

Using modelling to predict particle breakage

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Abstract

For products that comprise powder materials, the particle size distribution is critical to the function of the product as it affects the ability to process the powder (flowability), the structure of the product and its interaction with other components. Many industries use milling processes to reduce particle size, in other particle handling operations unwanted particle breakage occurs through attrition. Particle size reduction is complex; depending on the inherent strength of individual particles which is invariably distributed within a population, as well as the stresses individual particles experience which varies with location and time within a process. Prediction of particle breakage therefore requires experimental characterisation of the strength of a powder sample and estimation of the stresses that particles are exposed to in the process. One approach for estimating these stresses is using the Discrete Element Method (DEM) to simulate the particles and their interactions in the process. In this presentation, two examples of this approach are demonstrated. The first predicts attrition occurring by shear deformation in an agitated filter drying process, which follows crystallisation in active pharmaceutical ingredient production. The second predicts ribbon milling due to impact and shearing in battery cathode production.

Biography

Colin Hare is a senior lecturer in Chemical Engineering at Newcastle University and a visiting senior lecturer at the University of Surrey. His research is focused on creating fundamental relationships between material properties, process conditions and product performance in powder-based manufacturing processes, utilising experimental and computational techniques. He graduated with MEng and PhD degrees in Chemical Engineering from the University of Leeds. He has received funding from the International Fine Particle Research Institute (IFPRI), Corning Inc., the European Commission and the EPSRC, to research particle breakage, powder flow under low stresses and high strain rates, heat generation and transfer in powders, and powder coating. He received the Young Researcher Award at the UK Particle Technology Forum 2012 and the IChemE Nicklin Medal 2015. He is the secretary and former treasurer of the IChemE Particle Technology Special Interest Group (PTSIG).