MICRODYN NADIR

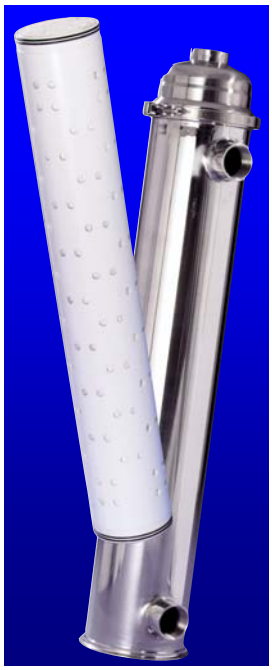
ADVANCED SEPARATION TECHNOLOGIES

MOLSEP®

Hollow Fibre Cartridge

General Instructions and Technical Information for the Use of

FN 20 / FK 20



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1. Introduction

This instruction brochure is intended to provide general information only. For further details, please contact your local representative of MICRODYN-NADIR Filtration.

Please read the following instructions carefully before handling all MOLSEP® Hollow fibre modules. Observe the recommendations and operating conditions very care-fully. Wrong handling or operating conditions can lead to decreased performance or even to module damage. In case of questions or problems, please contact your sales representative or our technical customer service at:

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NOTE:

This information is based on our latest state of knowledge and is intended to provide only general notes on our products. At any time we reserve the right to make modifications due to new developments. Any existing property rights must be observed. Our products are sold under our General Conditions of Purchase and Sale. NADIR Filtration does not accept any warranties other than these stated in our General Conditions of Purchase and Sale. Explicitly, we do not give performance or lifetime warranties. Our products are ultra- and nanofiltration membranes and devices which are intended for use by especially trained personnel only. We do not accept liability for any inquiry or damages to persons, equipment or products caused directly or indirectly by the use of the products offered herein. Any warranty for product delivered in a defective state is limited to replacement of said product only.

2. Description of MOLSEP® Hollow Fibre Module

MOLSEP® Hollow Fibre Modules are based on the doubly asymmetric MOLSEP membrane providing high mechanical strength. This and the wide range of membrane types make MOLSEP Hollow Fibre Modules suited for all applications that re-quire high packing density and purity Membranes of various cut offs made from polyethersulfone, polyacrylonitrile and cellulose acetate are available. Hollow fibre inner diameters range from 0.5 mm to 1.4 mm, module sizes from 10 to 17 m^2.

MOLSEP® Hollow Fibre Modules have proven particularly successful in wine filtration, pure water production, for pharmaceuticals and electronics as well as surface water treatment.

Membrane material	Type	Feature	Application
Polyethersulfone	FUS	High chemical resistance, double-layered	Pure water for pharma-ceuticals and electronics, wine, vinegar and juice filtration
Polyacrylonitrile	FUY	hydrophilic, double-layered	Juice filtration, pharma
Cellulosetriacetat	FUC	very hydrophilic double-layered	(surface) water treatment

Table 1: Applicable Pressure Limits for Different Operating Temperature

3. Module Selection

As the application suitability for each module is limited, determination of the module and membrane feasibility are best achieved by preliminary tests using a pilot test system.

4. Condition as Supplied

The quality control of each MOLSEP® Hollow Fibre Module is composed of following steps.

1. Inspection of Hollow Fibre Leakage
2. Inspection of Water Permeability
3. Dimensional Inspection
4. Appearance Inspection
5. Inspection of Air-Tightness

Delivered modules have passed all these steps!

The module is filled with 20 % propylene glycol and 1 % benzoic acid to prevent the fibres from being dried out and inhibit biofouling while transport and storing.

For the module, measures against freezing in the range of about –7 °C are taken.

5. Handling the Module

Transportation of a MOLSEP® module

The impact on a module by falling or collision may cause the module to crack or break. Transportation and handling of a module should be carried out with sufficient care.

Freezing of modules

Freezing of the module will cause the membrane and vessel to crack. Hence, freezing must be avoided. Handle and store the module in the environment at higher than 0 °C.

Drying of a MOLSEP® module

The module is sealed in its package. When the module is taken out of the package and left uncontained, the membrane can dry out. Drying of the membrane may result in irreversible damage. Sealing is necessary for long-term storage.

Organic solvents

Contact of module casing with organic solvent must be avoided. It is possible that the contact of a module casing with an organic solvent or the use of a splicing tape leads to damage of the casing. In order to remove soiling from the casing, the casing should be wiped with water or ethanol.

Sun / UV Exposure of a MOLSEP® module

Exposure to direct sunlight or ultraviolet rays from such sources as germicidal lamps, even indoors, may deteriorate components of the module. Modules should be stored in the dark.

Dead-end Filtration

If the concentrate outlet is plugged (dead-end mode) the filtration capacity will reduce rapidly.

Returning a MOLSEP® module

In the case of returning a module to MICRODYN-NADIR Filtration, please inform the MICRODYN-NADIR Filtration representative of the module serial number. Cleanse the module, fill it with preservative solution, seal watertight, package carefully to avoid transport damage and send it to the indicated destination.

6. Mounting the Module

While designing and installing the piping, please take into consideration that the module must be installed free of mechanical stress. Flexible tubing should be applied (if possible) to compensate vibrations and thermal expansion of the pipes and the module.

The module should be attached for use in the following procedure:

1. Take out the module from packing and check whether the module has been damaged during the transportation or not.
2. Before mounting a module, system and tubing should be cleaned to make sure that residual foreign matter and oily materials from the system cannot enter the module.
3. Drain the preservative solution used for shipping before mounting the module. If the module from which the preservative solution is drained is left as it is for a long time, the module will be

contaminated and dried at the inside. This results in the reduction of the capacity of the membrane module.

