MICRODYN NADIR

ADVANCED SEPARATION TECHNOLOGIES

Manual

SEPRODYN®-Modules with PE-Membranes

Standard program of MICRODYN-NADIR for microfiltration

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1. Crossflow-Microfiltration - Technical Information

Instructions for the Use of SEPRODYN® Modules

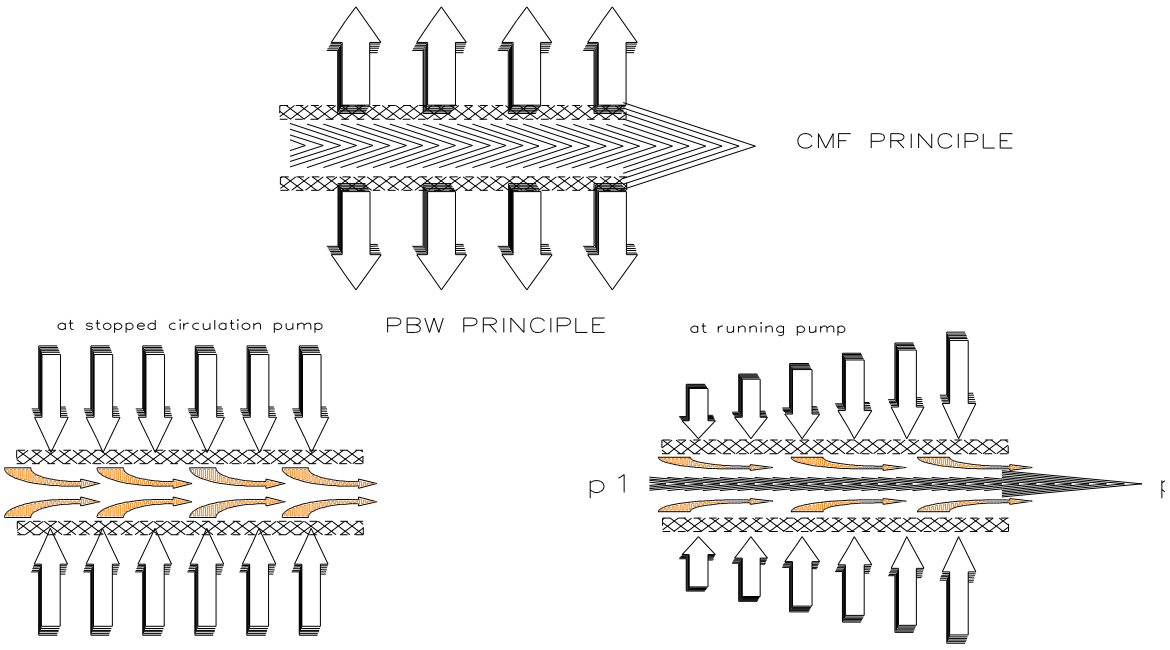

Figure 1: Principle of CMF and Periodical Back Pulse (PBP)

SEPRODYN® modules have been developed for crossflow microfiltration (CMF), a modern filtration procedure for separating suspended solids and for low concentrated emulsions.

The separated particles form a deposit layer which is reduced to a very low thickness by means of

a) shearing forces at the membrane surface due to tangential flow

b) periodic back Pulse (PBP) of the membrane.

Both procedures contribute to high and stable flux efficiency.

The microporous membranes are self-supporting and have a very narrow pore distribution. All module types can be cleaned with the periodical back pulse (PBP) technique.

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2. Materials and Basic Module Design

SEPRODYN® modules contain a bundle of tubular membranes made of polyethylene (PE) that is tightly potted at both ends with a tubular casing and a cap made of polypropylene, polysulfon or high-grade steel. (Figure 2) This way a space is formed for the clear permeate and the retentate.

