

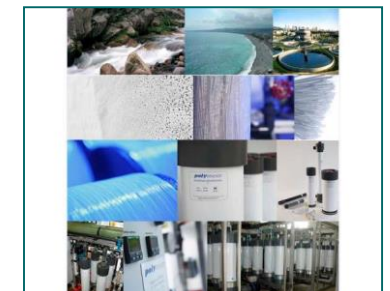


# New ultrafiltration membrane made with new polymer material for long lasting and rejections performances, Neophil™

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# Presentation outlook

1. Introduction
2. Presentation of the membrane Neophil™
3. Demonstration of sustainable performances
  1. Ageing bench and protocol
  2. Release of additives during ageing
  3. Pores size distribution evolution with ageing
  4. Virus surrogate MS2-phage rejection with ageing
  5. Fouling trends before and after ageing
4. Conclusions

# Introduction

Brief history of UF/MF membrane material development in water treatment

CA  
Cellulose Acetate  
superhydrophilic  
polymer, low  
fouling

PS and PES  
thanks to its  
better resistance  
in large UF plant  
(more robust) +  
hydrophilic  
additives, mostly  
PVP.



PVDF  
stronger  
resistance to  
oxidant  
(chlorine),  
no breakage.  
But  
hydrophobic

New material =  
Durable hydrophilic  
PVDF using special  
di-bloc copolymers  
blended in PVDF

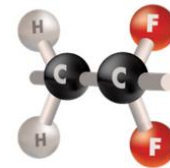
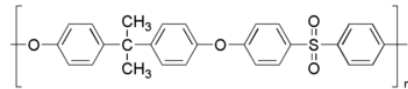
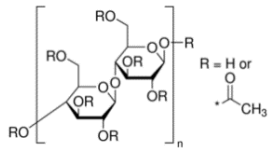
1980's

1990's

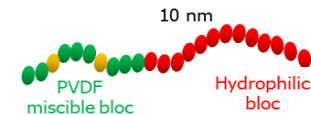
2000's

2010's

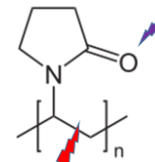
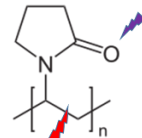
2020's



Neophil™



ARKEMA  
INNOVATIVE CHEMISTRY

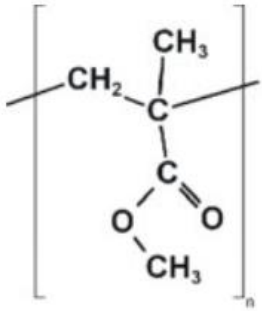


polymem  
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# Presentation of the membrane Neophil™



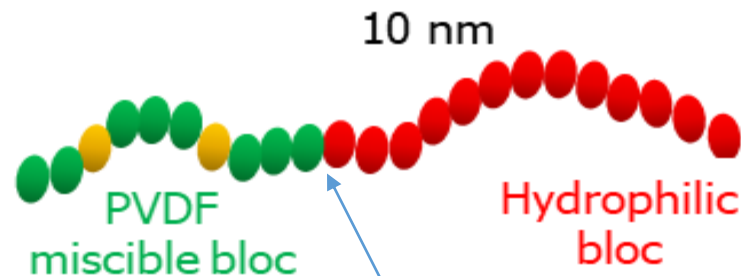
Block copolymer and membrane spinning process optimizations  
(Arkema-Polymem)



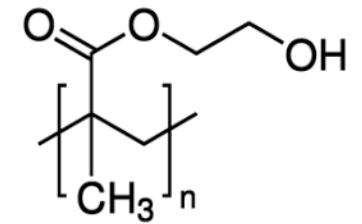
Hydrophobic PMMA :  
Polymethylmethacrylate



Diblock ; Amphiphilic



Covalent bonding

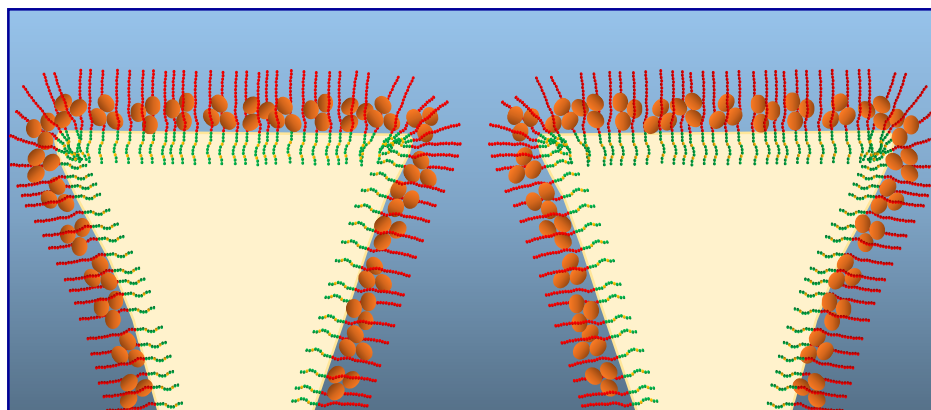
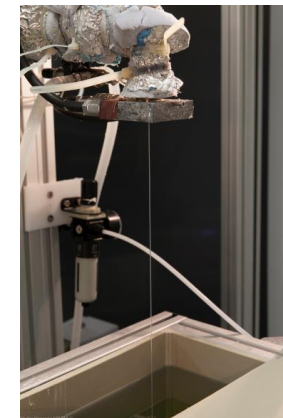
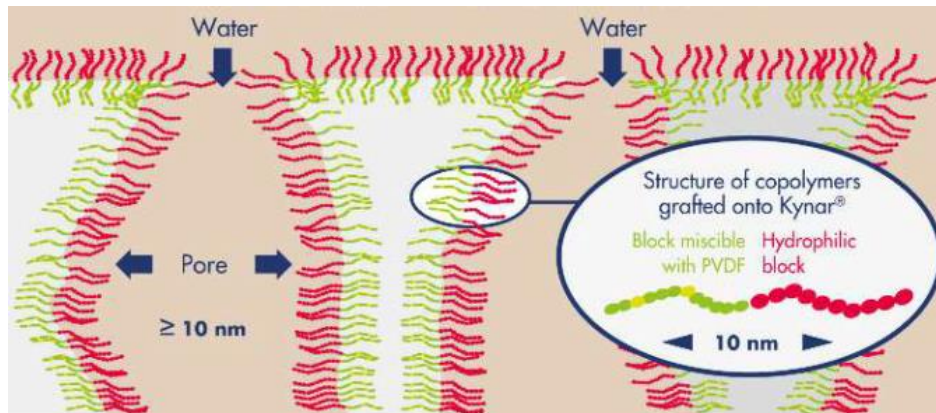


