

Innovative ultrafiltration membrane made with
durable hydrophilic additives for durable filtration
performances and particles rejections
Neophil™

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Jean Michel Espenan

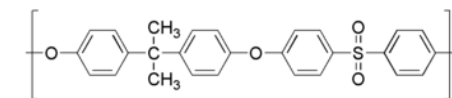
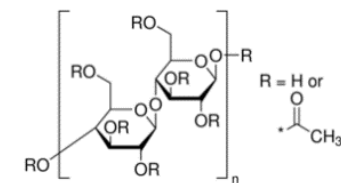
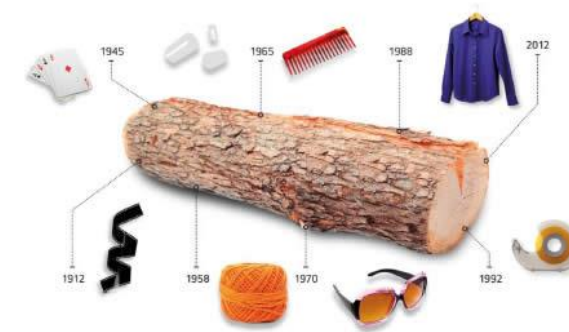
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www.polymem.fr





A UF membranes brief history

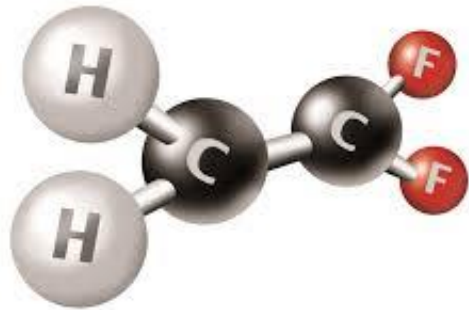
- **1988** : Cellulose acetate membranes started to lead membrane market (superhydrophilic polymer, no NOM adsorption, very low chemical cleaning frequency. Amoncourt 1988.
- **1998** : PS and PES replaced cellulose acetate thanks to its better resistance in large UF plant (more robust) even if it's less hydrophilic. New use of hydrophilic additives, mostly PVP. Easy and fast to produce true UF membranes.





A UF membranes brief history

- **2008**, PVDF recommended by consultant engineers in USA (largest membranes market) due to its strong resistance to chlorine.
- There were important PES hollow fibers breakages in very large plants in USA.
- PVDF is a stronger material





In 2008, conventional PVDF membranes

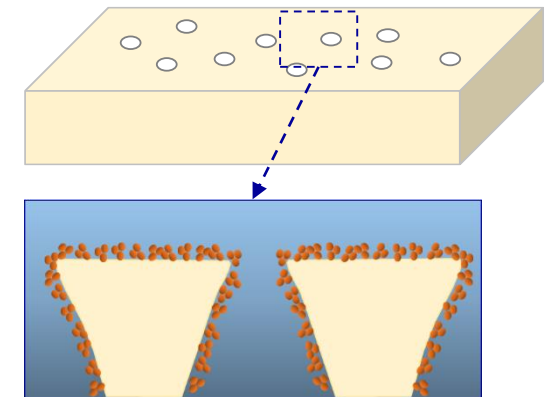
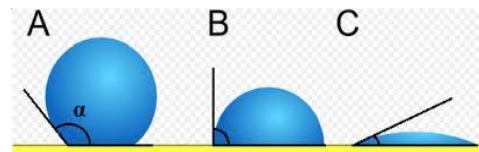
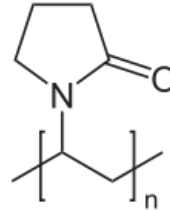
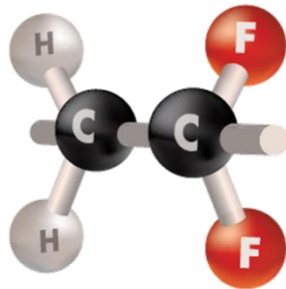
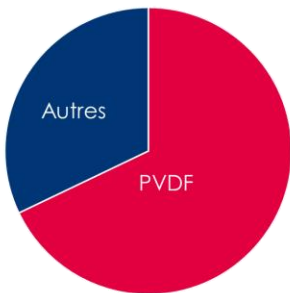
Fluorinated polymers very hydrophobic



Hydrophilic additives



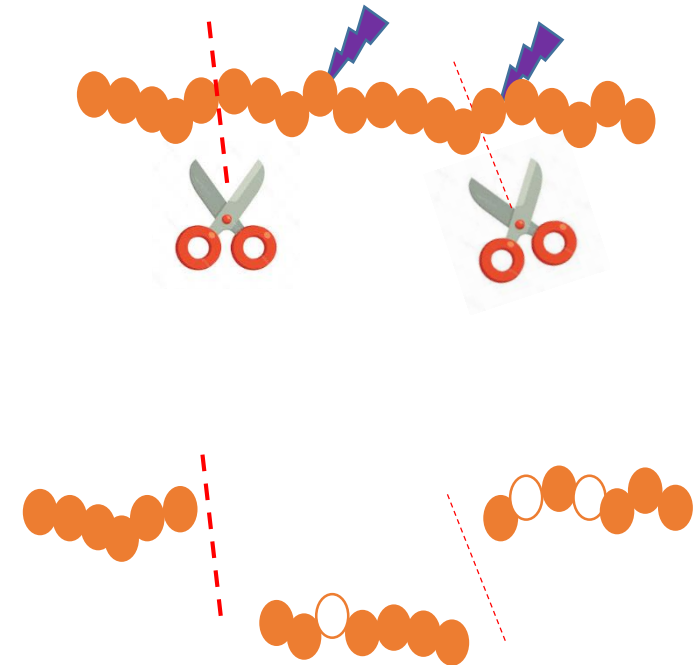
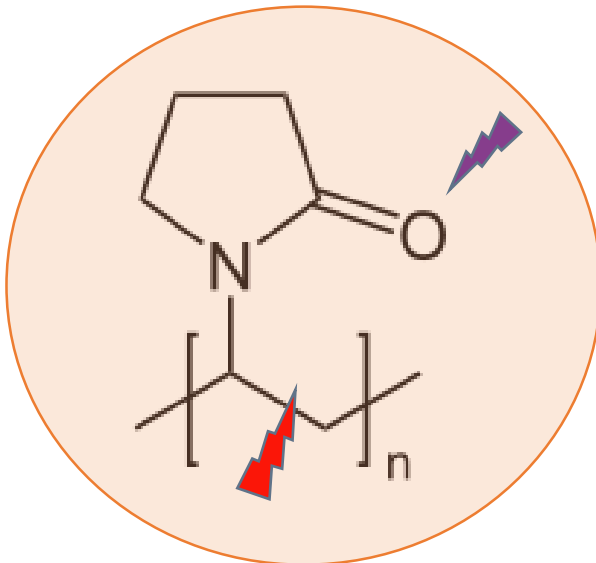
Hydrophilic membranes



