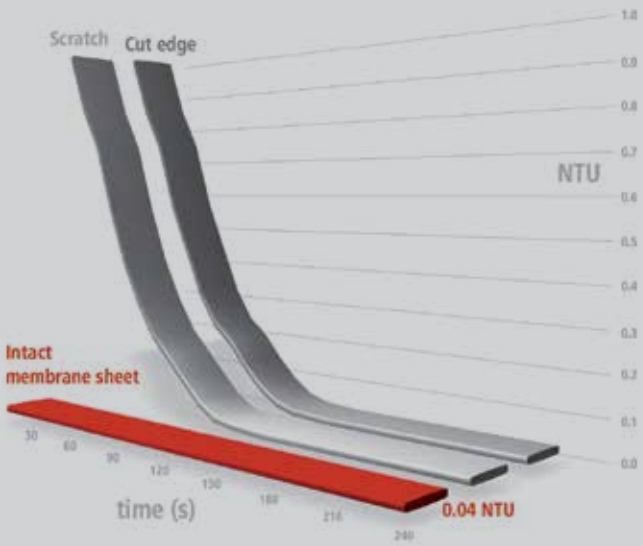
With the laminate used in the BIO-CEL® module MICRODYN-NADIR has found a way to solve this problem. Instead of fixing the membrane on a mounting plate from both sides, the membrane is being laminated from two sides onto a special spacer material.

Subsequently, "laminate sheets" are being cut out of this laminate and welded on the sides. The suction of the clear filtrate is done through a permeate hole in the center of the sheet.

In case of damage caused to the membrane the spacer material allows for a sealing of the damage through the help of the biomass in the system. Even after the occurence of a severe detraction of the membrane laminate, solids and bacteria can still be rejected by the membrane laminate.

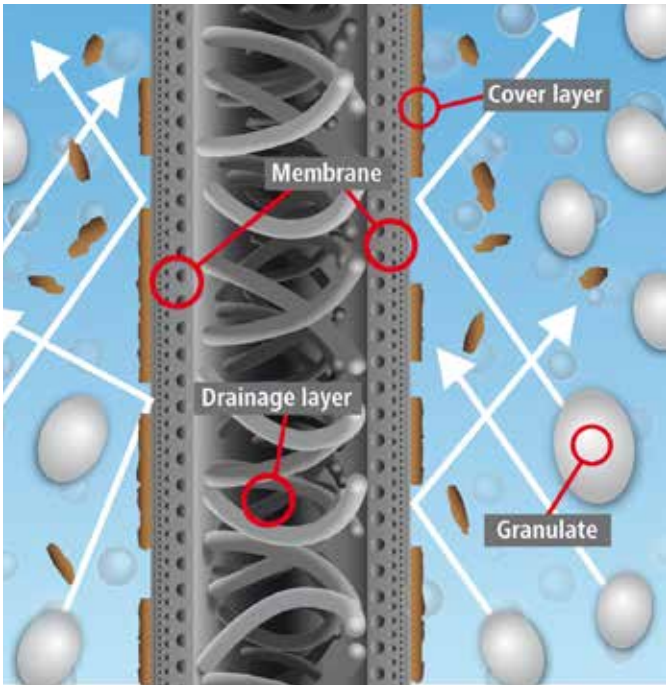
Laboratory tests have proven that the membrane laminate "heals" itself in less than two minutes even under worst case conditions.





Energy optimization through BIO-CEL®-MCP

(Mechanical Cleaning Process)



As a further process-integrated feature, the BIO-CEL® membrane module can also be cleaned mechanically, through the use of the patented BIO-CEL®-MCP [2)] (Mechanical Cleaning Process), which helps to reduce operating costs as well as to minimize the energy demand. This innovative process reduces the formation of a fouling layer. The membrane cleaning process is being supported by the crossflow aeration and the use of the cleaning efficiency of inert, organic material (MCP granulate).

The MCP granulate is added directly into the activated sludge. The airflow induced by the module-integrated membrane aeration system draws the MCP granulate up between the membrane sheets. As the MCP granulate rises, the membrane area is continually cleaned through the direct contact of the granulate with the sludge on the membrane surface. The fouling layer formed during the filtration process is removed reliably without compromising the functionality of the membrane.

In the downstream area outside the membrane modules, the current draws the granulate back to the base of the module where it enters again into the upstream flow. The MCP granulate has been designed for permanent usage. It is retained in the filtration tank by suitable separation systems.

This mechanical cleaning can only be used in conjunction with BIO-CEL® modules, because other module types do not incorporate the required constructional and hydraulic characteristics to perform a mechanical cleaning.

Long-term testing shows that a chemical free operation is possible. The efficiency and reliability of the MCP technique could be proven by the continuous operation of a pilot plant for two years. Other large scale applications have been operating successfully for a number of years.

