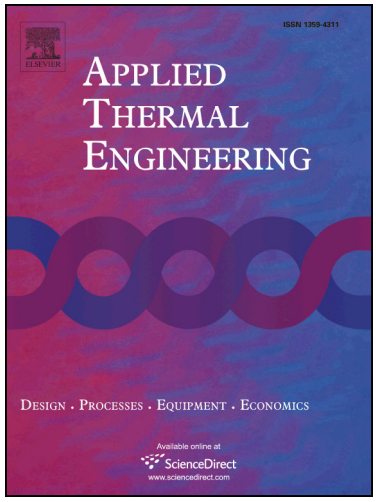

Thermo-hydraulic characteristics of laminar flow in a circular tube with porous metal cylinder inserts

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Abstract

Based on periodic surface models, a novel type of porous metal cylinder inserts (PMCIs) was designed in this work to improve heat transfer. The thermo-hydraulic performance of laminar flow was numerically studied on a circular tube with PMCIs. The effect of porosity, pore types, spacer length and clearance on the heat transfer performance was investigated. Liquid water was used as the working fluid. The numerical results show that the Nusselt number increases by 2.15-7.17 times the value of the plain tube, while the friction factor is augmented by 5.98-11.68 times. The performance evaluation criterion (PEC) value is 1.2-3.16. The computation results indicate that the Nusselt number and friction factor increase with the decrease in spacer length. Moreover, the effect of porosity on the thermo-hydraulic performance is also investigated. The results show that better PEC values of the tube can be obtained with smaller porosity. The effect of pore types on the heat transfer performance is also reported. Besides these findings, it indicates that the clearance is very sensitive to the heat transfer performance. The better heat transfer performance of the tube can be obtained with larger clearance. Compared with other inserts, the novel PMCIs can transfer more heat than other inserts under the same pumping power which can guide us to optimize heat exchanges.

Keywords：Porous metal cylinder inserts; Periodic surface model; Heat transfer enhancement.