

For sale, rent and/or lease

June, 2015

Multi-process membrane systems for lab and industrial tests (NPMS series)

These turnkey versatile systems are designed for the lab and on-site industrial tests for the following membrane processes:

- Pressure-driven (MF, UF, NF, RO = PDMS series): www.rvf-filtration.com/Products/RO.html
- Osmotically-driven: **FO** as forward osmosis, **PRO** as pressure retarded osmosis, **PAO** as Pressure Assisted Osmosis
- Thermally-driven (**MD** as membrane distillation)
- Chemical potential driven (**PerVap** as pervaporation)
- Hybrid processes: +**DiaF** as diafiltration, **MBR**, **FO+MD**, **RO+MD**, **RO+FO**, **RO+FO+MD**, **MF/UF+RO** or **NF**

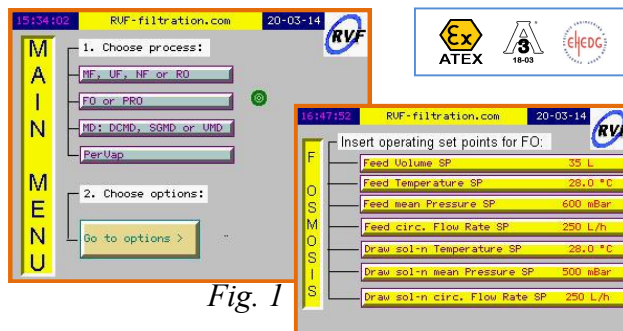


Fig. 1

These systems are equipped with all necessary equipments (pumps, valves, sensors, membrane module(s), tank(s), heat exchanger(s), heater and/or cooler, electric cabinet, PLC & DAQ system) in order to work under heavy laboratory or industrial conditions during short, long and very long cycle period. The client has only to provide feed liquid, electric power, compressed air, gas source, water and chemicals for CIP and rinsing, to dispose permeate (distillate) and concentrate.

If you plan to apply your system for the treatment of dangerous liquids (radioactively, biologically, chemically or off-shore use) we propose highly reliable Ethernet as well as Wireless connectivity devices (IoT devices) in order to organize the remote monitoring and control via WEB server.

All our systems include: design, manufacturing, integration, installation supervision, commissioning, training, maintenance contract, IOM manual.

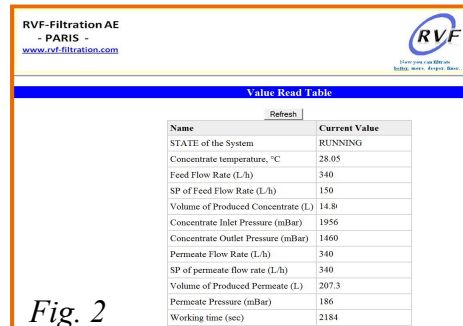
Design of the system:

- Membrane modules which may be used onto the system:
 - Hollow fiber (inside-to-outside or outside-to-inside)
 - Tubular: organic, ceramic, stainless steel membrane
 - Dynamic filtration RVF (www.rvf-filtration.com)
 - Spiral wound
 - Flat sheet

All above mentioned modules may be used on the same multi-process system

Modes of functioning:

- special starting mode preventing the initial membrane from clogging/fouling (very important for MF & UF)
- cross-flow onto both sides of the membrane in co- or counter-flow
- under excessive pressure: the membrane module is positioned onto the discharge pipe of the pump (gauge pressures onto the module: $P_{in} > 0$ and $P_{out} > 0$ or $= 0$)
- under negative pressure: when the membrane module is positioned onto the suction pipe of the pump (gauge pressures onto the module: $P_{in} = \sim 0$ and $P_{out} < 0$)
- under combined pressure mode (gauge pressures onto the module: $P_{in} > 0$ and $P_{out} < 0$)
- using draw solution or sweeping gas onto permeate/distillate membrane side



Name	Current Value
STATE of the System	RUNNING
Concentrate temperature, °C	28.05
Feed Flow Rate (L/h)	340
SP of Feed Flow Rate (L/h)	150
Volume of Produced Concentrate (L)	14.8
Concentrate Inlet Pressure (mBar)	1956
Concentrate Outlet Pressure (mBar)	1460
Permeate Flow Rate (L/h)	340
SP of permeate flow rate (L/h)	340
Volume of Produced Permeate (L)	207.3
Permeate Pressure (mBar)	186
Working time (sec)	2184