Hydrophilic bloc = pHEMA  
Polyhydroxyethylmethacrylate



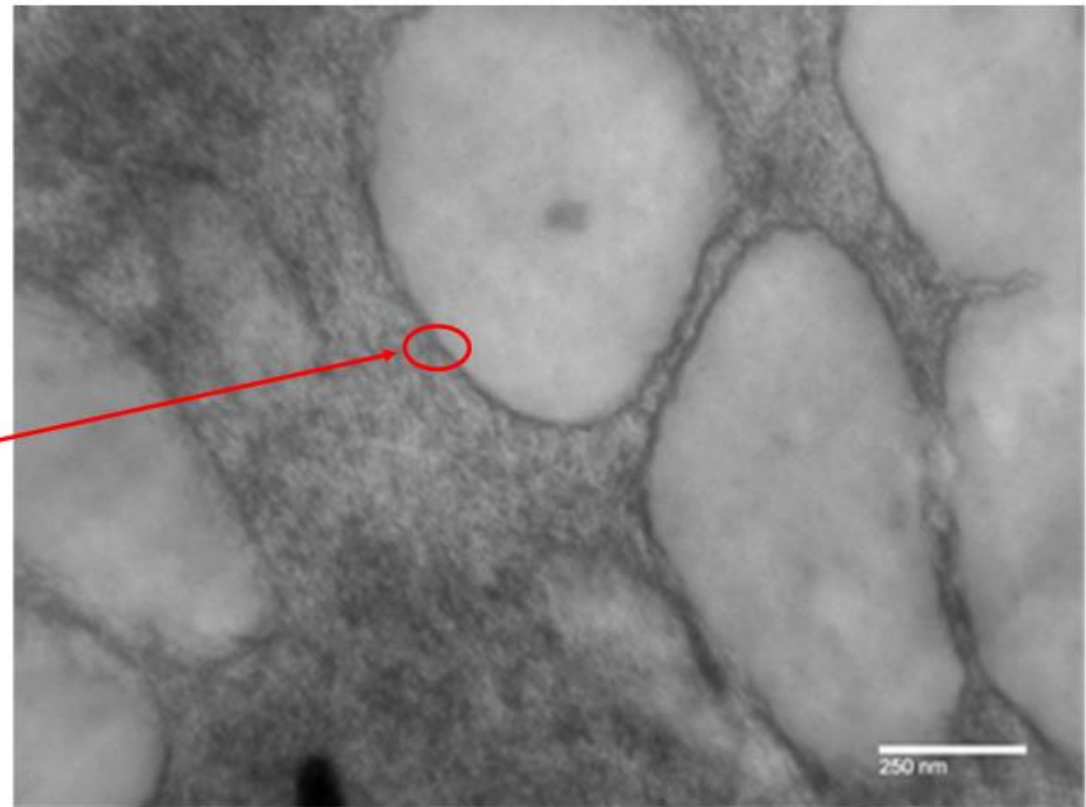
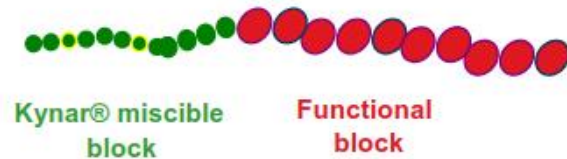
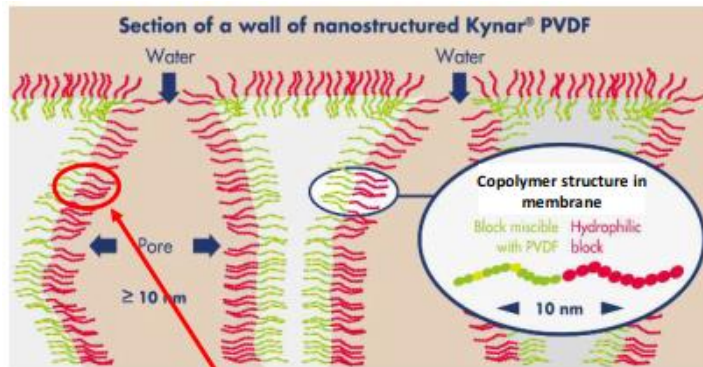


