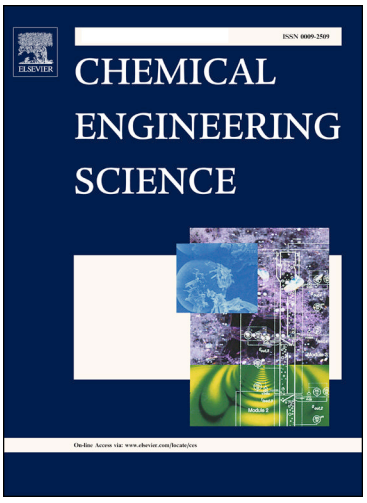

CFD study of the effect of unsteady slip velocity waveform on shear stress in membrane systems

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CFD study of the effect of unsteady slip velocity waveform on shear stress in membrane systems

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Abstract

An unsteady forced slip velocity has an important effect on the flow conditions adjacent to a membrane interface, which can help control concentration polarisation (CP) and fouling. This study explores the effect of non-sinusoidal slip velocity waveforms on mass transfer and shear stress in membrane channels. The hydrodynamics and mass transfer of unobstructed and obstructed membrane channels under the influence of slip velocity are simulated using two-dimensional computational fluid dynamics (CFD). At a Reynolds number where vortex shedding occurs, the results show that both sinusoidal and non-sinusoidal slip velocity profiles cause a similar increase in mass transfer and shear stress. However, for systems without vortex shedding, a non-sinusoidal waveform with a sudden decrease in slip velocity can significantly increase maximum shear stress (by over 20 %). This effect shows a clear advantage of non-sinusoidal slip velocity profiles over sinusoidal slip velocity profiles.

Keywords: CFD, Slip velocity, Non-sinusoidal waveform, Mass transfer enhancement, Shear Stress

1 Introduction

The efficacy of reverse osmosis (RO) membrane operations is limited by concentration polarisation (CP) and fouling. Although reverse osmosis (RO) modules usually