

ABSTRACT

Agarwal, Siddhartha M.S.M.E., Purdue University, May 2017. Modeling the Scaling of Intra-Tablet Coating Variability. Major Professor: Carl R. Wassgren, School of Mechanical Engineering.

Pharmaceutical tablets usually exhibit variability in coating where the distribution of coating between tablets as well as over an individual tablet's surface is not uniform. The former is known as inter-tablet coating variability, and the latter is called intra-tablet coating variability. This work is focused on the intra-tablet coating variability and how it varies across different scales of the tablet coating operation. The discrete element method (DEM) is used to simulate the dynamics of almond-shaped tablets in coating pans of five different sizes. Polyhedral particles have been used in place of glued spheres to represent the tablet shape more accurately. An OpenGL program is used to simulate the spray and calculate the coating thicknesses.

The virtual spray nozzles are placed at the center of the drum, and the spray direction is adjusted at each scale to be perpendicular to the tablet bed at most times. The tablet bed gets more flat in the spray area as the scale increases. There is some uncertainty in the spray angle at any scale, but the coating variability is insensitive to that. A major finding from the present work is that the asymptotic intra-tablet coating variability consistently increases with increasing pan size, indicating that it depends on the flow behavior as well, and not just the tablet shape. Also, since these are asymptotic values, the tablets require a considerable amount of time to achieve these values. It is difficult to reach the asymptotic values at lab scales since the operation is performed for a shorter duration for fewer tablets.

The average angular displacement of a tablet while crossing the spray has been observed to be an important characteristic that represents the level of agitation among the tablet orientations. A higher angular displacement correlates to a reduced value of intra-tablet coating thickness variability. Based on this, increasing the width of the spray area in the streamwise direction is proposed to increase the angular displacement by increasing the time taken by the tablets to cross the spray area.