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工程热物理

圆管内对流换热的场协同理论分析

傅耀 王彤 谷传纲

上海交通大学机械与动力工程学院 上海交通大学机械与动力工程学院 上海交通大学机械与动力工程学院

摘要： 以空冷电机转子通道内的流动换热问题为背景，将场协同理论应用于旋转坐标系中。通过理论分析，指出了场协同理论应用于静止坐标与旋转坐标中的差异，说明了在旋转坐标系下对流换热问题的规律。采用数值模拟方法对旋转坐标下的三维轴向直圆管模型内部流动与换热进行了研究，验证了理论分析结果，并进一步对比了不同转速、不同入口条件下换热情况。理论分析与数值计算结果均证明在旋转坐标系下，高转速带预旋入口条件的轴向通道内固体壁面对流体做功量对总换热量的影响不可忽视。

关键词： 旋转圆管 场协同理论 对流换热 入口预旋 数值计算

Analysis on the Convective Heat Transfer in a Rotating Tube With Field Synergy Principle

FU Yao WANG Tong GU Chuan-gang

School of Mechanical Engineering, Shanghai Jiaotong University School of Mechanical Engineering, Shanghai Jiaotong University School of Mechanical Engineering, Shanghai Jiaotong University

Abstract: The field synergy principle was applied to the cooling system of the generator rotor with rotating coordinate system. Theoretical analyses for convective heat transfer were presented in both rotating system and the static one. A three dimensional model of the axial straight circular rotating tube was built for numerical simulation. The numerical simulation results with different boundary conditions and different rotating speeds were presented to verify the theoretical analysis results. The results show that the work of the solid wall with high rotating speed should be taken into account in the case with pre-rotational inlet condition.

Keywords: rotating tube field synergy principle convective heat transfer pre-rotation numerical simulation

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通讯作者: 王彤

作者简介:

作者Email: twang@sjtu.edu.cn

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