Fig. 2



Fig. 3, 3a

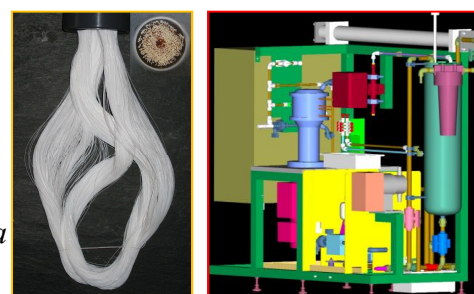


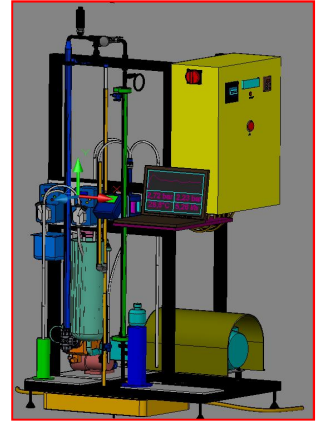
Fig. 4, 4a



Fig. 5

- CIP system (heating, temperature regulation, automatic stop)
- System for integrity testing: for membrane & module
- Sensors and transmitters (analog 2-wire or digital output for pressure sensors: in the last case the accuracy is better than 0.05% FS), *non exhaustive list*:
 - pressure at the concentrate side before the module
 - pressure at the concentrate side after the module
 - pressure at the permeate/distillate side or average trans-membrane pressure
 - flow rate for cross-flow on the feed side
 - flow rate for permeate/distillate/draw solution
 - flow rate for concentrate bleed (if you want to work at constant VRF)
 - temperature in the concentrate's loop
 - temperature in the permeate/distillate/draw solution loop
 - level in the feed and the permeate/distillate/draw solution tanks
 - special standard (conductivity, pH, ORP, ion-specific, optical) sensors
 - newly developed inexpensive automatic devices:
 - for the measurement of the low flow rate values in the range: from several tens ml/h to several L/h
 - limiters for the flow rate in the liquid circulating loops

Fig.6



- Possibility to control (and to monitor) the following parameters:

- volume (height of liquid column) in the tank(s)
- mean (inlet/outlet) pressure of the concentrate
- permeate or trans-membrane pressure
- permeate/distillate/draw solution flow rate
- draw solution flow (co- or counter-current: FO)
- feed flow rate (cross flow velocity)
- VRF (volume reduction factor) or recovery factor (continuous or intermittent bleed of the concentrate)
- number of the diafiltration volumes (using the known initial volume of the liquid inside the system)
- temperature in the feed (concentrate) and permeate circulation loops (cooling or heating by the heat transfer fluid or using electric heater)
- temperature during CIP procedure (control by the electric heater)
- concentration of the chemicals during CIP
- minimization (automatic or manual) of the concentrate volume at the end of filtration cycle
- possibility for the operator to select the desired regulation (control) parameter(s) to be adapted for the process

Fig. 7

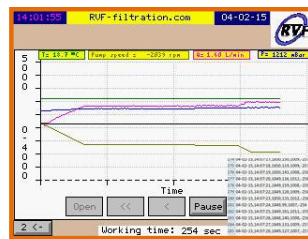
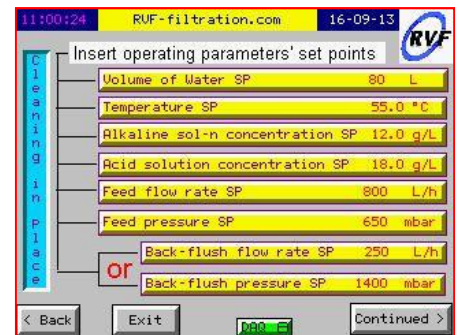


Fig. 8, 8a



- Screening system or pretreatment by MF/UF is proposed (with manual or automatic cleaning of the system)
- Data acquisition (DAQ) system with software:
 - data storage
 - history of the system functioning
 - online (remote) access to the data & to the other parameters
 - real-time data and curves
- PLC controlling the system (permits various degrees of automation: manual, semi- and fully automated working):
 - Color or black touch screen
 - Screen size
 - Analog inputs' number
 - Analog outputs' number
 - Whole remote monitoring and control via specially created WEB server
 - Data log function

yes
possible
possible
possible

to choose
3.5 inch or higher
4, 8 or 16
2, 4 or 6
possible
possible

- Memorization of the system’s activity during months / years
- Online modification of the set points possible
- Ethernet and Wireless connectivity devices for remote control (if needed) possible
- Update of the PLC’s program thru Internet (its adaptation to new challenges) possible

