Development of a setup to enable stable and accurate flow conditions for membrane biofouling studies

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ABSTRACT

Systematic laboratory studies on membrane biofouling require experimental conditions that are well defined and representative for practice. Hydrodynamics and flow rate variations affect biofilm formation, morphology, and detachment and impacts on membrane performance parameters such as feed channel pressure drop. There is a suite of available monitors to study biofouling, but systems to operate monitors have not been well designed to achieve an accurate, constant water flow required for a reliable determination of biomass accumulation and feed channel pressure drop increase. Studies were done with membrane fouling simulators operated in parallel with manual and automated flow control, with and without dosage of a biodegradable substrate to the feedwater to enhance biofouling rate. High flow rate variations were observed for the manual water flow system (up to ≈9%) compared to the automatic flow control system (<1%). The flow rate variation in the manual system was strongly increased by biofilm accumulation, while the automatic system maintained an accurate and constant water flow in the monitor. The flow rate influences the biofilm accumulation and the impact of accumulated biofilm on membrane performance. The effect of the same amount of accumulated biomass on the pressure drop increase was related to the linear flow velocity. Stable and accurate feedwater flow rates are essential for biofouling studies in well-defined conditions in membrane systems.

Keywords: Feed flow rate; Biofouling; Pressure drop; MFS operation system; Controlled biofouling studies

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