

# Strong bacterial flocs are important for filtration properties of membrane bioreactors

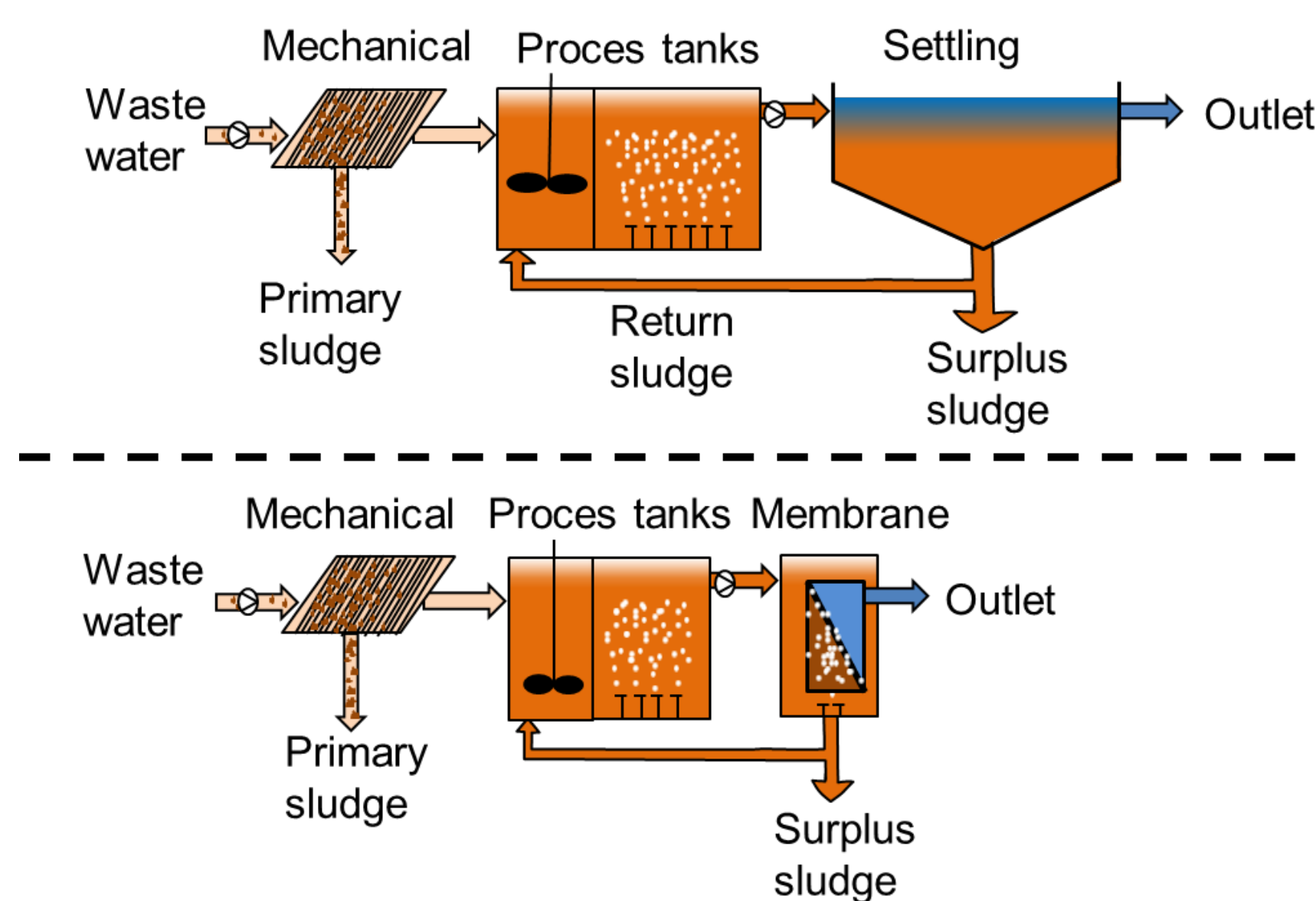


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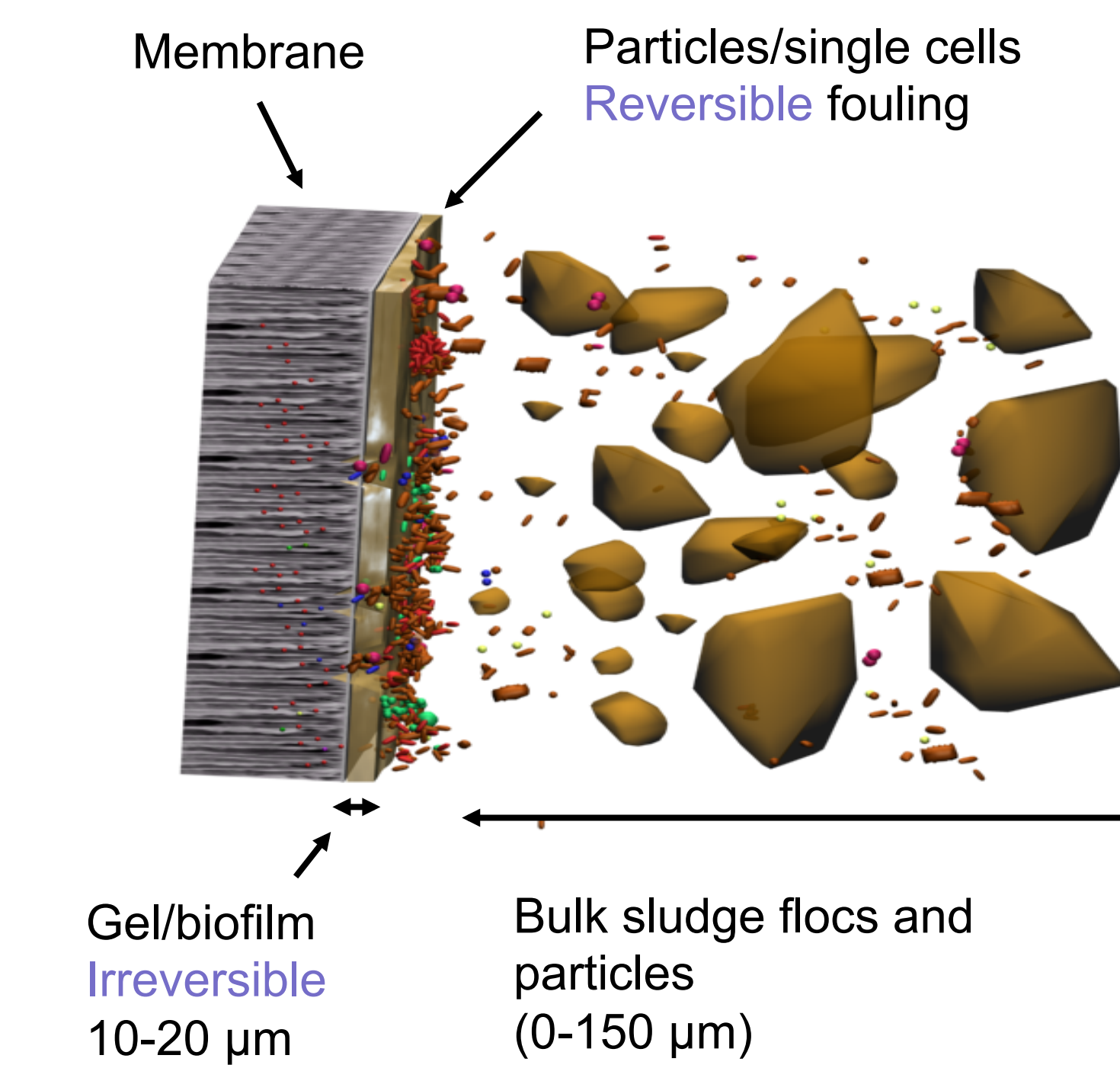
