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TRANSPORT PHENOMENA & FLUID MECHANICS

T-形分叉槽道纤维悬浮湍流场物数值模拟

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摘要 The concentration and orientation of fiber in a turbulent T-shaped branching channel flow are investigated numerically. The Reynolds averaged Navier-Stokes equations together with the Reynolds stress turbulent model are solved for the mean flow field and the turbulent kinetic energy. The fluctuating velocities of the fluid are assumed as a random variable with Gaussian distribution whose variance is related to the turbulent kinetic energy. The slender-body theory is used to simulate the fiber motion based on the known mean and fluctuating velocities of the fluid. The results show that at low Reynolds number, fiber concentration is high in the flow separation regions, and fiber orientation throughout the channel is widely distributed with a slight preference of aligning along the horizontal axis. With increasing of Re, the high concentration region disappears, and fiber orientation becomes homogeneous without any preferred direction. At high Reynolds number, fiber concentration increases gradually along the flow direction. The differences in the distribution of concentration and orientation between different fiber aspect ratio are evident only at low Re. Both Re and fiber aspect ratio have small effect on the variance of orientation angle.

关键词 fiber suspension, distribution, orientation, turbulent branching channel flow, numerical simulation

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Numerical research on the fiber suspensions in a turbulent T-shaped branching channel flow

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Key words fiber suspension; distribution; orientation; turbulent branching channel flow; numerical simulation

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