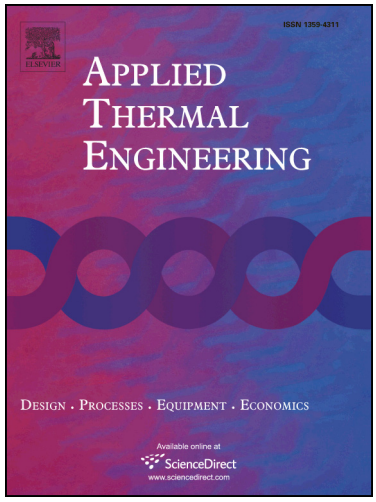

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Numerical investigation of heat transfer and entropy generation of laminar flow in helical tubes with various cross sections

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Abstract

This study evaluates heat transfer performance and entropy generation of laminar flow in coiled tubes with various cross-sections geometries i.e. circular, ellipse and square, relatives to the straight tubes of similar cross-sections. A computational fluid dynamics model is developed and validated against empirical correlations. Good agreement is obtained within range of Reynolds and Dean numbers considered. Effect of geometry, wall temperature, Reynolds number and heating/cooling mode were examined. To evaluate the heat transfer performance of the coiled tube configurations, a parameter referred as Figure of Merit (FoM) is defined as the ratio heat transfer rate to the required pumping power. In addition, exergy analysis is carried out to examine the inefficiency of the coiled tube configurations. The results indicate that coiled tubes provide higher heat transfer rate. In addition, it was found to be more efficient as reflected by lower entropy generation as compared to straight tubes. Among the studied cross-section, square cross-section generates the highest entropy, followed by ellipse and circular counterpart. Entropy production from heat transfer contribution is two order-of-magnitude higher than that of entropy

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