

Integration of direct microfiltration and reverse osmosis process for resource recovery from municipal wastewater

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ABSTRACT

For the sustainability of water resources, the recovery of water, organic matter (OM), energy, and nutrients from municipal wastewater become very attractive resources. As direct application of water, nutrient, and energy recovery from municipal wastewater cannot be feasible, the wastewater needed to be concentrated. In this study, the molecular weight distribution of OM content was determined in wastewater samples, up-concentration potential of direct microfiltration (DMF) of municipal wastewater and water recovery were investigated. In OM fractionation studies, around 52% of the chemical oxygen demand (COD) in wastewater was particulate or colloidal (>10 kDa) and 48% was soluble (<300 Da). In DMF tests, the COD concentration was concentrated up to 1,573 mg/L after sequential DMF experiments. Additionally, the theoretic total energy requirement of the DMF process was found around 0.3 kWh/m³ and it would be potentially energy positive. In crossflow experiments, the reverse osmosis (RO) process was performed using DMF effluent. When microfiltration and RO membranes were chemically cleaned, flux recovery rates of 100% and 99% were achieved, respectively. However, the foulants could not be completely removed during the cleaning according to scanning electron microscopy, atomic force microscopy, and attenuated total reflection-Fourier-transform infrared spectroscopy results of the virgin, fouled, and cleaned membranes. This study reveals that the DMF+RO process is a promising technology for the recovery of OM and water from municipal wastewater.

Keywords: Direct membrane filtration; Reverse osmosis; Resource recovery; Water recovery; Membrane fouling

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