STUDIES ON A DOUBLE TUBE HEAT EXCHANGER WITH NOVEL SURFACE ENHANCEMENT FOR SINGLE PHASE AND MULTI-PHASE HEAT TRANSFER

by

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ABSTRACT

The study is conducted to evaluate the performance of a straight double tube heat exchanger using two novel and versatile enhancement configurations, namely Turbo-C (Copper Top Cross) and EXTEK (Twisted Multi-Head), usable in single phase forced convection as well as in phase change. Such tubes are used in condensation as well as evaporation in a double tube heat exchanger assembly, typically as used in water source heat pumps. The study covers several aspects, viz., establishment of the flow development length, local and total friction factors, convective heat transfer in single-phase flow, two-phase pressure drop and condensation heat transfer.

The Reynolds number ranges for the study are as follows. Flow development length: $800 < Re < 2300$ for laminar flow and $4500 < Re < 27,000$ for turbulent flow. For friction factor and heat transfer the Reynolds number range spanned 800 to 65,000. Heat transfer coefficients are determined by the Wilson Plot technique in laminar and turbulent flow and correlations are proposed for Nusselt numbers. The Colburn analogy is employed to obtain the form of the correlation in the Wilson plot tests. Comparisons are then made between heat transfer and flow friction. Correlations are proposed for flow development length, friction factor and heat transfer coefficients in single-phase flow.

Finally the condensation heat transfer coefficient for the overall average and local average is evaluated for $Re > 25,000$. During each test sequence the single phase region is evaluated based on results from the Wilson plot and Colburn *j*-Factor test results. The local condensation studies are conducted first, followed by the overall average condensation test. The results from the local condensation are then utilized for comparison with the overall average, by averaging the local coefficients by means of numerical quadrature. Two-phase pressure drop is also evaluated ot obtain the Lockhart-Martinelli parameters and given as a function of the two phase multiplier.