**Compressibility of the fouling layer formed by membrane bioreactor sludge and supernatant**

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Membrane bioreactors (MBR) are increasingly used for wastewater treatment as they give high effluent quality, low footprint and efficient sludge degradation. However, the accumulation and deposition of sludge components on and within the membrane (fouling) limits the widespread application of MBR. Hence, for MBR systems operated at constant flux mode, the applied pressure should be increased over time, to compensate for the lower permeability. Increasing applied pressure causes compression of the fouling layer and results in a more severe permeability decline [1]. In a general view, the fouling layer consists of two distinct parts; an inner gel layer formed by components present in the supernatant of the MBR sludge, and an outer layer made of MBR sludge flocs [2].

The supernatant contains a significant amount of biopolymers and the particle size of the supernatant components is much smaller than the sludge flocs. Therefore, in this study it is hypothesized that fouling layers produced by MBR sludge flocs and supernatant possess different degrees of compressibility.

Pressure step experiments were applied to study the compressibility of the fouling layers formed by MBR sludge flocs and by MBR sludge supernatant. Sludge was sampled from a pilot MBR plant which was fed by municipal wastewater. Supernatant was obtained by centrifugation and microfiltration of MBR sludge. Microfiltration was done to remove the microorganisms and minimize the possible interferences by biological growth. Compressibility of the gel layer was studied in a dead-end filtration system, whereas the compressibility of a fouling layer formed by MBR sludge was studied in a submerged system hollow sheet membrane by TMP stepping.

It was shown that the fouling layer formed by the MBR sludge was highly compressible within the pressure range 0.08 - 0.13 bar. The fouling layer resistance increased while fouling layer compression was reversible. Conversely, the supernatant filtrations showed that the gel layer is compressible within the range 0.1 - 2 bar applied pressure. Calculated resistance of the gel layer indicated that higher pressure causes higher change in resistance. The results of the gel compression study showed a lower compressibility of gel layers than the fouling layer formed by sludge flocs. At pressures between 0.1 to 0.5 bar there was no significant change in specific cake resistance with pressure compared to the linear increase in specific cake resistance at pressures in the range 0.75 – 2 bar. Only at higher pressures, the gel layer showed compressibility. Therefore, the compressibility of supernatant formed gel layer is negligible in MBR operation, which typically is up to 0.1 bar TMP.

**References**

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