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多相流和计算流体力学

颗粒旋转对鼓泡流化床内气固两相流动特性影响的数值模拟

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摘要

运用考虑颗粒自旋转流动对颗粒碰撞能量交换和耗散影响的颗粒动理学方法，建立鼓泡流化床气固两相Euler-Euler双流体模型，数值模拟流化床内气体颗粒两相流动特性。分析表明，颗粒平动温度与旋转温度之比是法向和切向颗粒弹性恢复系数和摩擦系数的函数。与不考虑颗粒旋转效应计算结果相比，考虑颗粒旋转效应后床内较容易形成气泡，颗粒自旋转运动将导致床内非均匀结构更明显。并且床层平均空隙率和床层膨胀高度增加，床中心区域颗粒轴向速度提高，床内颗粒平动温度下降。考虑颗粒旋转效应后预测的颗粒轴向速度和颗粒脉动速度与文献实验结果基本吻合。考虑颗粒旋转效应后获得的气泡直径更接近于前人经验关联式。

关键词

颗粒旋转 颗粒动理学 鼓泡流化床

分类号

扩展功能

本文信息

Supporting info

PDF(2890KB)

[HTML全文](0KB)

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Numerical simulation of gas and particles flow behavior considering effect of particle rotations in bubbling fluidized beds

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Abstract

The flow behavior of bubble and particles in a gas-solid bubbling fluidized bed was simulated by using a two-fluid model incorporating the effect of particle rotations based on the kinetic theory for rapid granular flow of slightly frictional spheres.A simplified model was implemented without changing the current kinetic theory framework by introducing an effective coefficient of restitution to account for additional energy dissipation due to frictional collisions.Simulations were performed to study the bubble dynamics in a bubbling gas-fluidized bed without and with the consideration of particle rotations.With particle rotation，bubbles were easily formed in the bed，the particle concentrations decreased，and the bed expansion increased.Simulated results indicated that the axial velocities of particles increased，and the translational granular temperature of particles decreased in comparison with the case without particle rotation in the center regime of bed.It was found that the present model with particle rotations better captures the bubble dynamics and time-averaged bed behavior.With the consideration of the effect of particle rotations，the simulated axial velocities and fluctuating velocities of particles were in agreement with literature，and the predicted bubble diameters were close to the calculated results from literatures.

Key words

particle rotation kinetic theory of granular flow bubbling fluidized bed

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