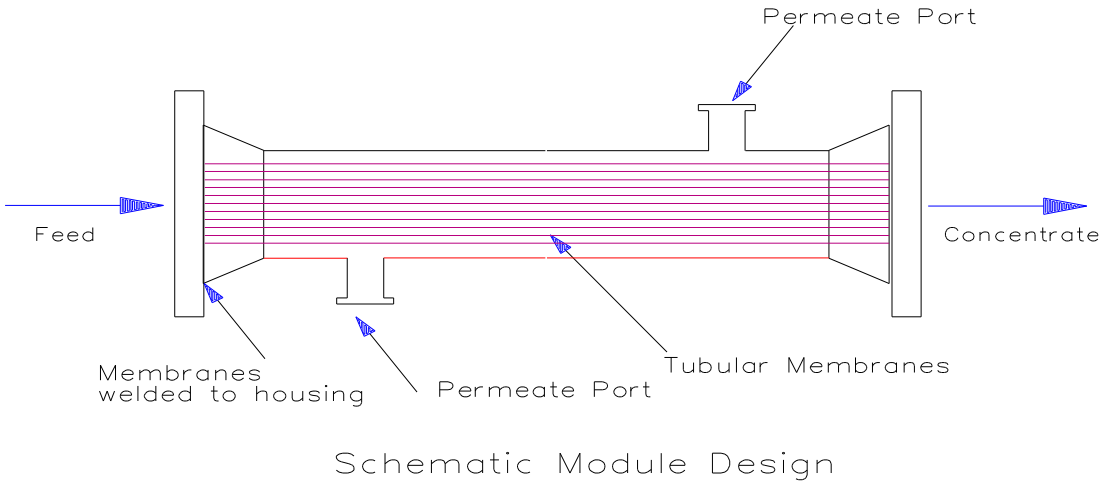

Figure 2

The tubular membranes made of PE are welded together with an end cap made of polyethylene which is tightly pressed in the casing.

The most important geometric dimensions and measures are found in the data sheets (for download on www.microdyn-nadir.de). Additional materials, e.g. O-rings, are also listed in these sheets.

O-rings with a certificate have to be required separately.

3. Pore Size

SEPRODYN® modules contain a PE-membrane with a pore size of approx. 1,0 micron. These membranes are made symmetrically. The separation of substances occurs at the membrane surface.

4. Module Position and Activation

SEPRODYN® modules can be installed into a system vertically as well as horizontally (figure 3). Each module shows two permeate outlets, normally only one is used during filtration. The position of the outlet should be at the end of the module (low pressure side) if it is in a horizontal position.

A horizontal position is recommended for filtration of suspensions with a large amount of sedimenting solids. In the horizontal position the port for the permeate must be the top outlet, to allow for the complete module to fill with liquid.

In vertical position the permeate outlet always has to be upwards so that the air can be removed from the module completely.

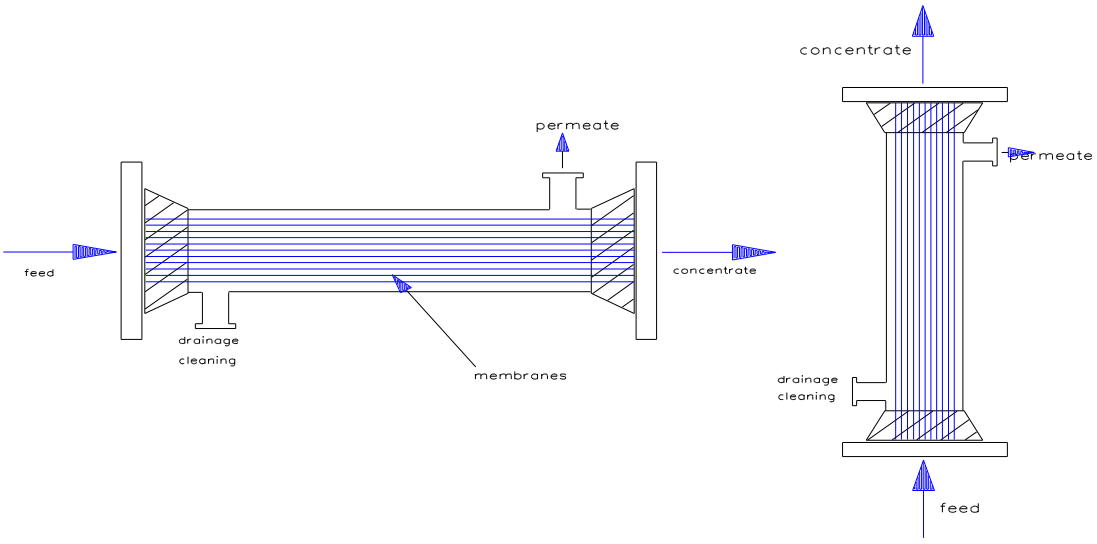

Figure 3: Module position and permeate outlet installed in a horizontal position

The membranes are activated by water pressure. Fill the module(s) bubble free with water at both sides (feed and permeate side). Then a pressure of 2 bar has to be applied to the module(s) for approx. 10 sec. After this procedure the module is activated and the required filtration pressure can be adjusted.

5. Shutdown of a System

During a long shutdown, the plant must be cleaned completely (washing with water) and filled with e.g. a 1% NaOH solution to avoid bacterial contamination.

The membrane's separation properties will not change through drying.

6. Operating and Back Pulse Pressures

In CMF, a liquid is pumped through the modules. The hydraulic pressure drops from the inlet value P1 to the outlet value P2 due to the liquid flow. It is necessary that the filtrate pressure pF is lower than p1 for filtration to occur.

To achieve lasting stability of filtrate flow we recommend to begin the filtration at a low pressure level and increase pressure to optimal performance during the filtration.

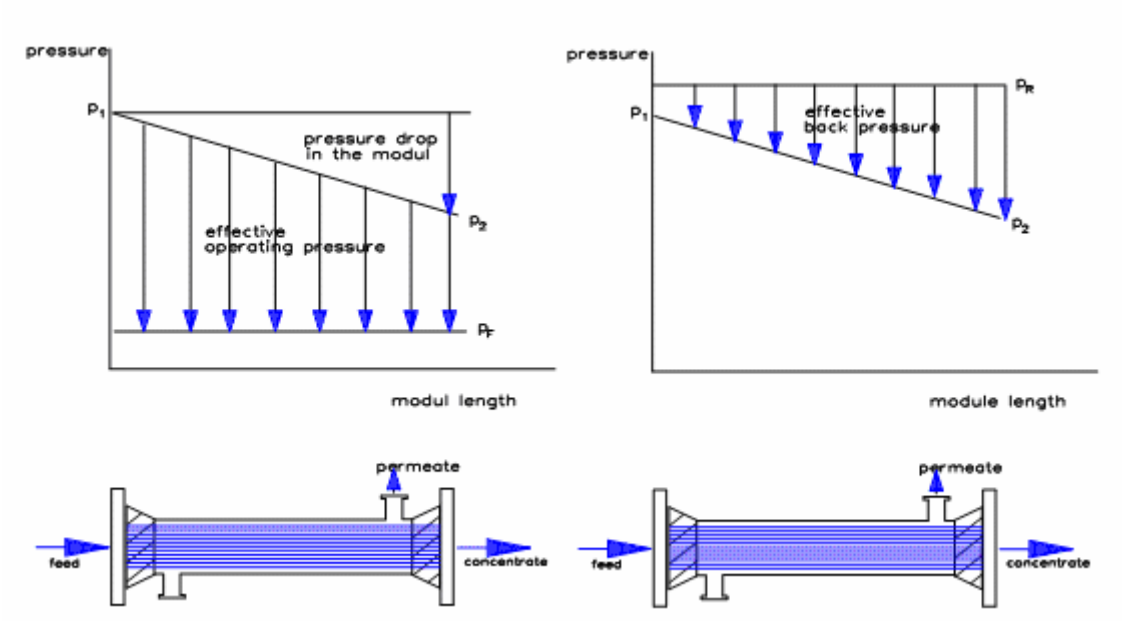

Figure 4: Pressure situation during filtration and PBP

The allowable operating pressure (P1 - PF) depends on the membrane and the temperature. These values are listed in the data sheets of the modules.

In PBP mode, PF must increase to a value higher than P1. This procedure creates an implosion stress for the membrane. The PBP-pressure (pressure above outlet pressure P2) indicated in the data sheets should not be exceeded to prevent the membrane tubes from imploding.

Air bubbles in the module always affect the efficiency of the Back Pulse. Generally the permeate outlet should be placed at the drain end of the module. In vertical position the permeate outlet always has to be on the upper side.

7. Speed Recommendations

The favourable flow velocity for membrane tubes ranges from 2 to 4 m/s.

PBP intervals of 1 to 30 min are recommended, depending on the product. Generally the PBP filtrate volume is less than 5 % of the total filtrate quantity.

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8. Pressure Loss of SEPRODYN® Modules

The energy consumption of a crossflow microfiltration system is determined mainly by the circulating volume and the pressure losses of the module. The pressure loss is affected by

- the properties of the circulating fluid (e.g. rheologic behavior, viscosity and the concentration of suspended particles)
- the velocity resistance in the circulation (modules, fittings, piping system)
- the conditions of operation (flow velocity).

Usually the greatest velocity resistance in the circulation occurs in the parallel or serially operated modules. Here only the relationship between the pressure drop and the mean linear velocity of a liquid in the MICRODYN modules is considered. The pressure drop □p of MICRODYN modules using water at 20 ℃ is shown in the following figure.

