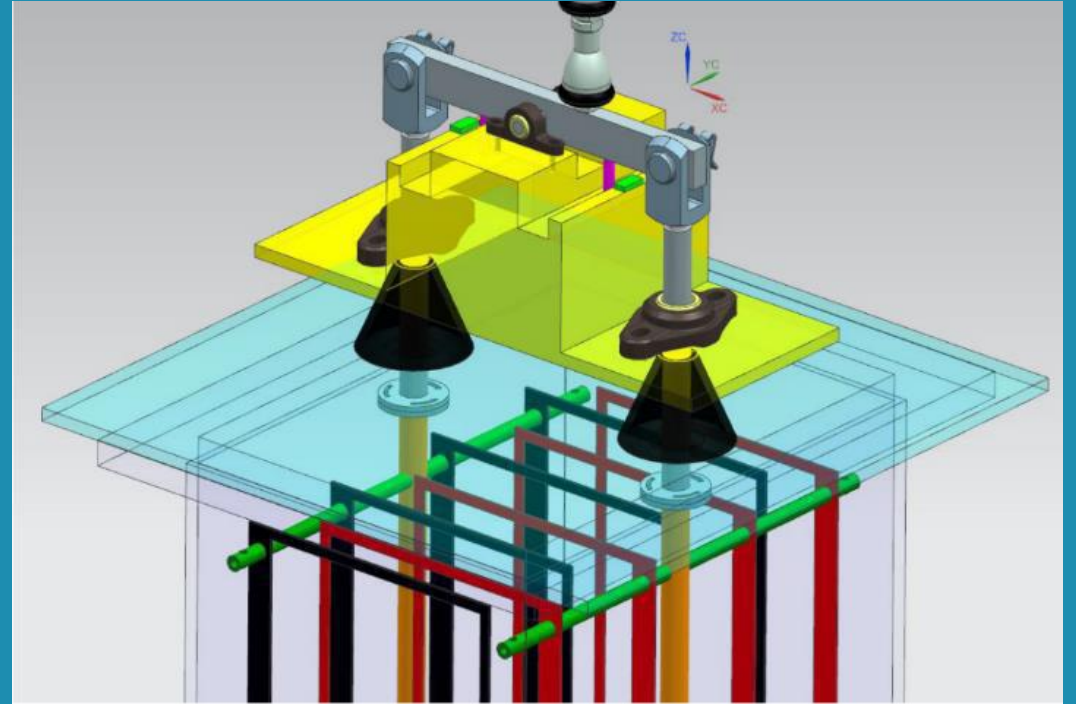


# Magnetically induced membrane vibration (MMV) system for wastewater treatment

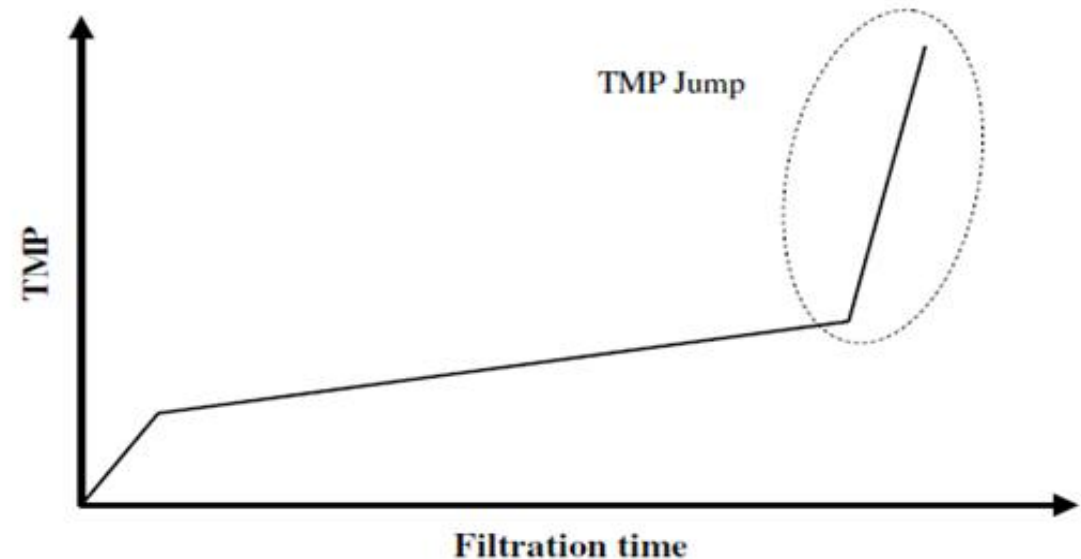
