Effective heat exchange with optimum gap size of a compact steam methane reformer (SMR) reactor using CFD

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Hydrodynamics of a compact steam methane reforming (SMR) reactor for H2 production from natural gas were investigated using a computational fluid dynamics (CFD) model including heat transfer and reversible chemical reactions. The SMR reactor consisted of two main zones: combustion chamber for reaction heat supply and catalyst-bed for the SMR reaction. The realizable k – epsilon turbulence model with enhanced wall treatment, the discrete ordinates (DO) radiation model, and the volumetric reactions were used in the CFD model. The various cases with sleeve gap sizes of 2, 3, 4, 5 and 7 mm were considered at the sleeve velocities of 15, 19 and 23 m/s. The performance criteria including the overall heat transfer coefficient, hydrogen production rate, lower heating value efficiency, and heat flux uniformity were employed to analyze and select an optimum sleeve gap size. The SMR process with an optimum sleeve gap size showed a good heat efficiency.