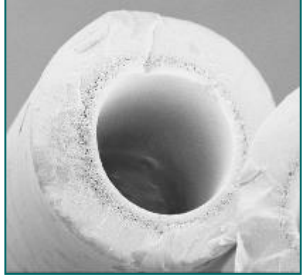


In 2008, conventional PVDF membranes

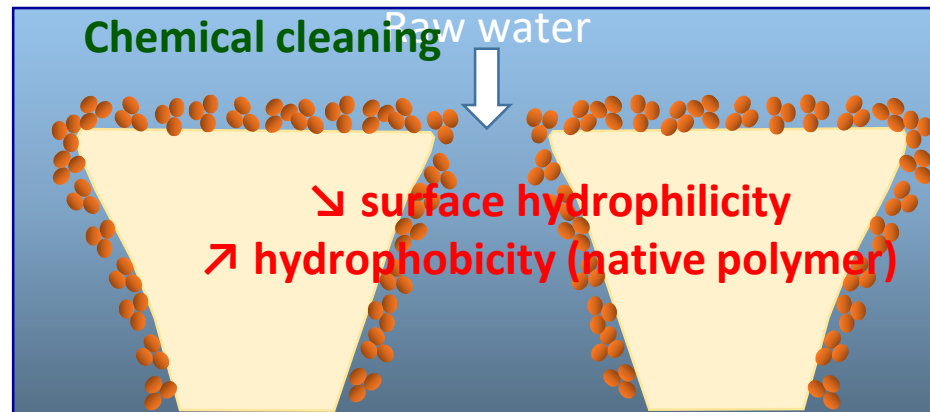
PVP resistance to chlorine is weak



PVP degradation mechanisms with chlorine



In 2008, conventional PVDF membranes





**Our thoughts in 2008 : “Ideal membranes
should be made with a 4th material
generation, a durable hydrophilic PVDF”**

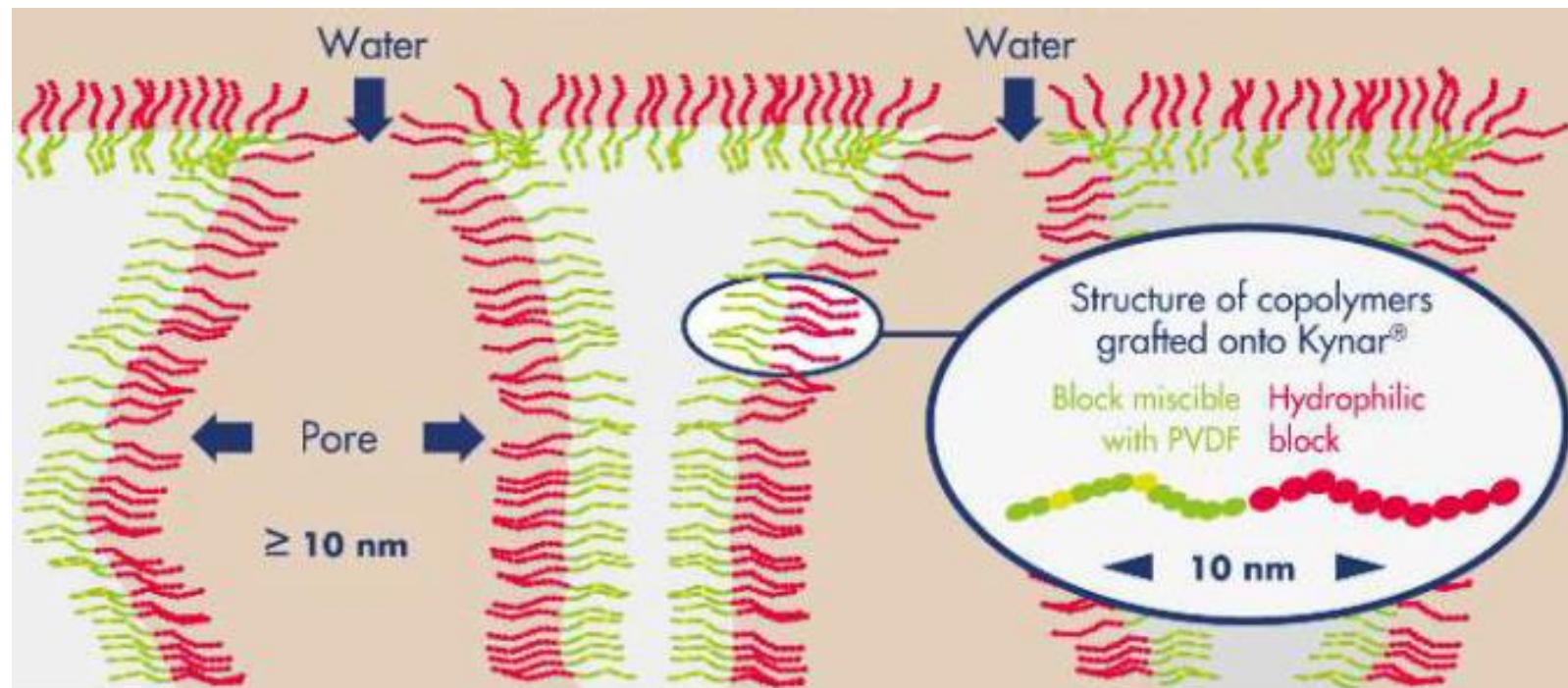
*Polymem and Arkema wish when we started cooperative programs
in 2008*



Neophil™ idea

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INNOVATIVE CHEMISTRY



Conventional membranes vs Neophil™

Conventional PVDF membrane

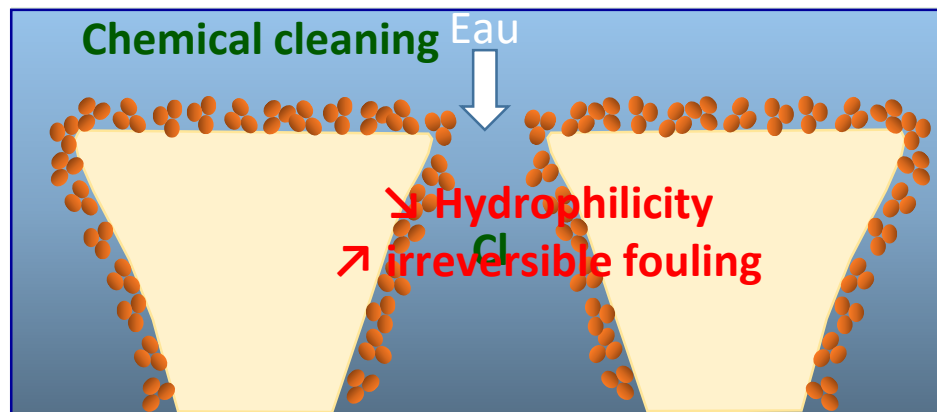
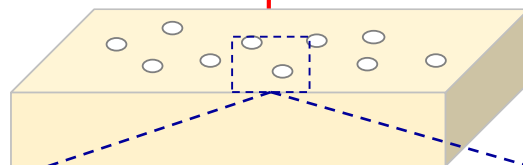