# Presentation of the membrane Neophil™



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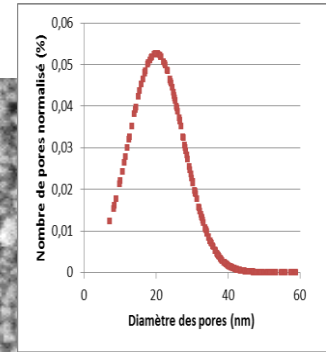
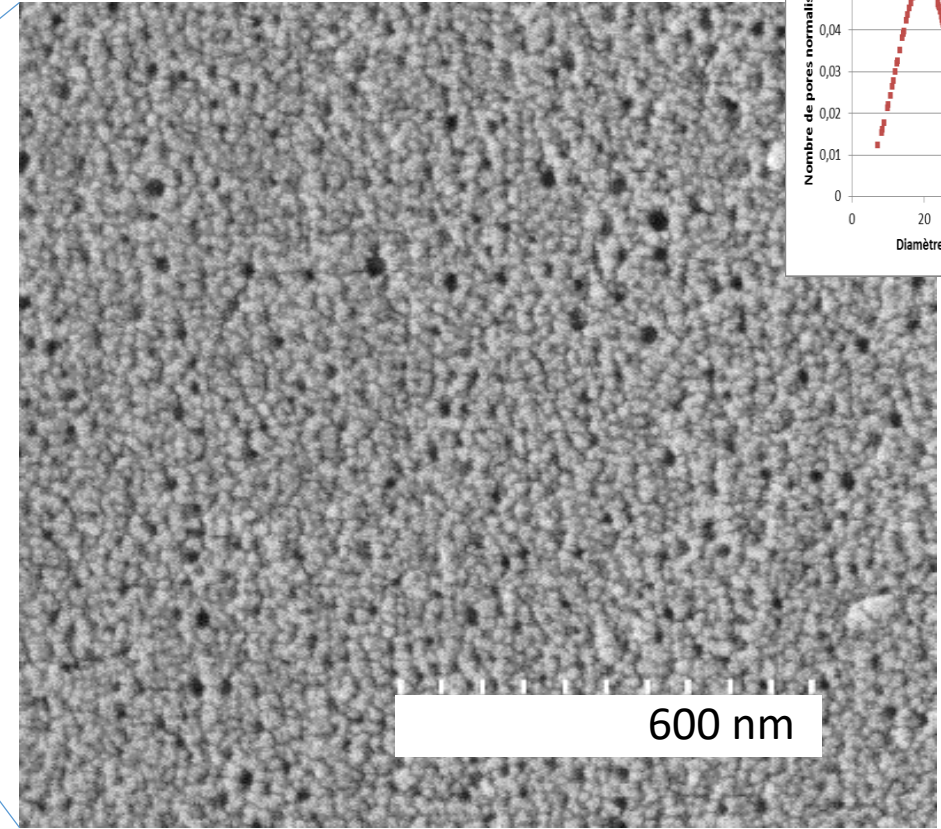
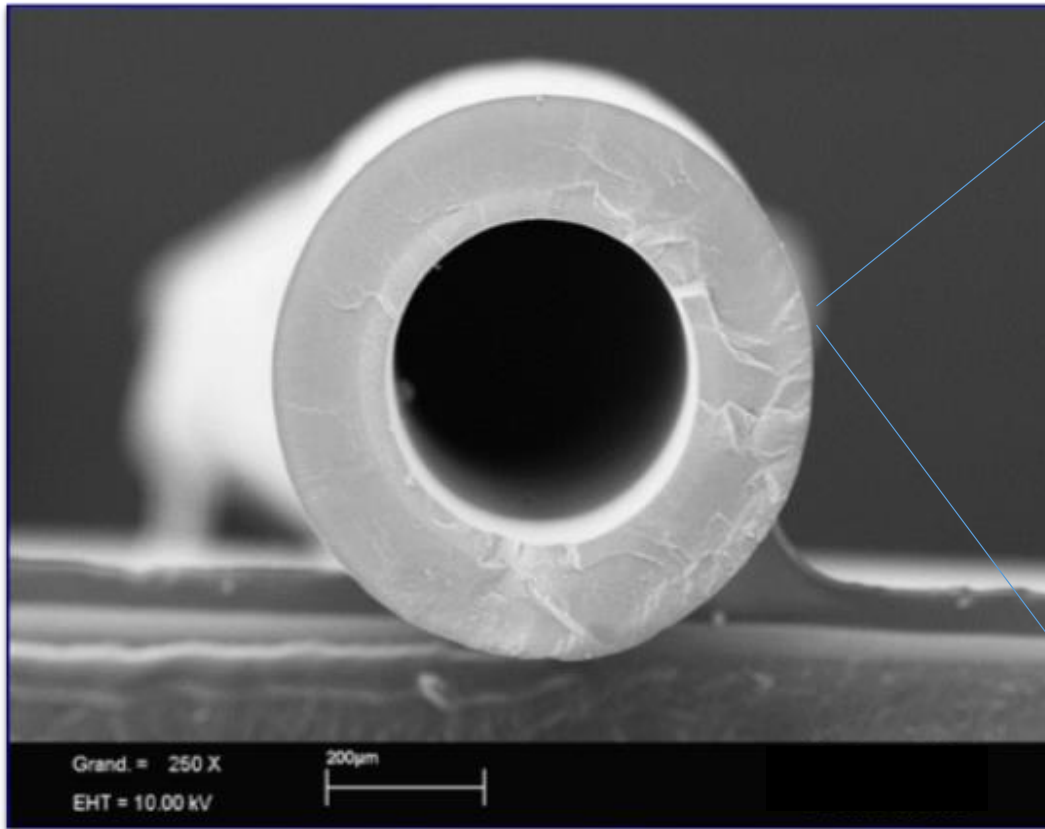
## Block copolymer localization



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



# Presentation of the membrane Neophil™





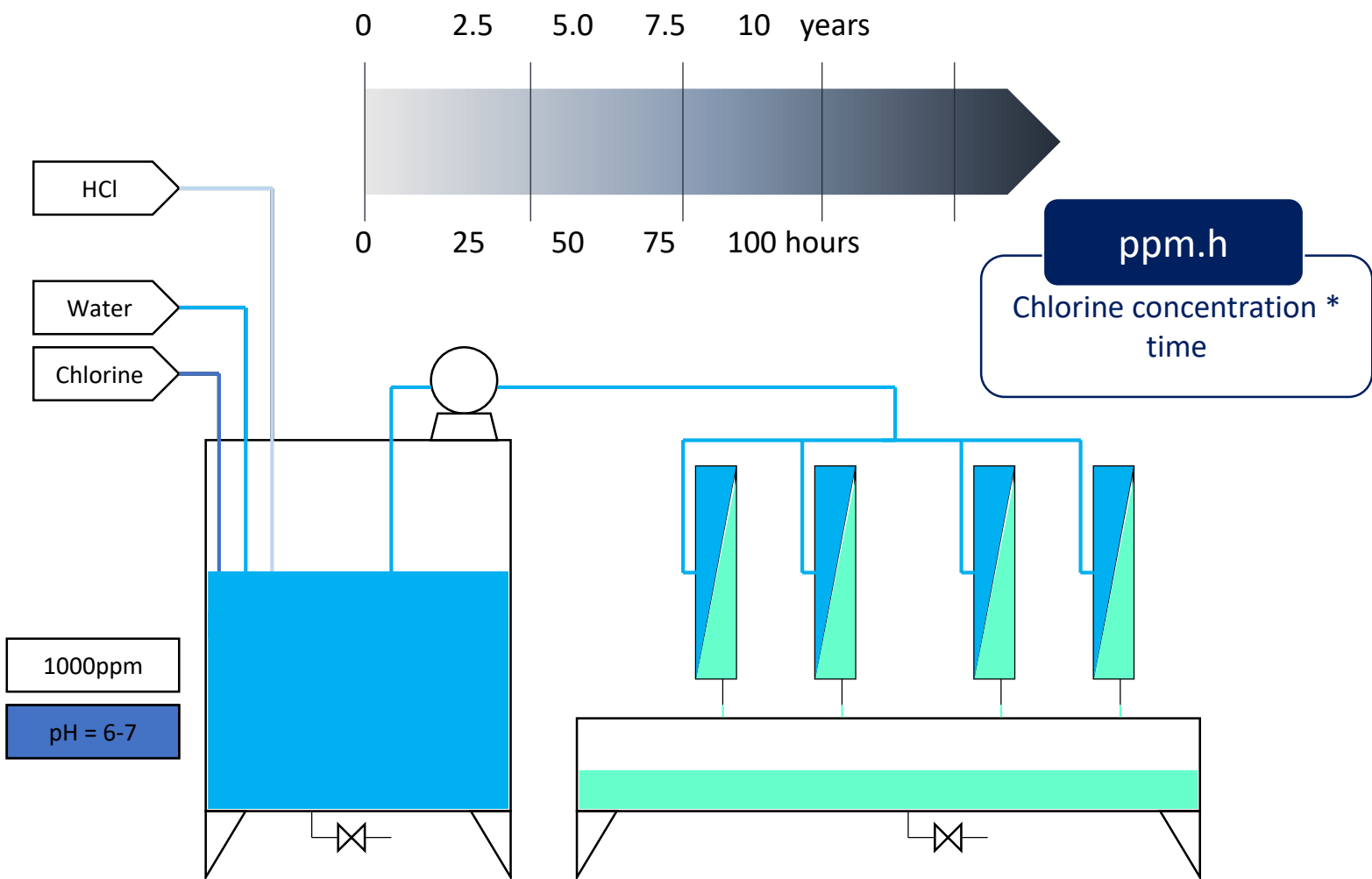
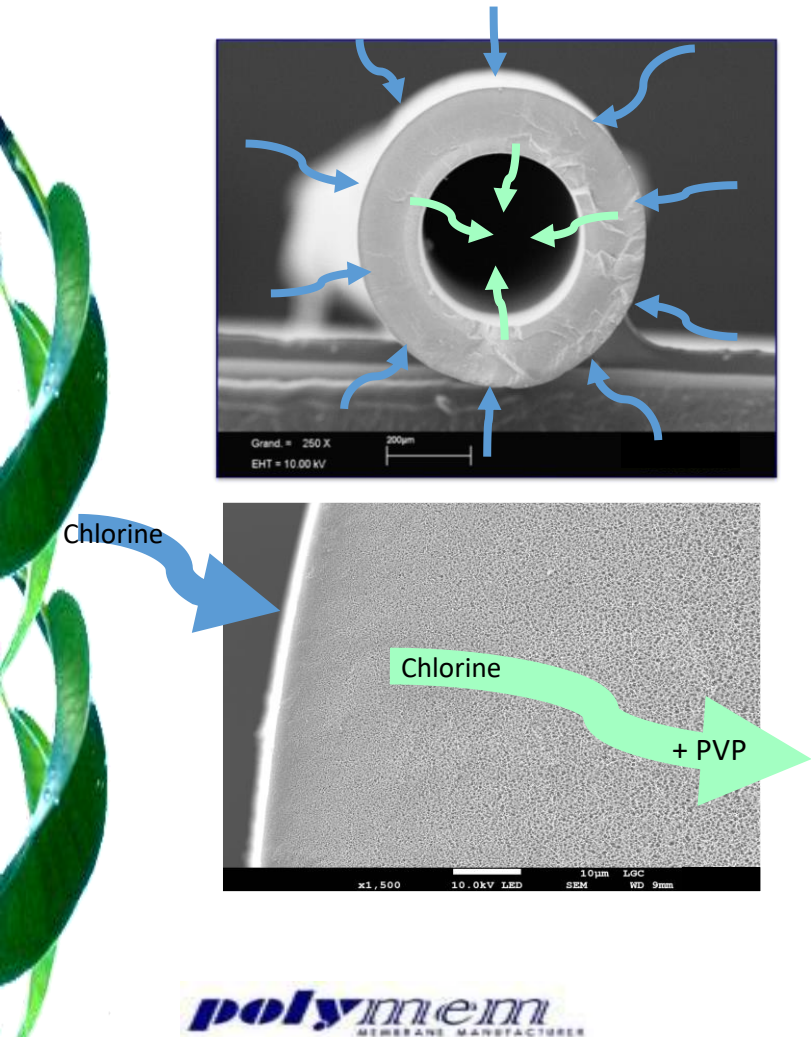
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# Demonstration of sustainable performances

