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Variability and limits of the unified membrane fouling index: application to the reduction of low-pressure membrane fouling by ozonation and biofiltration

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ABSTRACT

The impacts of ozone (0–8 mg O_3 L^{-1}) and filtration with biological activated carbon on membrane fouling by surface waters were investigated using three low-pressure membranes (two ceramics—UF or MF—and one polymeric—UF). The unified membrane fouling index (UMFI) was used to quantify the reversibility and irreversibility of membrane fouling. Minimum UMFI were calculated and repeatability assays were performed in order to evaluate the analytical detection limit and the precision of the method, respectively. The lowest ozone dose tested (1 mg O_3 L^{-1}) reduced the total fouling by 44, 63, and 41% for the polymeric membrane, the UF ceramic membrane, and the MF ceramic membrane, respectively. Further increase of the dose led to minor or no improvement, except for the ceramic MF membrane. For the ceramic membranes, a similar trend to that observed for total fouling was observed for hydraulically irreversible fouling. For the polymeric membrane, the hydraulically and chemically irreversible fouling were too low to be measured. Although biofiltration reduced the average dissolved organic carbon and turbidity by 25 and 50%, respectively, no significant fouling reduction was observed. The results indicate that irreversible fouling measurements are highly variable and most of the time below the analytical detection limit.

Keywords: Drinking water; Membrane; Fouling; Ozonation; Biological activated carbon; Microfiltration; Ultrafiltration; Unified membrane fouling index; Ceramic

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