Neophil™ long lasting hydrophilic PVDF ultrafiltration membrane in Gigamem® large modules. Benefits and case studies

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Presentation outlook

1. Introduction
2. Durable hydrophilic membrane Neophil™ : a breakthrough development in membrane technology
3. Large module Gigamem® : a breakthrough development in membrane process design
4. Cases studies
5. Conclusions

1. Introduction

UF Membrane filtration processes are now widely used in water treatment

- Drinking water production
- Wastewater treatment
- Seawater filtration for desalination (with RO) or oil reservoir injection (with NF)

Filtration principle by steric exclusion

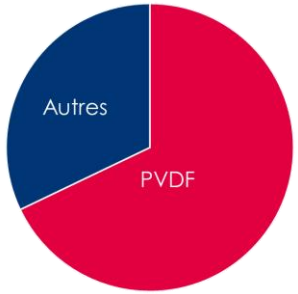
- => high quality of the treated water whatever the influent quality.
- => 0 mg/l SS; turbidity < 0,01 NTU; bacteria and viruses removal >4 to 6 log ; SDI_{15}<1
- => always the same permeate quality whatever the effluent
- => Entirely automatic and robustness plants. Lifetime > 10 years
- => Cost of m² of membrane has decreased and competes today multimedia filters
- => Very large plants > 300 000 m3/d

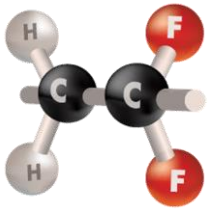
1. Introduction

Are membranes becoming convenience products?

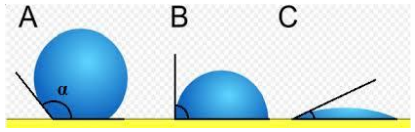
Innovations are still expected because

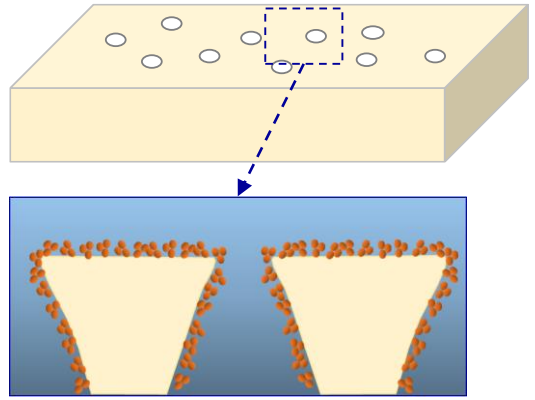
1. Life time of membrane is expending but in the membranes loose their performances over the time (10 years life time is long)



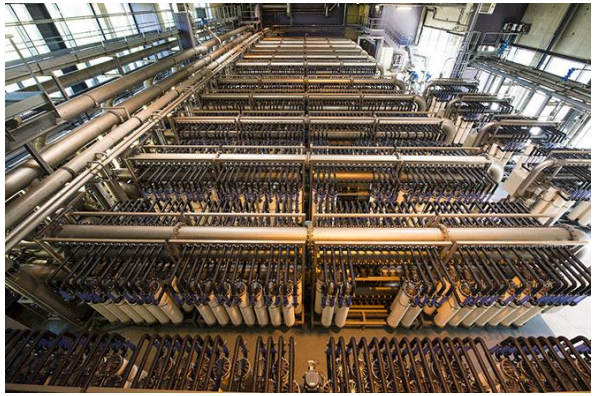


Hydrophilic additives





2. The membranes plants cost should continue to decrease to replace conventional pre-treatment : Change the membrane design paradigm



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Membrane fabrication

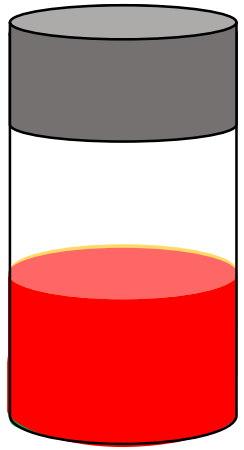
- ***Polymers and solvent introduction***