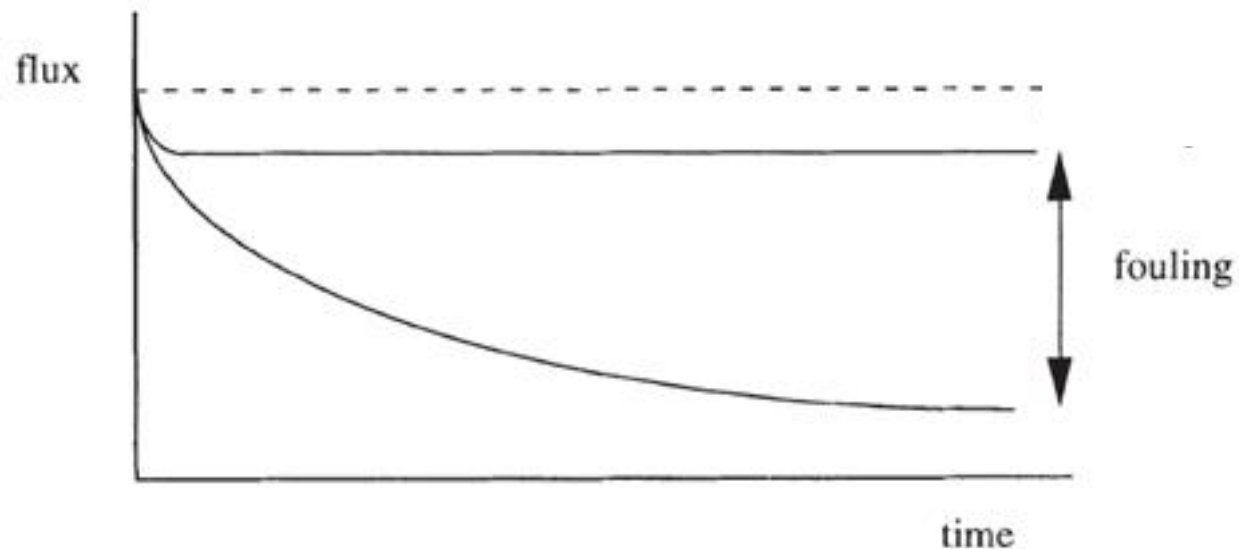
Quintelier Martijn  
Supervisor: Matthias Mertens  
Promotor: Prof. Ivo Vankelecom



