Ultra-low-pressure membrane filtration for simultaneous recovery of detergent and water from laundry wastewater

ABSTRACT

Reusing water and excess detergent from the laundry industry has become an attractive method to combat water shortages. Membrane filtration is considered an advanced technique and highly attractive due to its excellent advantages. However, the conventional membrane filtration method suffers from membrane fouling, which restricts its performance and diminishes its economic viability. This study assesses the preliminary performance of submerged, gravity-driven membrane filtration—under ultra-low trans-membrane pressure (△P) of <0.1 bar—to combat membrane fouling issues for detergent and water recovery from laundry wastewater. The results show that even under ultra-low pressure, the membrane suffered from compaction that lowered its permeability by 14% under △P of 6 and 10 kPa, with corresponding permeabilities of 2085 ± 259 and 1791 ± 42 L/(m^2 h bar). Filtration of a detergent solution also led to up to 8% permeability loss due to membrane fouling. During the filtration of laundry wastewater, 80–91% permeability loss was observed, leading to the lowest flux of 15.6 L/(m^2·h) at △P of 10 kPa, 38% lower than △P of 6 kPa (of 25.2 L/(m^2·h)). High △P led to both the membrane and the foulant compaction inflating the filtration resistance. The system could recover 83.6% of excess residual detergent, while most micelles were rejected (ascribed from 71% of COD removal). The TDS content could not be retained, disallowing maximum resource recovery. A gravity-driven filtration system can be self-sustained with minimum supervision in residential and industrial laundries. Nevertheless, a detailed study on long-term filtration performance and multiple cleaning cycles is still required in the future.