## 1. Ageing bench and protocol



# Demonstration of sustainable performances

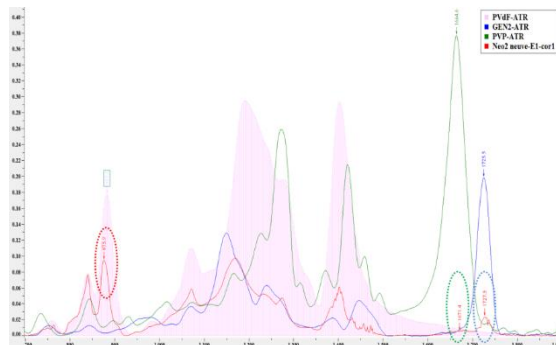
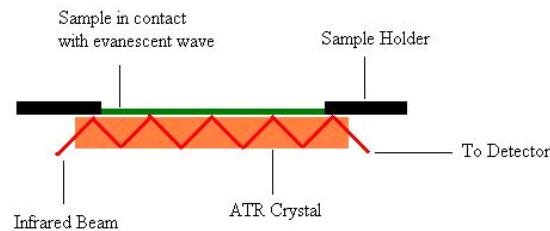
## 1. Ageing bench and protocol summary

- Soaking minimised ageing : just ageing of the surface in contact with solution
- Use of dynamic filtration (10 LMH) to age deeply the structure of the membrane to release additives
- Ageing solution : chlorine at 1000 ppm and pH 6-7
- Control and adjustment of concentration and pH
- Long test duration (several weeks) : 100 000 and 200 000 ppmh simulating the entire lifetime of chlorine exposure (10 years)
- 3 fibers aged : Neophil™ and 2 references (PVDF with only PVP and commercial PVDF)