Porogenous and hydrophilic additives

Only PVDF

Additives

Polymers



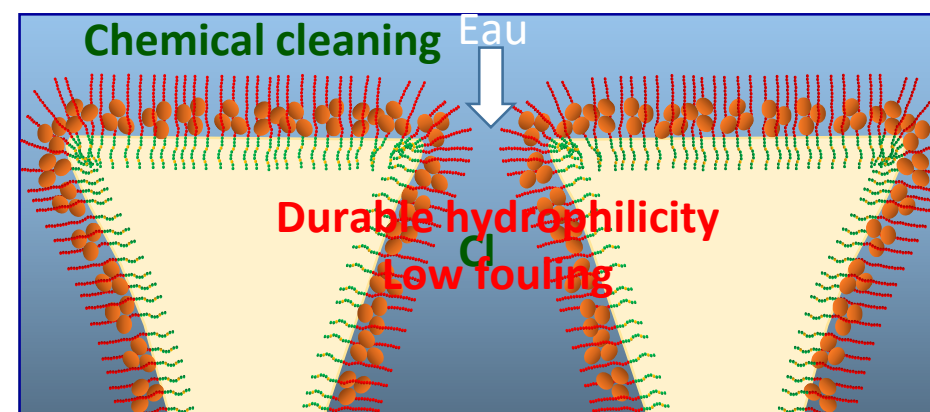
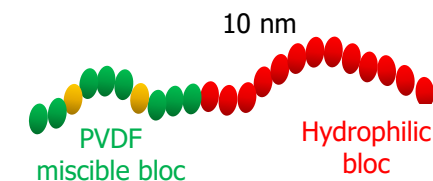
Neophil™ Membrane PVDF

