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流体力学与传递现象

考虑局部非热平衡的流体层流横掠多孔介质中恒热流平板的传热分析

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摘要

对流体层流横掠多孔介质中恒热流加热的平板，应用Brinkman-Forchheime-extended Darcy流动模型和流体与多孔介质之间局部非热平衡理论建立守恒方程组，应用数量级分析和积分法，得出了速度边界层厚度、热边界层厚度、壁面黏性摩擦系数和对流传热系数、流体与多孔介质之间局部温差的计算公式。结果表明，速度边界层与光板时明显不同，其在平板前端迅速增长，之后越来越平坦，趋于一个恒定值;而热边界层则沿着流动方向不断增长，类似于光板时的情况;局部的表面对流传热系数在平板前端达最大值，之后逐渐减小，也类似于光板时的情况;多孔介质与流体间的局部温差在平板前端达最大值，之后呈现沿着流动方向逐渐减小的变化趋势。

关键词 多孔介质 层流横掠平板 局部非热平衡 边界层分析

分类号

Heat transfer of laminar flow over a plate embedded in porous medium with a constant heat flux under local non-equilibrium condition

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Abstract

The Brinkman-Forchheime-extended Darcy model was used to analyze the laminar flow over a plate heated with a constant heat flux embedded in a porous medium by considering the local non-equilibrium between the fluid and porous medium.The conservation equations were established and simplified by analyzing the order of magnitude of each term.The formulas of velocity and thermal boundary layer thicknesses，convective heat transfer coefficient and local temperature difference between fluid and porous medium were obtained by using an integration method.It is shown that the velocity boundary layer in the porous medium is obviously different from that of free stream over a plain plate.It develops very quickly at the beginning and reaches a steady thickness gradually.However，the development of the thermal boundary layer and the change of the local convective heat transfer coefficient are more similar to that of a plain plate.The local temperature difference between the porous medium and fluid achieves the maximum at the beginning，and then decreases gradually along the flow direction.

Key words porous medium laminar flow over a plate local non-equilibrium boundary layer analysis

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