其它

多孔介质对封闭腔体内对流传热传质的影响

刘芳[1,2],陈宝明[2],王丽[2]

1. 山东大学能源与动力工程学院, 山东 济南 250061;
 2. 山东建筑大学热能工程学院, 山东 济南 250101

摘要：

利用两区域法,其中在多孔介质区域利用Forheimer-Brinkman-Darcy方程,纯流体区域使用Navier-Stokes方程对部分填充多孔介质的二维封闭腔体内的自然对流传热传质进行数值研究。采用有限元法辅之以流体与多孔介质交界面上的连续性弱约束条件对两区域方程进行求解,分析了多孔介质厚度、渗透率及孔隙率的变化对封闭腔体内传热传质的影响。数值结果表明:当多孔介质厚度小于0.2时,其厚度的增加可明显削弱传热传质;大于0.2时,其影响明显减弱。渗透率从10^{-3}降低至10^{-6}时,腔体中流动减弱,导致平均传热传质速率降低。随孔隙率增加平均传热传质速率近似线性增加。

关键词： 多孔介质 自然对流 复合腔体 传热传质

Influence of porous medium on convective heat and mass transfer in a partially porous cavity

LIU Fang[1,2], CHEN Bao-ming[2], WANG Li[2]

1. School of Energy and Power Engineering, Shandong University, Jinan 250061, China;
2. School of Thermal Energy Engineering, Shandong Jianzhu University, Jinan 250101, China

Abstract:

Natural convective heat and mass transfer in a partially filled with porous medium was studied by using the two-domain approach. The Forheimer-Brinkman-Darcy equation was developed for the porous medium, whereas the Navier-Stokes equation was set up for the clear fluid region. A continuous interfacial condition was used at the interface between the clear fluid region and porous medium and the equations were solved by the finite element method with weak constraint condition at the interface. Influences of thickness, permeability and porosity of the porous medium on heat and mass transfer were mainly considered. The numerical results showed that heat and mass transfer could be quickly weakened when thickness of the porous medium is no more than 0.2. The flow became obviously slower when permeability decreased from 10^{-3} to 10^{-6} and also heat and mass transfer. Average heat and mass transfer velocities increased linearly with an increasing porosity.

Keywords: porous medium   natural convection   composite cavity   heat and mass transfer

通讯作者：

作者简介: 刘芳(1977-), 女, 山东胶南人, 博士研究生,主要研究方向为复杂介质中的传热传质.E-mail: fliu@sdjzu.edu.cn
作者Email:

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