**EPS and cationic composition influence on sludge fouling propensity**

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**ABSTRACT**

Although membrane bioreactors (MBR) over the past decades have become a more and more viable/applied technology for wastewater treatment, the process efficiency is still limited by the accumulation of sludge components on and within the membrane (membrane fouling). Studies have shown that fouling depends on the interplay between sludge content and characteristics as well as membrane characteristics and its operation. In this, the extracellular polymeric substances (EPS) level has been shown to be a significant factor determining sludge fouling propensity, but a detailed knowledge of the exact role of EPS is missing. In this study, biological sludge samples from municipal and industrial wastewater treatment facilities including conventional activated sludge (CAS) and MBR facilities were analyzed to establish the correlations between EPS content, degree of flocculation and fouling propensity. Sludge samples were characterized by physical and chemical parameters, e.g. pH, conductivity, particle size distribution, content of ions and extracellular polymeric substances and degree of flocculation. The recently developed method was used to assess fouling propensity, providing information on the kinetics of fouling layer formation, and specific resistance and compressibility of the fouling layer.

Analysis showed that degree of flocculation and ratio distribution of proteins, humics and carbohydrates in EPS were the main parameters affecting fouling propensity. The ratio between extractable EPS and polyvalent cations indicates the degree of flocculation, with a low ratio showing a high degree of flocculation and low fouling propensity. High ratios of EPS to polyvalent cations on the other hand characterized large but weak sludge flocs with high shear sensitivity, resulting in highly compressible fouling layers. High concentrations of extracted EPS resulted in higher degree of fouling, whereas an effect of elevated filtration resistance by dissolved EPS was only observed for carbohydrate fraction. In addition, it was shown that the EPS composition governs filtration properties as high fractions of carbohydrates in the EPS matrix showed to increase fouling propensity. This explains the weaker floc forming properties of carbohydrates-rich sludge relative to humics- and proteins-rich sludge. Hence higher degree of flocculation and thereby larger flux and slower development of fouling layers was observed for samples with high fractions of proteins in EPS. Correlation analysis showed positive dependency between the inlet COD/N ratio and the fraction of carbohydrates in total EPS and extractable EPS, which explains why systems with high COD/N ratio in the influent had lower flux through the membrane.