KU LEUVEN

The Impact of CFD Modeling on Membrane Module Design

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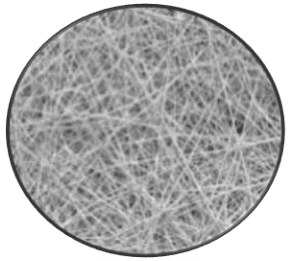
Outline

- Membrane module design for Protein separation
- Conclusion

Membrane module design for Protein separation

Develop an optimized membrane for the effective capture of proteins or viruses



Membrane characterization

- Thickness
- Specific surface area (S)
- Tortuosity (Fiber orientation)
- Fiber diameter (ε, D, S)

D_{RNA}=11.9 × 10^{-11} [m^2/s]

D_{RNA} ….f(pH, C, T)

UI%

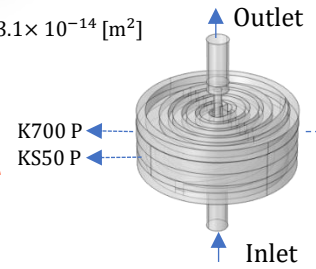
High performance membrane module

(UI%, u_{conv}, S, ΔP)

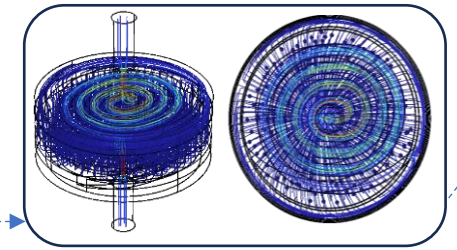
K700 P: th=3[mm]; K=3.1× 10^{-13} [m^2]

KS50P P: th=3[mm] ; K=3.1× 10^{-14} [m^2]

Designed

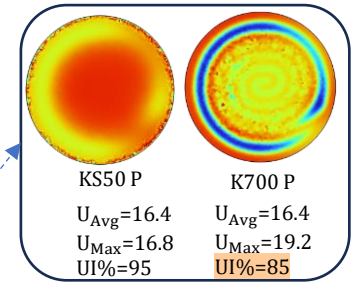


Without using CFD



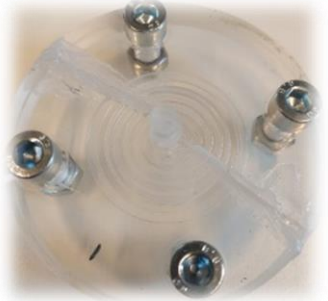
Streamlines

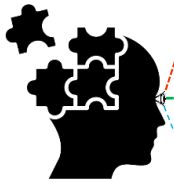
$V[\frac{\mu m}{s}]$

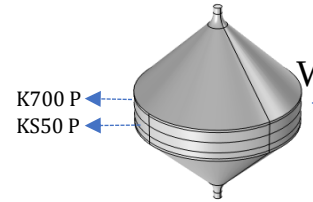


ΔP = 1567 [Pa]

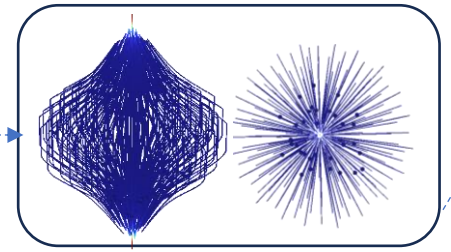
Without using CFD



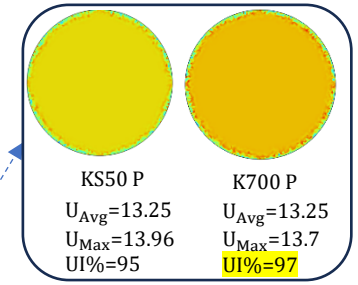




With using CFD (optimized)

