Coupling volume of fluid (VOF) and discrete element (DEM) methods to simulate the spray drying process

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Drying of suspensions is a common phenomenon – known to everyone who ever spilled a drop of coffee leaving behind an unlovely coffee stain. However, drying of fluids containing particles is an important process step in many industrial applications. Examples are the spray drying of ceramic granules or ink-jet printing of electronic circuits, e.g. for RFID tags. The main questions addressed by our numerical simulations concern the development of deposit/granule morphology and the influence of suspension and process parameters.

The talk will give a brief introduction of the simulation methods (VOF/DEM) used and their representation in OpenFOAM. One focus will be on the particle based DEM, where some new extensions were necessary and had been implemented in OpenFOAM, e.g. for enhanced force laws taking into account the change of the particle's environment during drying. The second focus will lie on the newly implemented solver for coupling VOF and DEM within OpenFOAM. This coupled solver is a combination of the standard OpenFOAM solvers *interFOAM* (VOF) and *icoUncoupledKinematicParcelFoam* (DEM) with additional coupling forces, e.g. for capillary effects on particles at a drop surface. Finally, the application of the newly implemented solver on the process of spray drying of ceramic granules will be presented and discussed along with some simulation results.

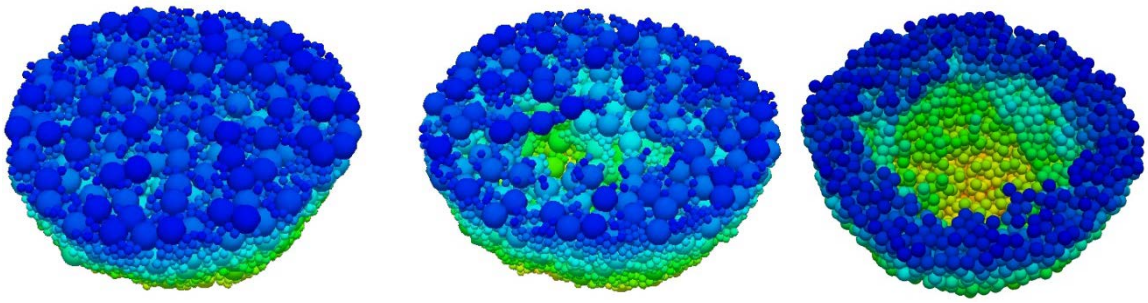

Figure 1: Spray dried granules simulated with a customized version of OpenFOAM. From left to right: dense, porous and hollow granule.