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传递现象

管壳式换热器壳侧湍流流动与换热的三维数值模拟

邓斌, 陶文铨

西安交通大学动力工程多相流国家实验室，能源与动力工程学院,陕西 西安 710049

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摘要 综合应用体积多孔度、表面渗透度和分布阻力方法建立了适用于准连续介质的N-S修正控制方程. 用改进的k-ε模型考虑管束对湍流的产生和耗散的影响，用壁面函数法处理壳壁和折流板的壁面效应，对一管壳式换热器的壳侧湍流流动与换热进行了三维数值模拟. 对计算结果进行了归纳，并与换热器冷态实验、前人的研究结果进行了对比分析, 从而证明了该方法能更有效地模拟管壳式换热器壳侧的流动特性，压降实验数据和计算结果符合良好.

关键词 管壳式换热器 多孔介质 湍流流动与换热 数值模拟

分类号

THREE-DIMENSIONAL NUMERICAL SIMULATION OF TURBULENT FLOW AND HEAT TRANSFER CHARACTERISTICS IN SHELL SIDE OF SHELL-AND -TUBE HEAT EXCHANGERS

DENG Bin,TAO Wenquan

Abstract

A three-dimensional, staggered grid, full-implicit consistent control-volume numerical model was presented for the analysis of turbulence fluid flow and heat transfer in the shell side of shell-and-tube heat exchanger.The numerical model used the distributed resistance method along with the concept of volumetric porosities, surface permeabilities to account for the presence of tubes in the heat exchangers. A modified k-ε model was used to account for the effects of tubes on turbulence generation and dissipation. Shell and baffle walls were modeled by using the wall function approach. The three-dimensional model was validated by comparison of the computed pressure drop distribution with experiment data obtained on an E shell type heat exchanger model and the previous research results. Good agreement between the simulation results and experimental data is obtained. It showed that the three-dimensional numerical model could more effectively simulate the flow characteristics in the shell-side of heat exchanger than the previous numerical simulation models.

Key words shell-and-tube heat exchanger porous medium turbulent flow and heat transfer numerical simulation

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通讯作者 陶文铨 wqtao@xjtu.edu.cn