Abstract Title	*A hybrid hollow fiber nanofiltration process for organic micro-pollutant removal from wastewater*
Topic	**X** Improving water quality O Resilient water systems O Circular solutions: Reuse, Recover and Recycle O Transitions in water, agro/food and energy
Challenges and Solutions	The challenge is finding a suitable, sustainable method for final removal of micropollutants from wastewater. The solution we investigate is to use nanofiltration to retain the micropollutants from effluent, and return them to the wastewater treatment plant for final removal.
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Abstract	The increasing concentration of organic micro-pollutants (OMP) in water poses a threat to both the environment and human health. Hollow fiber nanofiltration (HF-NF) membranes have shown great potential for the removal of OMPs from wastewater effluent. We propose to recirculate the concentrate stream of a commercially available HF-NF membrane towards the preceding biological treatment of wastewater to increase the removal of OMPs. We investigated the total removal of a bioreactor combined with the HF-NF membrane, and the effect of recovery and membrane configuration on the retention of OMPs. This was done in a continuously operated pilot system at 1 m^3/h. We analyzed 10 OMPs with LC-MS, varying in size, charge

	and chemistry. The removal in the biological step varied from -20% (carbamazepine) to 99% (caffeine), with an average bioremoval of 47%. We found highest membrane process retention for the lowest measured recovery, of 70%. At this recovery, a higher process retention was obtained for a Feed&Bleed-configuration (FB) compared to a Christmas-Tree-configuration (CT). The CT-configuration outperformed the FB-configuration at 90% recovery however, because the majority of CT-permeate is created at relatively low recovery. A high NF retention is important to obtain high combined removal for OMPs with a low bioremoval, such as carbamazepine. The membrane retention of carbamazepine was 58%, leading to a small improvement in projected combined removal. The combined removal increases substantially for OMPs with a high membrane retention and a moderate biological removal, such as amisulpride, with 38% bioremoval and up to 85% retention. The projected combined removal is above 80% with concentrate recirculation, thus more than doubling the total removal by adding the HF-NF, without the creation of a waste stream. This makes it worthwhile to experimentally investigate the concept with concentrate recirculation, including the effect of the concentrate on the biological reactor.
Figures/diagrams/illustrations