化工学报 2007 58 (05): 1163-1171 ISSN: 0438-1157 CN: 11-1946/TQ

多相流和计算流体力学

下行床气粒流动行为的Eulerian-Lagrangian模拟

赵永志, 程易, 丁宇龙, 金涌

清华大学化学工程系，绿色反应工程与工艺北京市重点实验室

收稿日期 2006-6-26 修回日期 2006-8-28 网络版发布日期 2007-5-29 接受日期

摘要 采用计算流体力学和离散单元方法耦合模型（CFD-DEM）对二维下行床内的气粒流动行为进行了全床数值模拟。模拟结果展示了下行床典型操作条件下特有的气固动态流动结构：沿流动方向存在明显的入口控制区、过渡区和（完全）发展区;颗粒聚团并不是出现在浓度相对较高的入口区，而是在过渡区之后的发展过程中逐渐形成较多的、松散的动态聚团结构。下行床发展段呈现典型的近壁浓环结构，这与实验结果基本一致。考察了颗粒之间以及颗粒与壁面之间的碰撞参数对下行床内气固流动结构的影响，发现完全弹性碰撞颗粒体系在入口区呈现最快速的颗粒分散;而对本文研究的操作条件，颗粒碰撞参数对发展段时均流体力学行为只产生轻微的影响。

关键词 下行床 流体力学 离散单元法 计算流体力学 聚团现象

分类号

Eulerian-Lagrangian simulation of hydrodynamics of gas-solid flows in downer

ZHAO Yongzhi,CHENG Yi,DING Yulong,JIN Yong

Abstract

The gas-solid flows in two-dimensional downer were simulated by using a CFD-DEM method.The simulation results showed the typical flow structures in the dower.Along the flow direction, there existed the entrance region, the transition region, and the (fully) developed region, in which the clusters started to form in the transition region instead of the entrance region with a denser particle concentration.With the flow development, the clusters grew in size and increased in number.Particles inside each cluster were loosely collected, flowing in the same direction as the bulk flow.The lateral distribution of solids fraction in the fully developed region was non-uniform, with a denser ring near the wall.These results agreed well with the experimental results reported in the literature.The influence of the physical properties of the wall and particles on the global solids flow structure was investigated.The ideally elastic particles with no friction during collisions dispersed very rapidly and uniformly at the entrance.The influence of the collision parameters between particles on the lateral flow structure was not obvious in this work.

Key words downer hydrodynamics discrete element method (DEM) computational fluid dynamics (CFD) clustering phenomena

DOI:

通讯作者 程易 yicheng@tsinghua.edu.cn