Adhesion force measurement in micron-sized particles from centrifugal force based studies using particle size analysis techniques

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ABSTRACT

The Discrete Element Method (DEM) is increasingly popular for modelling at individual particle level from which the bulk behaviour can be discerned. The use of DEM requires the particle contact parameters to be calibrated. Among others, particle-particle and particle-wall adhesion are important key properties for a cohesive powder that define the powder flow dynamics in a process. Industrial powders often consist of irregularly shaped particles with wide particle size distributions - this leads to very complex adhesional forces. Atomic Force Microscopy (AFM) has been used to characterize these contact force distributions. On the downside, to accurately describe an entire force distribution using AFM measurements can be extremely time consuming and difficult to perform.

We aim to provide a less time consuming and an easier means for measurement of particle-particle and particle-wall adhesion forces in industrial powders. Our experimental setup is based on centrifuging powder samples with a subsequent particle size analysis through dynamic light scattering, and optical analysis. Extracting particle size information from the centrifuged sample plays a vital role in measuring the adhesion force. We also compare our results of adhesion force from particle sizing method to the force distribution obtained through AFM and discuss the validity of the approach and applicability of the proposed particle-sizing techniques. Based on this work we propose a simple simulation set-up to calibrate the adhesion force of particles in a DEM computational model.