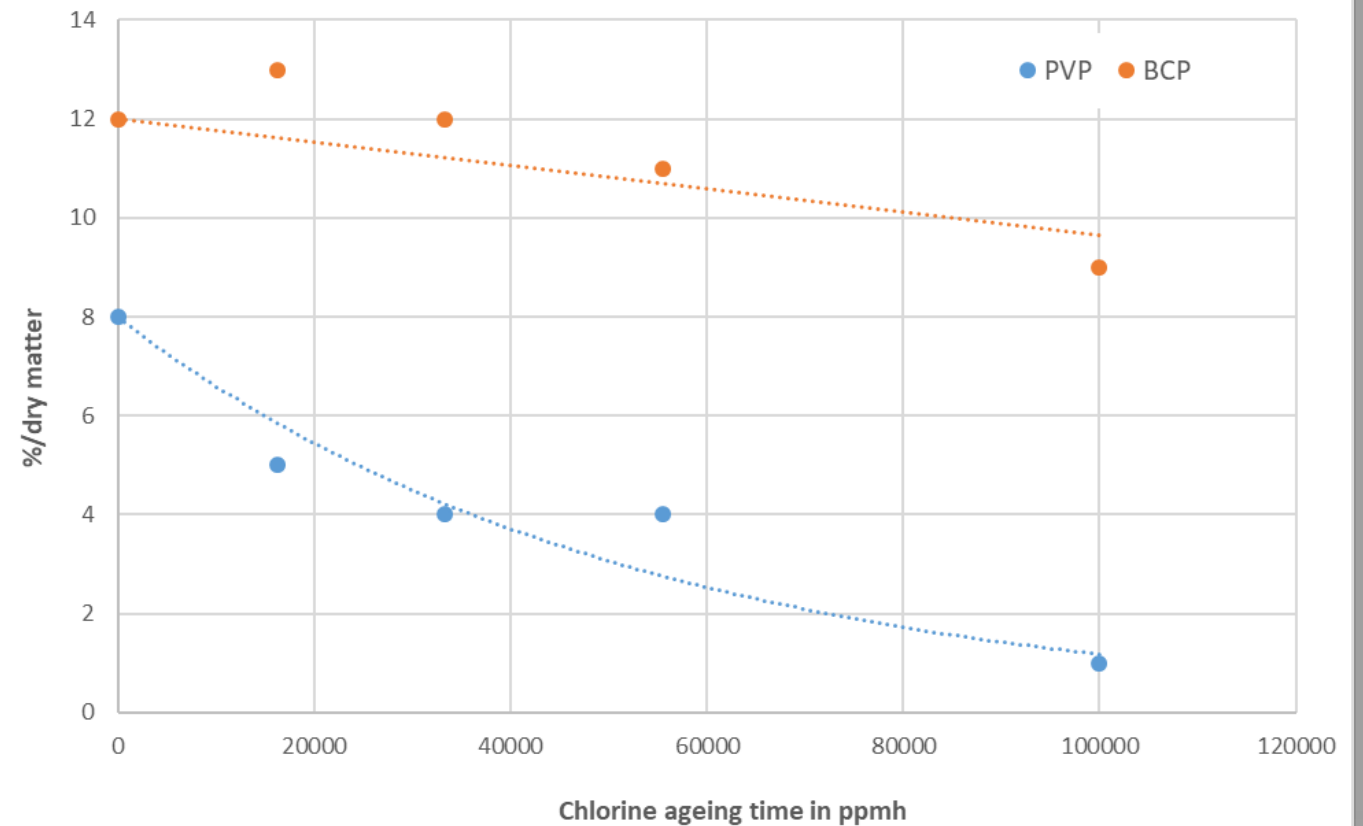
Membranes	Additives	Polymer
M1	PVP only	PVDF (Kynar MG15)
M2 Neophil™	BCP and PVP	PVDF (Kynar MG15)
M3 Commercial	PVP	PVDF

# Demonstration of sustainable performances

## 2. Additives PVP vs BCP releasing : ATR-FTIR of fiber outer surface



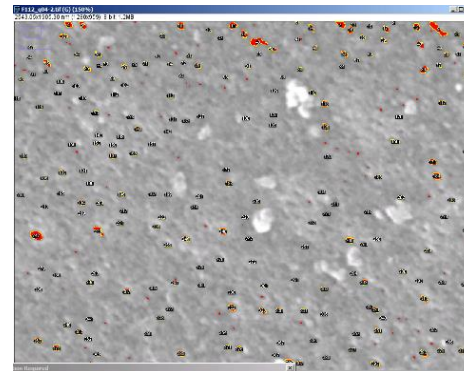
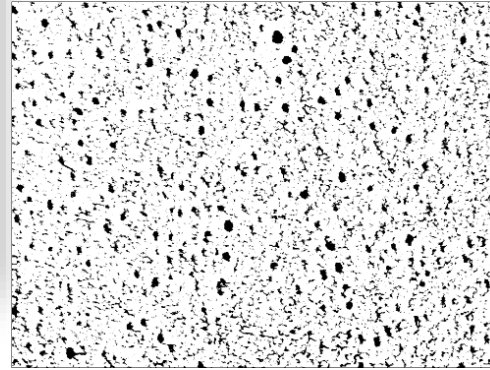
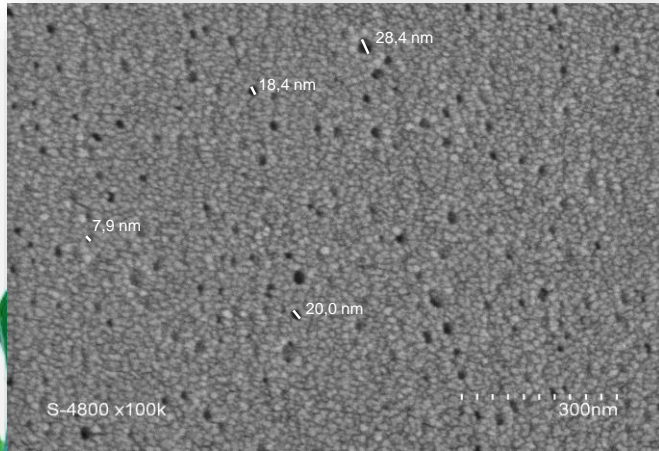
Additives concentration versus ageing time



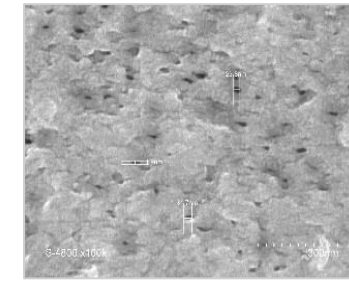
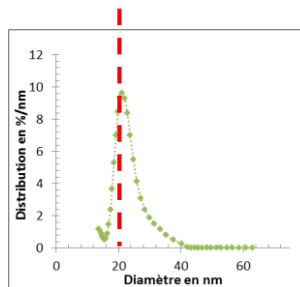
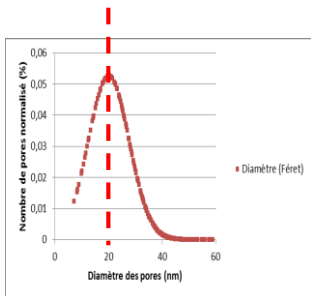


# Demonstration of sustainable performances

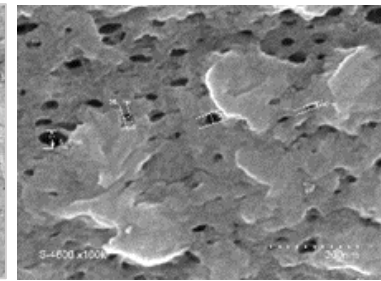
## 3. Pore size distribution after ageing