Porogenous and hydrophilic additives

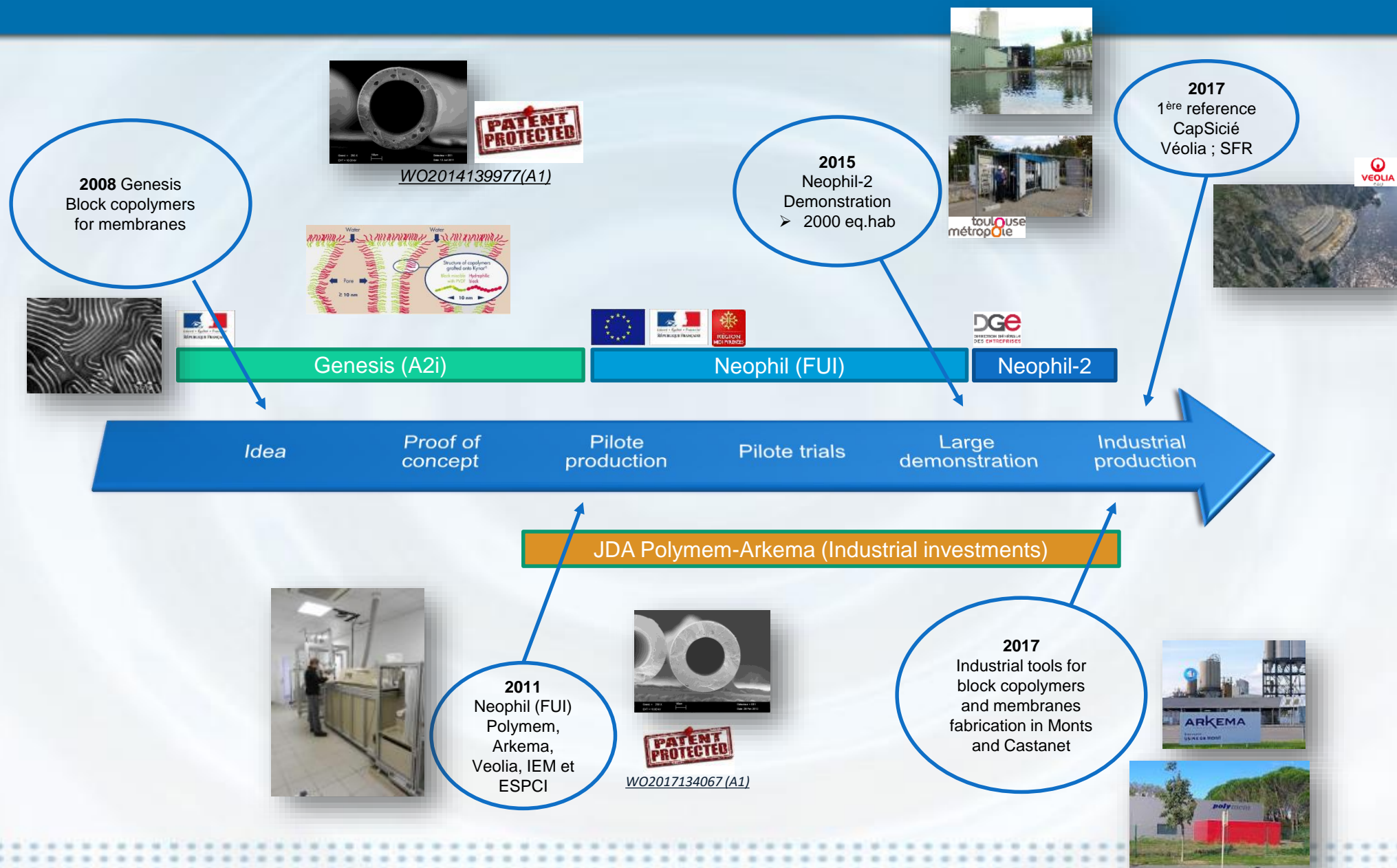


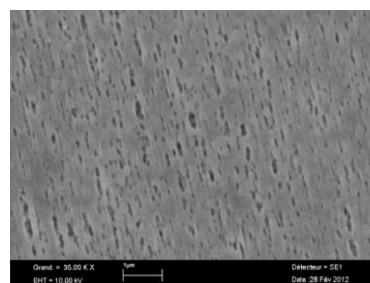
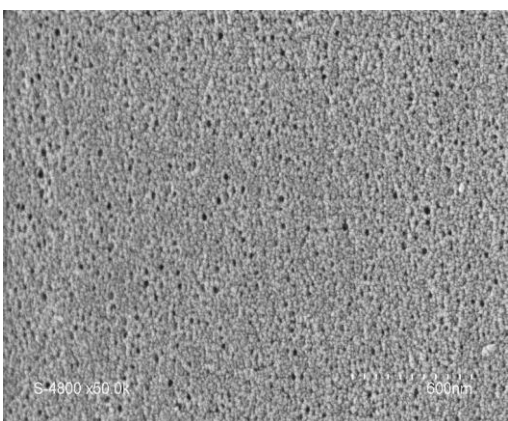
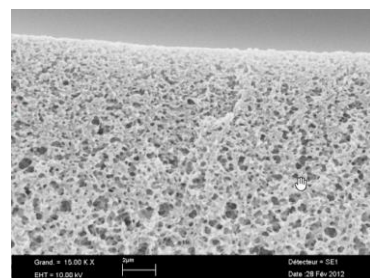
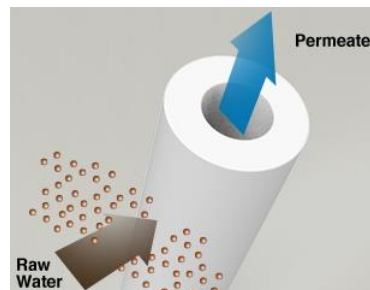
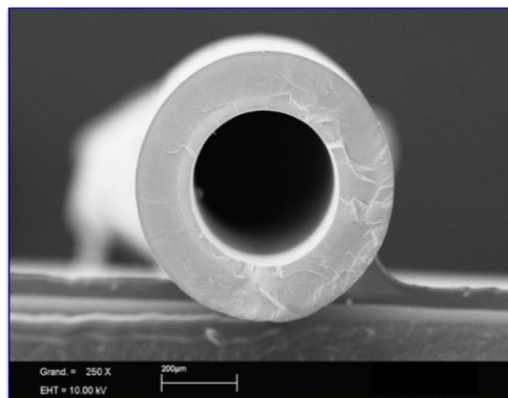
PVDF Kynar® + Durable hydrophilic additive DH100

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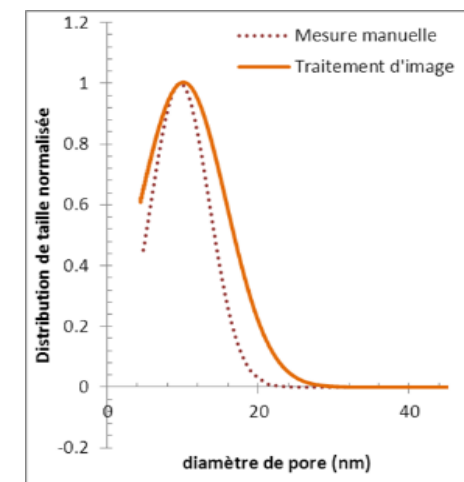
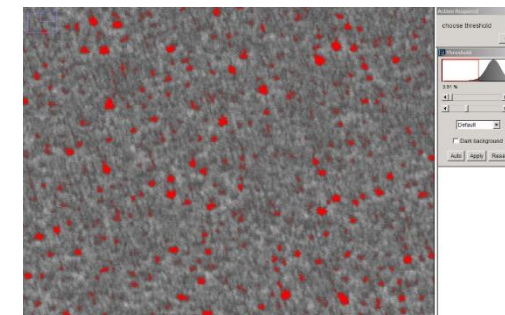


Neophil™, a French industrial development



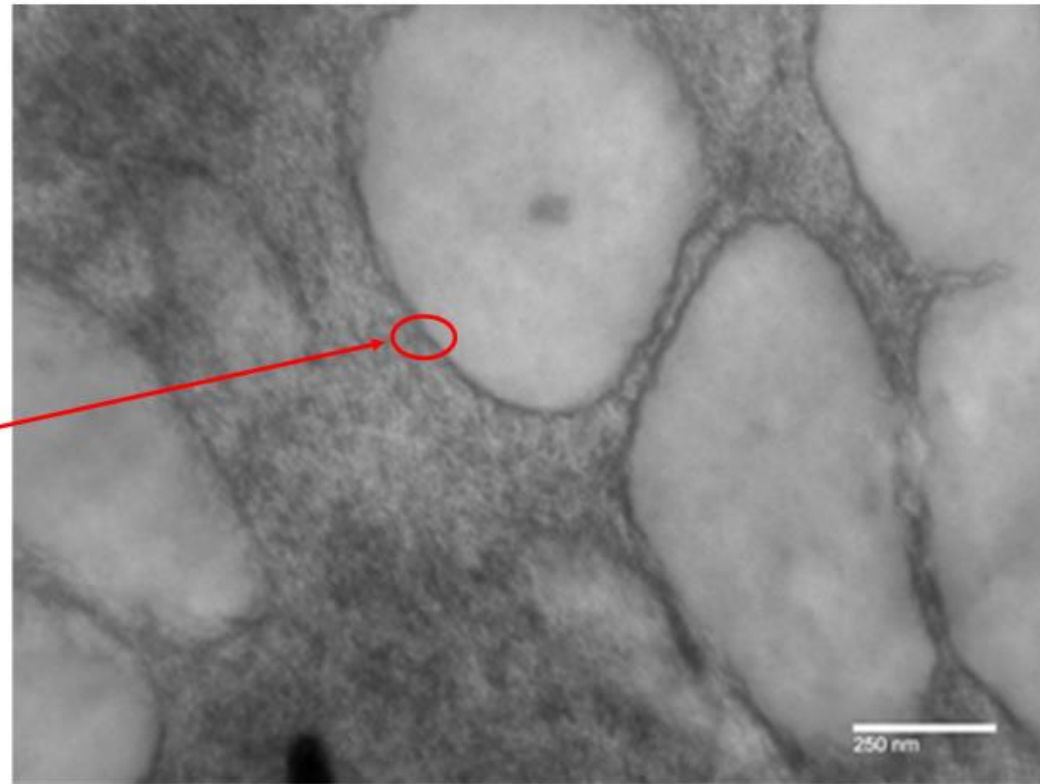
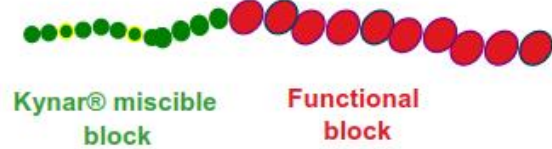
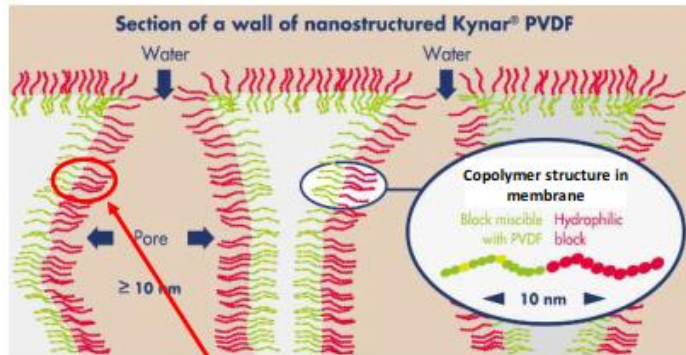


