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Micro- and Nanoparticle Transport and Deposition in Elliptic Obstructed Channels by Lattice Boltzmann Method

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Abstract : In this study, a two-dimensional lattice Boltzmann method (LBM) was considered for the numerical simulation of fluid flow in a channel. Also, the Lagrangian method was used for particle tracking in one-way coupling. Three hundred spherical particles with specific diameters were released in the channel entry and an elliptical object was placed in the channel for flow obstruction. The effect of gravity, the drag force, the Saffman lift and the Brownian forces were evaluated in the particle motion trajectories. Also, the effect of the geometrical parameter, ellipse aspect ratio, and the flow characteristic or Reynolds number was surveyed for the transport and deposition of particles. Moreover, the influence of particle diameter between 0.01 and 10 μm was investigated. Results indicated that in small Reynolds, more inertial and gravitational trapping occurred on the obstacle surface for particles with larger diameters. Whereas, for nano-particles, influenced by Brownian diffusion and vortices behind the obstacle, the inertial and gravitational mechanisms were insignificant and diffusion was the dominant deposition mechanism. In addition, in Reynolds numbers larger than 400, there was no significant difference between the deposition of finer and larger particles. Also, in higher aspect ratios of the ellipse, more inertial trapping occurred for particles of larger diameter (10 micrometers), while in lower cases, interception and gravitational mechanisms were dominant.

Keywords : ellipse aspect elito, particle tracking diffusion, lattice boltzman method, larangain particle tracking
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