# The Calibration of Powder Models to Predict Powder Behaviour During Compaction

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The accuracy of predicting the pressure distribution in a roll compaction process using confined uniaxial compaction was assessed using microcrystalline cellulose (MCC, Avicel PH102) as a model pharmaceutical powder. The measured pressure-displacement data were described using the Johanson equation [1] and a comparison was made with data obtained from uniaxial compaction. In addition, an existing uniaxial compression relationship was adapted to describe the data with the advantage that it can be applied to the whole pressure range especially at the smaller values. It has been shown that the calculated maximum pressures using uniaxial compaction data are generally less than those measured. Despite the differences between the measured and predicted pressure distributions, it is believed that uniaxial compaction is a useful method for screening different formulations in terms of ranking their expected performance in a roll compactor.

Furthermore a modified Drucker-Prager Cap (DPC) model was calibrated for mixtures of Avicel (Microcrystalline cellulose PH102) and A-Tab (di-calcium phosphate) with relative density as the internal state variable. Key material parameters were generated as inputs for a Finite Element (FE) die compaction model (see Fig. 1)

Three blends were investigated using a compaction simulator (Phoenix Services, UK) with 8 mm diameter flat, round punches, and an instrumented die to measure the radial stress. Compacts with a range of solid fractions, typically 0.45-0.86, were formed. The compaction velocity was 0.1 mm $s^{-1}$ in order to achieve quasi-static compression conditions. The dimensions, mass, axial and radial strengths of the compacts were measured. The data were used to determine the DPC parameters. These parameters were plotted as a function of solid fraction and fitted to empirical functions. A similar procedure was applied for granules produced via roll

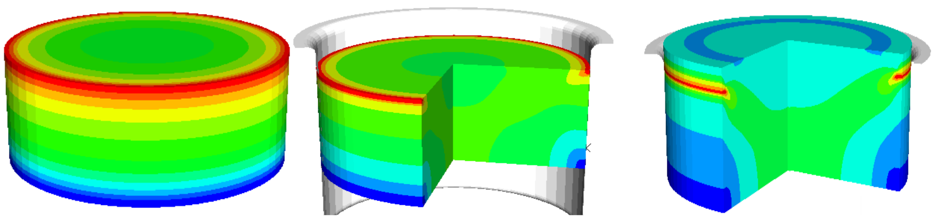

**Figure 1 FEA stress distributions using DPC material model for MCC Avicel 102. (Figures adapted from R Bharadwajh [2])**

[1] Johanson, J. R. , A Rolling Theory for Granular Solids. *J. Applied Mechanics,* 1965, 842-848

[2] L.H. Han, J.A. Elliott, A.C. Bentham, A. Mills, R. Bharadwajh, G.E. Amidon, B.C. Hancock. A modified Drucker-Prager Cap model for die compaction simulation of pharmaceutical powders. International Journal of Solids and Structures 45 (2008) 3088–3106