MSE-3: Determination of Scaling Laws in Powder Consolidation

Alexander Sherwood, Alexander Grimaldi

Problem Statement:

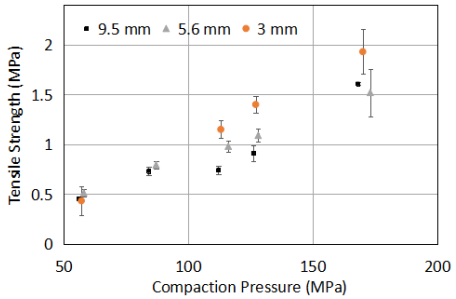
How do the fill packing, compaction behavior, and strength development of pharmaceutical powder compacts change as the ratio of die diameter over particle size decreases?

Approach:

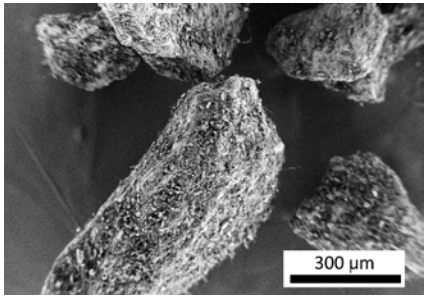
Performed both experiments and simulations to examine behavior across different die diameters, with constant particle size:

- Compacted and simulated tablets with various parameters.
- Measured density and strength of experimental samples and density of simulation results.
- Compared fill density, force-displacement curves, compact density, and tensile strength produced in large and small dies.

Results:



Mannitol Strength Increased at Smaller Die Diameter



Non-equiaxed Mannitol Grains with Rough Surface Texture

- Experimental – provided verification of properties at different sizes.
- SEM – revealed particle morphology, of major importance to flowability.
- Simulation – reproduced density decrease due to wall effect.

Discussion & Conclusions:

- Both experimental and simulated results indicated a decrease in fill packing density at smaller ratios of die to particle diameter.
- Materials with poor flow properties showed a greater density change, while those with lower Weibull modulus showed a greater strength change.
- Variations between compaction curves were generally rather small, although material-dependent.

Contact: Dr. Antonios Zavaliangos,

A. W. Grosvenor Professor,
Materials Science & Engineering
E-mail: zaval@drexel.edu
Phone: 215-895-2078

DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering