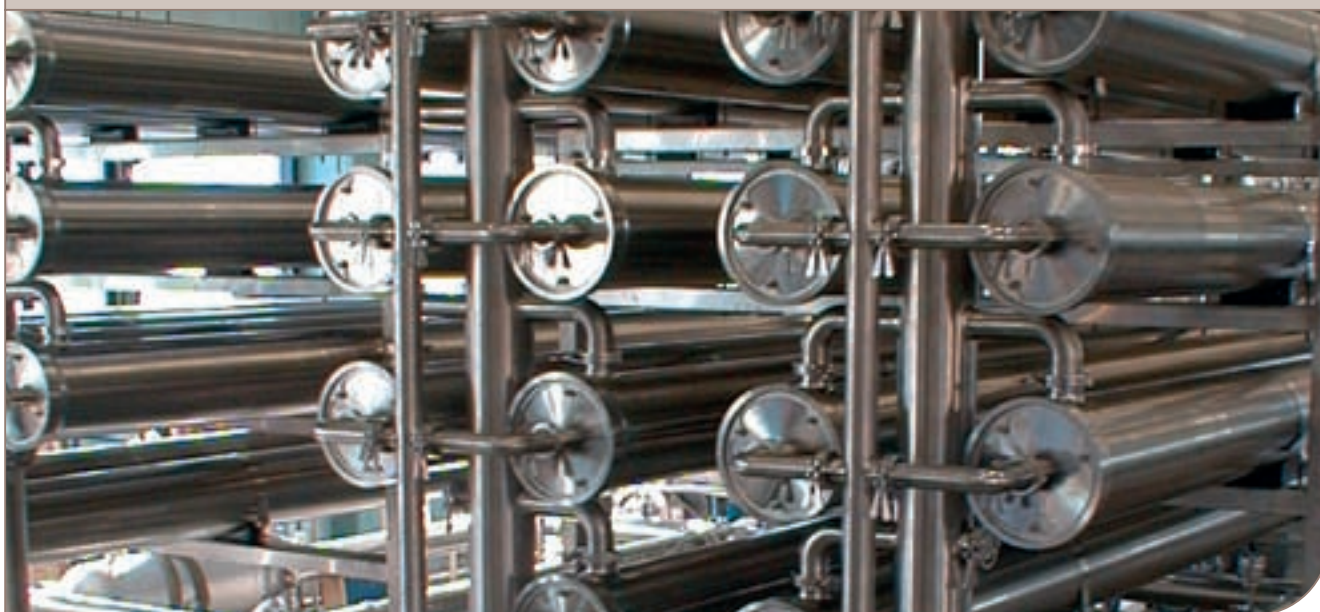




Alfa Laval Membrane RO/NF system

Reverse osmosis and nanofiltration system for concentration and recovery



The Alfa Laval Membrane RO/NF system is a cross-flow reverse osmosis (RO) and nanofiltration (NF) membrane system designed for automatically controlled continuous product concentration and water recovery.

This system provides cost-effective standardized solutions to a wide range of specific concentration and by-product recovery requirements. It is designed to provide minimal hold-up volume and with a stringent focus on hygiene throughout.

Applications

The Alfa Laval Membrane RO/NF system is normally used as a concentration and recovery stage within other processes, reducing the volume of a feed solution by removing water. The system can be used for the cost-effective removal of water from products such as fruit juice, yeast extract, vinasse, coffee, tea, sugars, proteins and UF permeate solutions prior to evaporation.

Energy consumption normally amounts to 4–8 kW per m³ water removed and for concentration up to 20–40% TS depending on the characteristics of the feed solution and the operating pressure. Units of this type are in considerable demand for installations that process apple juice, blood plasma,

gelatine and egg as well as for the recovery of valuable by-products from waste permeate streams in ultrafiltration systems. The process temperature is related to the particular feed product being treated. Typical temperatures are in the range 15–60°C (58–140°F) as best suits the individual product. This results in both high product quality and low energy consumption.

Design

Alfa Laval Membrane RO/NF systems are supplied as a frame-mounted unit featuring pre-assembled component items and prefabricated piping. The unit is ready for operation as soon as it is installed and connected to the supply systems for upstream and downstream product, utilities and power.

