Predictive Modelling of Continuous powder blending with Application in the Pharmaceutical Industry

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ABSTRACT

The use of modelling techniques is essential in the Pharmaceutical industry to conduct a predictive modelling of pharmaceutical unit operation and also can be applied to a wide range of application areas, such as drug discovery, biopharmaceutical, pharmacokinetics and pharmacodynamics, drug substance (including chemistry and manufacturing), and drug product [1]. Pharmaceutical ingredients are often multicomponent granular substances and mixing and maintaining their blends poses a daunting challenge for a process designer. Mixing can be an intermediate step in a process chain or it may be aimed at producing the end product of desired quality. Good understanding of mixing mechanisms and the effect of material, equipment, and processing conditions on blend quality is necessary [1]. Recently in pharmaceutical industry, continuous powder blending has been recognised as an efficient alternative to the traditional batch blending of powders due to its capability in handing high-flux continuous tablet manufacturing [1].

The focus of this work is the study of the influence of operating conditions e.g. feed rate and impeller speed; and geometric designs such as mixer size, impeller or screw size and type on the continuous blending indices like continuous mixing efficiency and residence time distribution. In order to perform a mechanistic modelling, Discrete Element Method (DEM) [2] is used. The realistic simulations included a large number of particles are conducted to elucidate the details of the mechanism governing the complicated powder blending process and lead us to optimum design. Furthermore, High performance computing (HPC) facilities as well as highly parallelised open source codes like LIGGGHTS [3] are used.

REFERENCES

[1] K. Marikh, H. Berthiaux, V. Mizonov, E. Barantseva and D. Ponomarev, "Flow analysis and Markov chain modelling to quantify the agitation effect in a continuous powder mixer", *Chemical Engineering Research and Design*, **84**, 1059-1074 (2006).

[2] P. A. Cundall and O. D. L. Strack, "A discrete numerical model for granular assemblies", *Gotechnique*, **29**, 47-65 (1979).

[3] C. Kloss, C. Goniva, A. Hager, S. Amberger, and S. Pirker. "Models, algorithms and validation for opensource DEM and CFD-DEM", *Progress in Computational Fluid Dynamics, An Int. J.*, **12**, 140-152, (2012).