# Fouling in MBRs



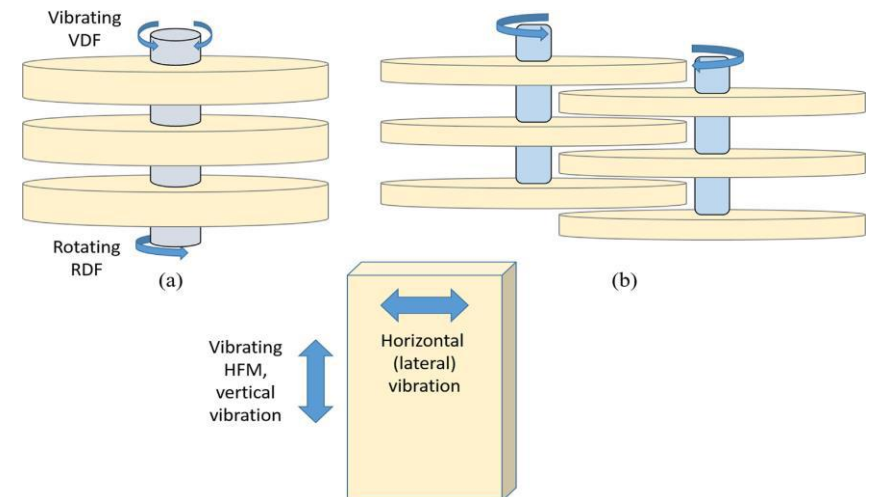
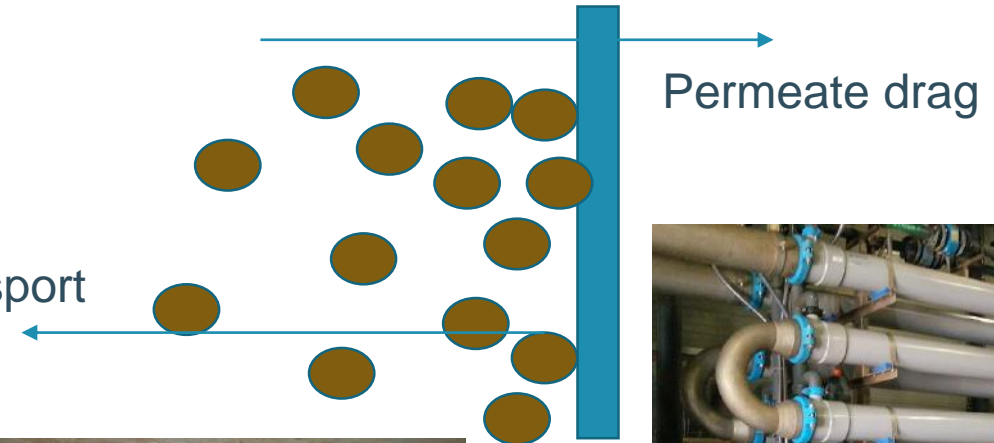
- Interactions biomass-membrane surface: Biofouling
  - Pore clogging: cell debris and colloidal particles
  - Sludge cake formation



# Fouling management

- Reduce fouling rate
  - Hydrodynamic control
    - Crossflow
    - Sparging
  - Shear enhanced control
    - **Move membrane relative to bulk**
- Chemical & mechanical cleaning
  - Ageing + damaging of the membranes

