

Title: Membrane bioreactor fouling behaviour assessment using principal component analysis

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Abstract: To converge membrane bioreactors (MBR) towards more optimal and cost-efficient operation, an accurate measure of the membrane state and fouling propensity of the sludge is of utmost importance for operational control strategies. Sufficient information might be present in the vast data sets that are routinely logged from these installations. In this contribution, historical data sets of a lab-scale MBR were mined to investigate the monitoring and diagnosis potential.

Transmembrane pressure (TMP) data were segmented according to the cyclic filtration/backwash/relaxation pattern. The data of each complete cycle were regarded as a single multivariate measurement and transformed using principal component analysis (PCA), forming a new and condensed data set containing only a limited number of variables called principal components (PCs). These PCs form a reduced space in which data can easily be visualized and it was possible to link locations in the PC space to both fouling severity and fouling reversibility. This implies that the membrane fouling state can be monitored and diagnosed for its fouling nature, merely by analyzing ordinary process data, in this case TMP. Furthermore, this analysis does not require additional measuring devices, recognizes data patterns and can easily be automated. The technique still needs to be applied to full-scale. In future, it can form the basis of an early warning system of fouling. Extensions beyond monitoring by improving diagnosis and adding a control step are also possible.