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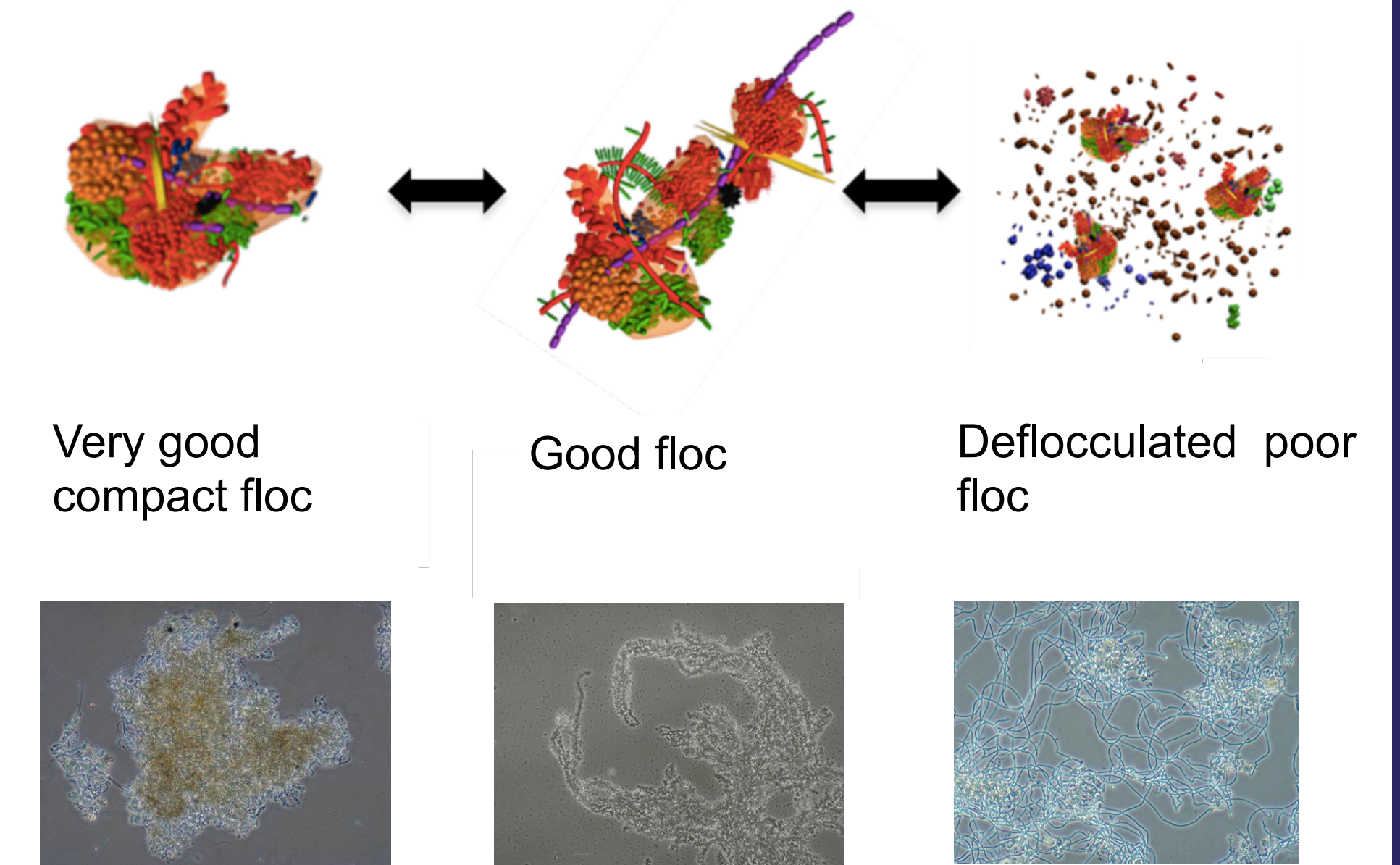
## INTRODUCTION



**1.** Bacterial consortia in the form of flocs play a key role in wastewater treatment. Recently, membrane bioreactors (MBRs) made its entry into the field due to the advantages of high effluent quality and low footprint. However, in the conventional activated sludge process there is a selection for flocculated bacteria, while dispersed bacteria are removed with the effluent.