Backtransport



# MMV system

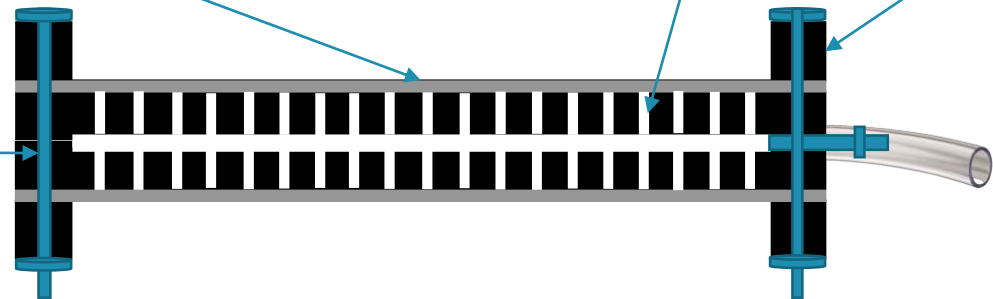
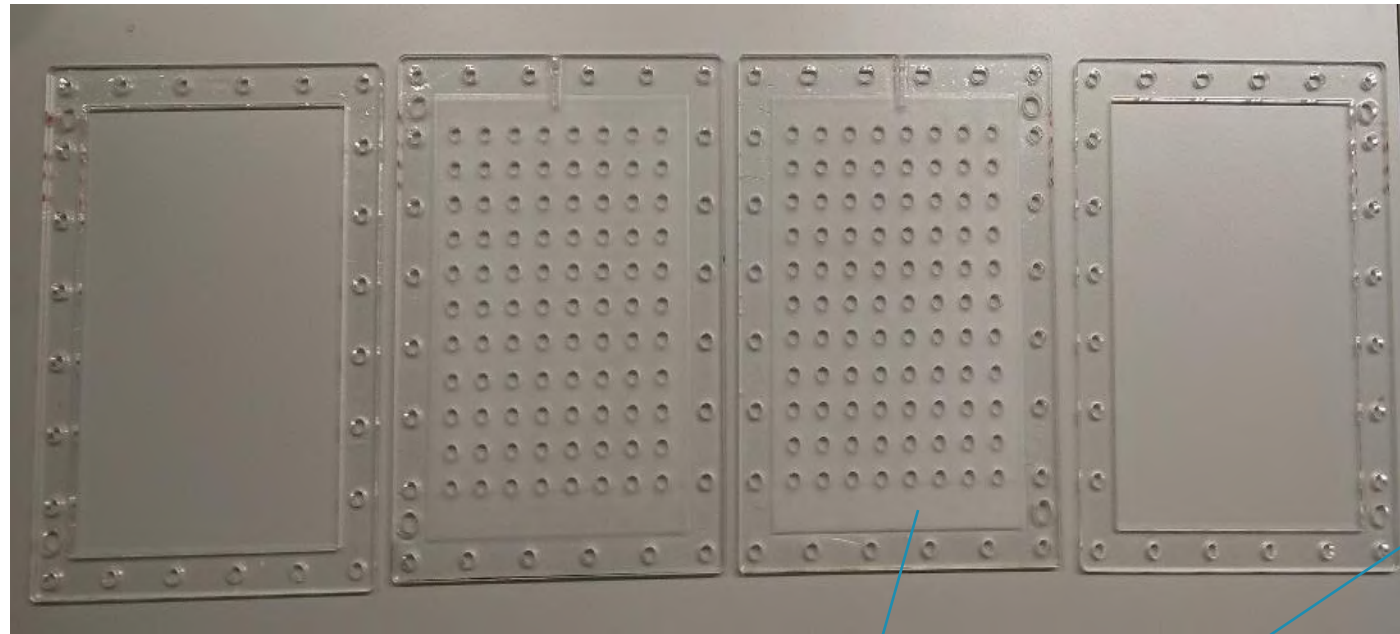
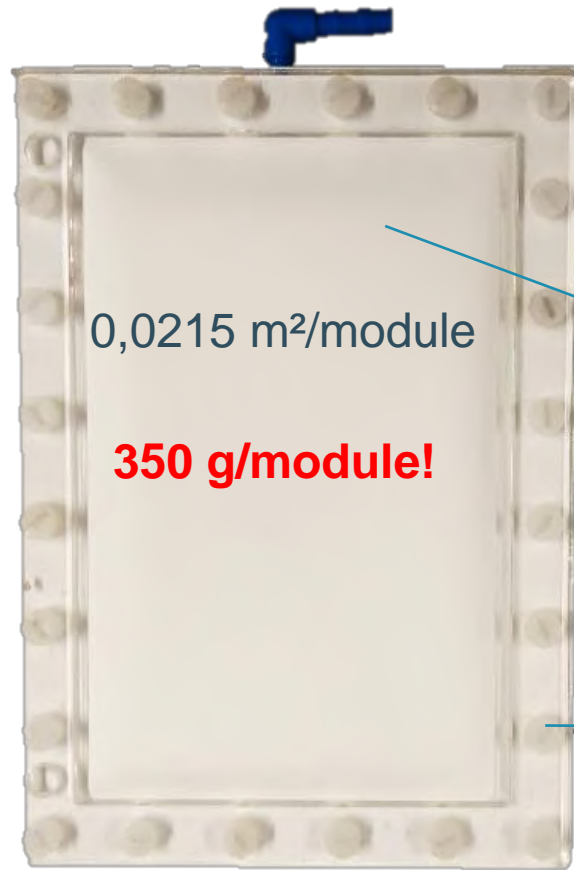
- **M**agnetically induced **M**embrane **V**ibration
- Strong electromagnet
- Electromagnetic field flips when current is reversed
- Oscillating motion transferred to 4 membrane modules
- Tunable parameters: Freq (0-12Hz), Amp (0-9mm)



