Material Science

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A novel method to evaluate powder flow properties using small sample quantities

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Objectives There are several methods in the literature to quantify powder flow, such as Carr's index, critical orifice diameter or powder rheometry. A disadvantage of these methods is that they require large sample sizes to perform a measurement. Novel, investigational and lab scale powder processing techniques, such as SEDS or freeze drying, may not produce sufficient sample sizes to allow the use of these techniques to quantify flow, an important consideration for pharmaceutical manufacturing processes.

Methods In the Xcelodose system, powder is retained in a dispense head (hopper) with a known number, diameter and surface area of holes. Tapping the dispense head via a solenoid will break powder bridges, dislodging the powder, causing flow onto an eight place balance below. For a given powder and dispense head the amount of powder dispensed is proportional to the number and frequency of taps. A variety of heterogeneous powders, as well as nine spray dried lactose:lactose monohydrate blends, with different flow properties, were tested using the Xcelodose system. The powders were tested in three hoppers with the same hole surface area but different hole diameters and the amount of powder dispensed recorded. From this a 'Flow Gradient' was calculated. These powders were then tested using Carr's index and Basic Flow Energy (BFE, Freeman Powder Rheometer) and these results compared.

Results For the group of heterogeneous powders there is a clear correlation between Carr's index and the Flow Gradient ($R^2 = 0.8376$, $P < 0.001$), allowing flow categorisation, similar to Carr's of the powders. With the lactose powders the BFE was also compared. A correlation between Flow Gradient and BFE of 0.8793 ($P < 0.01$) was observed for these 9 blends. This correlation improves to 0.9417 ($P < 0.001$) if only the 7 poorly flowing powders are included, suggesting the value of this technique for poorly flowing powders (Figure 1).

Conclusions A novel method for the measurement of flow properties with very small quantities of material has been developed and validated against different powder types and different established powder characterisation methodologies. The flow gradient method produces an excellent correlation with larger scale measurement methods and would be suitable to categorise powder flow when the amount of material is limited.

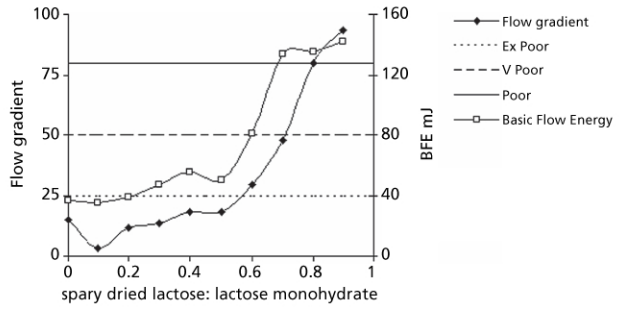

Figure 1 Comparison of Flow Gradient and Basic Flow Energy for lactose blends.