Computational fluid dynamics simulations of membrane gas separation: Overview, challenges and future perspectives

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ABSTRACT

Membrane-based gas separation (GS) has emerged as a competitive separation technology for industrial gas separation applications due to its simpler operation and cost-effective approach. This paper reviews the computational parameters and boundary conditions involved in model simulations, including the general assumptions made for the gas separation process. The transport mechanisms used for dense and porous gas separation membranes are discussed, followed by verification studies of CFD models. The impacts of different operation parameters, such as the temperature, pressure ratio, variation in hydrodynamics, and membrane selectivity, on membrane performance are evaluated in terms of gas permeation flux and concentration polarisation (CP). This review also describes the effect of obstacles (feed spacers) and various unsteady flow approaches for improving performance. Finally, challenges and future perspectives in CFD simulation involving membrane gas separation are provided.

KEYWORDS

Computational fluid dynamics; Membrane gas separation; Dense and porous membranes; Gas permeation mechanism; Concentration polarization

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