Analysis of Fluid-Particle-Wall interactions in a Spiral Jet Mill

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ABSTRACT

The spiral jet mill is a popular size reduction device, particularly in the pharmaceutical industry, due to its ability to reduce particulate solids to the lower end of the micrometre size range. While this process is very energy intensive, it is not however, energy efficient. A very small amount of the supplied energy is used in the breakage of the particles. Due to the workings of the jet mill, it is difficult to quantify the amount of energy transferred from the fluid to the particles, and also between the particles themselves. Numerical simulations present a method of predicting the milling behaviour of the spiral jet mill, and thus the use of energy within the system.

Using the Discrete Element Method coupled with Computational Fluid Dynamics, the Hosokawa Micron 50AS laboratory spiral jet mill has been simulated. The model of the grinding chamber has been constructed by CAD, which includes the grinding and injector (feed) nozzles. Simulations involving particles with the size range of 1 – 100 µm, and grinding and injector pressures ranging up to 4 bar, have been carried out. The simulation data are compared to experimental results for validation and further refinement of the simulation model. The transfer of fluid energy to the particles, and the energy involved in the particle-particle and particle-wall collisions have been analysed.