- ***Warming and mixing***

Solvent

Polymers } ***Dope solution***

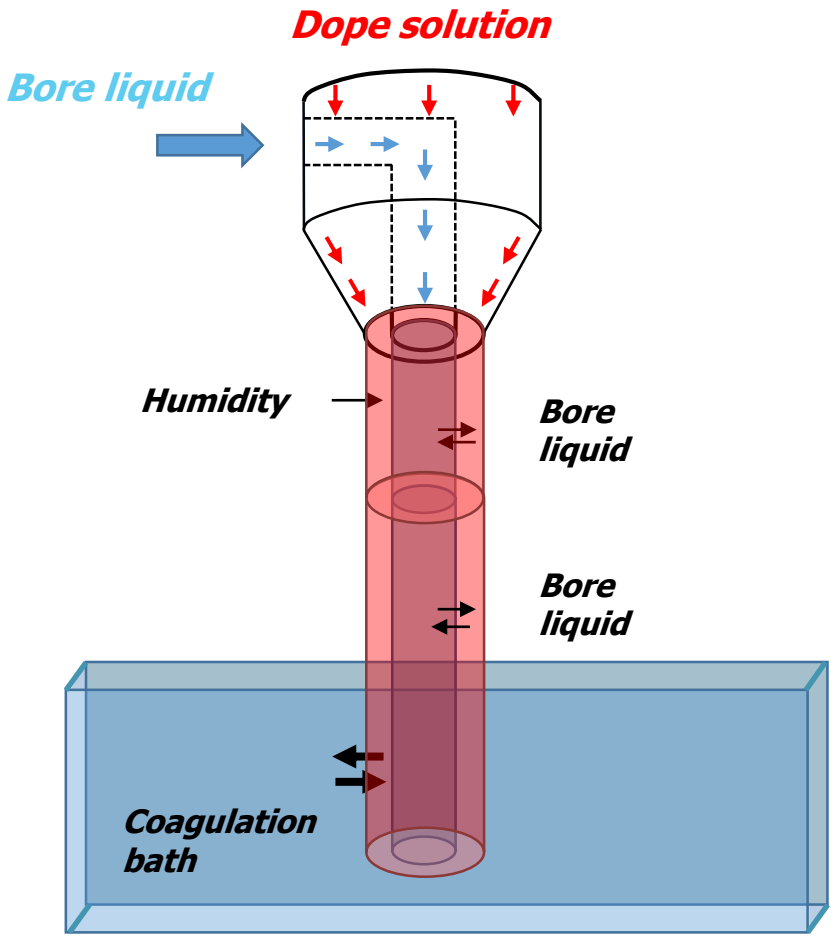
Additives



- ***Extrusion of dope solution through spinnerets***

- ***Bore liquid injection in the same time***

- ***Phase infversion***



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Other membranes vs Neophil

Conventional PVDF membrane

Porogenous and hydrophilic additives

Additives

Polymers

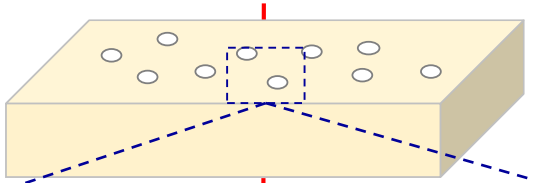
Only PVDF

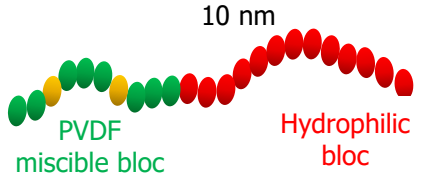
Neophil Membrane PVDF

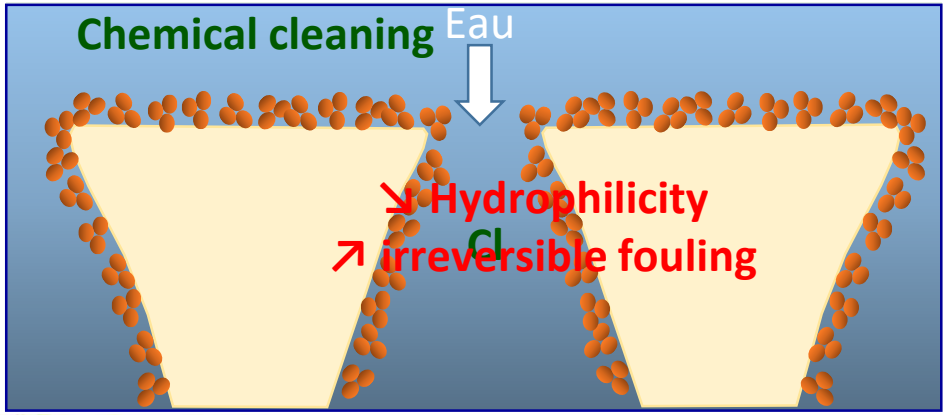
Porogenous and hydrophilic additives

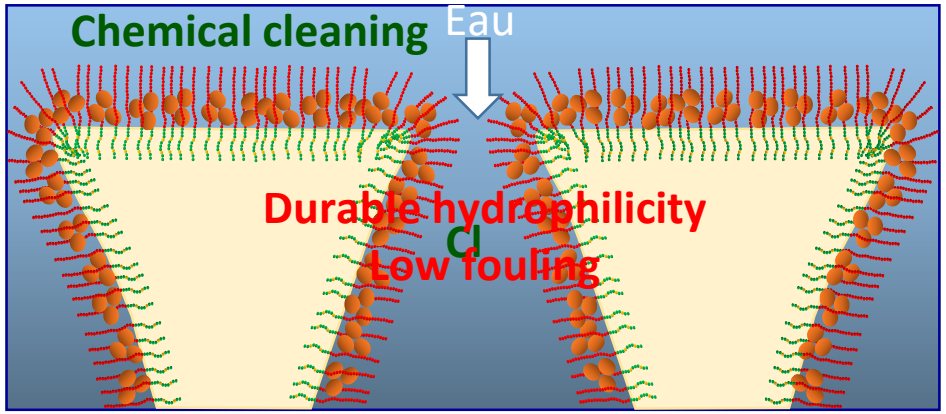
PVDF Kynar® + Durable hydrophilic additive DH100

ARKEMA









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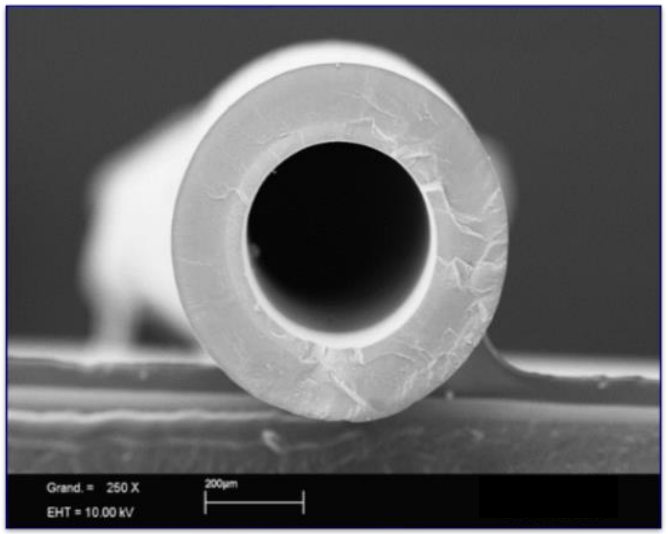
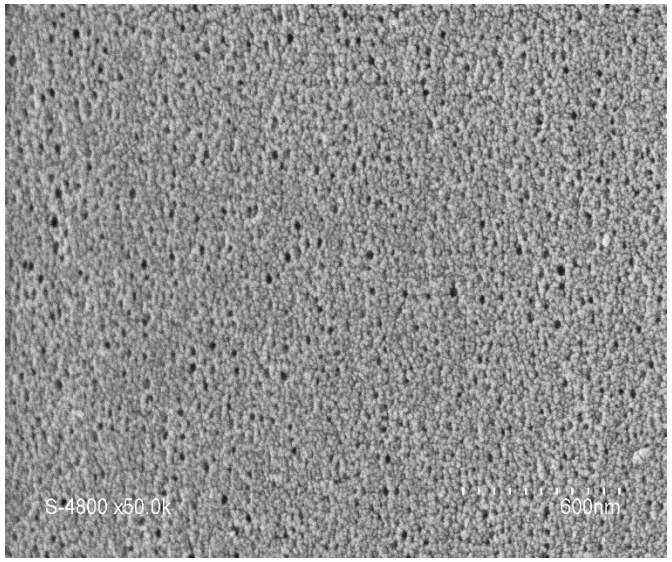
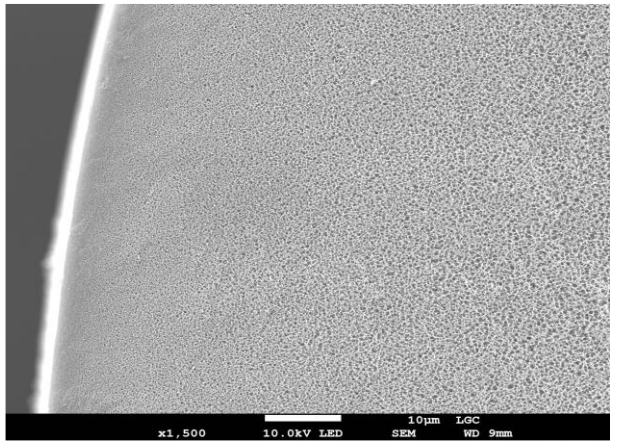
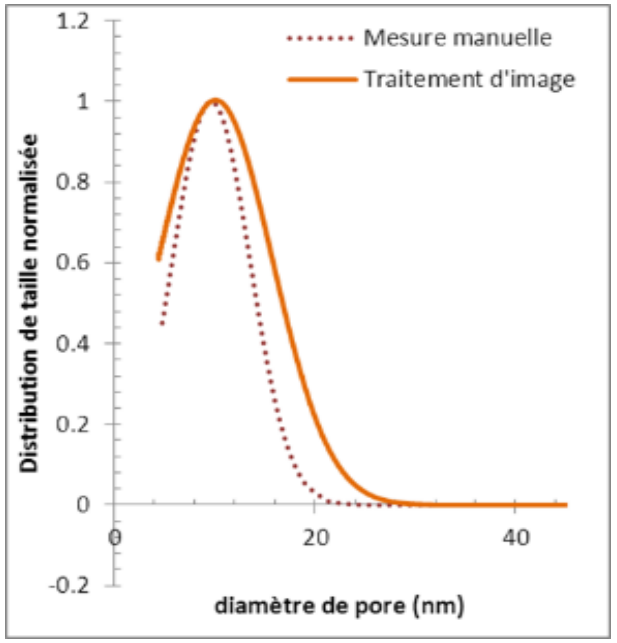
Main Neophil characteristics





