Influence of the section size on the simulation accuracy in a Wurster coater

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ABSTRACT

Industrial fluid-bed coating operations involve the flow of over 100 million beads in a large-scale Wurster-coating device. Experimental measurements available from such large scale operations are limited as only few beads (10-100) can be analyzed. Coupled Computational Fluid Dynamics (CFD) - Discrete Element Method (DEM) simulation can help to create a better understanding of the process and identify key parameters that influence coating-thickness uniformity. Earlier simulation were limited to simulate laboratory cases with limited amount of particles (< 1 million particles). With recent advances in computational hardware and software, including graphics card (GPU) based processing, simulations of larger industrial-scale systems can be attempted.

For simulating the particle movement the eXtented Particle System “XPS” is used and coupled to AVL Fire® for the fluid phase using a two way coupling method. XPS runs on the GPU while AVL Fire® runs on the CPU which allows a very efficient coupled simulation and allows to simulate several million particles on normal desktop PC using a NVidia GPU. Still to simulate the full Wurster geometry takes a lot of time and it is more efficient to simulate just a section of the Wurster coater and rely on the azimuthal symmetry of the Wuster coater design to save on computational time and resources.

In this study we use a laboratory coater going from the full 360° model to a 90° section model and an industrial Glatt 15-30 Wurster coater going from 360° to a semi 2d model showing the influence the simulated section size on the simulations results. Going from a 360° to a near 2d simulations in the industrial coater the section size will be continually decreased and the minimal section for realistic simulation in combination with simulation duration will be evaluated. All simulation will be run for 22 seconds allowing for 2 seconds initialization phase in which a steady state regime is achieved. After all simulations are finished they are compared in regards to the flow behavior, residence time distribution in the coating zone and the cycle time distribution.

The results in this study will help to increase the knowledge of the possibilities to simulate industrial scale coating processes as well as the limitation of domain size reduction using CFD-DEM simulation.