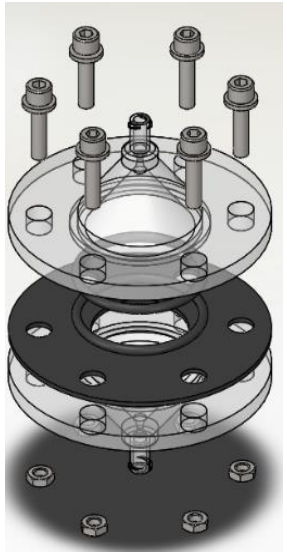


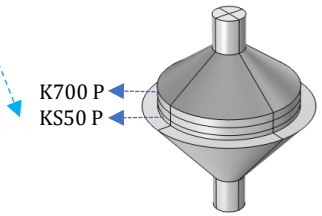
$V[\frac{\mu m}{s}]$



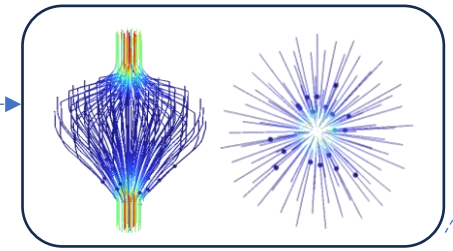
ΔP = 1257 [Pa]

With using CFD
(Mechanical design)

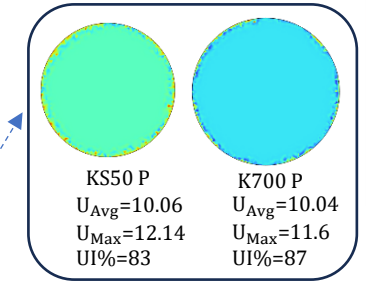




With using CFD (Literature)