The piping, pumps, strainers, valves and fittings, as well as the control panel, are all manufactured by Alfa Laval. This provides users with a significant advantage in terms of effective service and reduced spare parts inventory.

This pre-assembled, frame-mounted set-up also results in easy, reliable operation, along with straightforward maintenance that helps keep downtime to a minimum.

All piping and equipment in contact with the product or with CIP (Cleaning In Place) liquids are of sanitary-level design, and steel parts are made of AISI 316L stainless steel. The spiral membranes also comply with sanitary-level requirements and with all relevant food and dairy standards.

The system is controlled and monitored via a PLC operator panel that includes a motor control centre equipped with frequency drivers on the pumps to reduce energy consumption. The system uses 3 x 400 VAC/50 Hz power with enclosures for motors and a combined control/motor control centre with IP54-standard protection.

The control and operation of the Alfa Laval Membrane RO/NF system are intended to provide automatically controlled continuous product concentration. Cleaning is based on CIP procedures, controlled and monitored by the operator via the local PLC operator panel.

Operating principle

Alfa Laval RO/NF membrane filtration units feature completely automated operation via the easy-to-use MemProC® control system. This includes separate modes for selecting production, cleaning, sanitation and water recirculation operations, complete with all the necessary sub-sequences. This ensures safe, reliable operation of the entire system.

The feed product is introduced into the feed tank system by the level control feed valve. The feed pump then pumps the product to a number of membrane filtration stages connected in series – the so-called loops. Each loop consists of

a number of spiral housing modules, containing the unique Alfa Laval spiral reverse osmosis or nanofiltration membranes. These membranes permit water to pass into the permeate stream, while the juice, proteins, sugars, etc. are rejected and thus become increasingly concentrated as they pass through one loop after another.

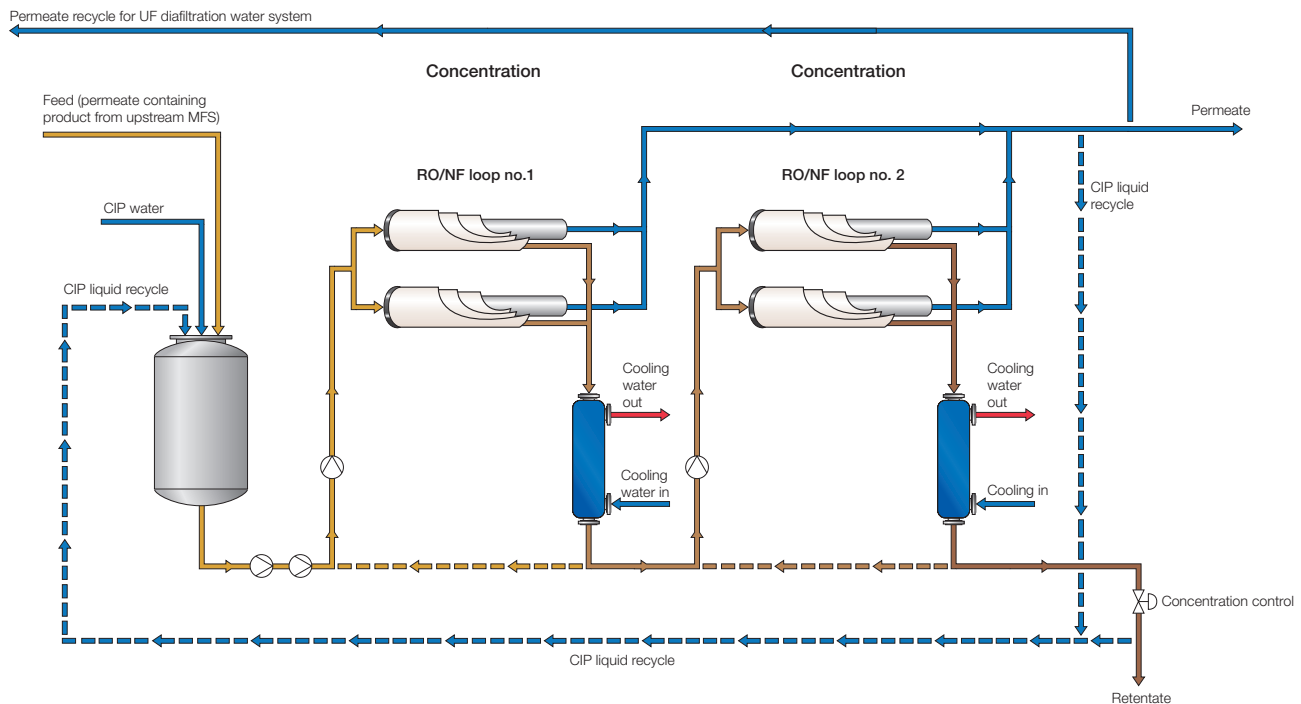
In each loop, the recirculation pump system provides the membranes with the cross-flow rate that is appropriate for keeping fouling to the minimum, balanced against the overall capacity of the system. The unit also contains a cooling system for removing any heat generated by the pumps.