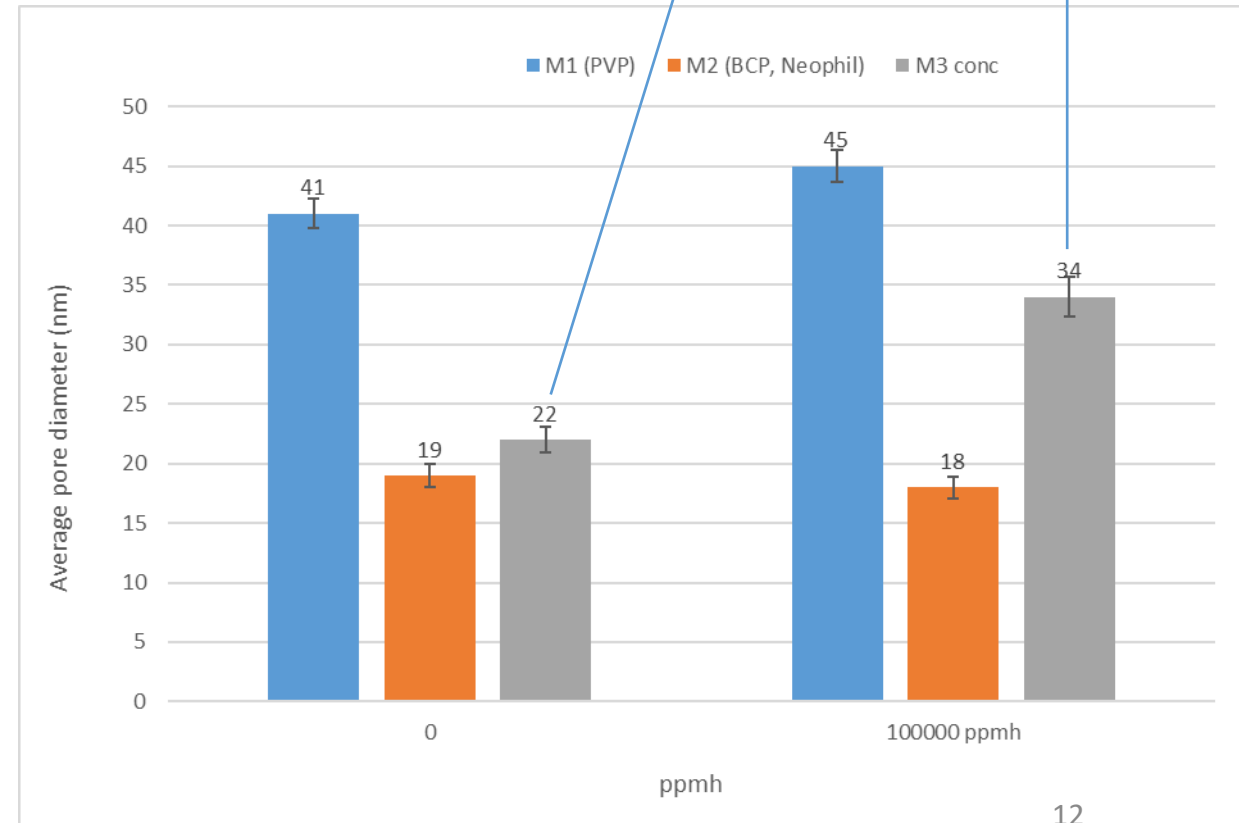
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M3 new



M3 aged 100 000 ppmh



**polymem**  
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# Demonstration of sustainable performances

## 4. Virus surrogates MS2-Phages rejection after ageing

Standard ASTM F838-15A

MS2-Phage bought at ATCC

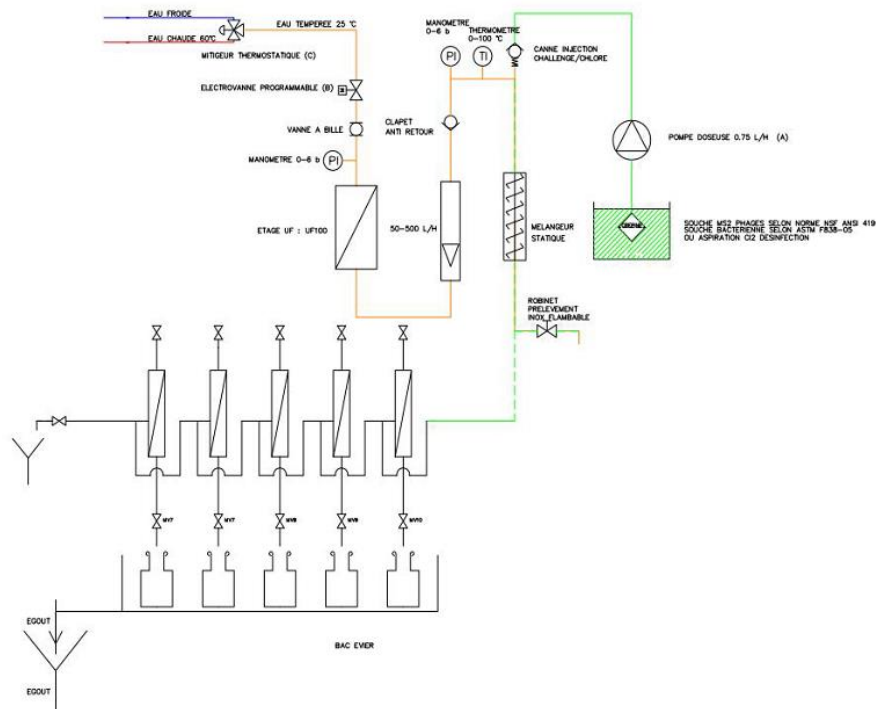
Cartridge size 0.3 m<sup>2</sup> (reproducibility on 3 cartridges)

