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Effect of long-term operation on membrane surface characteristics and performance in membrane distillation

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Abstract

In this study, significant changes to surface morphology and decreased surface hydrophobicity were observed on both the feed and distillate sides of membrane distillation membranes after 100 days of operation. Contact angles decreased by 56 and 26% on the feed and distillate sides, respectively. Surface roughness also decreased by 92 and 57% on the feed and distillate sides, respectively. Moderate morphological changes were also observed after 20 days of operation. While decreased hydrophobicity and surface roughness on the feed side were associated with fouling/scaling deposits and not changes to the actual membrane surface, decreased hydrophobicity and surface roughness on the distillate side indicated changes to the actual membrane surface. Often, membrane hydrophobicity is assumed to be recoverable if foulants can be removed; however, if membrane hydrophobicity decreases due to physical changes in the membrane surface, hydrophobicity may not be fully recoverable and membrane lifetime may be reduced. Despite significant reductions in feed-side hydrophobicity, distillate conductivity remained low, indicating that other membrane characteristics, such as distillate-side and internal or pore wall hydrophobicity, may play an important role in maintaining rejection during long-term operation.

Keywords: membrane distillation; hydrophobicity; surface roughness; surface morphology; long-term performance

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