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# In-Depth analysis of a Tablet Press Feed Frame with DEM

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The pharmaceutical industry is moving towards continuous manufacturing processes, replacing traditional batch production. The advantages include smaller footprints of processing units, faster turnaround times, and better control of quality parameters. The last step of a continuous direct compression line is tableting. The tablet press controls critical quality attributes (CQAs) of the final dosage form such as tensile strength, and tablet weight variability.

This work presents a discrete element method (DEM) model of the tablet press. The focus is on the flow of the blend in the feed frame, not the compression step itself. The model can predict the filling of the individual die holes which is linked to the tablet weight variability, as well as the powder flow and the residence time distribution of material which is linked to the content uniformity. The calibration routine for the cohesive DEM contact model is described in [1,2], where it has been successfully validated for a continuous mixing process.

DEM simulations are carried out for a range of process parameters including throughput, paddle speed, turret speed, and tablet size. The results show that lower paddle speeds in the feed frame are preferable to reduce the tablet weight variability. Interestingly, the weight variability is smaller at 30kg/h process throughput compared to 20kg/h. The reason is that within the explored settings the 30kg/h process produces larger tablets (diameter 11mm vs 9mm) at a lower turret speed (48prm vs 80rpm). As a consequence, the die holes are more consistently filled at a higher throughput.

The DEM simulations allow sampling of particles at the position of the in-line NIR probe tip window. Comparing the tracer concentration at the NIR probe tip position with the concentration in the die holes (content uniformity in the final tablet) shows that the NIR probe is quantitatively more sensitive in predicting the influence of incoming content uniformity disturbances. The reason for this behavior can be explained by the NIR probe location, which is upstream in the tablet press and above the filling paddle wheel. Additional mixing between the filling and dosing paddle wheel enables for further damping of the content uniformity peaks seen by the in-line NIR probe. The result is a smoother content uniformity profile in the final tablets. These results have implications on the process control and can reduce the amount of discharge of out-of-spec material.

## REFERENCES

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