**2.** For MBR biomass, single bacteria will be retained by the membrane, so a high content of planktonic cells and soluble extracellular polymeric substances (EPS) may be observed, whereas the large sludge flocs are removed from the surface by cross flow.



**3.** The filtration properties are determined by the sludge floc quality. The quality of the flocs relates strongly to the microbial community structure.

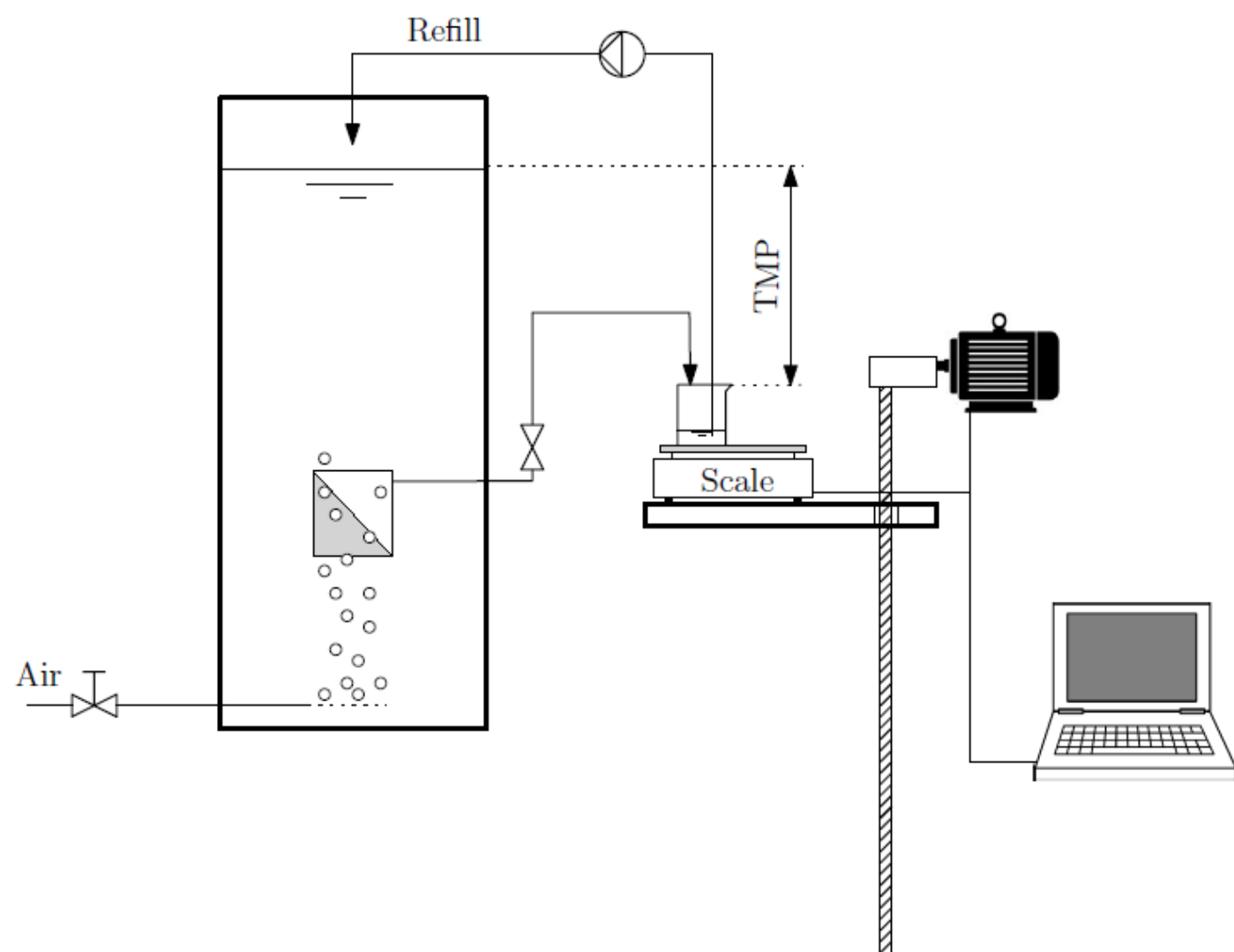
