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PII: S0376-7388(17)32085-9
DOI: https://doi.org/10.1016/j.memsci.2017.10.009
Reference: MEMSCI15635

To appear in: *Journal of Membrane Science*

Received date: 30 July 2017
Revised date: 1 October 2017
Accepted date: 4 October 2017

Cite this article as: Jung-Gil Lee, Yongsun Jang, Luca Fortunato, Sanghyun Jeong, Sangho Lee, TorOve Leiknes and Noreddine Ghaffour, An advanced online monitoring approach to study the scaling behavior in direct contact membrane distillation, *Journal of Membrane Science,* https://doi.org/10.1016/j.memsci.2017.10.009

# An advanced online monitoring approach to study the scaling behavior in direct contact membrane distillation

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## Abstract

One of the major challenges in membrane distillation (MD) desalination is scaling, mainly $CaSO_4$ and $CaCO_3$. In this study, in order to achieve a better understanding and establish a strategy for controlling scaling, a detailed investigation on the MD scaling was performed by using various analytical methods, especially an *in-situ* monitoring technique using an optical coherence tomography (OCT) to observe the cross-sectional view on the membrane surface during operation. Different concentrations of $CaSO_4$, $CaCO_3$, as well as NaCl were tested separately and in different mixed feed solutions. Results showed that when $CaSO_4$ alone was employed in the feed solution, the mean permeate flux (MPF) has significantly dropped at lower volume concentration factor (VCF) compared to other feed solutions and this critical point was observed to be influenced by the solubility changes of $CaSO_4$ resulting from the various inlet feed temperatures. Although the inlet feed and permeate flow rates could contribute to the initial MPF value, the VCF, which showed a sharp MPF decline, was not affected. It was clearly observed that the scaling on the membrane surface due to crystal growth in the bulk and the deposition of aggregated crystals on the membrane surface abruptly appeared close to the critical point of VCF by using OCT observation in a real time. On the other hand, NaCl + $CaSO_4$ mixed feed solution resulted in a linear MPF decline as VCF increases and delayed the critical point to