- External diameter
  - 0.74mm
- Available in other sizes
  0.45 – 2.50 mm
- Water permeability
  400 – 500 L/h.m².bar@20°C
- Mecanical strengh
  - 6.0 Mpa
- Elongation > 160 %
- Pore diameter 15 – 25 nm
- Viruse removal (MS2-phage)
  > 4 log on new fiber
  > 4 log on aged fiber
  (100 000ppm.h/200 000 ppm.h chlorine pH6-7)





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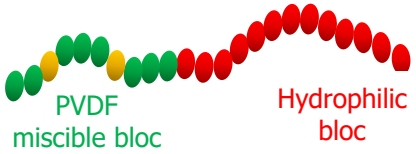
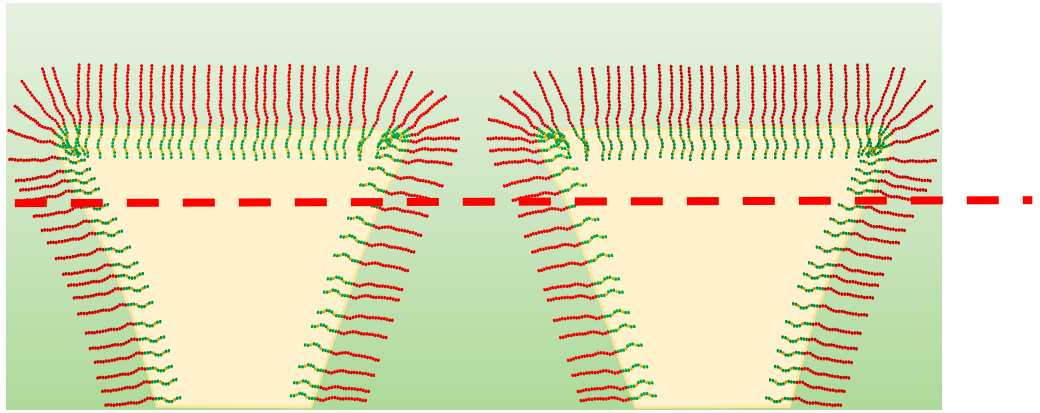
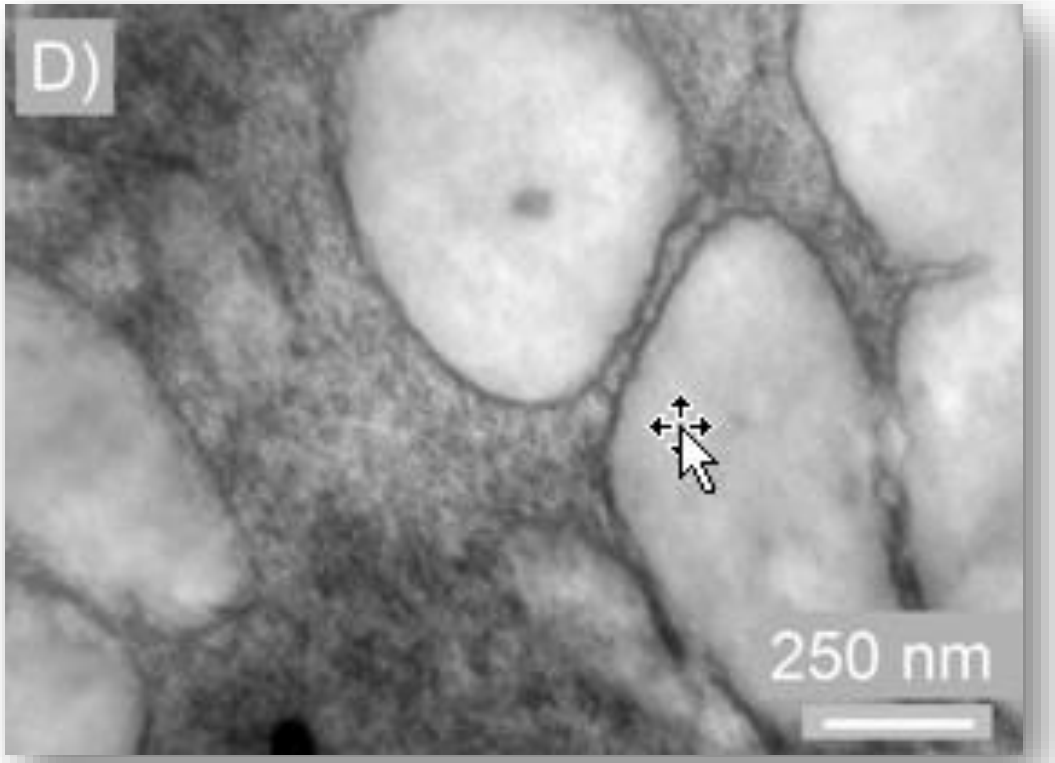
Localization of antifouling surface additives in the pore structure of hollow fiber PVDF membranes

Evdokia K. Oikonomou[a,1], Szilvia Karpati[a], Sana Gassara[b], André Deratani[b], François Beaume[c], Olivier Lorain[d], Sylvie Tencé-Girault[a], Sophie Norvez[a,*]