- Standard external diameter
 - 0.74mm
- Available in other diameter 0.45 – 2.50 mm
 - Water permeability 400 – 500 L/h.m².bar@20°C
 - Mecanical strength 6.0 Mpa
- Elongation > 160 %
- Pore diameter 15 nm
- Viruse removal (MS2-phage)
 - > 4 log on new fiber
 - > 4 log on aged fiber
 (100 000ppm.h/200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





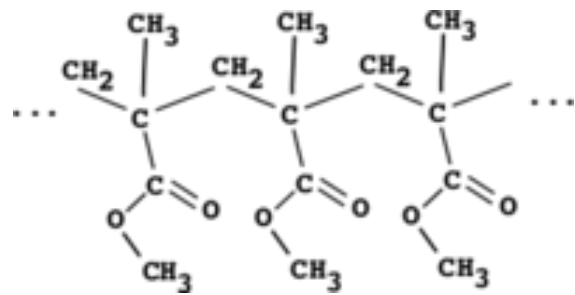
Block copolymer localization



TEM – Stained Block Copolymer (Oikonomou, et al *J. Membrane Sci*, **538**, (2017), 77-85)



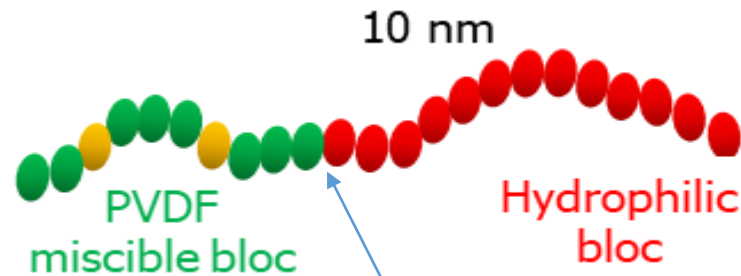
Block copolymer optimization (Arkema-Polymem)



PMMA :
Polymethylmethacrylate



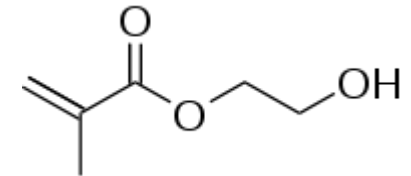
D51H = Dibloc 50/50

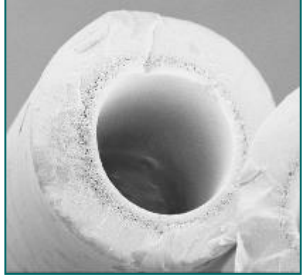


Covalent bonding

HEMA :

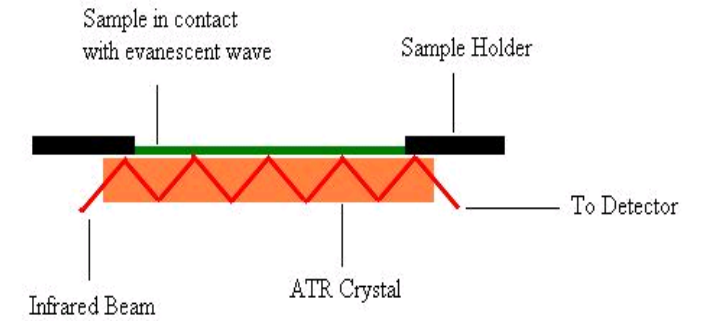
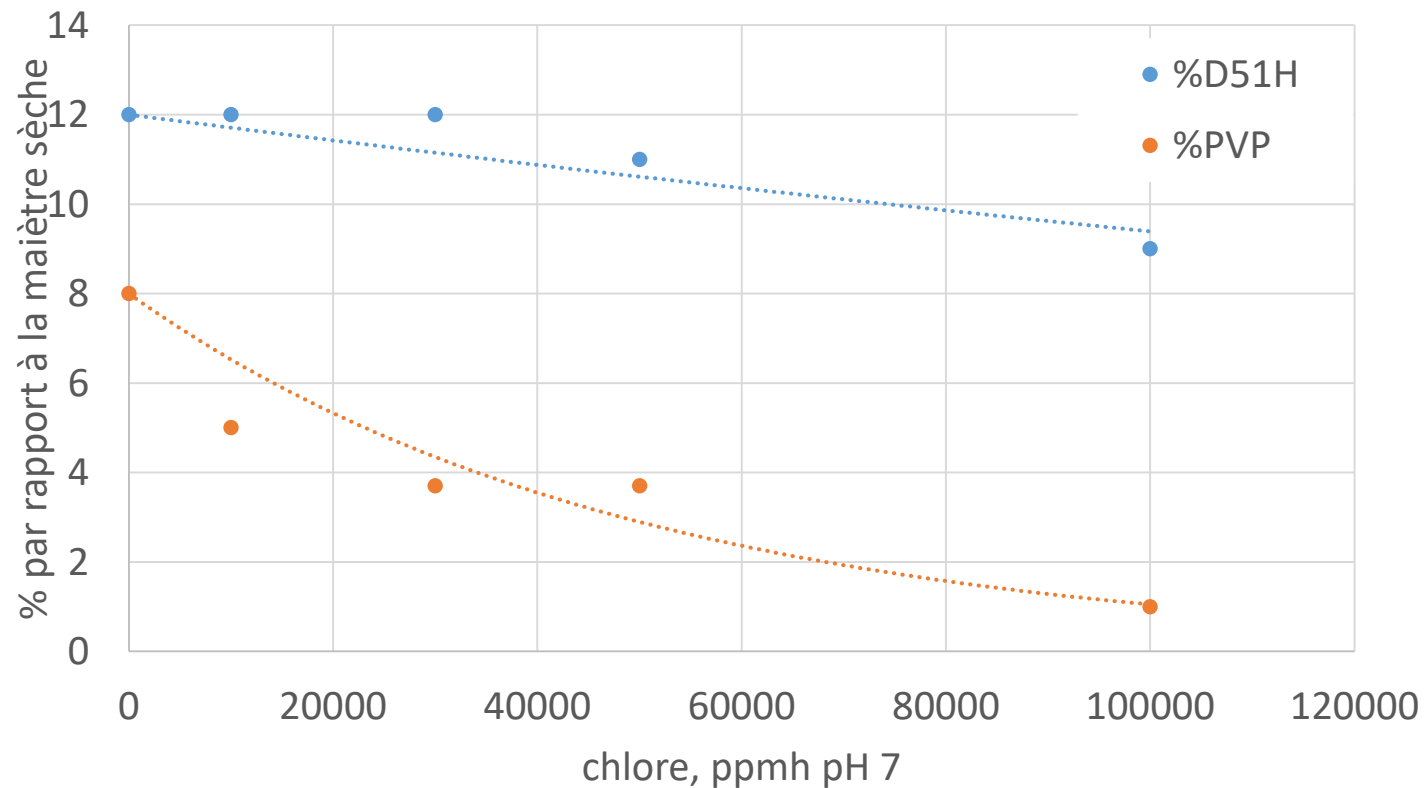
Hydroxyethylmethacrylate





