**Using Computed Tomography as a Tool for the Study of Packing and Crushing Properties of Materials**

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ABSTRACT

Computed Tomography (CT) with x-rays is a ubiquitous tool for non-destructive evaluation of the internal structure of materials. Here we show that micro-CT (with voxel size < 20 µm) also provides insight into properties of material behavior such as how granular materials crush or pack to fill space. These insights are important for understanding the performance of many pressed materials, such as food, pharmaceuticals, and high explosives (HE). Using sucrose crystals as a mechanical surrogate for HE, we performed CT scans after discrete crushing increments to visualize the evolution of the volume-weighted particle size distribution (PSD). As expected, the PSD developed toward a fractal distribution. A fractal PSD would be expected as sucrose (and HE) are brittle crystals and should fracture to optimally fill space. Our results show that a regime of crushing producing a PSD with a fractal dimension of 2.61 develops, consistent with results obtained via a traditional die-punch setup pressing to similar levels of compaction. Using plastic spheres, we also investigated the use of CT to evaluate the number of contact points per sphere (coordination number) during packing, and how this depends on the ratio of container to sphere diameter. The utility of CT as a diagnostic for both crushing and packing depends on CT data quality and the ability to effectively post-process, and in particular segment, for the desired information. These results demonstrate that CT is an effective tool for evaluating more fundamental properties of material behavior.

**Keywords:** Computed Tomography, Crushing, Fractal, Packing