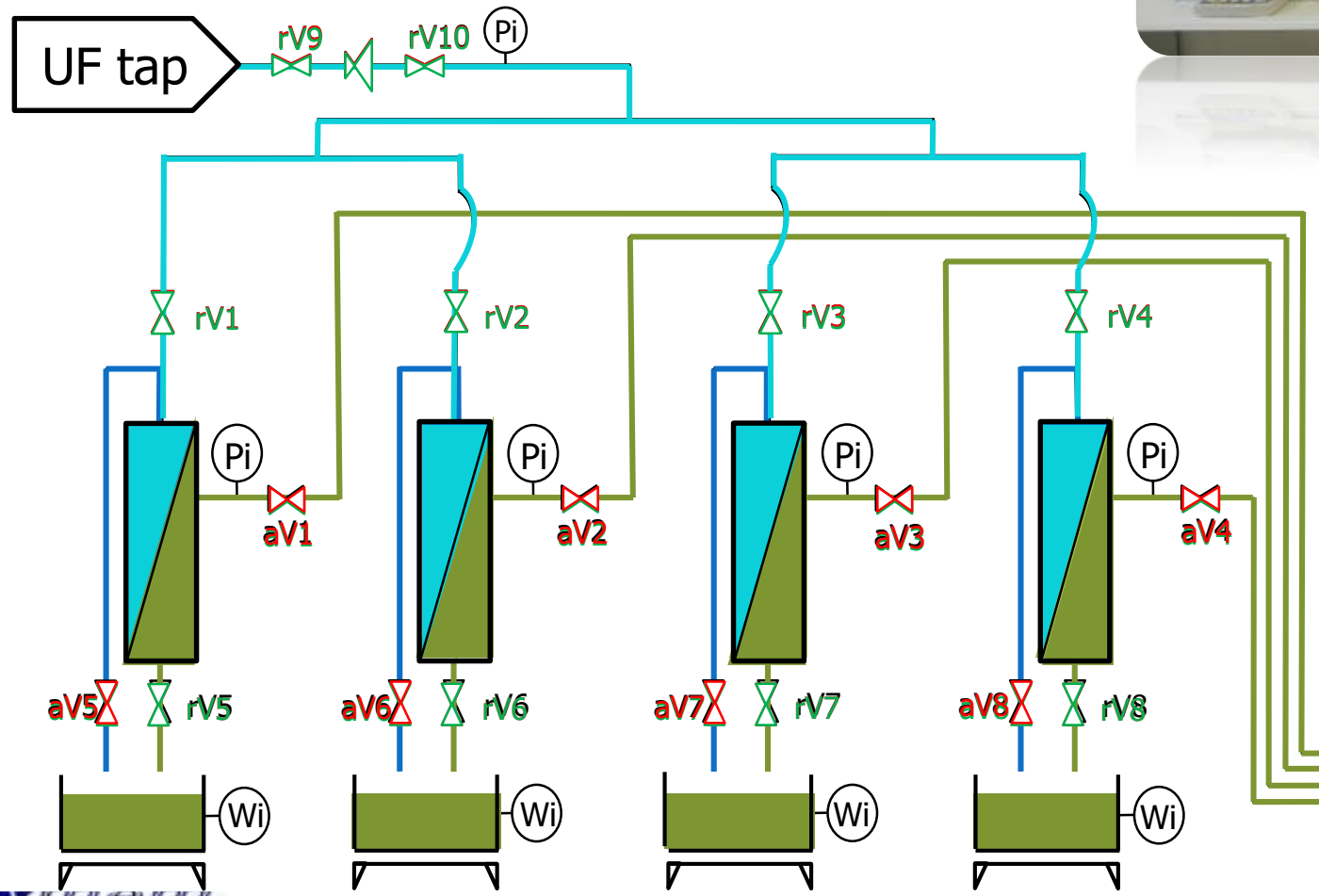
+ RuO_4

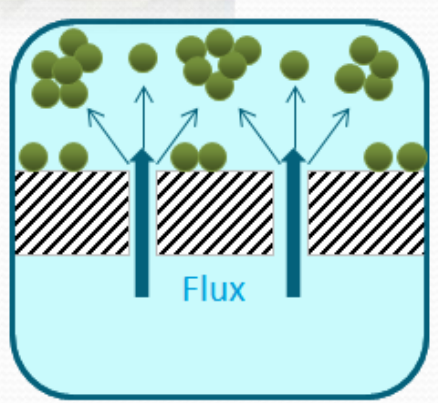




Lab scale validation

Backwash mode
Feed valves : OFF
Backwash valves : ON





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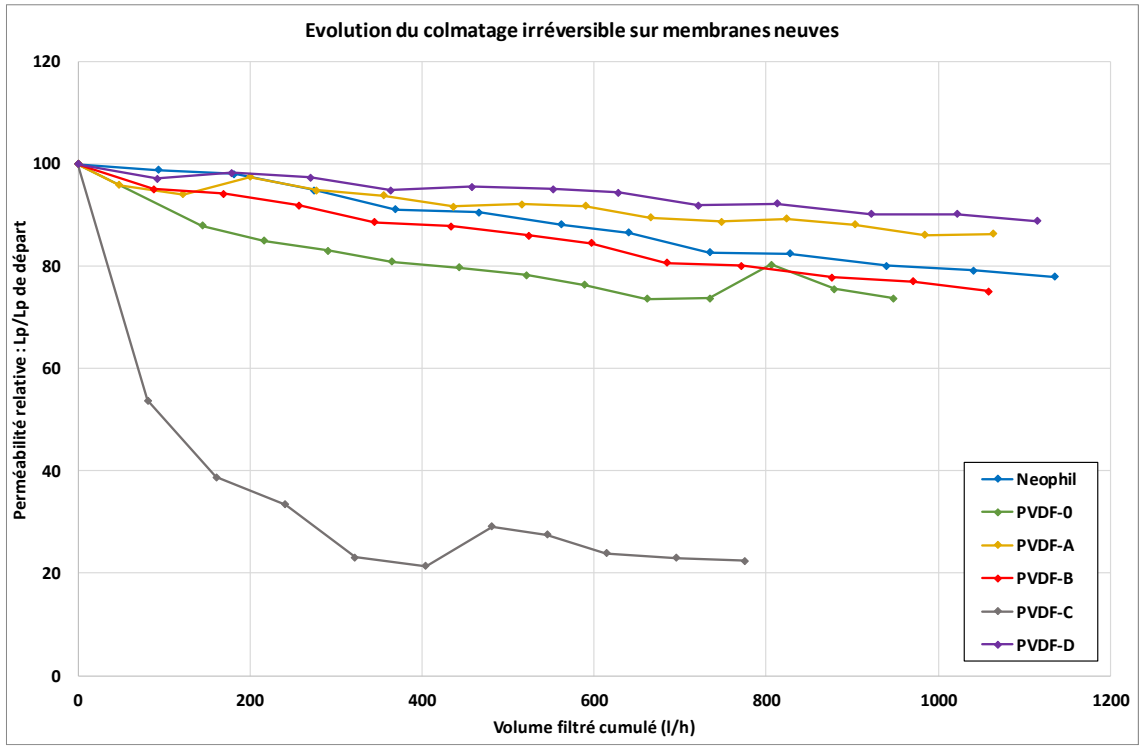