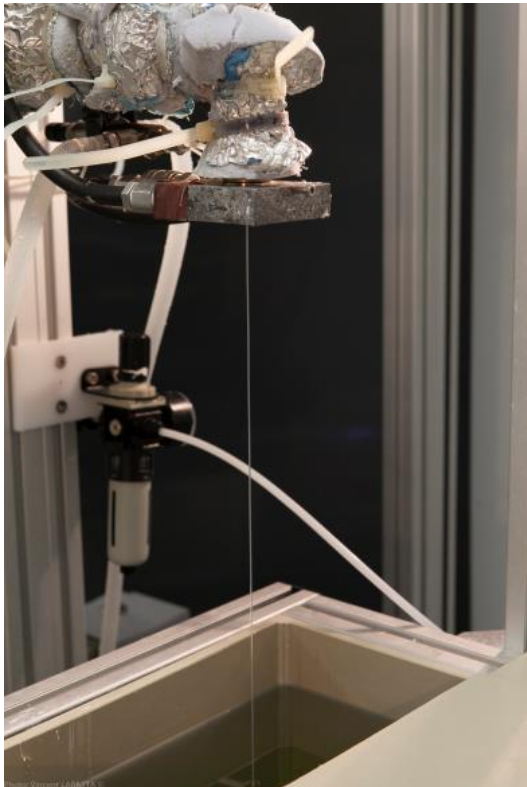
Ageing tests

ATR Neophil as a function of chlorine ageing





Pilot production of large Neophil™ batches



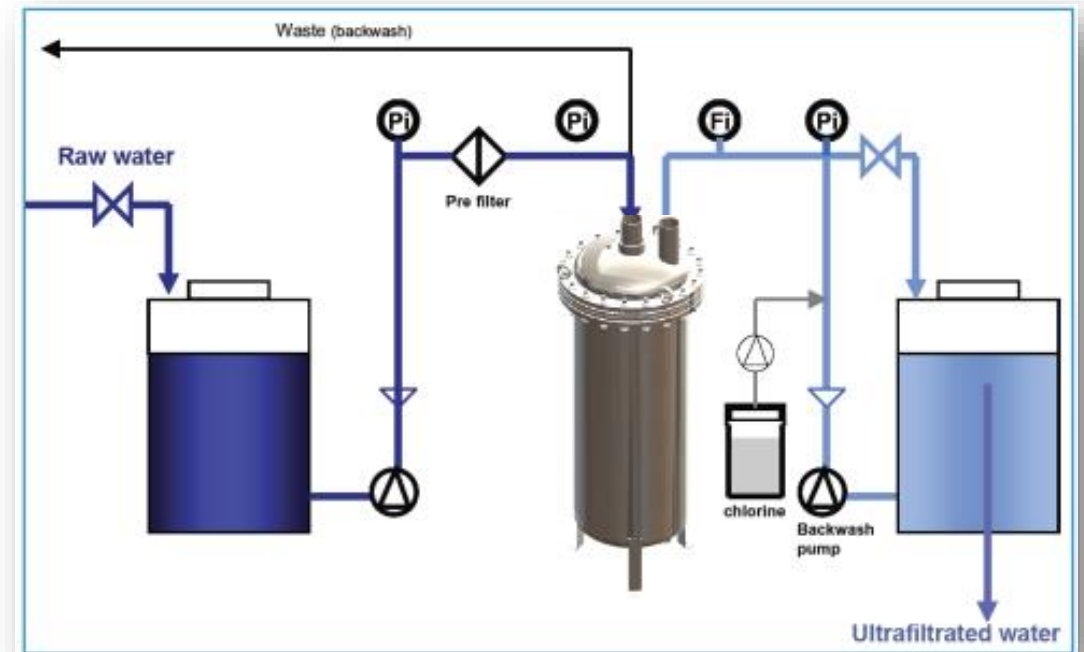
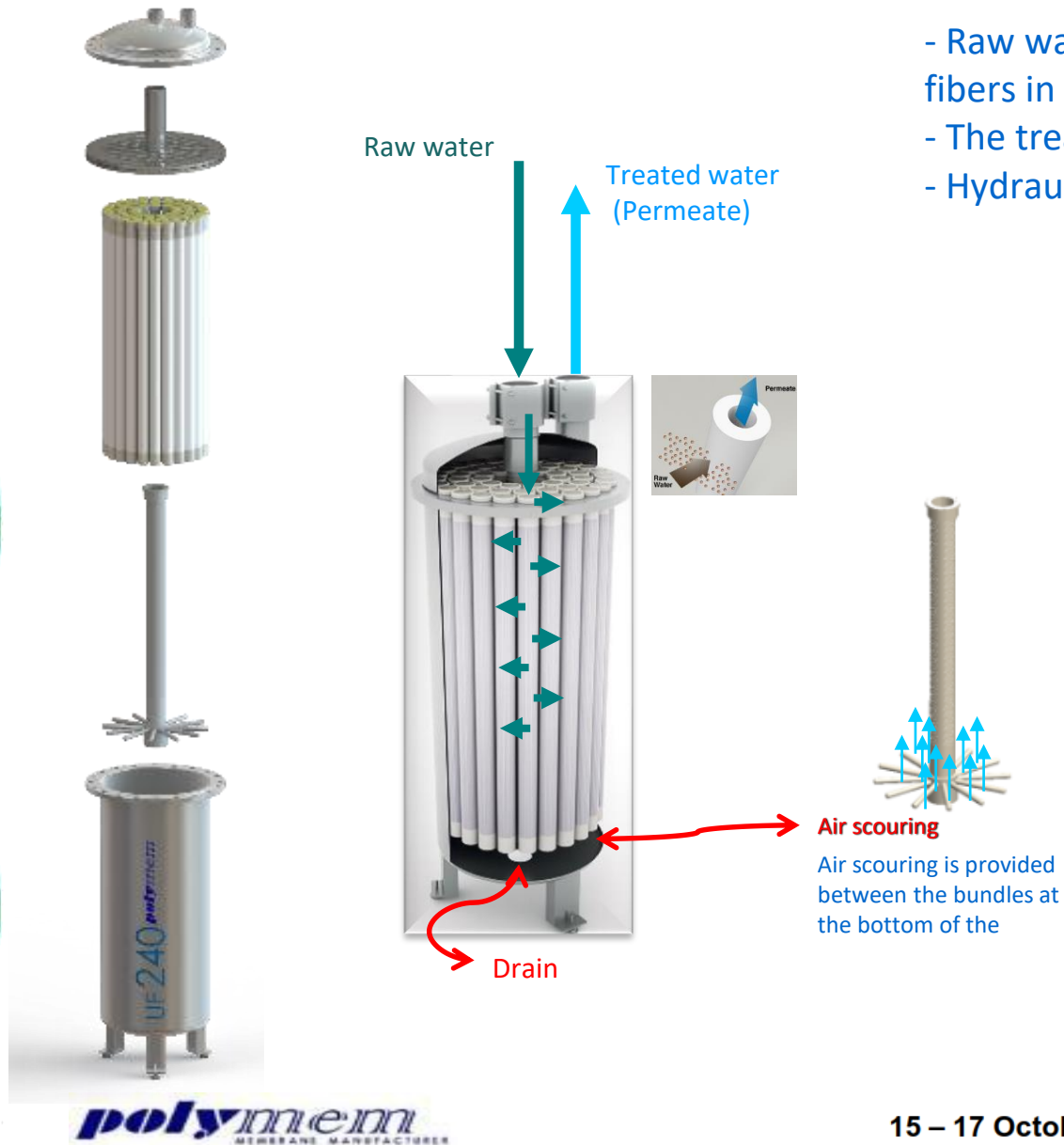