The permeate collected from the loops enters the permeate tank system, where the level control permeate pump discharges it upstream or downstream for either recycling or disposal via a drain system.

The retentate flow rate output is normally controlled by a flow ratio system – the Volumetric Concentration Factor (VCF) value – or by an optional density in-line instrument to obtain constant product concentration.

When a production cycle has been completed, the product is displaced out of the system by use of water to ensure maximum product recovery. This displacement sequence is followed by a water flushing step to remove any product left behind on the surface of the membrane.

The next step is a CIP sequence, the details of which depend on the specifications of the individual feed product.



Additional systems and equipment

The following systems and equipment are available as optional extras.

1. In-line density instrument to ensure constant product concentration in the final loop.
2. Loop plug-flow system for reducing the quantities of flushing water needed in the CIP sequence, by having a valve system in each loop. This makes it possible to include a clearly defined flushing-out sequence when using cleaning agents.
3. Heating section for CIP solution. This section uses low-pressure steam as the source of heat and is equipped with a heat exchanger, a temperature transmitter and a control valve system.
4. External CIP valve system with three diverting valves. This is used for cleaning external feed, retentate and permeate lines.

Specifications

	Alfa Laval Membrane RO/NF 10	Alfa Laval Membrane RO/NF 15	Alfa Laval Membrane RO/NF 25	Alfa Laval Membrane RO/NF 40
Operating time, hours/day	12–20	12–20	12–20	12–20
CIP, hours/day	3–4	3–4	3–4	3–4
Number of loops	1	2	2	3
Number of modules (housings)	6	6	12	18
Type of modules (housings)	M8.0-4-PN40	M8.0-4-PN40	M8.0-4-PN40	M8.0-4-PN40
Type of spiral	8038	8038	8038	8038
Number of spirals	24	24	48	72
Installed power, kW	70	81	140	195
Water consumption, m ³ (US gal) / CIP sequence	8 (2,114)	12 (3,171)	12 (3,171)	16 (4,228)
Pump seals, m ³ /day (GPD)	0.15 (39.63)	0.2 (52.83)	0.2 (52.83)	0.3 (79.25)
CIP chemicals, kg (lb) / sequence	5–10 (11–22)	10–15 (22–33)	10–15 (22–33)	15–20 (33–44)
Plant dimension, L x B x H, m	5 x 3 x 2.5	5 x 4 x 2.5	5 x 4 x 2.5	5 x 5 x 2.5
Plant dimension, L x B x H, ft	16.41 x 9.84 x 8.20	16.41 x 13.12 x 8.20	16.41 x 13.12 x 8.20	16.41 x 16.41 x 8.20
Space required, L x B x H, m	7 x 4.5 x 3	7 x 5.5 x 3	7 x 5.5 x 3	7 x 6.5 x 3
Space required, L x B x H, ft	22.97 x 14.76 x 9.84	22.97 x 18.04 x 9.84	22.97 x 18.04 x 9.84	22.97 x 21.33 x 9.84
Weight, kg (lb)	3,500 (7,718)	5,000 (11,025)	6,750 (14,884)	9,500 (20,948)
Noise level, dB (A)	< 80	< 80	< 80	< 80
Feed operation pressure, bar (psi)	35–40 (508–580)	35–40 (508–580)	35–40 (508–580)	35–40 (508–580)

Note: the Alfa Laval Membrane RO/NF 10 system can also be used for operation in batch mode.