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# Retrofitting membrane bioreactor (MBR) into osmotic membrane bioreactor (OMBR): a pilot scale study

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## Abstract

Forward osmosis (FO) technology that has been applied to a membrane bioreactor (MBR) is referred to as osmotic MBR (OMBR). The new concept developed in this study aims at retrofitting (partly or fully) existing MBR into OMBR, thus llimiting the investment costs, allowing for more flexible and combined operation of MBR and OMBR and to fulfil water quality needs. Submerged FO modules were developed by modifying Kubota microfiltration (MF) modules commonly used in MBR and fitting them with new generation thin-film composite FO membranes. The similar design and water fluxes of both MF and FO modules allowed for an unbiased comparison of OMBR and MBR. For the first time, stable OMBR operation with water fluxes above 10 $L.m^{-2}.h^{-1}$ was achieved using synthetic seawater as draw solution. The proof of concept of retrofitting of MBR and OMBR was demonstrated using a 50L reactor under varying operating conditions. Findings indicated that standalone OMBR operation is challenging due to salinity build-up which impacts bacterial activity and permeation flux. Fouling occurred in the FO modules to the same degree as MF but osmotic backwashing proved to be an efficient cleaning solution for OMBR. The energy reduction benefit of using an osmotic gradient instead of hydraulic pressure to drive permeation was outweighed by the energy required for draw circulation in OMBR. Loss of selectivity of the FO membranes was observed due to superficial (active layer) physical damage. However, the overall high rejection of trace organic contaminants by OMBR (>90%), due to high FO membrane rejection and biological degradation, is a great benefit for OMBR implementation in water reuse schemes.