Flux 50 L/h.m<sup>2</sup>

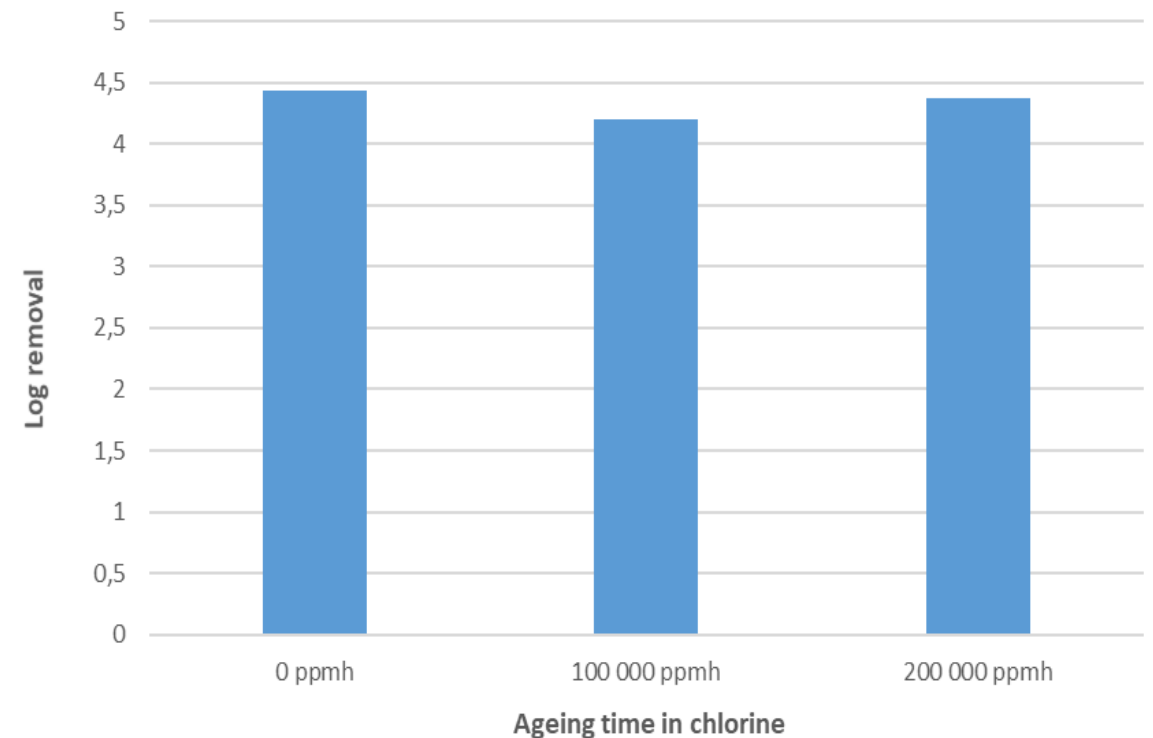
Feed solution 10<sup>6</sup> pfu/ml

> 10<sup>6</sup> pfu/cm<sup>2</sup>

Counting method : E.coli lysis plaque assay

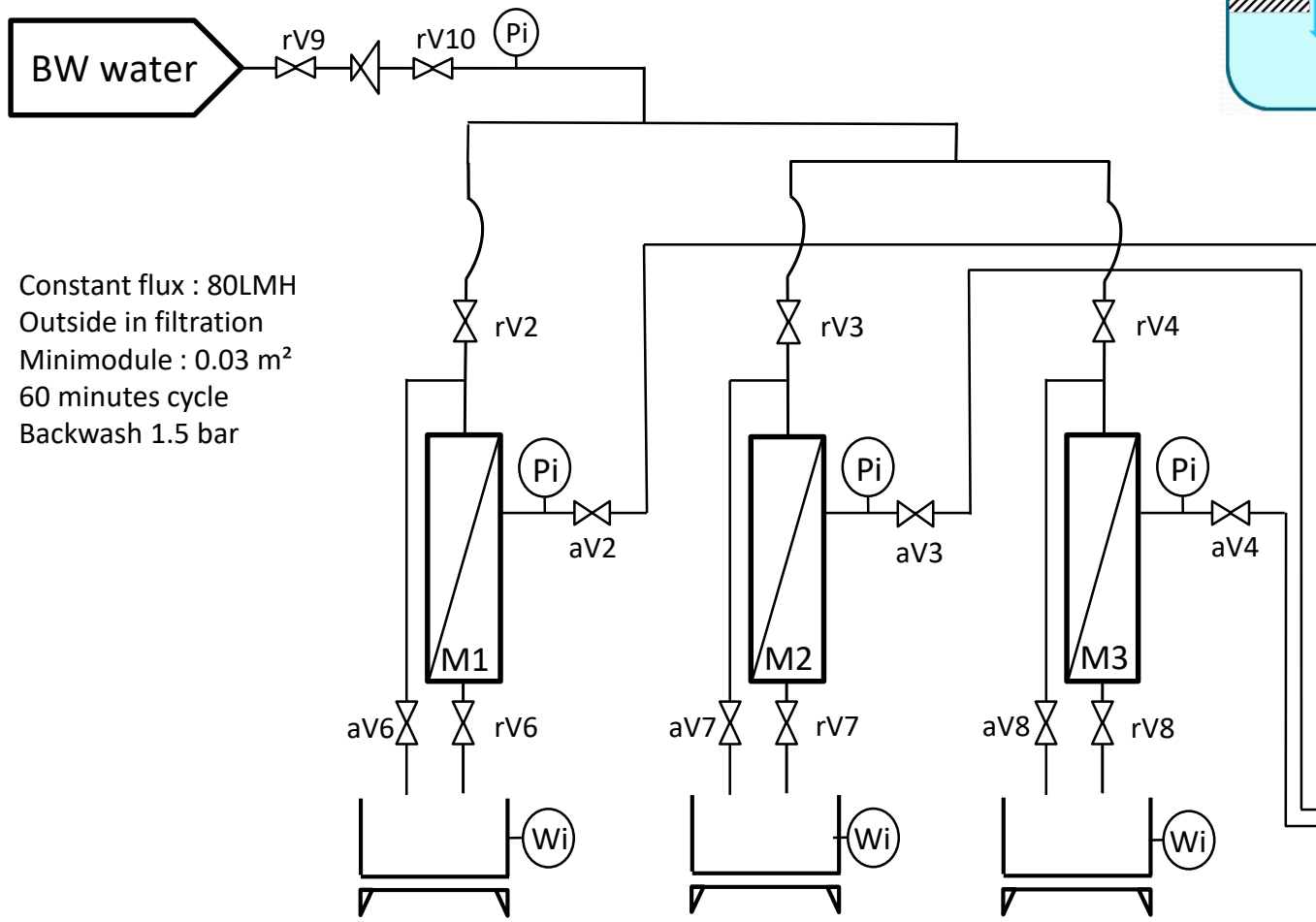


Neophil MS2-phage log removal

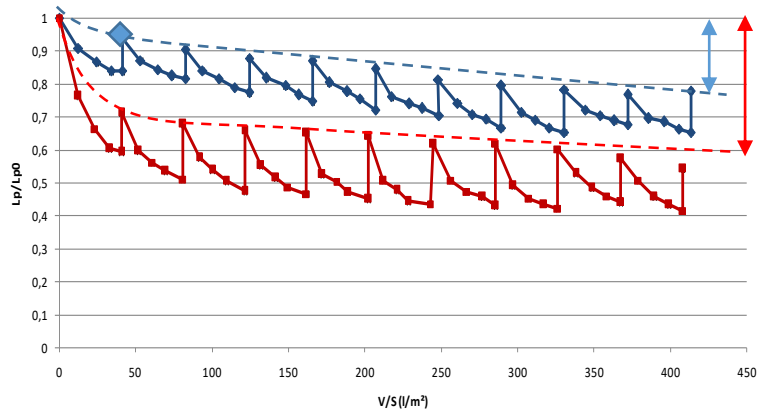
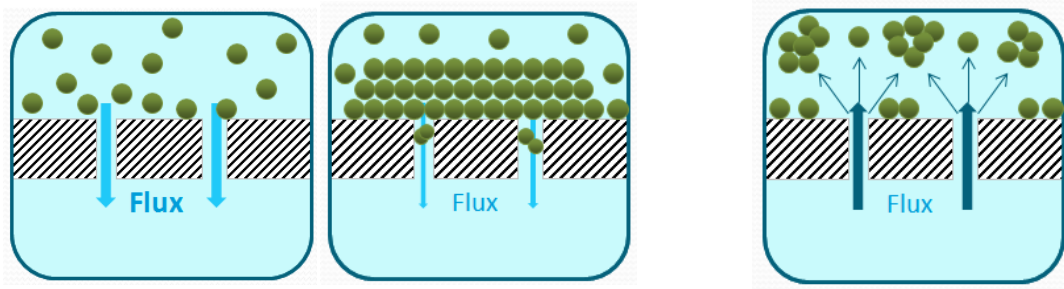