## AIM

The aim of this project was to investigate whether increased levels of planktonic bacteria deteriorate the membrane performance due to fouling.

## METHODS

### Filtration

Filtration system with immersed flat sheet PVDF membrane scoured with air.

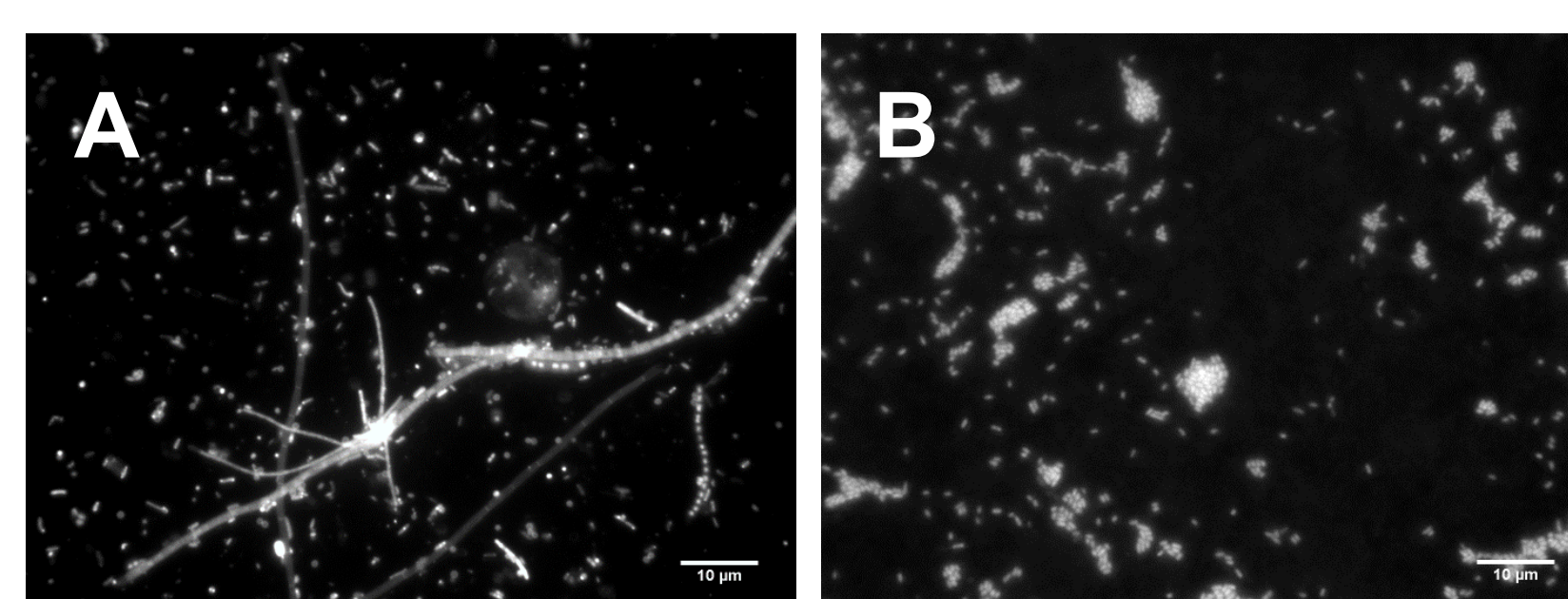


### Suspensions

1. Planktonic culture of *Pseudomonas* UK4 washed in PBS to prevent growth.
2. MBR Sludge sample centrifuged at 800 x g for 2 minutes to remove flocs.

