Effects of Electrostatic Charge on Particle Adhesion and its Influences on Powder Flow Properties

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Characterising powder flowability can be challenging e.g., for pharmaceutical formulations when only a small quantity of samples is available. For the case, a novel method has been developed at the Wolfson Centre using a few milligrams of powders. The technique applies Bond number to represent powder cohesiveness, which detects particle adhesion at median particle size using a mechanical surface energy tester. The method shows promising results for powder flowability prediction and other flow properties for a wide range of powders varying in particle properties such as particle size, particle shape and particle density. However, a study on different grades of Acetaminophen showed that the predictions did not match the results measured using a shear cell tester (Particle Flow Tester, Brookfield), which revealed that there must be other contribution forces in the cohesiveness measurements.

The suspected cause is believed to be the impact of electrostatic charge on powders, as electrostatic force can significantly contribute to the measurement of particle adhesion. The current study focused on the electrostatic charge measurements of acetaminophen dense and acetaminophen micronized with different particle size distributions. The charge measurements have been compared to the charge measurement for other common materials such as Lactose, Avicel and Calcium Carbonate, which all give a good prediction of powder flow properties. The comparison shows that both the acetaminophen dense and the acetaminophen micronized have very significant charges under normal handling conditions compared to the other common materials. The charge level of the acetaminophen can be 20 times higher than that of the different materials measured. If a charge level is significant, the electrostatic charge can strongly influence the adhesion measurement, but it will not appear in a shear cell test as the consolidation force overtakes it.

It is concluded that electrostatic charge can be a strong contributor to particle adhesion, which can influence powder flow properties at low consolidation stress; it will not be significant in a shear cell test due to the high consolidation stress applied.

Keywords: Powder flowability; Particle physical properties; Formulated powders; Electrostatic charge; Low consolidation stress