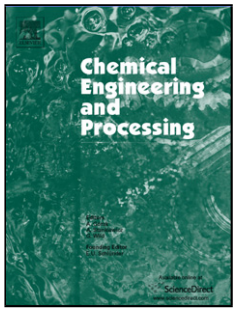

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Numerical investigation of mixing enhancement for multi-species flows in wavy channels

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Abstract

The present study considers the mixing characteristics of gaseous species in a channel with wavy walls. Waviness imparted along the walls are uniquely defined by the wavelength (λ), amplitude (a) and phase difference (PD). A quasi-incompressible formulation in a three-dimensional collocated finite volume framework is employed for the numerical simulations. Results show that wavy channels lead to enhanced mixing, quantified by the mixing efficiency (M), compared to that of a plane channel. Moreover, the use of asymmetric channels (with 0° PD) shows better mixing capability than their symmetric counterparts (with 180° PD) for same wavelength and amplitude. We argue, based on numerical results that the enhanced mixing in the asymmetric channels is due to the generation of alternate recirculation patterns, leading to higher transverse velocities. These transverse convective currents combined with diffusion are observed to aid the mixing process. A complete set of parametric studies is subsequently carried out to investigate the effect of the geometric parameters of waves along with Reynolds number, Peclet number for the 0° PD wavy channel. It is observed that for a given length, there exists a critical wave number that maximizes the mixing efficiency.

Keywords: Species mixing, isothermal, wavy channel, mixing efficiency, CFD

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