4. Use a clamping ring to attach the module to the plant!

   Attach the module in such a way that liquid will flow in the liquid-flow direction due to the arrow mark on the module label. First connect the feed clamp, then connect the concentration clamp and last the permeate outlets. Make sure that no distortion is caused in each connecting point. Then, carry out the regular clamping alternately. Over-tightening may cause the connectors to break! Thus, sufficient care is necessary!

   Take care to avoid slipping of the seals while mounting the module.

5. Please avoid excessive stress on the module caused by dislocating piping and connectors.

7. Start-Up Procedure

1. **Removal of sealing liquid**

   For the purpose of removing the sealing liquid remaining in the module, it is necessary to rinse the module by using pure water (demineralised water, etc.). Make sure of no leakage from the connection points of the apparatus. If leakage occurs, stop the operation and take measures such as further clamping.
   It is very important that residual air is completely removed from the system by low pressure operation. Increase gradually the amount of rinsing water to that of water specified for regular operation and carry out the rinsing for at least 20 minutes. In this case, drain completely the permeated water and the concentrated water.

2. **Filtration of feed**

   It is very important that residual air is completely removed from the system by low pressure operation (prevention of air hammer).
   Avoid increasing rapidly the pressure and the flow rate at start-up. Adjust gradually them to the specified conditions and then operate the apparatus.

8. Operating Conditions

In datasheet you will find the limits of operating conditions. In order to control the flow rate and pressure of the system, it is necessary to equip the membrane system with flow rate regulating valves, pressure regulating valves and measurement instruments (not part of supply).

The optimal flow rates differ depending on. A high flow rate limits the formation of a fouling layer on the membrane and keeps the permeate flux on a high level.

The permeate flux also depends on the transmembrane pressure. Take into account that high filtration pressures raises thickness and density of the fouling layer and may result in decline of permeate flux.

pressure drop:

$$\Delta p = p_{IN} - p_{OUT}$$

transmembrane (operating) pressure:

$$p_{TMP} = \frac{p_{IN} + p_{OUT}}{2} - p_{Perm}$$

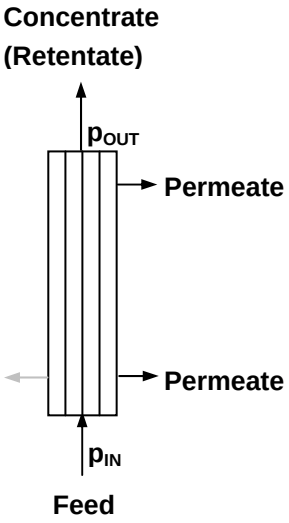

Figure 1: Pressure Input - Output

NOTE:

It is necessary to find optimal flow rate and transmembrane pressure by carrying out preliminary tests!

9. Cleaning and Regeneration

During operation of the module, the filtration capacity will reduce gradually. It is ne-cessary to recover the performance by periodic cleaning. Some cleaning systems will be described below.

Cleaning by circulating water

Stop the feed supply. Drain the feed tank and the whole plant. Fill pure water in the feed tank. Prior to circulation, a short term of rinsing to substitute water for the liquid remaining in the module. During rinsing drain the concentrate.

Switch the valves in this way that permeate and concentrate will return to the feed tank (cleaning modus). Then circulate the pure water with the feed pump for about 20 minutes. Drain the feed tank and the whole plant and then return to the filtration mode.

Cleaning by forward backward switching

In the apparatus shown in Fig. 6, the feed supply can be switched to flow in the for-ward or backward direction. This cleaning is effective in removing clogging matters at the end sides of the module. Moreover, this method combined with cleaning by backwashing is expected to have a high cleaning effect.

Cleaning by backwashing

The feed pump is stopped and the valve on the permeated liquid side is closed. The permeated liquid is pushed by the backwashing pump through the permeate port at a low pressure and flow rate. The permeate runs through the pores of the membrane in opposite direction. The fouling layer on the

membrane surface is removed and discharged from the system through the con-centrate outlet. The optimal interval of backwashing depends on the recovery of permeate flux and the loss of backwashed permeate.

NOTE:

Only permeate is suitable for backwashing!

Cleaning by chemicals

When the flux recovery with water is insufficient, it is recommended to carry out the following chemical cleaning.

Inorganic Soiling:

- citric acid: 1 - 2 % or
- oxalic acid: 1 - 2 %

Organic Soiling:

- NaOH : 0.05 – 0.5 %
- NaOCl : 100 – 500 ppm (effective chlorine)

Provide a chemical solution into a cleaning tank. Circulate the solution in the ordi-nary operation conditions so that the permeate and the concentrate are leaded back to the cleaning tank. Continue this circulation operation for 30 – 60 minutes. Discharge chemical solution from the system and rinse with pure water for 20 minutes

10. Pasteurisation

The following methods of pasteurising the module are recommended:

- Circulation cleaning for 30 minutes by using 200 ppm sodium hypochlorite (NaOCl) aqueous solution.
- Circulation cleaning for 80 minutes by using 1% Formaldehyde aqueous solution.

11. Long-term Storage

Clean thoroughly the module and keep it in a wet state. Use either of the following preservatives in order to prevent biofouling during storage.

- Formaldehyde: 0.5 %
- Sodium bisulfite ($NaHSO_3$): 1 %

Close the module with the original caps. Store the module in a horizontal position. Prevent the module from direct sunlight. The storage temperature should be in the range of 5 – 30 °C.

12. Module Lifetime

The end of the module's lifetime has been reached, when the separation characteristics of a module cannot be restored by cleaning, or when permeate flux has de-graded considerably. Please contact your representative of MICRODYN-NADIR for re-placement.