Determination of the flow properties of powders by means of a flow balance

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During the development of a formulation for a solid dosage form one of the criteria is to produce a powder system which flows freely from a hopper and uniformly into the dies of a tableting machine. Gunsel & Lachman (1963) found that the formulation having the fastest flow rate exhibited the highest intertablet weight variation. Gold, Duvall & others (1968) used a flow balance to find a correlation between flow uniformity and intertablet weight variation.

In a different way from Gold we have measured the uniformity of flow of powder through an orifice by recording the weight of powder flowing in consecutive time intervals. A force compensated commercially available top-loading balance (Mettler PE 1200) was used, in which a current, proportional to a force required to keep a given mass, in equilibrium is measured. The current is converted into a weight and is available in digital form for automatic data processing. At intervals of one second a timer unit gave an impulse and the value of the weight of powder on the balance at that time was digitized and punched onto paper tape. The tape was subsequently processed on a Hewlett-Packard 2100 computer and the flow rate, correlation coefficient of the flow curve, the mean, standard deviation and relative standard deviation of the quantity of powder flowing in consecutive time intervals of one second was calculated (Table 1). The computer also plotted the flow curve and its first derivative.

Table 1. *Flow properties of seven samples of direct compression lactose.* Orifice diameter = 7 mm; time interval = 1 s; no. of values = 120.

			First derivative		
Sample	Flow rate $g\ s^{-1}$	Correlation coefficient	mean $g\ litre^{-1}\ s$	standard deviation $g\ litre^{-1}\ s$	Rel. std deviation %
Sheffield Anhyd.	1·09	0·9999	1·10	0·07	6·07
DMV	2·08	0·9996	2·10	0·33	15·55
Foremost EA 45	3·32	0·9998	3·27	0·20	6·18
Foremost CS 99	3·33	0·9999	3·33	0·11	3·37
Meggle DIN 10	4·56	0·9999	4·56	0·08	1·7
Mutchler CA 49	2·10	0·9999	2·09	0·08	3·82
Merck	3·38	0·9998	3·35	0·19	5·53

The value of the standard deviation is taken as a measure of the uniformity of flow. Little correlation between the powder flow rate and the standard deviation can be seen, the samples with the fastest and slowest flow rates having almost equal values of standard deviation. Comparison of the results for Sheffield and DMV lactoses show that, although the latter flows almost twice as fast as the Sheffield sample its standard deviation is approximately five times higher. These results would explain the findings of Gunsel & Lachman (1963). It is suggested that as an aid to formulation the measure of the flow uniformity could be of value.

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