Important successes

Pilot trials and large demonstrations in Gigamem® modules

Demonstration plants

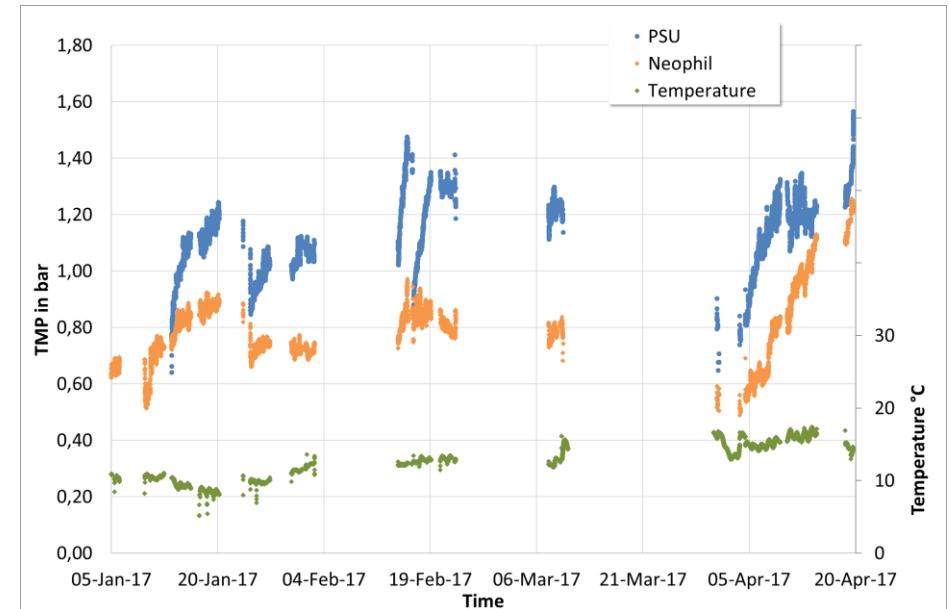
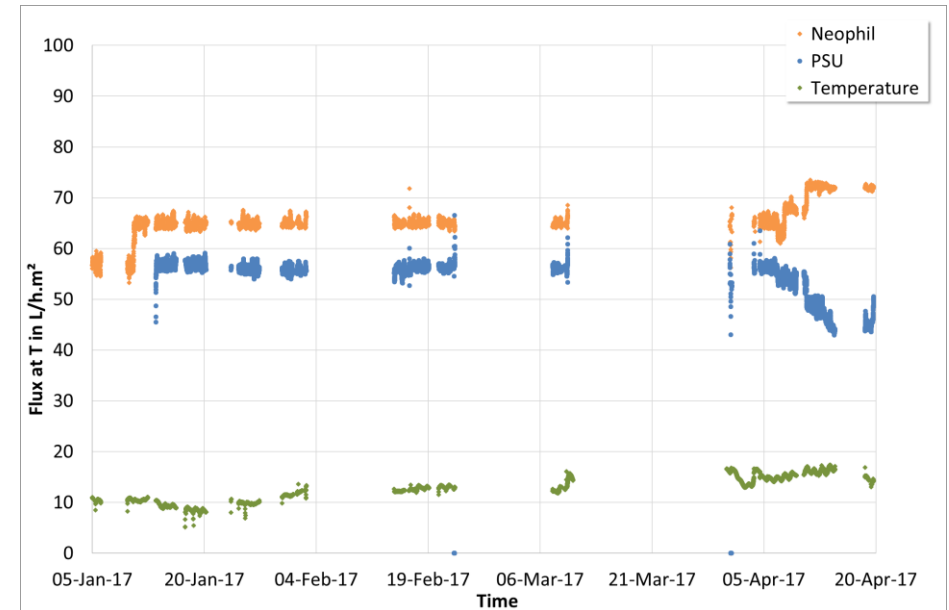
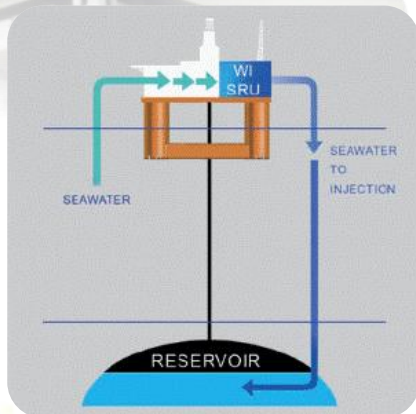
- Raw water feeds the central distribution pipe and pass through the hollow fibers in outside-in filtration mode.
- The treated water (permeate) is collected at the top of the module
- Hydraulic backwashes are performed regularly to clean the membrane



15 – 17 October 2018, Lyon (France)