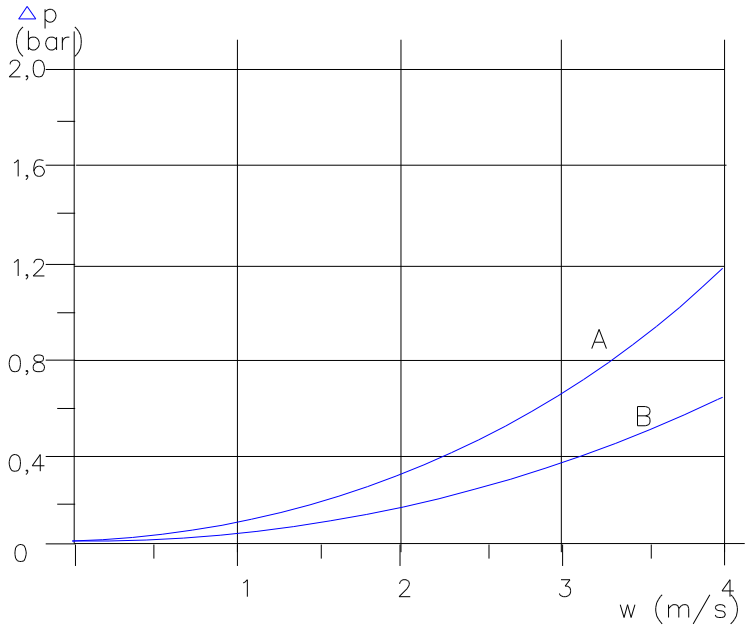

Figure 5: Pressure drop vs. speed of feed

Curve A: For modules with tubular membranes; d_i = 5,0 mm and 3 m total module length
SE 150 TP 1L

Curve B: For modules with tubular membranes; d_i = 5,0 mm and 1,5 m total module length
SE 090 TP 1N
SE 150 TP 1N

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9. Resistance to Chemicals

SEPRODYN® modules are made of PE-tubular membranes and a plastic casing made of polypropylene.

Aromatic and aliphatic hydrocarbons with low boiling points such as petrol ether, benzene, and carbon tetrachloride diffuse into the polymers and will cause swelling and decreasing mechanical strength.

Before filtration of these substances, consultation with MICRODYN-NADIR is necessary.

Exceptions are low volatile substances such as greases, oil and waxes. They cause negligible swelling and low mechanical strength reduction only.

Peroxydes may be used in small quantities and for a short time for cleaning purposes. The concentration must be discussed for the individual case.

The chemical resistance of SEPRODYN® modules is listed in the following table. The resistance depends on many factors such as temperature, concentration and intensity of mechanical stress. The data in the table are for reference only.

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Column 1: Resistance of SEPRODYN® Modules

SYMBOLS

+ resistant at operating conditions as per data sheet

/ limited resistance, swelling (only limited operating conditions)

- not resistant

MEDIUM	PE-Module		O-Ringe
	20℃	60℃	Viton
Acetone	+	/	+
ethanol, 96 %	+	+	+
Ethylacetate	/	-	-
Ethylether	+	+	/
ethylene glycol	+	+	+
formic acid (dil.)	+	+	-
amylic alcohol	+	+	+
aniline dye	+	+	+
petrol ether, Kp 100-140 C	/	-	+
Benzene	/	-	/
succinic acid (dil.)	+	+	+
Beer	+	+	+
bromic water, cold saturated	-	-	+
Butanol	+	/	+
Butyl	/	-	/
butyl glycol	+	+	+
calcium chlorid sol.aqueous	+	+	+
Chlorobenzene	+	/	+
Chloroform	+	-	+
Chlorosulfonic acid	-	-	/
chloric water (short time)	+	/	+
Cyclohexane	+	+	+
Cyclohexanol	+	/	+
Cyclohexanon	/	+	/
diethanol amine	+	+	+
Dichlorethylene	/	+	/
dichlorobenzene, cold sat.	/		/
dimethyl amine	/	-	+
ferric chloride (III), sat.	+	+	+
Vinegar	+	+	+
acetic acid, 10%	+	/	+
hydrofluoric acid, 10%	+	+	+
formaldehyde, 30%, aqueous	+	+	+
juices, aqueous	+	+	+
fructose, aqueous, cold sat.	+	+	+
Galvanic baths	+	+	+