MAJOR ADVANTAGES OF THE BIO-CEL®-MCP:

- **BIO-CEL®-MCP mechanically removes the cake layer from the membrane which significantly enhances the flux.**
- **Cost efficient process through a minimization of the installed membrane area and significantly lower energy demand as a result of reduced air sourcing requirements due to an enhancement of the specific flux**
- **Continuous membrane integrity – stable and reliable effluent quality**
- **No or low demand for chemical cleaning – thus, a continuous filtration process is possible**

Note: The Mechanical Cleaning Process (MCP) for BIO-CEL® membrane bio reactors was developed by MICRODYN-NADIR (S. Krause), Darmstadt Technical University (Peter Cornel) and Osnabrueck University of Applied Sciences (Frank P. Helmus and Sandra Rosenberger).

BIO-CEL® Membrane Material

Polymer	MWCO	Pore Size	Support Layer	Drainage	Chlorine Resistance
Polyethersulfone (PES)	150 kDa	0.04 µm	Polyester	Polyester	500 000 ppmh

BIO-CEL® Module and Operating Data

Parameters	BC10F-C10-UP150 [1]	BC50F-C25-UP150	BC100F-C25-UP150	BC416F-C104-UP150 [2]	BC XL-1 [2]
Membrane surface	10 m²	50 m²	100 m²	416 m²	1900 m²
Frame material	PVC	PE	PE	PE	Stainless Steel 1.4571
Cassette material	-	PVC	PVC	PVC	Stainless Steel 1.4571
Dimensions [mm]	610 x 154,5 x 1610	702 x 694 x 1563	702 x 1270 x 1563	1152 x 1298 x 2763	2100 x 2800 x 2650
Operating pressure	-30 to -400 mbar	-30 to -400 mbar	-30 to -400 mbar	-30 to -400 mbar	-30 to -400 mbar
Max. Backwash pressure	150 mbar	150 mbar	150 mbar	150 mbar	150 mbar
Max. operating temperature	40 °C	40 °C	40 °C	40 °C	40 °C
pH-range	2 – 11	2 – 11	2 – 11	2 – 11	2 – 11
Max. air flow rate (Vn) [3]	6 m³/h	30 m³/h	60 m³/h	140 m³/h	665 m³/h
Recommended content suspended solids (SS) [4]	12 g/L	12 g/L	12 g/L	12 g/L	12 g/L

Note: (1) Only for piloting purposes // (2) Excluding extra feet // (3) Vn is the volume flow rate at standard conditions according to DIN ISO 2533:1979-12 //
(4) Other concentrations possible. Please consult your MICRODYN-NADIR representative

BIO-CEL® Membrane Module

Decoding of the product code: **BC50F-C25-UP150**

Type	Frame Size	Cassette Size	Membrane Type
BIO-CEL® module	10 m²	10 m²	Ultrafiltration 150 kDa
	50 m²	25 m²	
	100 m²	25 m²	
	416 m²	104 m²	
	1900 m²	475 m²	

Final sizing and selection has to be approved by an official MICRODYN-NADIR representative. Please contact **phone + 49 611 962 6001** or **www.microdyn-nadir.de**

1 m² ≙ 10.764 ft² | 1L ≙ 0.26 us-gal. | 1" ≙ 2.54 cm

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MICRODYN NADIR

ADVANCED SEPARATION TECHNOLOGIES

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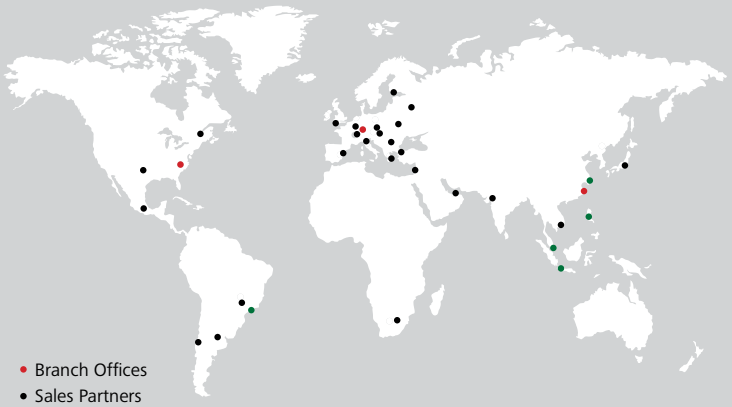
SEPARATION – OUR PASSION

For more than 45 years, MICRODYN-NADIR has developed innovative membranes and membrane modules for micro-, ultra- and nano-filtration as well as solutions to support our customers' needs in operation, performance, efficient membrane processes and regulatory compliance.

We will deliver products, information and services, which fully meet or exceed customer expectations. Our team focuses on continual improvement to achieve the highest possible level of customer satisfaction and to be recognized by our customers as the technology and quality leader.

We are not satisfied until our products have been successfully integrated into your customers' plants and processes. That is our passion.

Our quality system is designed to support these goals.



WE SUPPORT YOU – WORLDWIDE!

- Global availability
- Intensive technical consulting
- Ideal choice of membranes and modules
- Support with engineering and plant design
- Laboratory and pilot tests
- After Sales Service

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