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INTRODUCTION

- From intuition, an increase in MLSS would lead to an increased fouling rate in a MBR system.
- *However*, as described in literature the impact of MLSS on the fouling propensity is not that straightforward (1).
- Generally, the net transport of material (*N*) to the membrane surface can be described by the convective flux, diffusion, surface and particle interactions and hydrodynamics as described below (2).

$$N = JC - D\frac{dC}{dy} + p(\zeta) + q(\tau) \quad \text{Eq. 1}$$

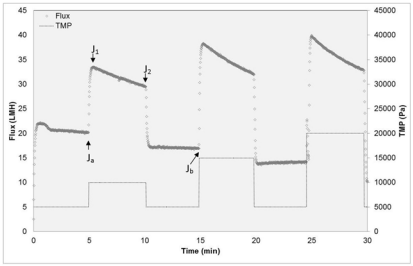
- MLSS is included in the convective flux but will also affect the other mechanisms – especially the effect on hydrodynamics is tricky.
- In this study, the impact of MLSS on fouling propensity and reversibility was investigated by short term pressure step experiments.

TMP STEP METHOD

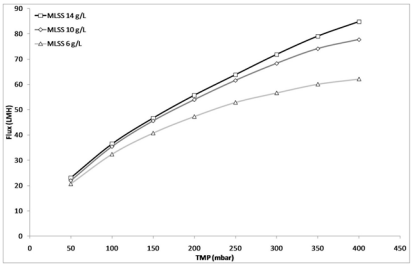
- The applied TMP step method includes intermediate low pressure steps enabling studies of fouling reversibility (3).
- The total and irreversible fouling rates are calculated using Eq. 2 and 3 for comparison of fouling propensity under varying conditions.

$$\frac{dR_{tot}}{dt} = \frac{(J_1 - J_2)\cdot\mu}{TMP}\cdot\frac{1}{dt} \quad \text{Eq. 2}$$

$$\frac{dR_{irr}}{dt} = \frac{(J_a - J_b)\cdot\mu}{TMP}\cdot\frac{1}{dt} \quad \text{Eq. 3}$$



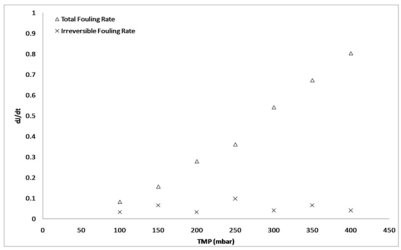
TMP STEP - MLSS IMPACT



- The figure shows the flux (J_2) of each step as function of pressure for the three different MLSS levels applied.
- It is seen that the most signification flux decline is obtained with 6 g/L whereas almost no flux decline is observed with 14 g/L.

FOULING REVERSIBILITY

The total fouling rate is linearly increasing with pressure as could be expected whereas the irreversible fouling rate is much lower and comparable at all steps. Hence, reversible cake formation is dominant rather than pore blocking or gel formation. The same was observed from the fouling rates calculated for the other MLSS levels.



Size distribution measurements showed that the sludge flocs were large (average>100 µm). In literature, MBR systems with addition of large polymer particles used to enhance scouring of the membrane surface have been described. Based on this, we suggest that the increase in fouling rate with decreasing MLSS can be explained by a scouring effect of the large sludge flocs. This scouring effect will increase with increasing MLSS since more flocs are present.

CONCLUSIONS

- In conflict with intuition, increased MLSS lead to a decrease in fouling rate under the given operational conditions - probably due to scouring effects of the large sludge particles.
- Current work includes modeling of TMP step results with the aim to design experiments that enables more thorough studies of fouling mechanisms, e.g. blinding of the fouling cake.

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