$V[\frac{\mu m}{s}]$

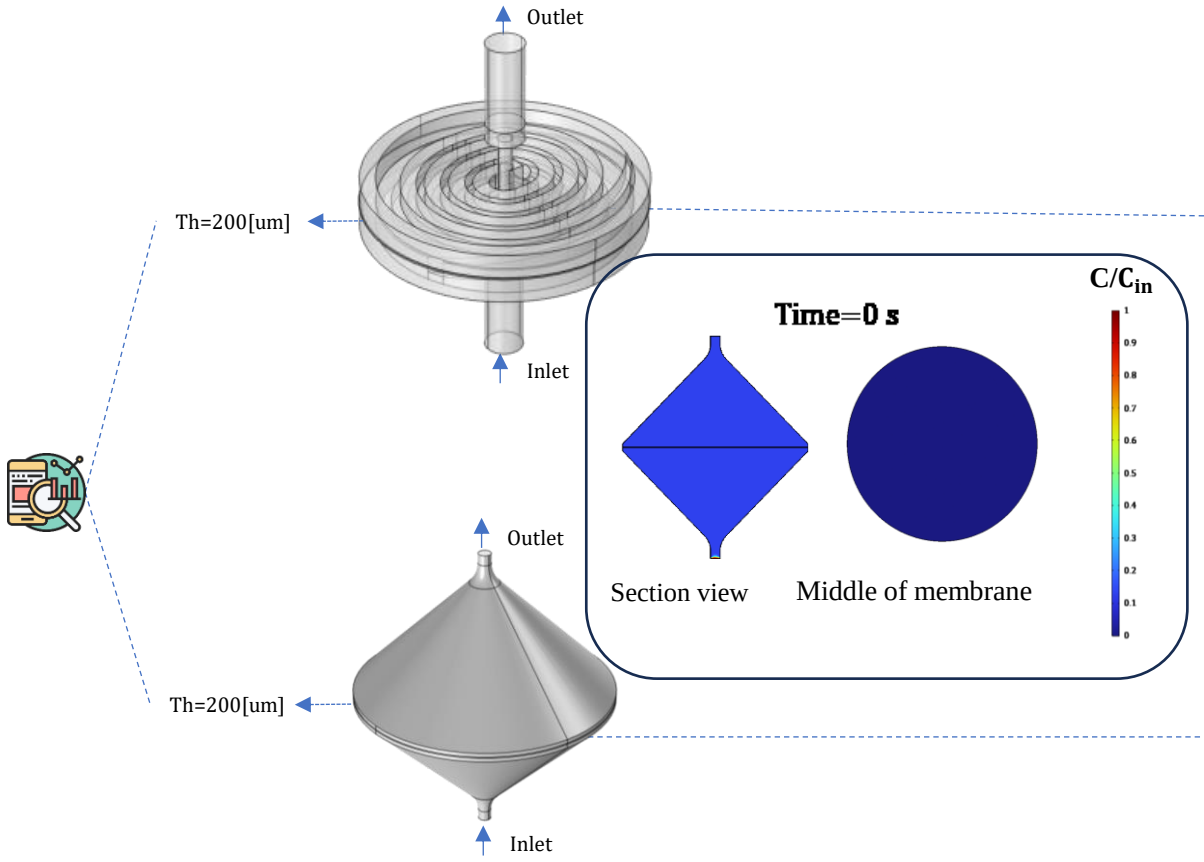


ΔP = 950.5 [Pa]

https://doi.org/10.1016/j.memsci.2021.119217

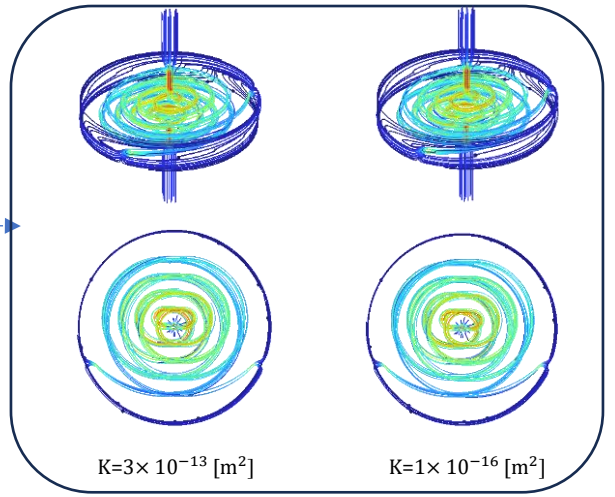
Membrane module design for Protein separation (Thin layer)

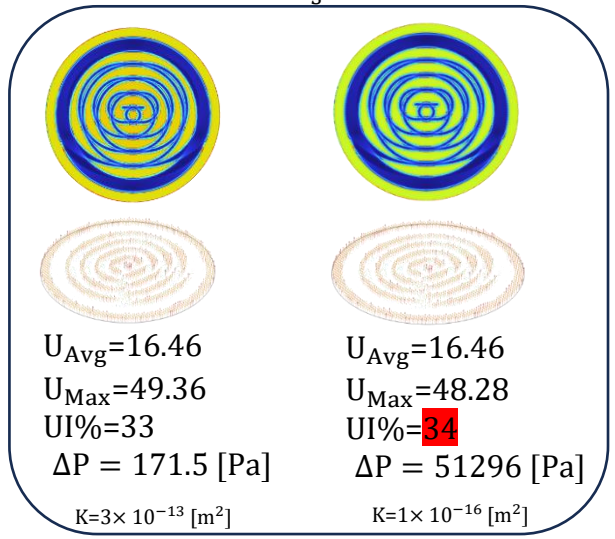
Design a membrane module for membrane characterization

