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Relationship between Performance Deterioration of a Polyamide Reverse Osmosis Membrane Used in a Seawater Desalination Plant and Changes in Its Physicochemical Properties

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Summary

While it is known that the performance of reverse osmosis membranes is dependent on their physicochemical properties, the existing literature studying membranes used in treatment facilities generally focuses on foulant layers or performance changes due to fouling, not on the performance and physicochemical changes that occur to the membranes themselves. In this study, the performance and physicochemical properties of a polyamide reverse osmosis membrane used for three years in a seawater desalination plant were compared to those of a corresponding unused membrane. The relationship between performance changes during long-term use and changes in physicochemical properties was evaluated. The results showed that membrane performance deterioration (i.e., reduced water flux, reduced contaminant rejection, and increased fouling propensity) occurred as a result of membrane use in the desalination facility, and that the main physicochemical changes responsible for performance deterioration were reduction in PVA coating coverage and bromine uptake by polyamide. The latter was likely promoted by oxidant residual in the membrane feed. Our findings indicate that the optimization of membrane materials and processes towards maximizing the stability of the PVA coating and ensuring complete removal of oxidants in the membrane feed waters would minimize membrane performance deterioration in water purification facilities.