$$\gamma_{max} = \frac{a\omega^{1,5}}{2\nu^{0,5}}$$

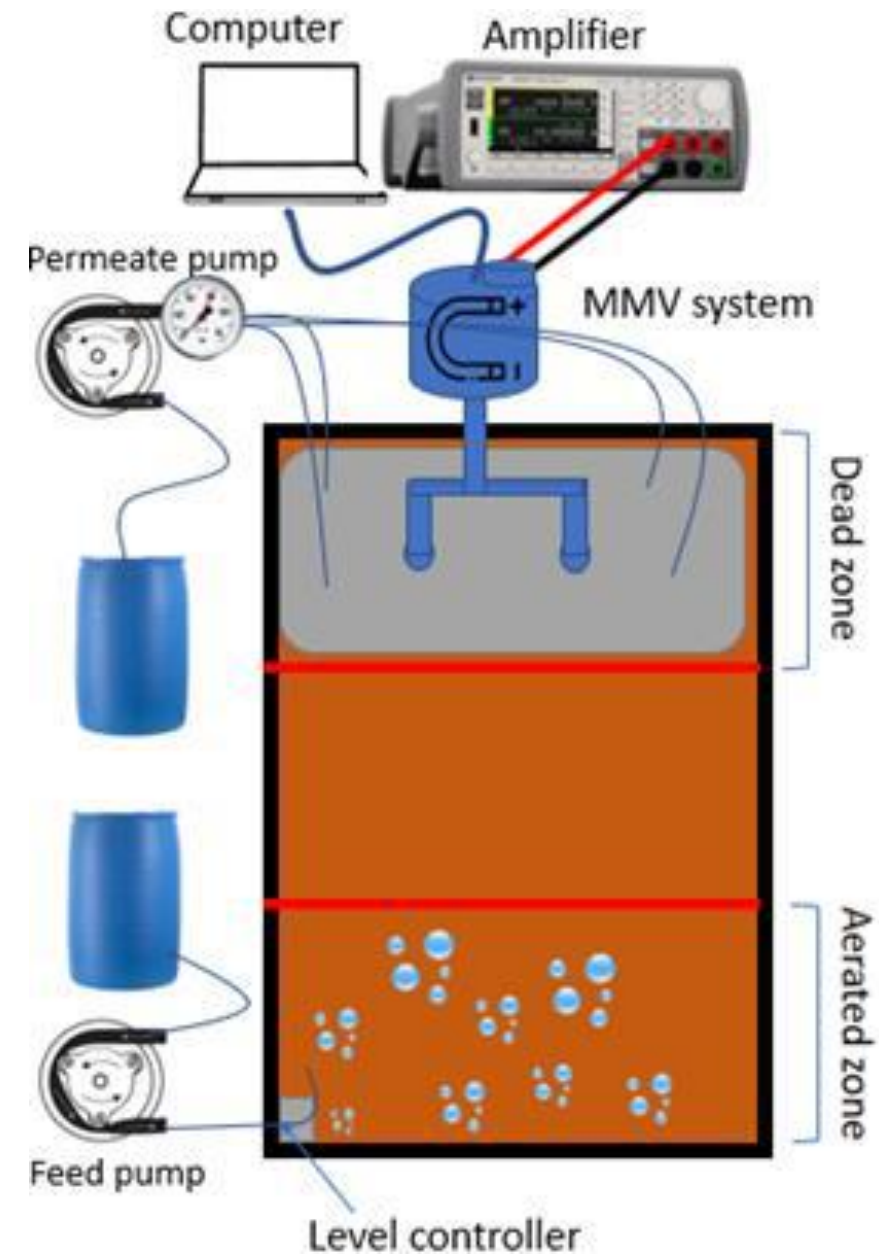


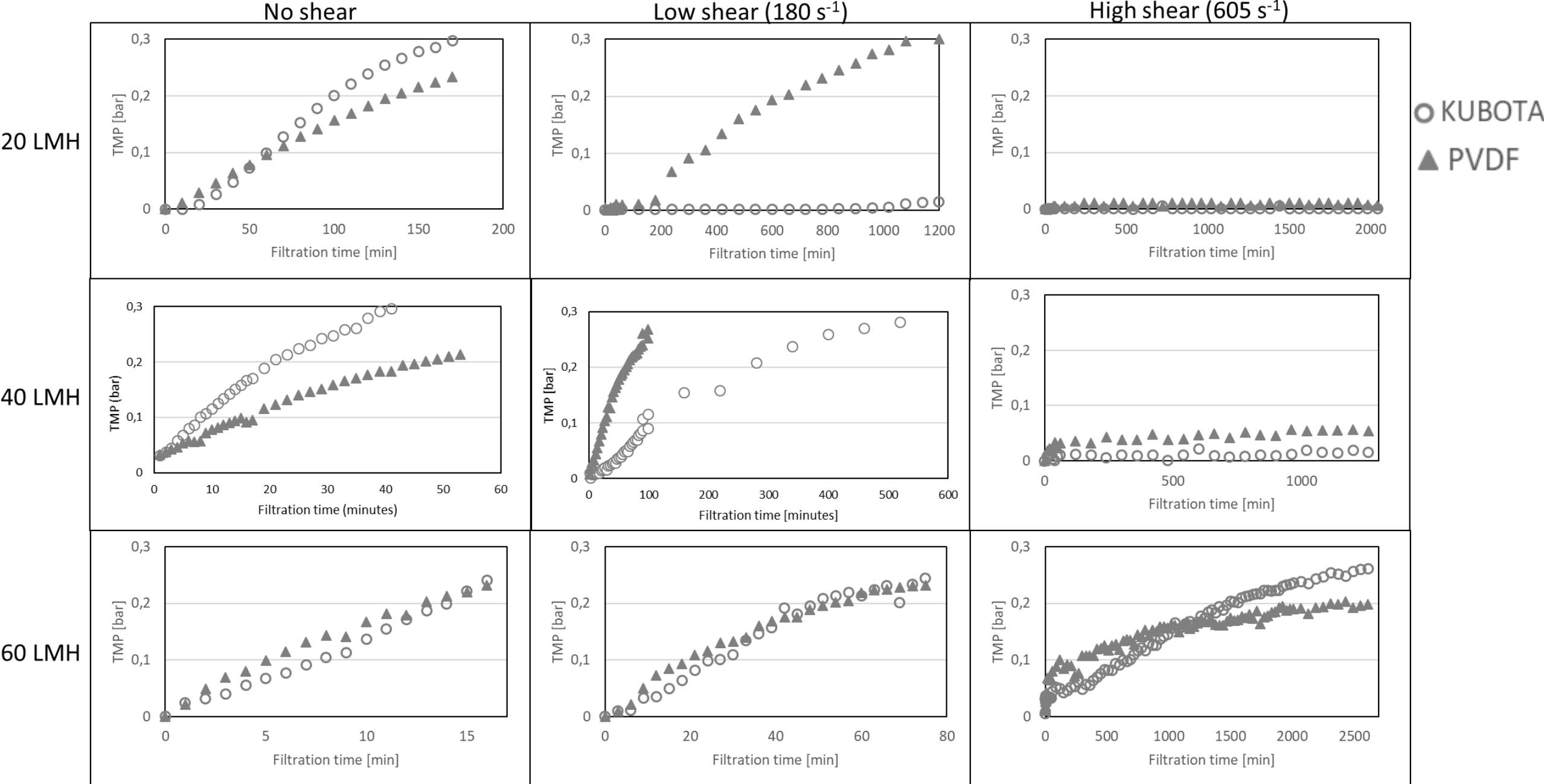
# New module design



Commercial membrane: Chlorinated PE (Kubota) 0.4 $\mu$ m + Lab made PVDF 11wt% - PVP 3 wt%

