中国化学工程学报 2007 15 (6): 821-827 ISSN: 1004-616x CN: 44-1063/R

TRANSPORT PHENOMENA & FLUID MECHANICS

规整填料内单相流的LDV实验研究

陈江波, 刘春江, 李莹珂, 黄莹, 袁希钢, 余国琮

State Key Laboratory of Chemical Engineering, Chemical Engineering Research Center, Tianjin University, Tianjin 300072, China

收稿日期 2007-1-30 修回日期 网络版发布日期 接受日期 2007-9-24

摘要 To date, many models have been developed to calculate the flow field in the structured packing by the computational fluid dynamics (CFD) technique, but little experimental work has been carried out to serve the vali-dation of flow simulation. In this work, the velocity profiles of single-phase flow in structured packing are meas-ured at the Reynolds numbers of 20.0, 55.7 and 520.1, using the laser Doppler velocimetry (LDV). The time-averaged and instantaneous velocities of three components are obtained simultaneously. The CFD simulation is also carried out to numerically predict the velocity distribution within the structured packing. Comparison shows that the flow pattern, velocity distribution and turbulent kinetic energy (for turbulent flow) on the horizontal plane predicted by CFD simulation are in good agreement with the LDV measured data. The values of the x-and z-velocity components are quantitatively well predicted over the plane in the center of the packing, but the predicted y-component is sig-nificantly smaller than the experimental data. It can be concluded that experimental measurement is important for further improvement of CFD model.

关键词 velocity profile structured packing laser Doppler velocimetry computational fluid dynamics

分类号

DOI:

Experimental investigation of single-phase flow in structured packing by LDV

CHEN Jiangbo, LIU Chunjiang, LI Yingke, HUANG Ying, YUAN Xigang, YU Guocong

State Key Laboratory of Chemical Engineering, Chemical Engineering Research Center, Tianjin University, Tianjin 300072, China

Received 2007-1-30 Revised Online Accepted 2007-9-24

Abstract To date, many models have been developed to calculate the flow field in the structured packing by the computational fluid dynamics (CFD) technique, but little experimental work has been carried out to serve the vali-dation of flow simulation. In this work, the velocity profiles of single-phase flow in structured packing are meas-ured at the Reynolds numbers of 20.0, 55.7 and 520.1, using the laser Doppler velocimetry (LDV). The time-averaged and instantaneous velocities of three components are obtained simultaneously. The CFD simulation is also carried out to numerically predict the velocity distribution within the structured packing. Comparison shows that the flow pattern, velocity distribution and turbulent kinetic energy (for turbulent flow) on the horizontal plane predicted by CFD simulation are in good agreement with the LDV measured data. The values of the x-and z-velocity components are quantitatively well predicted over the plane in the center of the packing, but the predicted y-component is sig-nificantly smaller than the experimental data. It can be concluded that experimental measurement is important for further improvement of CFD model.

Key words velocity profile; structured packing; laser Doppler velocimetry; computational fluid dynamics

通讯作者:
陈江波 cjliu@tju.edu.cn
作者个人主页: 陈江波; 刘春江; 李莹珂; 黄莹; 袁希钢; 余国琮