Conference abstract PMS06

Simulation Studies for the Effects of Particle Size and Blade Rake Angle on Particle Mixing

M. S. SIRAJ, S. RADL, J. G. KHINAST

Institute for Process and Particle Engineering (IPPE), Graz University of Technology, Graz, Austria

E-mails: m.s.siraj@TUGraz.at (M. S. Siraj), stefan.radl@TUGraz.at (S. Radl), khinast@TUGraz.at (J. G. Khinast)

Sci Pharm. 2010; 78: 633 doi:10.3797/scipharm.cespt.8.PMS06

Solid particle mixing is an important unit operation in process industry. In pharmaceutical industry it is of particular importance because the Active Pharmaceutical Ingredient (API) has to be properly mixed which is normally in the quantity of few milligrams in the final dosage form, and if not mixed properly can have no or severe therapeutic effects depending on API quantity.

Particle mixing is usually perceived as a simple unit operation because it does not involve any high-tech and complicated equipment but this operation is still under spotlight of latest research to understand complexity of the underlying physical phenomena. Mixing of solid particles depends on several parameters like nature of the material of the particles, their size, shape, number, and loading/unloading profile. It also depends on the size, shape, and material of the mixer container and likewise the size, shape, and material of the blades, fill level, position of the blade from bottom of the mixer, its speed, acceleration, any external surfaces/obstacles e. g. baffles present, phases involved, nature of the fluid (Newtonian or non-Newtonian) and its physical conditions like viscosity, surface tension, temperature, and pressure etc. Scale-up of powder flows and mixing is also a big issue because even small changes e. g. in equipment material, may change the powder flow and hence the mixing. Because of the number of parameters involved, mixing processes become complicated and expensive to understand experimentally.

In these mixing simulations of solid particles, DEM (Discrete Element Method) is used which treats every particle discretely and solves for each particle's position, velocity, and all the forces acting on it including contact forces, body forces, hydrodynamic forces and cohesive forces. In this presentation, some physical parameters affecting mixing like blade rake angles, size of particles, and their loading profile will be studied by setting up a number of simulation cases for dry particles. First, velocity profiles for these mixing simulations will be analyzed and then the effects of blade rake angles, size of particles and their loading profile on mixing will be studied by calculating mixing index for each case.