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Numerical Investigation on Flow and Heat Transfer Characteristics of Corrugated Tubes with Non-uniform Corrugation in Turbulent Flow

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Abstract

Based on finite volume method, the pressure drop and heat transfer characteristics of one smooth tube and ten different axisymmetric corrugated tubes, including two with uniform corrugation and eight with non-uniform corrugation, have been studied. A physical model of the corrugated tube was built, then the numerical simulation of the model was carried out and the numerical simulation results were compared with the empirical formula. The results show that: The friction factor decreases with the increase of Reynolds number ranging from 6000 to 57000, the value of which in the corrugated tubes with non-uniform corrugation (tube 03-10) are smaller than those with uniform corrugation (tube 01-02). The geometry parameters of tube (01) have advantages on the heat transfer enhancement in low Reynolds number flow region (from 6000 to 13000) and tube (07-08) have advantages on the heat transfer enhancement in high Reynolds number flow region (from 13000 to 57000). The vortex, existed in each area between two adjacent corrugations called second flow region, is the root of the enhancement on heat transfer in the corrugated tubes. The effectiveness factor decreases with the increasing of Reynolds number and the performances of the corrugated tubes with pitch of 12.5mm have advantages than these of 10mm under the same corrugation geometric parameter.

Key words: Numerical simulation, Corrugated tube, Non-uniformed corrugation, Turbulent flow