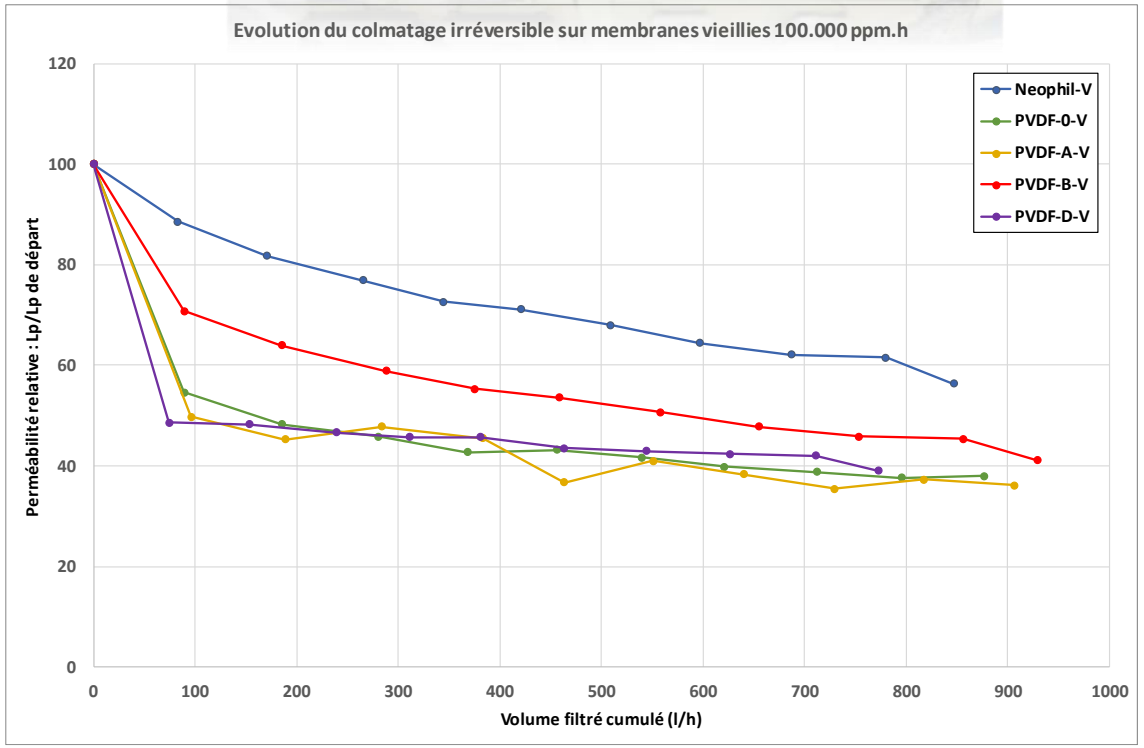

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Large module Gigamem® : a breakthrough development in membrane process design

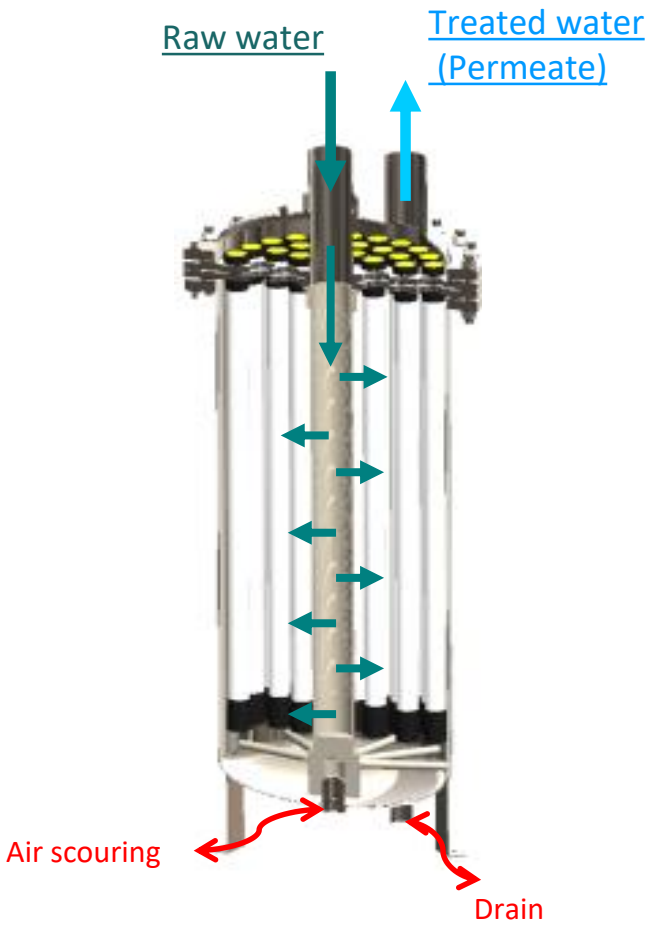
- UF/MF modules sizes are standardized between 8 and 12 inches
- Relative small treatment capacity per modules 3-5 m^3/h.
- Huge number of modules for large plant
- Polymem has launched a new mega module : Gigamem 540 m^2, 24 inches.

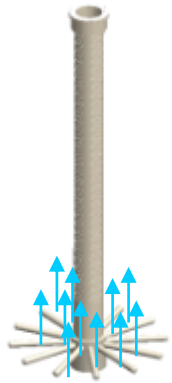
Large module Gigamem® : a breakthrough development in membrane process design

- The Gigamem® module is composed of
  - a large housing (ϕ=600m; H=1.75m) designed for conventional pressure applications <3bar (plastic or stainless steel) or high operating pressures <13bar (Glass reinforced plastic, GRP)
  - 49 independent filtration elements of 11 m² (ϕ=50 mm; H=1.5m) composed of several thousands of hollow fibers.
  - Total filtration surface per Gigamem of 540 m²
  - Associated with the Polymem UF 0.72 mm OD hollow fibers (dead-end outside-in filtration) manufactured from PSF or PVDF polymers
  - A specific repartition plate in which the bundles are installed with 2 O-rings.
  - A central distribution feed pipe
  - An air scouring system at the bottom of the vessel

Large module Gigamem® : a breakthrough development in membrane process design

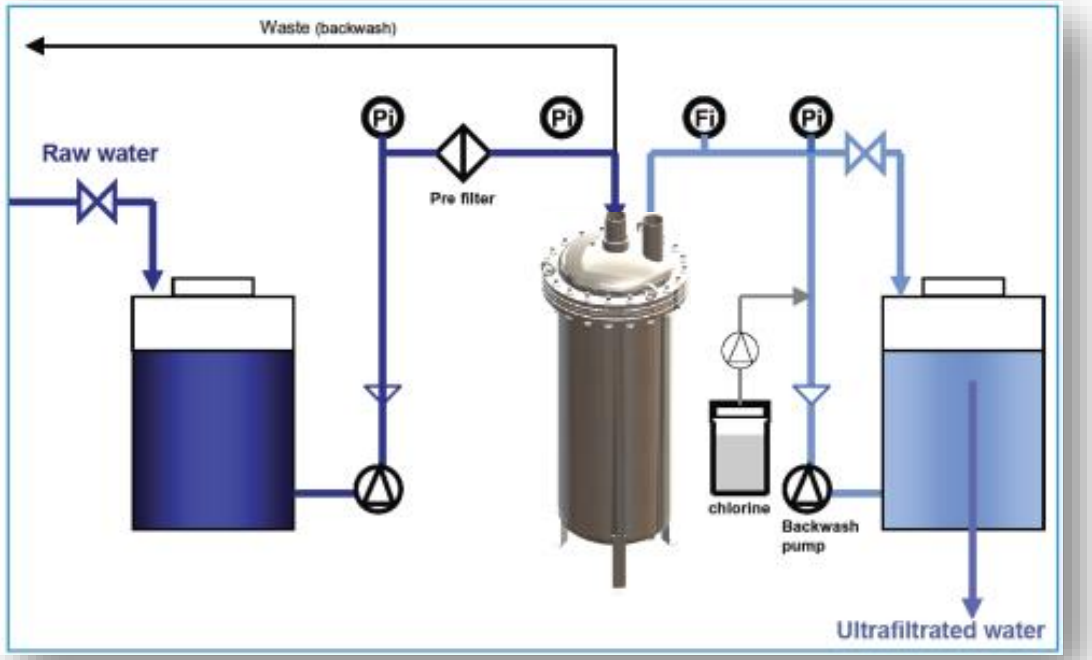
- Raw water feeds the central distribution pipe and pass through the hollow fibers (outside-in).
- The treated water (permeate)is collected at the top of the module
- Hydraulic backwashes are performed regularly to clean the membrane