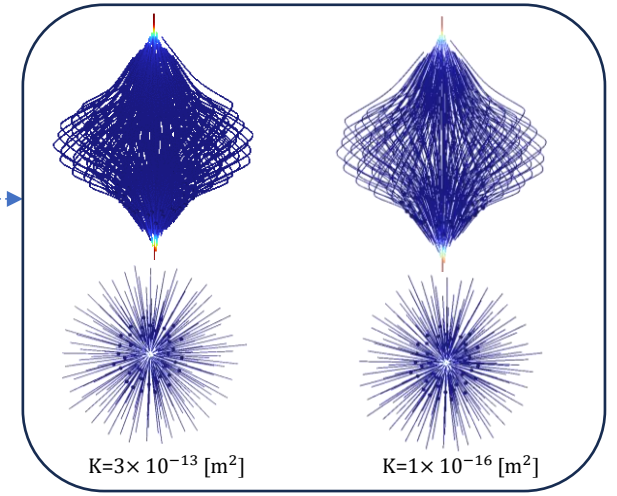


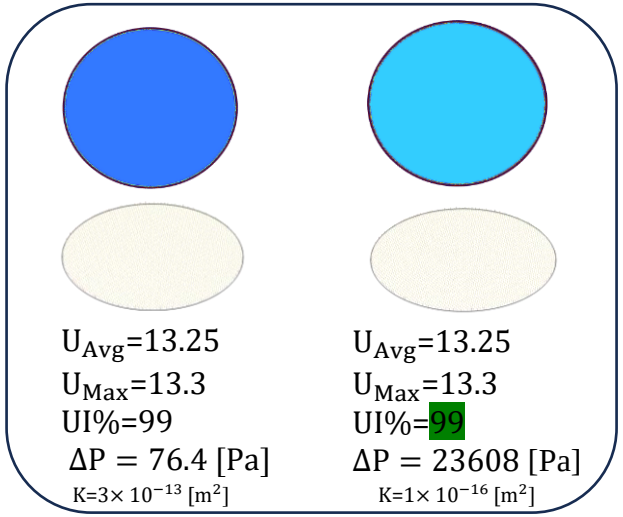
Streamlines

$V[\frac{\mu m}{s}]$







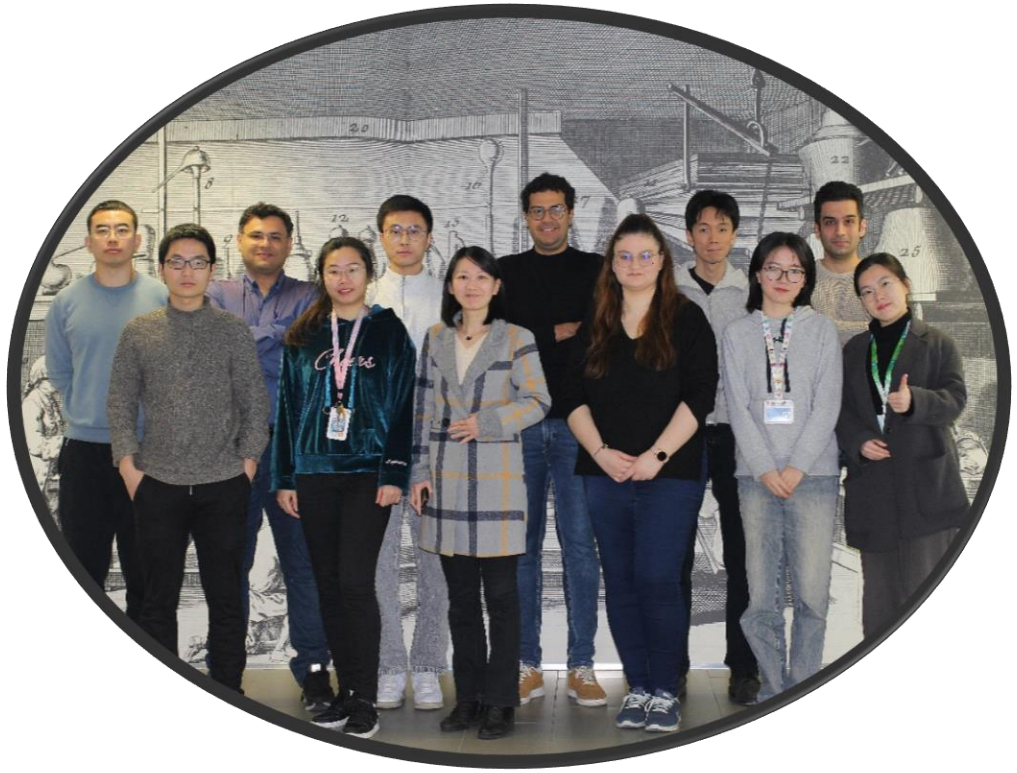


Conclusion

Membrane module design and flow field optimization, why?

- UI% of flow distribution (Module & Membrane)
- Accuracy in data collection (validation)
- Lower pressure drop (save energy)
- Membrane properties and morphology
- Effective scaling up for higher surface areas
- Liquid filling time in a shorter time

Thanks for your attention



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European Commission

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