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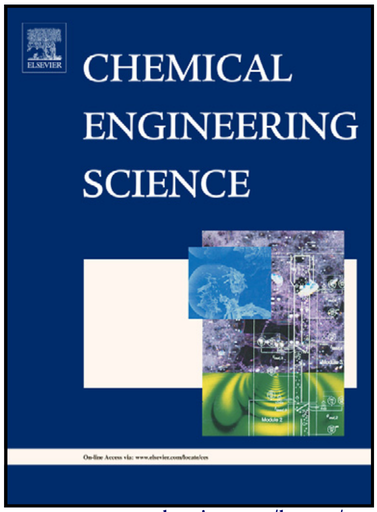

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A novel optimization approach to convective heat transfer enhancement for solar receiver

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Abstract

Convective heat transfer enhancement for solar receiver is considered as a variational problem in this paper. A predictive optimization method based on the minimum heat transfer entropy generation (MHEG) principle is developed for ideal gas in turbulent flow. A set of Euler-Lagrange equations is derived by the calculus of variations. By employing a porous media model and multiphase Volume of Fluid (VOF) model in the variational problem, the optimization constrained by the mechanical energy loss is performed to achieve a physically feasible geometry configuration to improve the performance of the convective heat transfer in a solar receiver. To validate and demonstrate the method, turbulent convection heat transfer process in a two-dimensional rectangular channel with fixed heat flux boundaries is optimized. The computation results show that higher air temperature at the outlet and lower wall temperature can be obtained, which may lead to the use of cheaper materials with lower heat-resistance for the exchanger. The present work shows that combining the calculus of variations with porous media and multiphase VOF model may be helpful for the design of efficient convective solar receiver.