The Effect of Fines on the Fluidization of Cohesive Powders

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ABSTRACT

Recent years have seen a surge in popularity of numerical methods such as Computational Fluid Dynamics (CFD) and the Discrete Element Method (DEM). By coupling CFD and DEM such that there is momentum transfer between the fluid and particle phase, it has become possible to perform detailed simulations of multiphase flows. This approach may lead to a better understanding of the underlying reasons for the complex behaviour exhibited by many systems of scientific and industrial interest.

Fluidized beds are a key industrial application of multiphase flows. When investigating the fluidization of dry particles below ~60μm, it becomes necessary to take into account the effect of cohesion due to van der Waals forces. Cohesive particles do not typically fluidize well due to the formation of agglomerates[1], however the addition of a small quantity of strongly cohesive fines (<20μm) to a system of larger particles leads to the unintuitive result of smaller bubbles and an earlier transition to turbulent fluidization[2].

In the present work we have investigated the effects of a particle size distribution on the fluidization of cohesive particles using coupled CFD-DEM simulations. Cohesion was modelled using a nonlinear contact force with an attractive component, designed to take into account the effects of surface roughness. The fluidization behaviour observed experimentally has been replicated qualitatively. Systems were characterized by measuring the size of bubbles, the coordination number of particles, and the velocities at which fluidization and bubbling occurred. This research sheds light on the mechanisms responsible for changes in fluidization behaviour. It will play a vital role in informing the design of optimal powder mixes for industrial fluidized beds such as fluidization reactors.

REFERENCES

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