Modeling of strongly polydisperse particulate systems for CFD-DEM simulations

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ABSTRACT

Particulate systems can readily be modeled and simulated with the discrete element method (DEM) [1]. Broad size distributions, however, pose a severe challenge: the number of particles per volume increases drastically, computational time steps need to be reduced and neighbour lists have to be created carefully. Especially the description of large systems requires an efficient treatment of the smallest particles present.

We propose simple, feasible models for the two limiting cases of two clearly separated scales and one broad distribution of sizes. For the former case, we investigate the transport of fines by a gas flow through a packed bed of coarse particles. We employ the well-known classification into static and dynamic hold-up which both interact with the gas and the solid phase. Besides expressions for these forces, correlations for the deposition and release of fines depending on the local bed morphology are required. The resulting model is validated against measurements by Takahashi et al. [2].

Regarding the second case we show how to approximate a broad size distribution of particles with a narrower one corresponding to parcels with adapted material parameters. We test our assumptions with the study of a horizontal jet entering a particle bed and forming a cavity.

Especially in dense beds where the mobility of small grains relative to larger ones is impeded by kinematic restrictions, such an effective-parcel approach can be expected to agree with detailed calculations based on the full size distribution. In dilute configurations with higher mobility, on the other hand, the assumptions of this approach are clearly challenged, which calls for a way to couple highly resolved with coarse-grained regions [3] in future work.

REFERENCES

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