A Linkage between Particle- and Cell-scale Drag Correlations for Packed Beds of Multi-sized Particles

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Abstract

Drag correlations for fluid-particles interactions of multi-sized particle systems are important in many industries. Currently such correlations are modelled at particle-scale (Method A) or cell-scale (Method B). However, they are often inconsistent in predicting either the overall fluid-drag force in a packed bed or the individual drag forces for different sized particles in the bed. In this work, a new model is proposed to build up a linkage between the two approaches (Methods A and B) for estimation of the drag forces in packed beds of multi-sized particles under creeping fluid flow conditions. The new model is based on using both the particle-scale parameter, the effective individual porosity, as well as the cell-scale parameter, the effective average diameter. A set of closed equations have been formulated to link these parameters, which can be solved by numerical iterations. The model is shown to be able to satisfactorily predict the overall and individual drag forces.

Keywords: Packed bed; Porous media; Multi-sized particles; Fluid mechanics; Drag force.