MEDIUM	PE-Module		O-Ringe
	20℃	60℃	Viton
Gelatine	+	+	+
glucose, aqueous	+	+	+
Glycerol	+	+	+
Glycol	+	+	+
Hexane	+	/	/
Isopropanol	+	+	+
potassium hydroxide, aqueous	+	+	+
potassium permanganate (2n)	-	-	+
saline, saturated	+	+	+
linseed oil	+	+	+
machine oil	+	/	+
sea water	+	+	+
Methanol	+	+	+
methylenechloride	+	-	/
Molasses	+	+	+
Milk	+	+	+
lactic acid, aqueous, 10%	+	+	+
mineral oils	+	/	+
mineral water, commercial qual.	+	+	+
natrium sulfite, 40%	+	+	+
sodium hydroxide solution(2n)	+	+	+
sodium hydroxide solution,52%	+	+	+
Nitrobenzene	/	/	/
fruit juices	+	+	+
oleum, 100%	-	-	/
olive oil	+	+	+
petrol ether	+	+	+
peracetic acid, 0,2%(see note)	-	-	+
plant oils	+	/	+
Pyridine	/	-	/
nitric acid (2n), aqueous	/	-	+
chloric acid, 30%ig, aqueous	+	/	+
sulfuric acid (2n), aqueous	+	/	+
soap solution	+	+	+
silicon oil	+	+	+
sodium carbonate solution	+	+	+
soy bean oil,cold saturated, aqueous	+	+	+
starch solution	+	+	+
Terpentine	-	-	-
carbon tetrachloride	-	-	-
Toluene	/	-	/
trichloro ethylene	+	+	/
trichloro acetic acid	+	/	+

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MEDIUM	PE-Module		O-Ringe
	20℃	60℃	Viton
Water	+	+	+
tartaric acid, aqueous, 10%	+	+	+
Whisky	+	+	+
Xylol	-	-	/
Citric acid, aqueous, 10%	+	+	+

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10. Chemical Membrane Cleaning

In order to obtain a high filtration capacity on a long-term basis, a chemical cleaning of the membrane is required at times. For this procedure the appropriate chemicals are acids or caustic solutions within the pH-range of 0,5 - 14.

Polyethylene is also resistant against peroxide (80.000 ppmh) and hypochlorite (80.000 ppmh at 25℃).

In many cases a very good result can be reached by flushing the cleaning solution from the permeate side through the membrane.

Employing crossflow to the membrane at low pressure level has a favourable effect on the cleaning process, as it is very effective and saves cleaning agents. Unspent chemicals may be pumped down for further use.

Starting this recommended way of cleaning, the module has to be cleared through the lower outlet. The cleaning agent is pumped in and pressed through the membranes. Then it must act in the module for a period of about 30 minutes to 1 hour. Afterwards a new cleaning agent is pumped through the module to replace the contaminated solution. The next step is a thorough flushing with water. When employing a combined cleaning e.g. alkaline – acidic this step is repeated with the new cleaning agent. The flushing with water removes all residues of the cleaning agent.

Although a cleaning with chemicals in flow direction is possible, dissolved substances may penetrate the membrane structure. This can produce a contrary effect if the substances are not dissolved completely. Furthermore the amount of chemicals needed is higher. A low pressure overflow of the membrane has a favourable effect on the cleaning process.

The temperatures indicated in the data sheet must not be exceeded.

Detailed cleaning instructions must be worked out on-site and depend on the product.

Generally the following rules apply:

Organic fouling of the membrane are predominantly handled with alkaline cleaning agents, esp. NaOH with a concentration level of about 1 – 5% at a temperature of 20 – 60℃.

Cleaning aids (tensides) speed the dissolution of fouling and of oily and greasy substances.

For cleaning of inorganic fouling e.g. mineral salts, ferrous compounds, mostly acidic agents are employed. Organic acids e.g. citric acid, oxalic acid, or mixtures of hydrochloric acid and oxalic acid have proved favourable due to their complex-building properties.

In case of serious problems with module cleaning we advise consultation of MICRODYN-NADIR.

The particulars given in this technical information reflect the latest published information of MICRODYN-NADIR as at the date of the same. MICRODYN-NADIR assumes no liability for the completeness of the same. Liability of any kind which is not covered by the warranty as specified in MICRODYN-NADIR 's Conditions of Sale cannot be accepted.

These informations are updated regularly. The newest versions are available for you at www.microdyn-nadir.de.