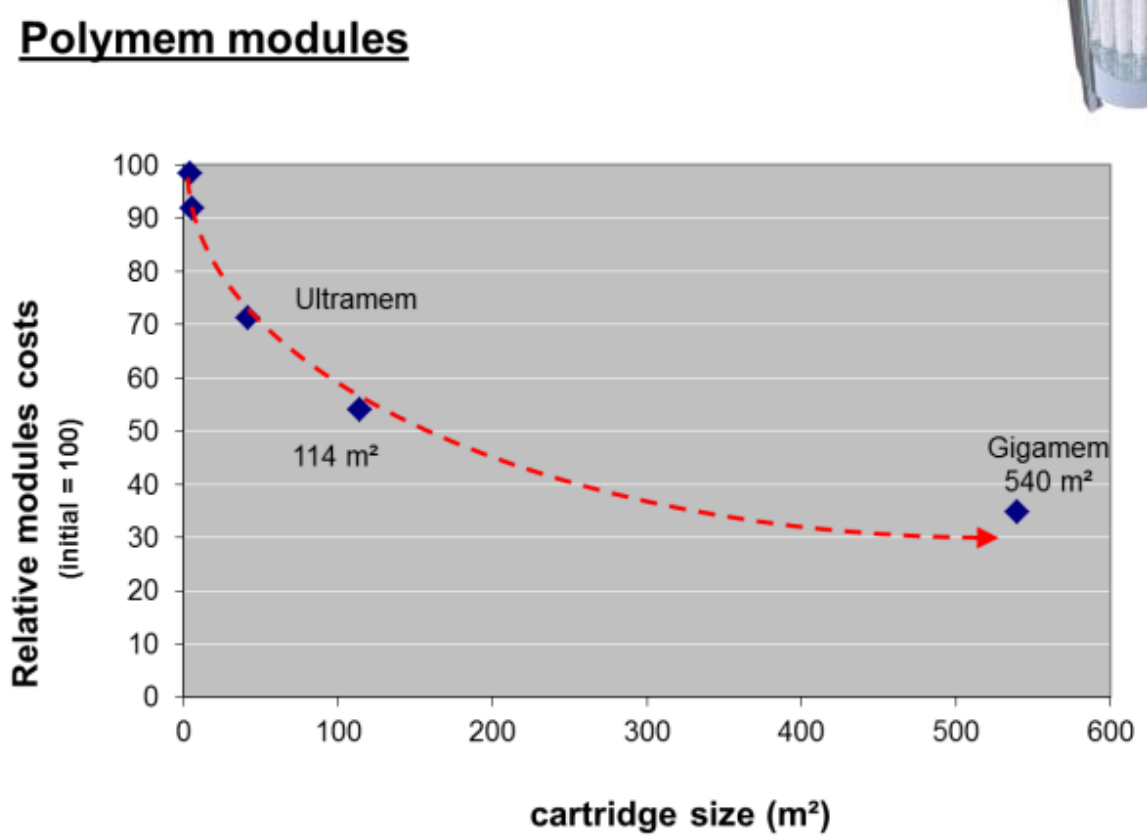
Air scouring

Air scouring is provided between the bundles at the bottom of the



Large module Gigamem® : a breakthrough development in membrane process design

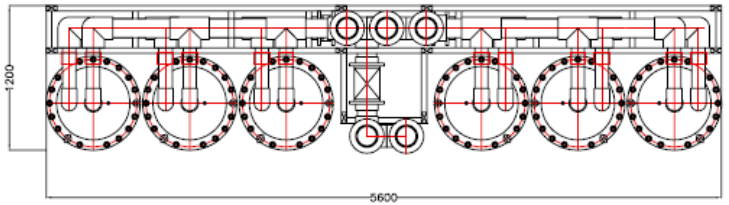
Membrane cost reduction : size effect + housing saving



