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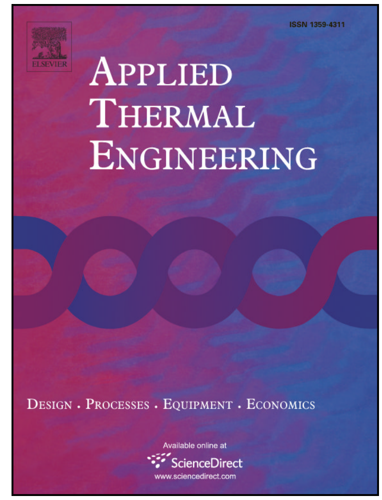

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Enhanced heat transfer and power dissipation in oscillatory-flow tubes with circular-orifice baffles: a numerical study

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Abstract

A numerical investigation has been carried out in order to characterize the power dissipation and heat transfer augmentation in standard circular-orifice baffled tubes operating with superimposed net and oscillatory flows. Unsteady pressure drop across the baffled tube has been monitored under different operating conditions and working fluids, in order to evaluate the power consumption of the device. A successful agreement with experimental data available in the open literature is presented. The simultaneously hydrodynamic and thermal developing flow has been modelled with uniform heat flux as boundary condition in the tube wall, using both water and thermal oil as working fluids. The achievement of spatial and time periodicity is thoroughly analyzed prior to the data reduction for the computation of Nusselt number. The time-resolved and time-averaged heat transfer characteristics are presented for a net Reynolds number ranging from $Re_n = 5$ to $Re_n = 200$ and oscillatory Reynolds number from $Re_o = 0$ to $Re_o = 800$ for a constant oscillating amplitude of $x_0 = d$. The strong dependency of Nusselt number on the operating parameters of the oscillations is reported. The methodology is validated using the heat transfer correlations available in the literature.

Keywords: Oscillatory flow, OBR, CFD, Heat transfer, Power dissipation

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