MODELLING OF FLOW OF POWDERS INTO CLOSED CAVITIES WITH CONSIDERATION OF AIR PRESSURE CONDITIONS

Hasan S. Elmsahli*, Reza Baserinia† and Csaba Sinka†

* Mechanics of Materials, Department of Engineering
University of Leicester
University Road, LE1 7RH, Leicester, UK
e-mail: hse3@le.ac.uk, web page: https://le.ac.uk

† Mechanics of Materials, Department of Engineering
University of Leicester
University Road, LE1 7RH, Leicester, UK
Email: ics4@leicester.ac.uk - web page: https://le.ac.uk

ABSTRACT

The flowability of powders into confined spaces (dies) has a great significance in a wide range of manufacturing products using the powder compaction process, such as pharmaceutical tablets, ceramics, powder metallurgy, detergent tablets and food products. Die fill, however, presents a particular feature: as the powder flows into a closed cavity, the ambient pressure increases as more and more powder is introduced; this opposes flow. On the other hand, previous experimental studies [1] demonstrated that a small reduction in air pressure at the discharge point increases the flow rate significantly.

The experimental procedures for measuring mass flow rates were simulated numerically using a coupled discrete element (DEM) - computational fluid dynamics (CFD) model where the behaviour of the solid particles is modelled using DEM and the fluid flow field is solved by CFD. The processing conditions and material characteristics properties were systematically investigated. The results of the numerical simulations are validated with the experimental findings. The coupled DEM-CFD model is then used to investigate the influence of particle properties on flow.

REFERENCES

[1] Baserinia R. and Sinka I.C. Mass flow rate of fine and cohesive powders under differential air pressure. European Journal of Pharmaceutics and Biopharmaceutics, under review