# Demonstration of sustainable performances

## 5. Fouling trends before and after ageing



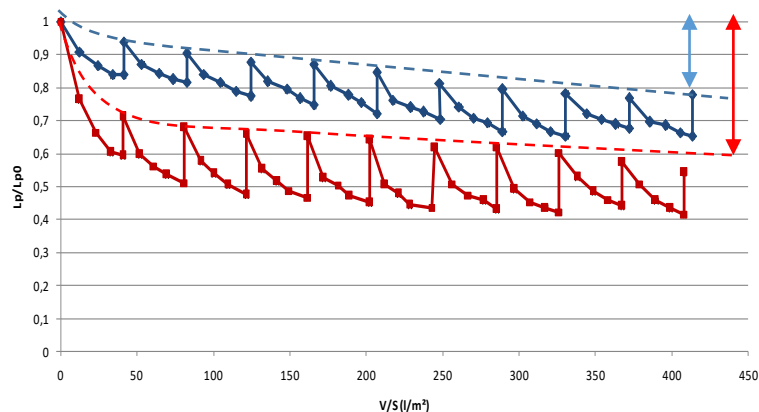
Constant flux : 80LMH  
Outside in filtration  
Minimodule : 0.03 m<sup>2</sup>  
60 minutes cycle  
Backwash 1.5 bar





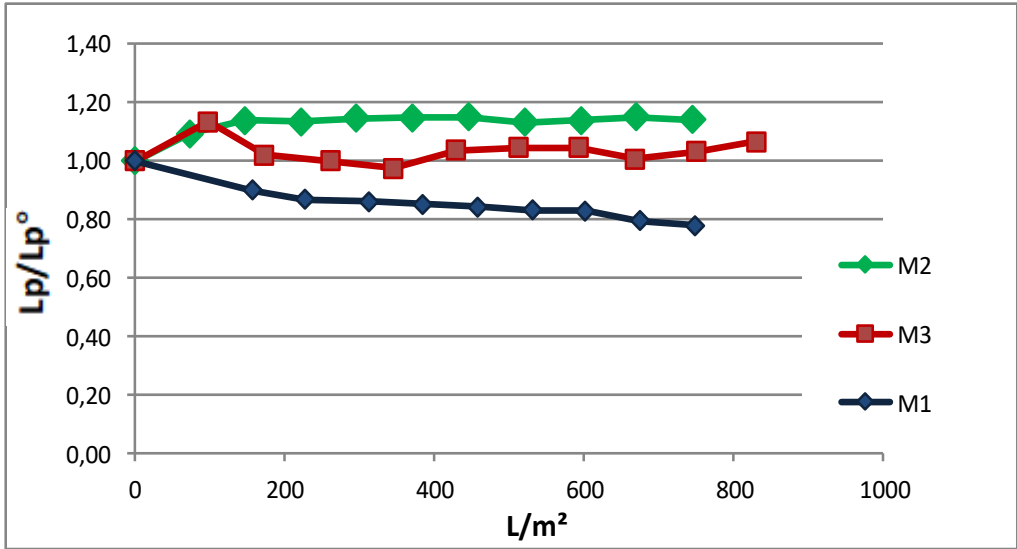
# Demonstration of sustainable performances

## 5. Fouling trends before and after ageing

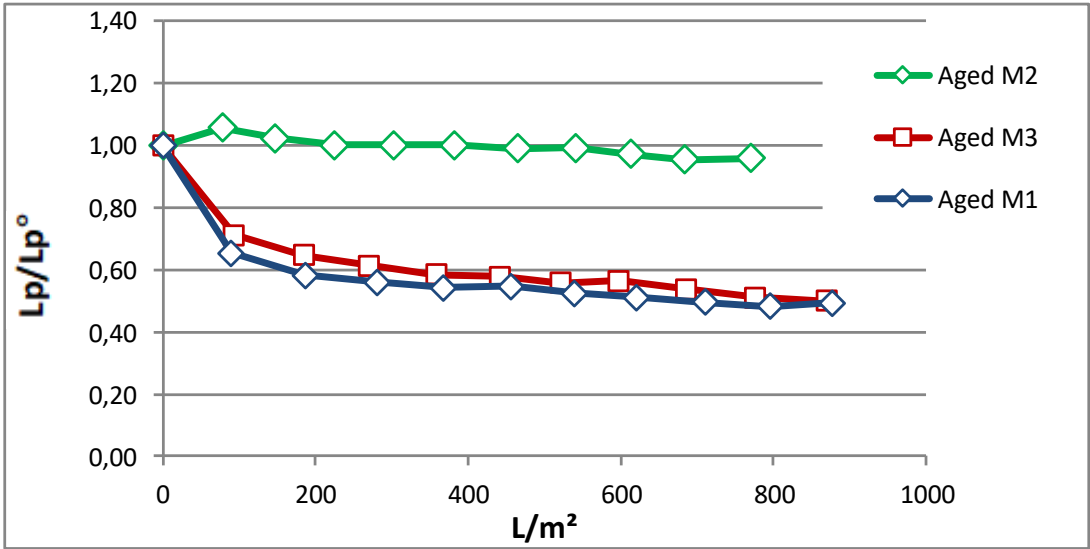


Membranes	Polymer	Additives
M1	PVDF Kynar MG15	PVP only
M2 Neophil™	PVDF Kynar MG15	BCP and PVP
M3 Commercial	PVDF	PVP

New



Aged 100 000 ppmh



# Conclusions

- New durable hydrophilic PVDF material was used successfully to make a new ultrafiltration membrane
- Compared to conventional additives, the di-block copolymer stays in the PVDF membrane matrix for long time
- The membrane Neophil™ shows remarkable stability of its performances for long time ageing exposures
- Pilot trials, demonstration plants and sells are in progress, confirming these remarkable proprieties
  - Water treatment plant at Tournefeuille, suburbs of Toulouse, in collaboration with Toulouse Metropole
  - Tertiary filtration in the Wastewater Treatment Plant of Ginestous in collaboration with Toulouse Metropole and Veolia for irrigation purposes
  - Current testing in MBR filtration with less chemical cleaning frequencies : presentation n°334780, Cavallié et al.
  - Seawater filtration in offshore platforms in collaboration with the companies Total and Schlumberger : poster n°150



# Acknowledgments

This work was supported by the Fond Unique Interministériel (FUI) through the Neophil project.



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## Thank you for your attention