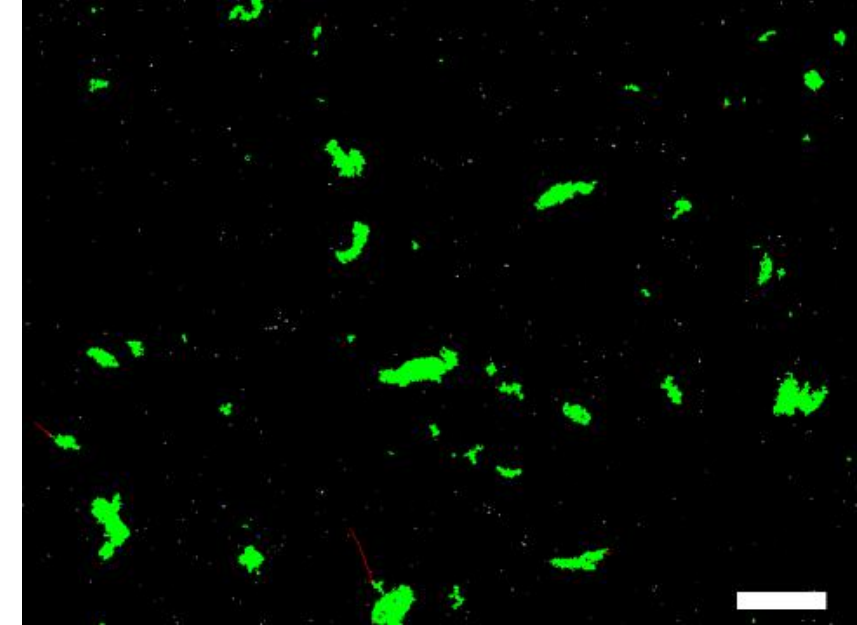
# Aerobic MMV setup



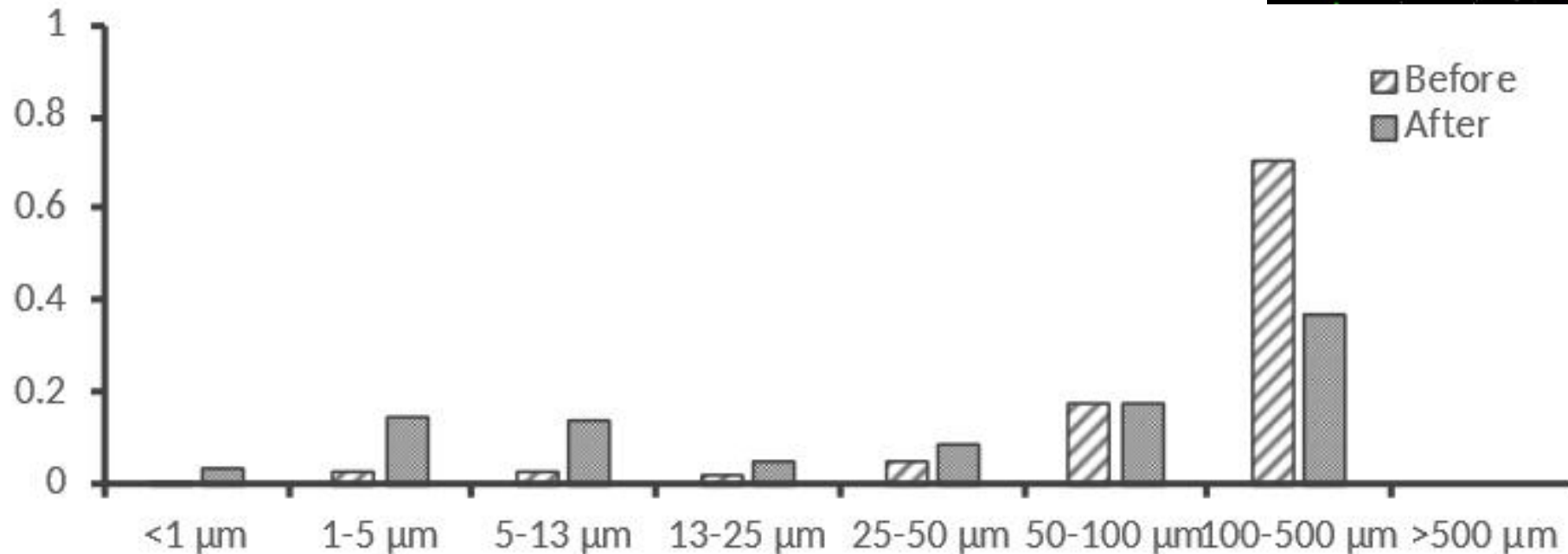


# Effects of high shear rates

- Disruption of the flocs  $\rightarrow$  fraction of small fragments increases
- “Shear rate dilemma”  $\rightarrow$  EPS release  $\rightarrow$  membrane fouling