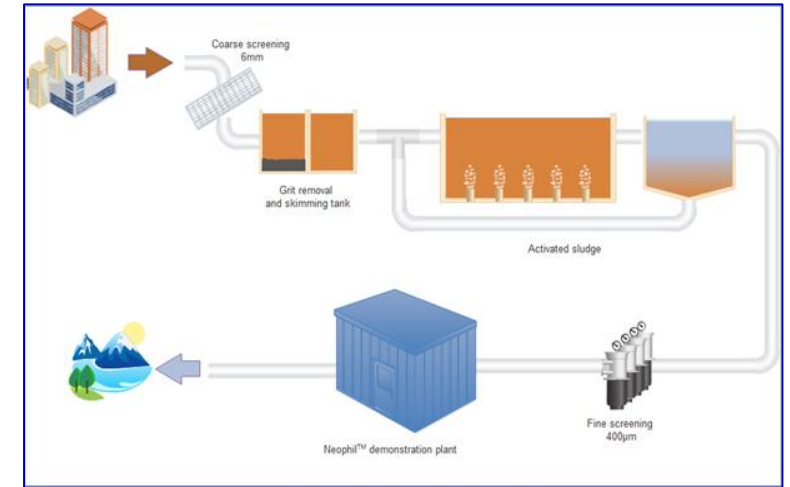
Pilot trials of Neophil on seawater filtration

- Seawater ultrafiltration for oil reservoir injection
- Platform test at Palavas-les-flots, Mediterranean sea
- Very poor quality of inlet water $SDI_{15} > 5$

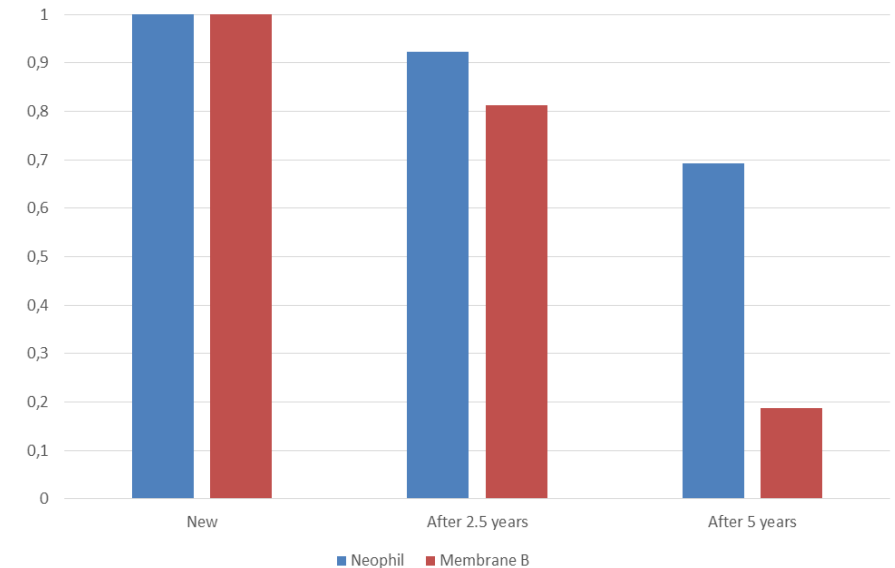


Demonstrations Neophil n°1 and Neophil-2

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



Membranes performance decline as a function of ageing time



Demonstrations Neophil n°1 and Neophil-2

- 500 m³/d : Tertiary treatment for reuse (Toulouse metropole)
- Large demo plant 540 m²



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Membranes



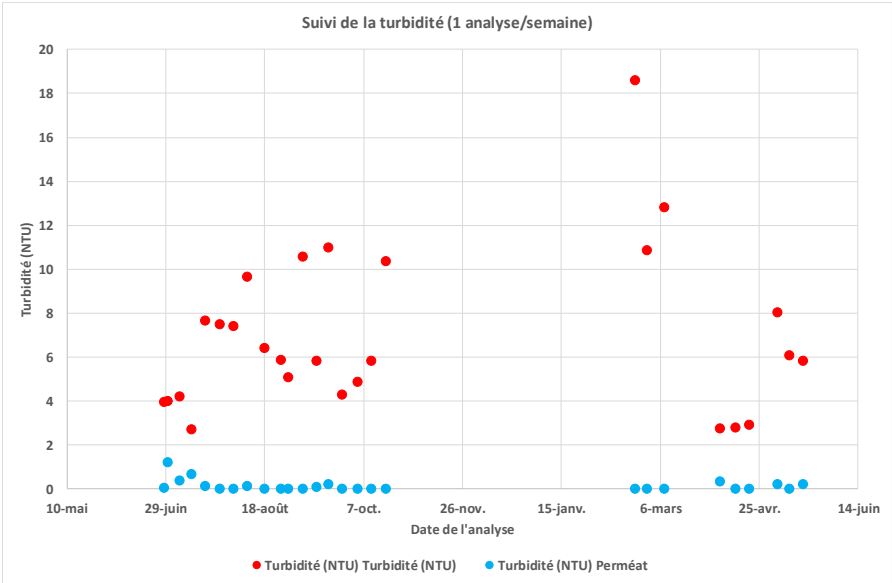
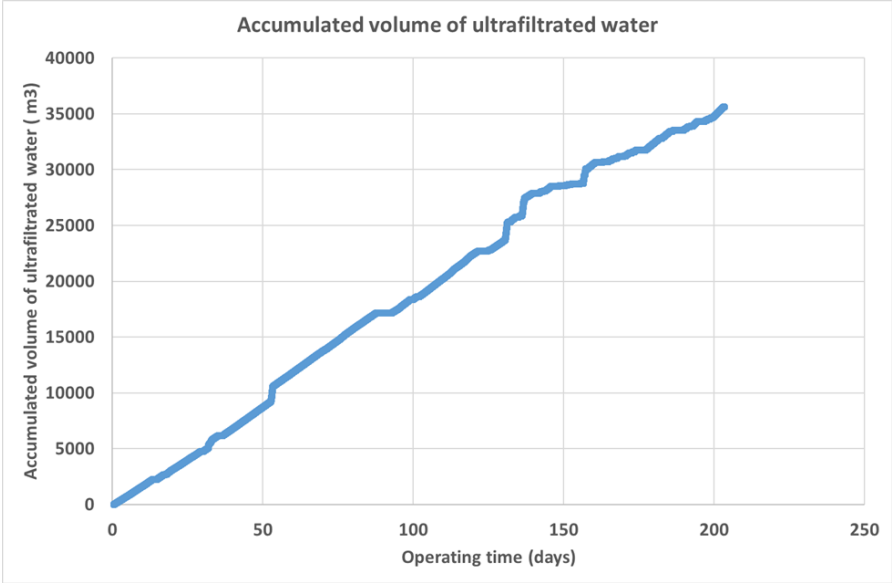
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VEOLIA
EAU

ESPCI
ParisTech

DGE
DIRECTION GÉNÉRALE
DES ENTREPRISES



Conclusions

- Neophil™, a French membrane development brings a breakthrough technology in membrane field
- Neophil™ membrane is available in large batches
- Neophil™ has NSF-Ansi 61 ACS agreements
- First reference in USA (Amherst) starting in 2017
- First reference in France (Toulon, Cap Sicié) starting in 2018



Thank you for your attention

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