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多相流和计算流体力学

颗粒团绕流曳力系数的LBM计算

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摘要　采用格子Boltzmann方法(Lattice Boltzmann method, LBM) 中的LBGK(Lattice Bhatnagar- Gross-Krook)模型和二阶精度的曲线边界条件处理方法对二维颗粒团绕流现象进行了数值模拟，并同时使用动量交换法计算了两种颗粒团构型中不同颗粒的曳力系数。结果表明：颗粒团曳力系数与颗粒聚团的构型有着密切联系，颗粒聚团的形成将导致颗粒团曳力系数大幅度减小。除颗粒团构型因素外，颗粒间距和流动Reynolds数也是导致颗粒团曳力系数发生改变的主要因素。当颗粒聚团存在时，颗粒团中不同颗粒的受力有较大差异，若忽略颗粒聚团效应，则颗粒团曳力系数的计算必然将产生偏差。

关键词

格子Boltzmann方法　动量交换法　曳力系数　颗粒团　两相流

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Evaluation of drag coefficient on particles in cluster by using lattice Boltzmann method

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Abstract

The LBGK（lattice Bhatnagar-Gross-Krook）model of the lattice Boltzmann method including second-order boundary condition treatment for curve geometry was employed to investigate the flow around particle clusters.The drag coefficient is a benchmark problem in the analysis of particle-fluid complex systems，especially，in a gas-solid fluidized bed.In the present work，the drag coefficient on a spherical particle in a cluster，was evaluated by using the momentum-exchange method directly.Two different configurations of cluster were measured based on the lattice Boltzmann method.Computational results indicated that the drag coefficient on an individual particle in a cluster depended heavily on the configuration of cluster.And the drag coefficient on the particle in the cluster was lower when that particle was shielded by other particles.Additionally，except for the configuration factor，both the inter-distance and Reynolds number had a strong effect on the drag coefficient on an individual particle as well.It was found that the drag coefficient on each particle varied drastically with clustering.Omitting the effect of clustering might result in incorrect drag forces in the simulation.

Key words

lattice Boltzmann method　momentum-exchange method　drag coefficient　particle clusters　two-phase flow

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