Large module Gigamem® : a breakthrough development in membrane process design

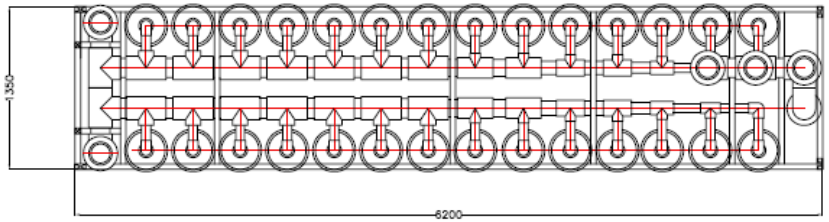
Footprint reduction

GIGAMEM

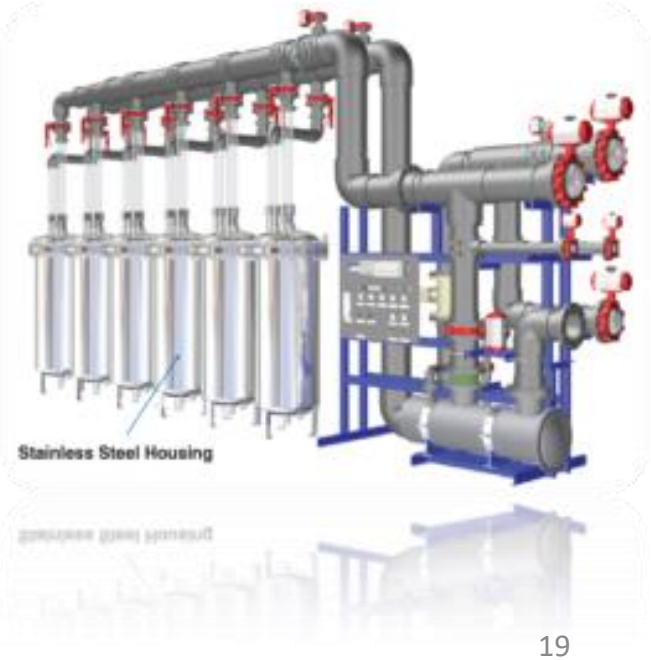


FOOT PRINT=6,72 m²

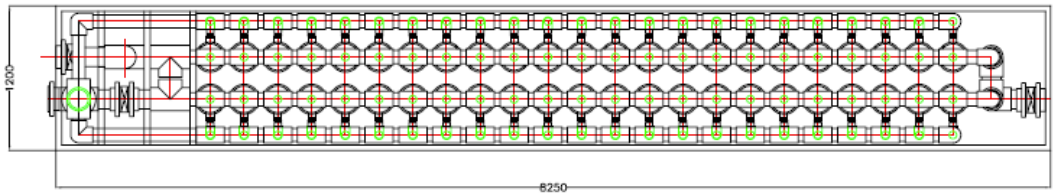
ULTRAMEM



FOOT PRINT=8,37 m²



COMPETITION



FOOT PRINT=9,90 m²

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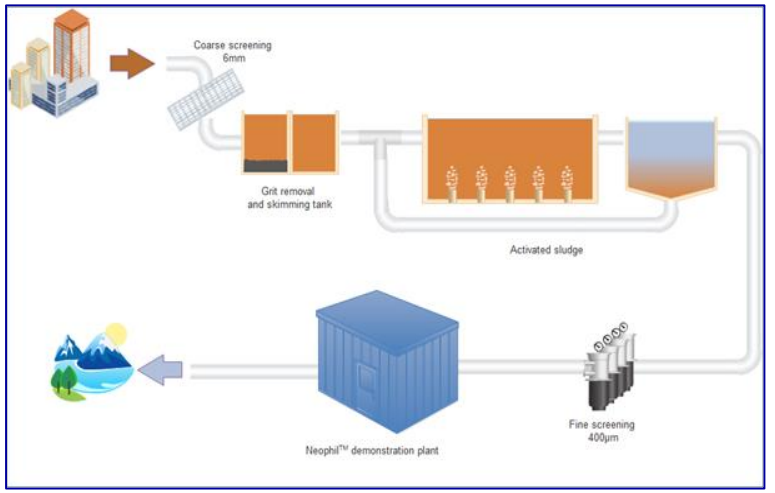
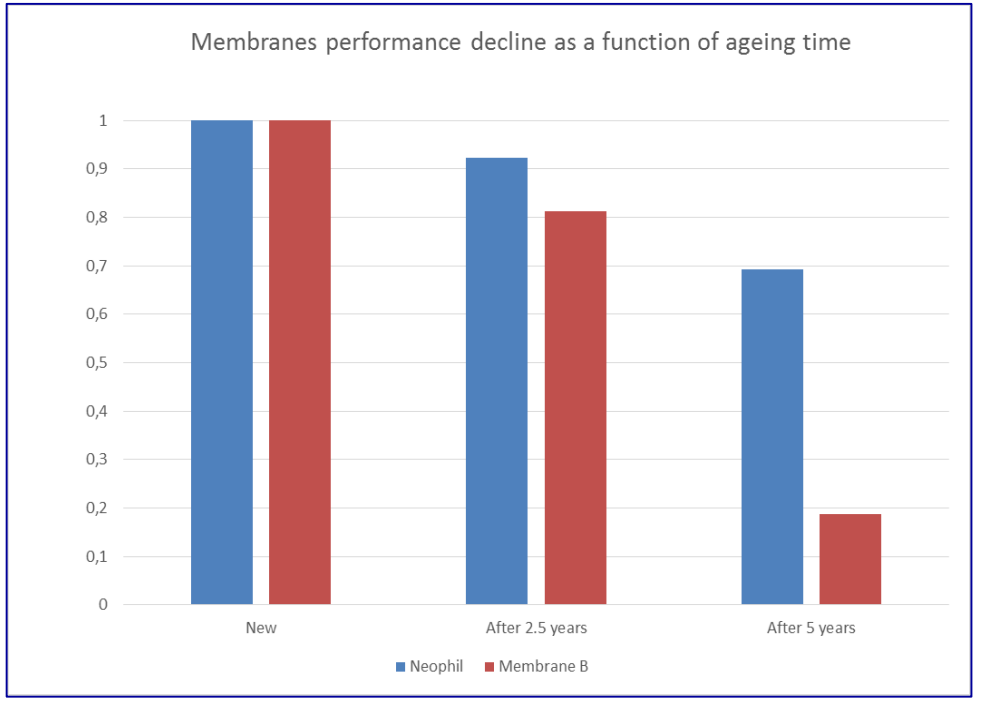
Demonstrations Neophil n°1 and Neophil-2

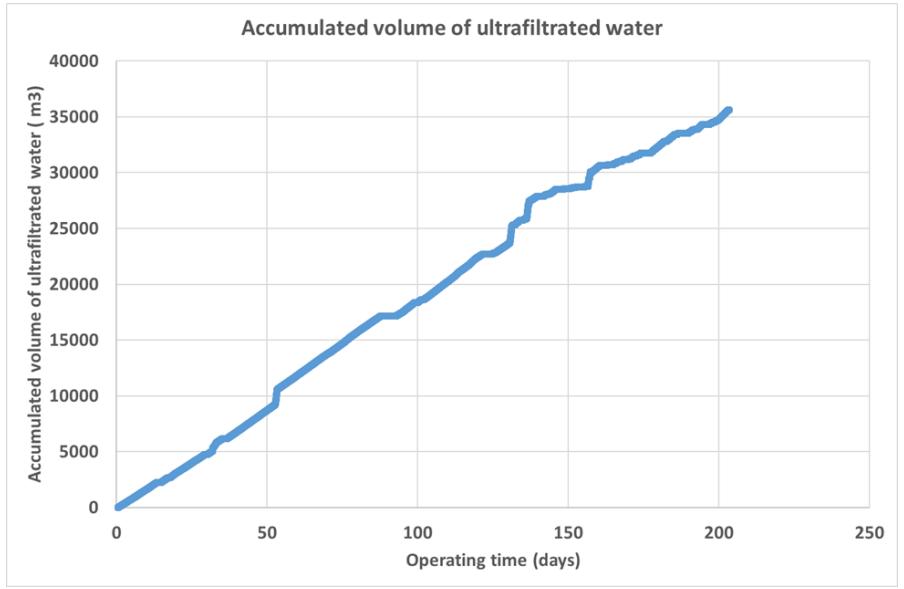
- Tertiary treatment for reuse (Magny en Vexin)
- Large demo plant 540 m² ; 20 m3/h ; 2000 pe