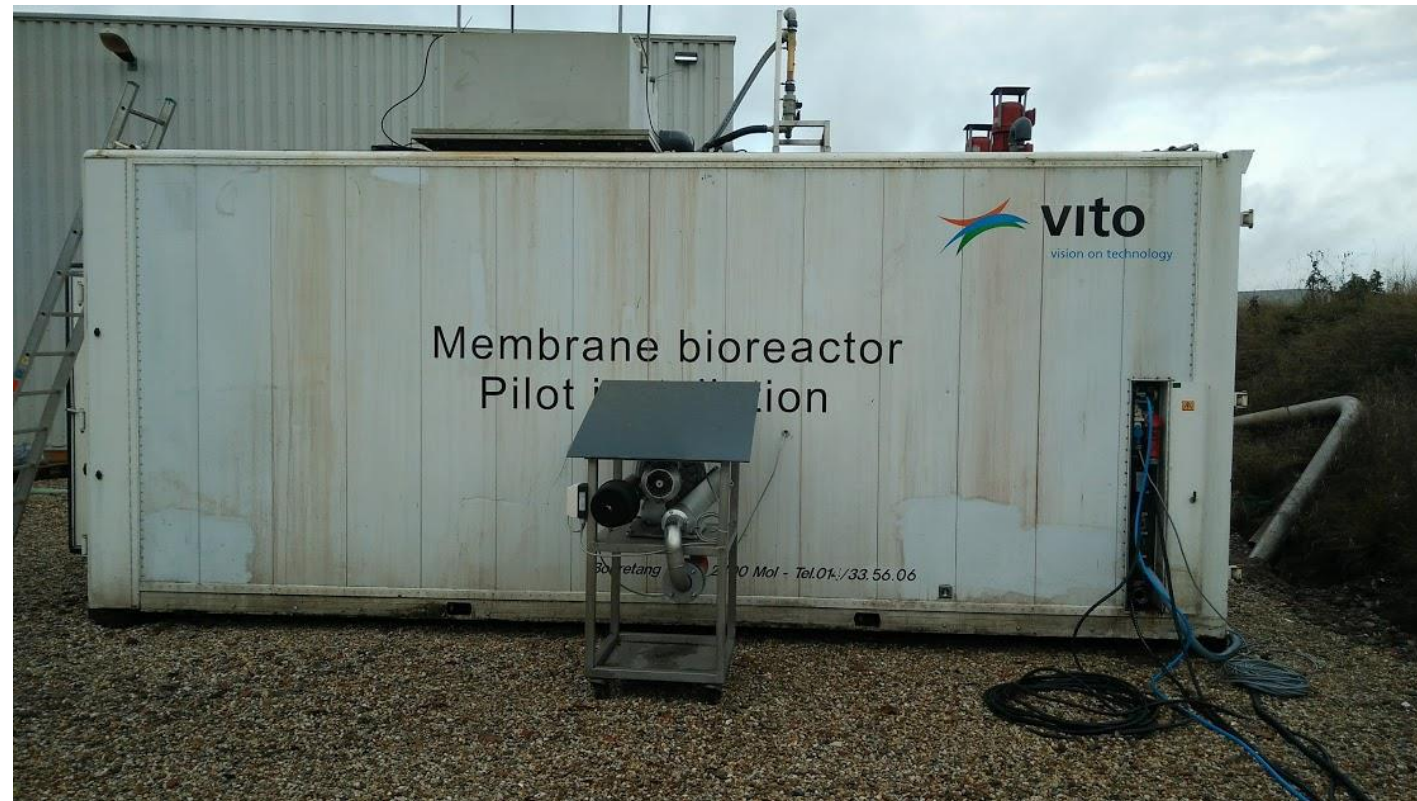
scale bar = 200 $\mu$ m





# Future research

Energy optimisation, effects of shear on sludge morphology, sparging parallel study, scale up!



# Conclusion

- **Excellent anti-fouling behaviour**
- **Increase in filtration time respectively by a factor of 133, at 60 L/m<sup>2</sup> h**
- **Watch out for floc erosion**



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A photograph of a wastewater treatment plant. In the foreground, a red lifebuoy is attached to a metal railing. Behind the railing, there are several large aeration tanks with brown, foamy water. In the background, there are various pipes, a yellow crane, and trees with autumn foliage under a cloudy sky. The word "Questions?" is overlaid in the center of the image.

Questions?