

Abstract

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CFD modelling of entropy generation in turbulent pipe flow: Effects of temperature difference and swirl intensity

This article extends the recent study by Saqr and Wahid (Applied Thermal Engineering 70 (2014) 486–493) on the criteria of heat transfer enhancement in swirl pipe flow based on the entropy generation minimization principle. The effects of wall–fluid temperature difference (ΔT) and swirl intensity (S_n) on entropy generation are considered in the present work. A Computational Fluid Dynamics (CFD) model of non-isothermal swirl pipe flow was developed, validated with established LDA measurements, and then used to study the Nusselt (Nu), entropy augmentation (N_s) and Bejan (Be) numbers in 77 different scenarios related to swirl-enhanced heat exchangers. Critical values of ΔT and S_n that correspond to unity N_s were identified. Then, based on the CFD results, two computer codes were developed in MATLAB software to correlate N_s and Be as functions of ΔT and S_n . These computer codes are openly provided in this article's appendix in order to contribute to the design and optimization tools of swirl-enhanced heat exchangers.