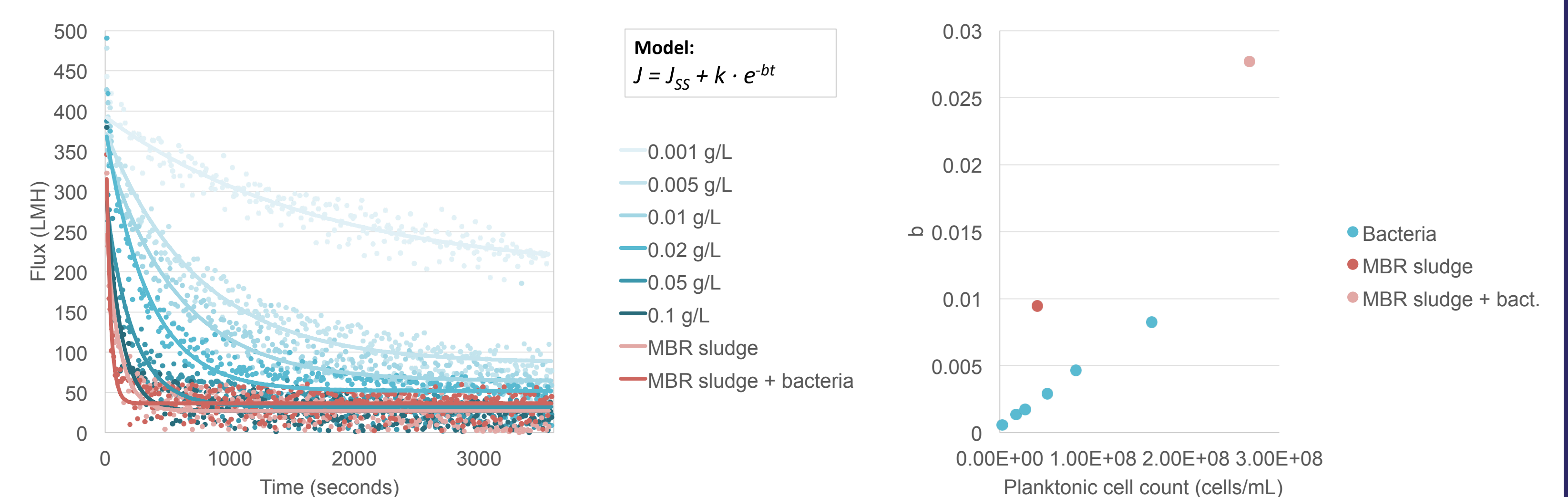
## RESULTS

### DAPI staining



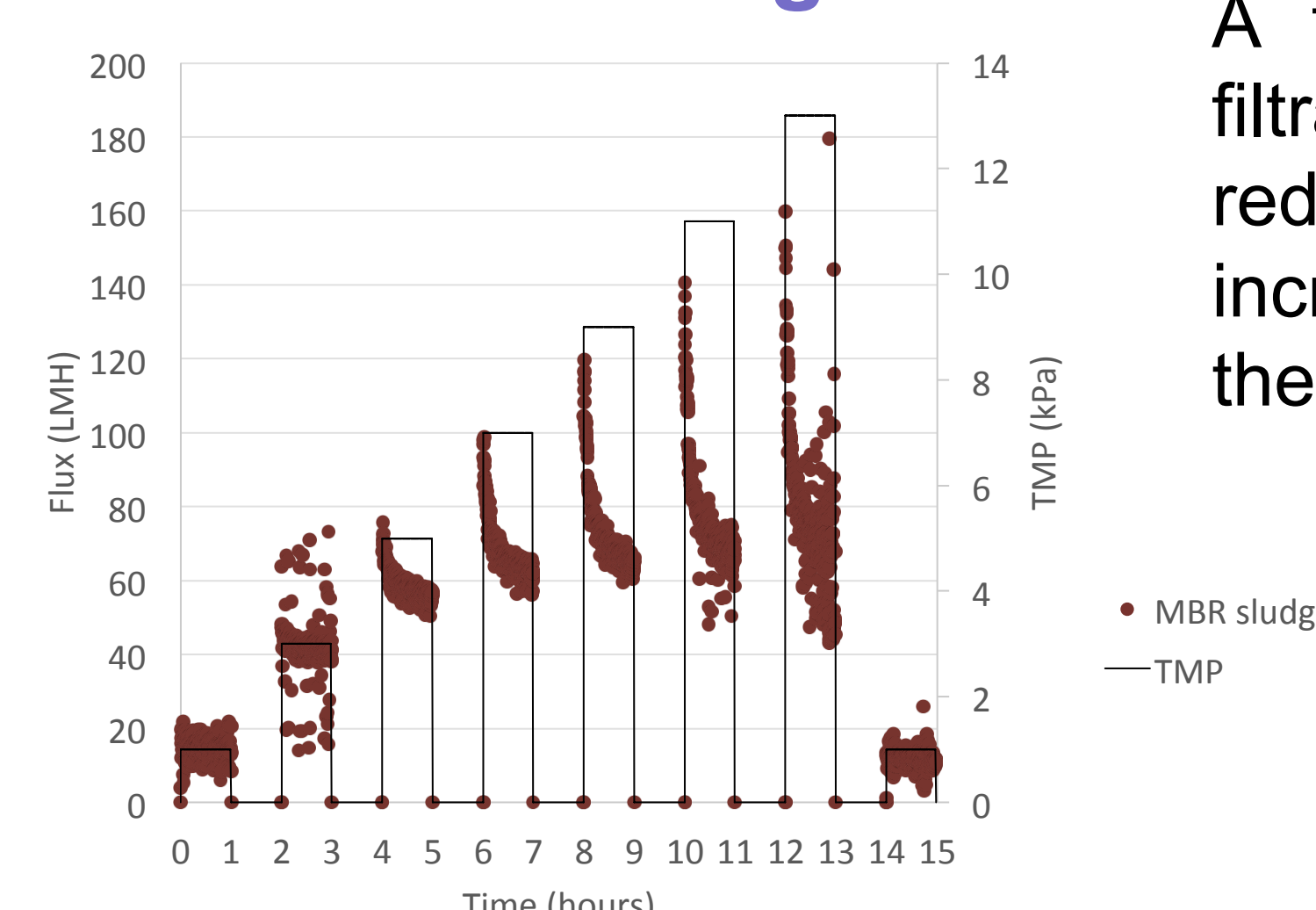
DNA stained **A)** MBR sludge supernatant (800xg 2 min) (Magnitude: x100). Many free cells in the size range of 1 μm. Cell count:  $3.56 \cdot 10^7$  cells/mL. **B)** Pure laboratory culture of a rod-shaped bacteria used in filtration tests (*Pseudomonas* UK4).

### Filtration



1 hour filtration experiment (5 kPa) of increasing amounts of planktonic bacteria show a clear correlation between number of cells and decrease in filtration. Addition of planktonic cells to sludge decreased filtration dramatically.

### Irreversible fouling



A transmembrane pressure (TMP) step test filtration reveals the irreversible fouling as the reduction in flux after a series of filtrations at increasing TMP and shows the severe effects of the planktonic cells.

Suspension	Flux reduction
MBR sludge	19 %
MBR sludge supernatant	15 %
Bacteria	61 %

## FINDINGS

- We demonstrated that the floc properties are very important for membrane performance in MBRs.
- The planktonic cells are particularly problematic.
- Future studies should establish methods to ensure good flocculation.