THE EFFECT OF PARTICLE SHAPE AND SIZE DISTRIBUTION ON GRANULATION BULK DENSITY AND TABLET WEIGHT VARIATION

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The variability in weight of tablets prepared on a rotary tabletting machine depends quite strongly upon the physical properties of the granulation fed to the machine. Lactose placebo granules (Thomas Kerfoot & Co) have been sorted into fractions of different shape and size distribution in order to examine the effect of these parameters upon tablet machine performance.

Four batches of granules were prepared by removing all material smaller than 120, 85, 60 and 44 mesh. Each of these batches was sorted according to particle shape using the shape sorting table described by Ridgway and Rupp (1970), to give 16 fractions from which batches of approximately 250 tablets were made on a Manesty Betapress. The same tooling was used for each batch and the depth of fill remained unchanged. The position of the upper punch roll was adjusted between batches to ensure, as nearly as possible, a constant compression force.

The loose poured bulk density of each powder was determined, as was the mean weight and the coefficient of weight variation of each batch of tablets. There was an abrupt change in the relationship between bulk density and shape at an apparent Heywood shape factor of 17 to 18. Up to this value an increase in shape factor led to a fall in bulk density. Above it bulk density appeared to be virtually independent of particle shape. The proportion of smaller particles had but little effect on the bulk density.

There is a great difference between the granule batches used in this work and those used by Ridgway and Scotton (1971) in that the latter consisted of single sieve-cuts, whereas those used here have a wider size distribution, even though successively larger amounts of smaller particles have been removed. For powders of equivalent shape, widening the size distribution increases the bulk density by between 7.5 and 20 per cent.

Because the weight of a tablet ultimately depends on the packing conditions in the die, anything that influences bulk density is likely to affect the tablet weight in the same way. This is demonstrated in the present work. An increase in particle shape factor reduced the mean tablet weight, but only up to a value of about 16 or 17. Above this the mean tablet weight, unlike the bulk density, remained virtually constant.

Changes in the coefficient of variation of tablet weight were also studied. Below a particle shape factor of about 18, an increase in particle shape reduced the weight variation, whereas above this value the trend was reversed and tablet weight became more erratic as the granules became more angular. Here also the differences in the proportion of small particles had no consistent effect.

Ridgway, K., & Rupp, R., (1970). Powder Technol., 4, 195-202.
Ridgway, K. & Scotton, J., (1971). J. Pharm. Pharmac., 23, Suppl., 213S.