Specifications (can be modified to fit your special application(s)):

1. Membrane surface area in the modules is as follows:
 - Hollow fiber module 0.05 - 2 m²
 - Tubular module 0.05 - 0.9 m²
 - Dynamic RVF module 0.02 - 1 m²
 - Spiral wound module 2.5 or 7 m²
 - Flat sheet module 0.01- 0.1 m²
2. Temperature of the fluids max 75 °C
3. Pressure of the fluid to provide by a client
4. pH range of the fluid (including CIP) to provide by a client
5. CIP system with temperature control (operator has to add the chemicals) possible
6. Storage (logging) the data from analog and digital sensors possible
7. Handling the alarms (real-time and history of the alarms) yes
8. Automatic shut down (if one of the limits is overpassed) with the description possible
9. Automatic “stair” test for the fast studies the membrane/liquid pairs (Fig. 10) (may be carried out sequentially on each side of the membrane or onto both sides at the same time)

10. May be designed in compliance with the following approvals



Fig. 10

Fig. 9

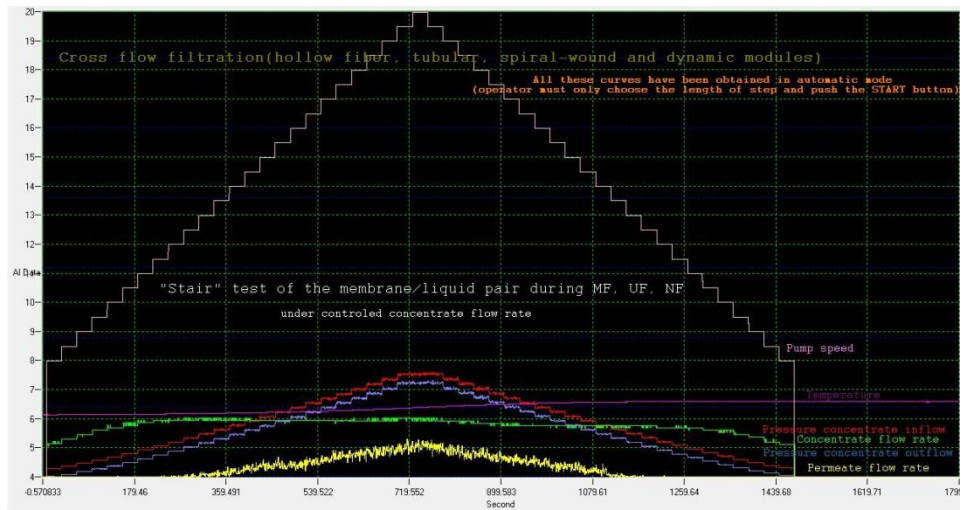
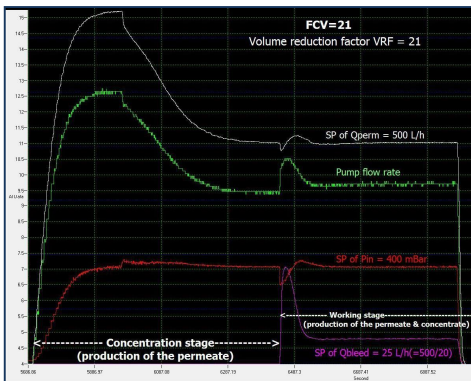


Fig.9-10. Examples of the real-time datalog screens (you’ll need a PC connected to the system)

And also:

- Development & design of the automation control for your existing test system (retrofitting, upgrade)
- Extensive testing onto our PLC controlled test bench is carried out for the optimum design of your system
- Procurement, installation of all necessary additional equipments: adaptation of the system fabricated and installed by RVF-filtration at the client’s site to the new challenges.
- Posterior update of the PLC's program: in order to adapt it to the new challenges of your test system (downloaded thru Internet)
- Rent and lease the system which was configured by yourself and fabricated by our company (followed by a transfer of ownership).