

论文

矩形微管内流动特性的实验研究

王樱, 刁彦华, 赵耀华

北京工业大学建筑工程学院

摘要:

以极性液体蒸馏水、无水乙醇和非极性液体R113作为实验工质, 流过相对粗糙度1.40%、水力直径170.37 mm, 相应高宽比为0.66的由晶体密封生长所形成的矩形紫铜微管, 测量微管进出口参数及微管内流体流量, 从而获得雷诺数Re与摩擦阻力系数f、Re与Poiseuille数Po、Re与压力梯度Dp/DL的关系。实验结果表明: 在43.17 < Re < 4 091.5的实验范围内, 流体的极性对微管流动阻力特性没有影响; 同时实验结果表明对于粗糙度为1.40%的矩形紫铜微管, 内壁面粗糙度对层流区摩擦阻力特性影响不大: 当Re小于1 600~1 800时, 所有微管内的流动阻力特性与经典理论预测值接近; 当Re =1 600~1 800时, 微管的f值开始偏离理论预测值, 流体发生转捩。

关键词: 矩形微管 雷诺数 摩擦阻力系数 转捩 压降

Experimental Study on Flow Characteristics in Rectangular Microtube

WANG Ying, DIAO Yan-hua, ZHAO Yao-hua

College of Architecture and Civil Engineering, Beijing University of Technology

Abstract:

Polar liquid distilled water, ethanol and nonpolar liquid R113 were used as the testing fluids, and let them flow through a rectangular microtube which was made of copper by crystal growth method with the relative roughness of 1.40%, the hydraulic diameter of 170.37 mm and the aspect ratio of 0.66, the relation of Reynolds number and friction factors, the relation of Reynolds number and Poiseuille number, and the relation of Reynolds number and gradient pressure were calculated from the measurement of the inlet and outlet parameters and the fluid flow velocities. The experimental results indicate that the polarity of the testing fluid is negligible during the Reynolds numbers range from 43.17 to 4 091.5, and it also demonstrates that the microtube with relative roughness of 1.4% almost does not influence the frictional characteristics in the laminar region; when the Reynolds number is below 1 600~1 800, the experimental data for frictional factors of all the testing fluids flow agrees well with the theoretical correlation presented, when the Reynolds number is over the range of 1600~1800, the frictional factors deviate from the theoretical correlations, so the transition to turbulent flow is validated.

Keywords: rectangular microtube Reynolds number frictional factor transition pressure drop

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通讯作者: 刁彦华

作者简介:

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