## Reduced-order modelling of flow and concentration polarization in membrane systems with permeation

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## ABSTRACT

Modelling of concentration polarization (CP) is important to ensure a successful membrane system design. Although computational fluid dynamics (CFD) remains a common approach to study CP, it usually requires a long computational time to investigate a short simulated time in membrane systems. In this work, we proposed a reduced-order model to predict CP in membrane systems with permeation. We modify Berman's velocity profile and incorporated it to the reduced-order model of the mass transfer equation. The proposed model shows excellent agreement with CFD results, while offering a reduction of two orders of magnitude in computational time. We also validate the model with published experimental data and demonstrate that the model can predict permeate flux in close proximity under various operating conditions. The proposed model offers an attractive alternative to solving the full Navier-Stokes and mass transfer equations, and opens the possibility to further investigate various approaches to reduce concentration polarization.

## **KEYWORDS**

Concentration polarization, Reduced-order model, Varying permeate flux, Reverse osmosis, Membrane

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