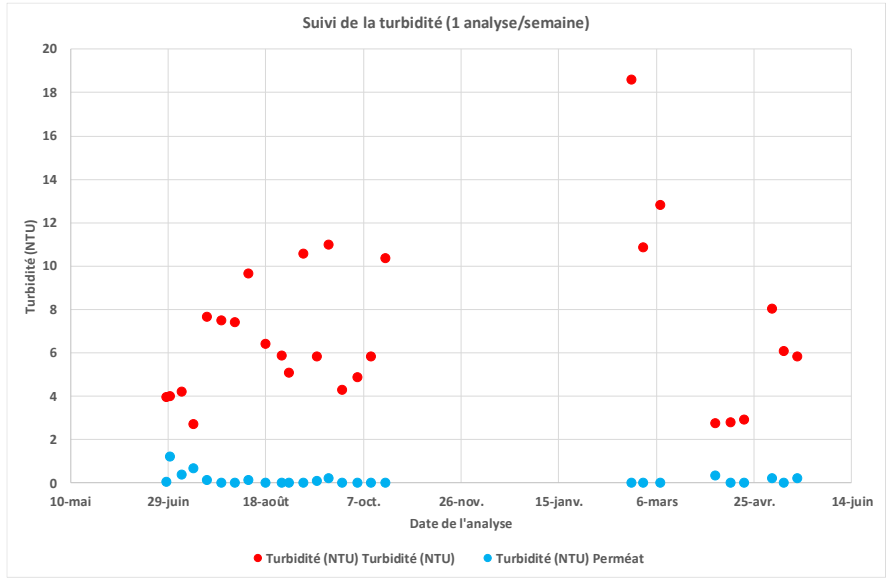




Demonstrations Neophil n°1 and Neophil-2

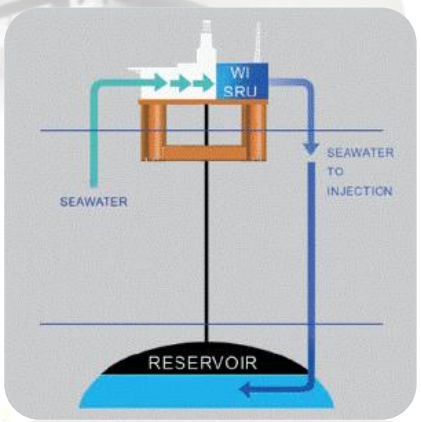
- Tertiary treatment for reuse (Toulouse metropole)
- Large demo plant 540 m² ; 20 m3/h ; 2000 pe





Demonstrations Neophil on seawater filtration

- Seawater filtration before NF for oil reservoir injection
- Plateform test at Palavas les flots, Ifremer
- Collaboration with Total (Oil and Gas company)



TOTAL
COMMITTED TO BETTER ENERGY

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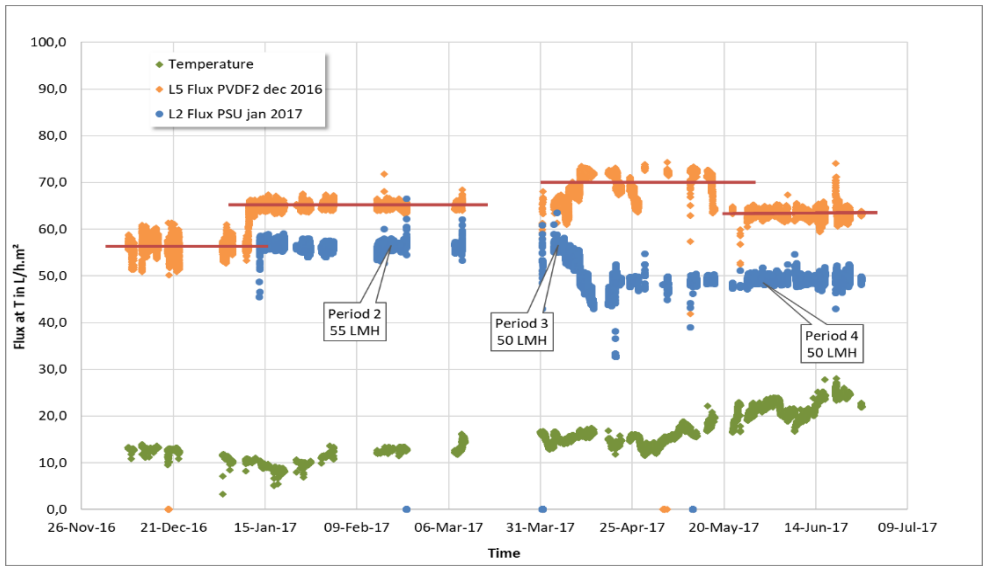

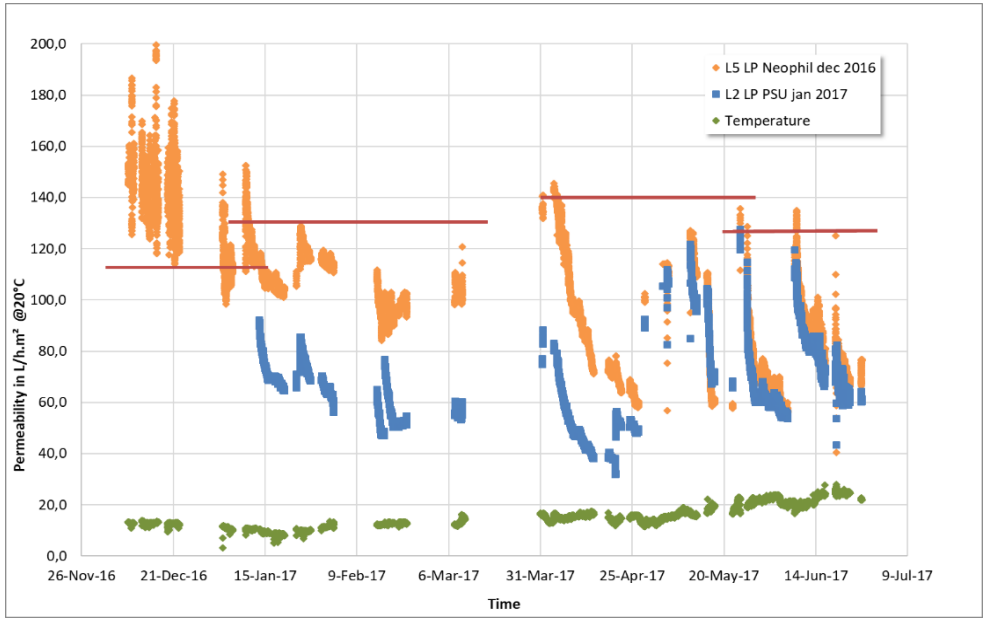

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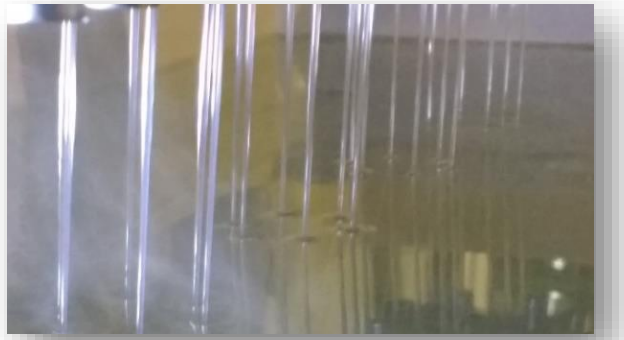
Conclusions

- Neophil ™ membrane development brings a breakthrough technology in membrane field
- Gigamem® large module design brings improvement to reduce capital investment for UF membrane plants
- Neophil™ is available in large batches
- Neophil™ has NSF-Ansi 61 agreement
- First reference in USA (Amherst) starting in February 2017
- First reference in France (Cap Sicié) to start in September 2017



Thank you for your attention

Questions?

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