

## Accepted Manuscript

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PII: S1359-4311(16)32503-0

DOI: <http://dx.doi.org/10.1016/j.applthermaleng.2017.04.134>

Reference: ATE 10283

To appear in: *Applied Thermal Engineering*

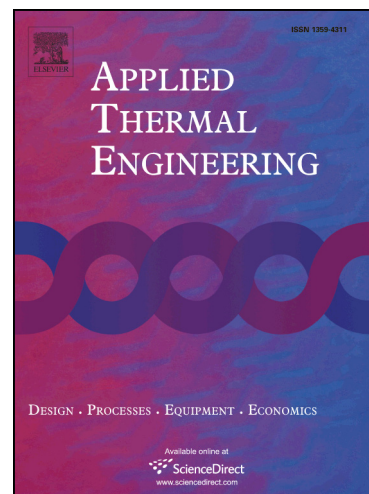
Received Date: 17 October 2016

Revised Date: 26 March 2017

Accepted Date: 26 April 2017

Please cite this article as: K.Y. Lim, Y.M. Hung, B.T. Tan, Performance evaluation of twisted-tape insert induced swirl flow in a laminar thermally developing heat exchanger, *Applied Thermal Engineering* (2017), doi: <http://dx.doi.org/10.1016/j.applthermaleng.2017.04.134>

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# Performance evaluation of twisted-tape insert induced swirl flow in a laminar thermally developing heat exchanger

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## Abstract

Twisted tapes are known to enhance convection heat transfer with an accompanying rise in pressure drop where the enhancement is essentially attributed to the secondary swirl flow. The heat transfer enhancement attributed to twisted-tape inserts in a laminar counter-flow concentric tube heat exchanger is investigated experimentally. The twisted tapes are characterized by different twist ratios. Empirically, the twisted tapes increase the friction factor by ten folds and the Nusselt number by three folds. The performance evaluation of the twisted-tape inserts is scrutinized based on various performance criteria such as the pumping power ratio, flow resistance ratio, heat transfer augmentation efficiency, Nusselt number ratio, heat duty ratio, and effectiveness ratio. The performance evaluation is based on two different conditions—variable and constant pumping power. An analysis on the dominance between free convection and swirl-flow-induced convection is performed through the buoyancy force and centrifugal force balance. This provides a sound explanation of the distinct heat transfer characteristics for different ranges of Reynolds number. This comprehensive analysis of performance evaluation provides interesting insights into the role played by the twisted tape insert in the contribution of energy transport in laminar forced convection.

**Keywords:** Heat transfer enhancement; performance evaluation criteria; swirl flow; twisted-tape insert

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