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CFD-DEM Modelling and Analysis of the Continuous Separation of Sized Particles Using Inertial Microfluidics

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Abstract : The inertial difference induced by the microfluidics inside a curved micro-channel has great potential to provide a fast, inexpensive, and portable solution to the separation of micro- and sub-micro particles in many applications such as aerosol collections, airborne bacteria and virus detections, as well as particle sortation. In this work, the separation behaviors of different sized particles inside a reported curved micro-channel have been studied by a combined approach of computational fluid dynamics for gas and discrete element model for particles (CFD-DEM). The micro-channel is operated by controlling the gas flow rates at all of its branches respectively used to load particles, introduce gas streams, collect particles of various sizes. The validity of the model has been examined by comparing by the calculated separation efficiency of different sized particles against the measurement. On this basis, the separation mechanisms of the inertial microfluidic separator are elucidated in terms of the interactions between particles, between particle and fluid, and between particle and wall. The model is then used to study the effect of feed solids concentration on the separation accuracy and efficiency. The results obtained from the present study demonstrate that the CFD-DEM approach can provide a convenient way to study the particle separation behaviors in micro-channels of various types.

Keywords : CFD-DEM, inertial effect, microchannel, separation
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