BUILD-UP OF POWDERS IN AUGER FILLERS

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Build-up is the transformations of a powder to a smeared deposit adhered to a surface and is effectively a form of granulation as it involves the transformation of a number of particles into a single discreet and solid mass. Currently much progress has been made in developing understanding of situations in which powders undergo well defined changes involving the whole or a large portion of the bulk. For example the conditions under which a powder will flow out of a hopper have been investigated in great depth. However phenomena such as build-up where a small fraction of the bulk undergoes changes over longer periods of time e.g. several minutes or hours, have attracted much less attention, even though they could be the critical factors that dominate the reliable operation of a powder handling process.

Auger fillers (Fig. 1) have been used for the packing of powders in the detergent, food and pharmaceutical industries for many years. As a powder passes through the auger a number of particles are transferred through the clearance between the auger and the straight funnel, as the auger rotates. The stresses exerted on the particle within the clearance have a large effect on the powders behaviour, which depends upon the magnitude of the clearance. Crutchley & Bridgwater (1997) showed that the level of attrition experienced by particles with in a small clearance is dependent upon the ratio of the magnitude of the clearance to the particle diameter. A key finding for their study was that once the clearance exceeds 2.2 particle diameters no further attrition was observed.

Fourteen surfactant containing powders manufactured by Procter & Gamble were studied. Each of these powders were placed into the hopper of an auger filler (a semi automatic filler fitted with free flow auger tooling, manufactured by ALLFILL International Ltd.). The powders were then filled with the auger rotating at 840rpm through 3 revolutions per dose, with a 1 second interval between doses. Experimental results revealed that torque increases as build-up increases and the build-up tendency decreases as the clearance is increased (Fig.2). Also it was also found that the mechanical properties of the powders studied play a role in determining whether a powder will form build-up. A key find of this work has been that for powders to form build-up they must not only contain particles capable of entering the auger/straight funnel clearance but must also have particles which are both weak and ductile. The fourteen powders studied were characterised via uniaxial compaction with subsequent application of the Kawakita lumped parameter model and via measurements of tablet strength. It was found that powders which formed build-up had both low 1/b Kawakita parameters and low tablet strengths (Fig.3).

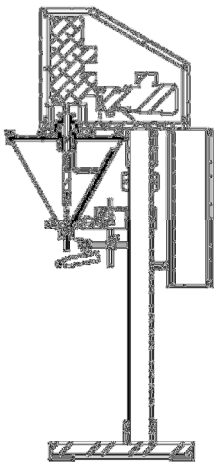

Figure 1: An auger filler.

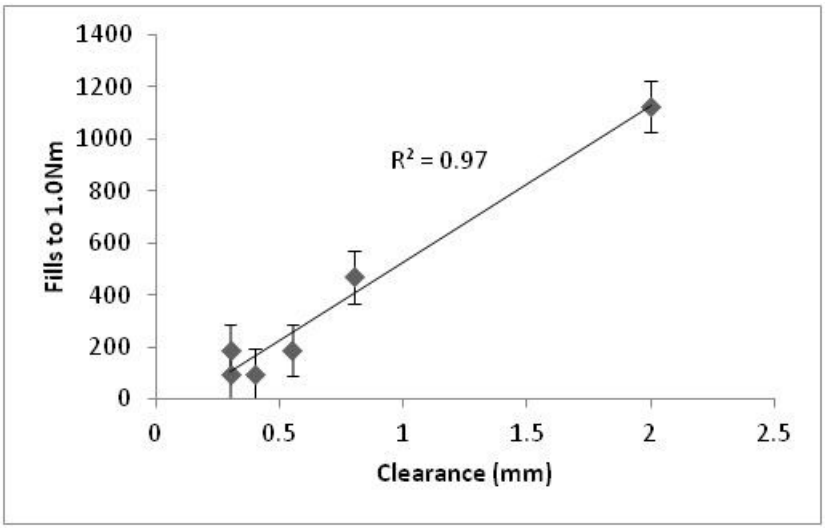

Figure 2: The effects of clearance on powder build-up.

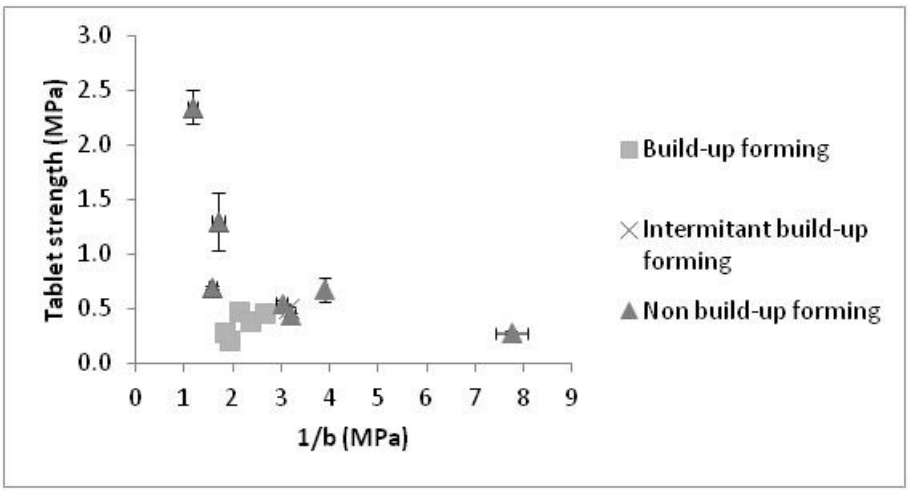

Figure 3: The effect powder properties on build-up in an auger filler.