Analyzing tensile strength and fracture behavior in MCC and Lactose composite tablets

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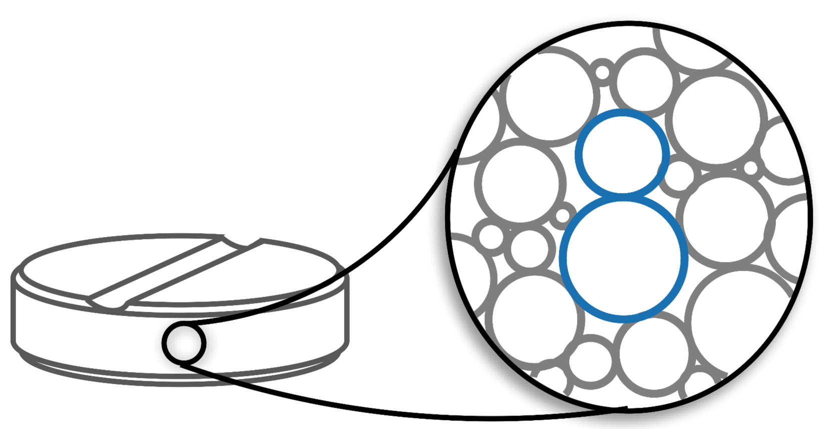
nanoHUB UNDERGRADUATE RESEARCH EXPERIENCE

Background and Introduction

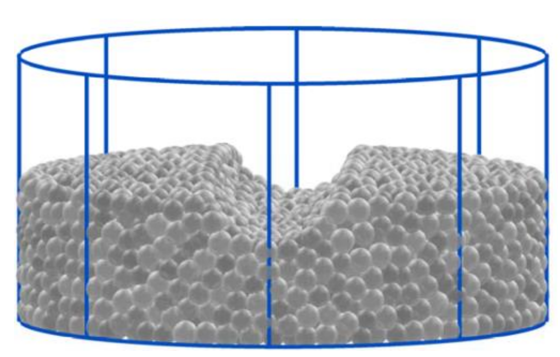
- Analyzing the tensile strength of compacted particle composites is crucial in pharmaceutical industry.
- The density and porosity of compacted tablets will determine how quickly it will be absorbed by a body that digests it.

Predictive constitutive models of inter-particle interactions for a variety of physical mechanisms



Dominant mechanisms:
- Elastic deformations
- Plastic deformations
- Bonding
- Strain-rate mechanisms
- Friction and fracture
- Water intake and swelling

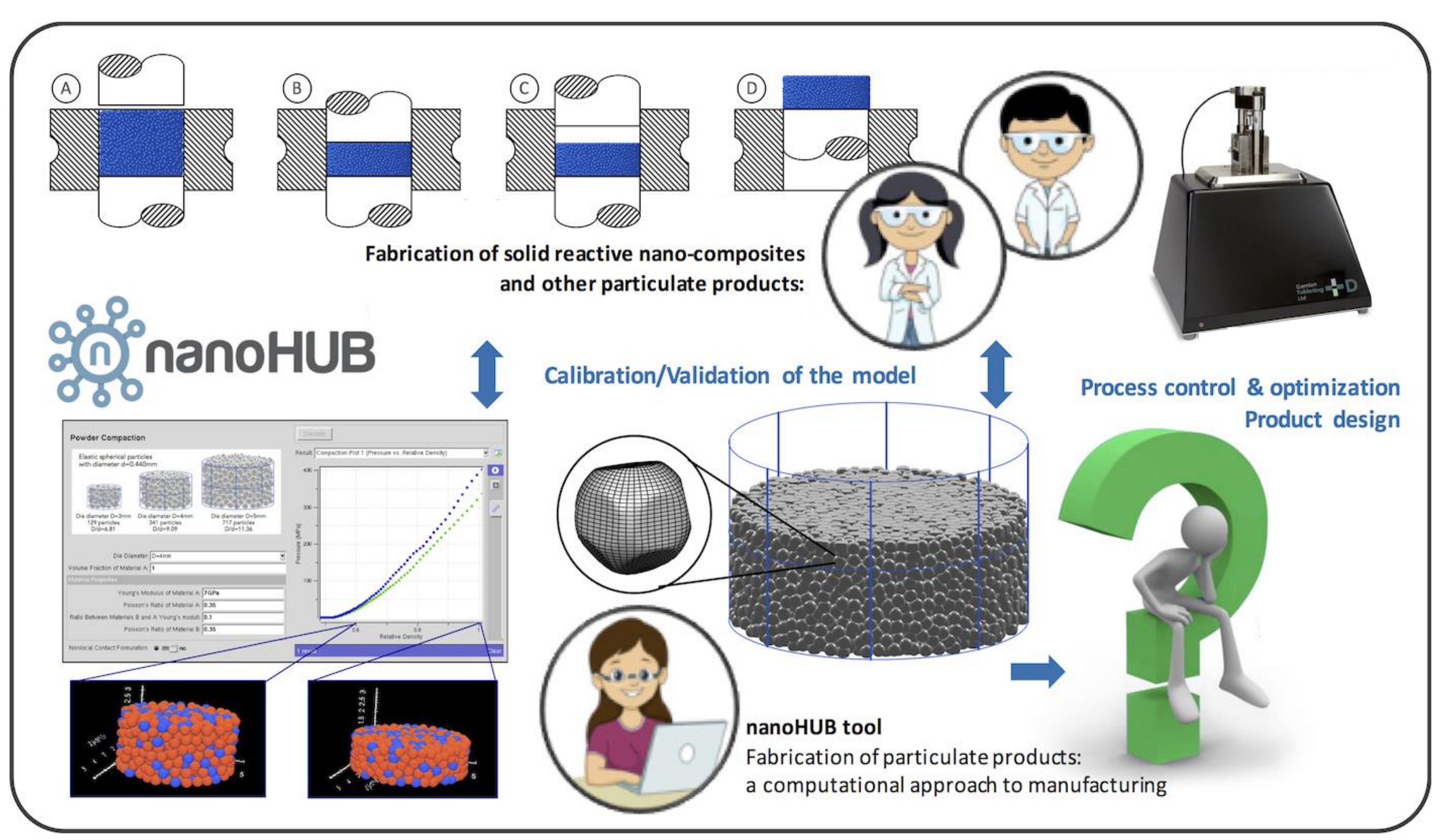
Concurrent and efficient multi-scale strategies which are fully-descriptive at the granular scale



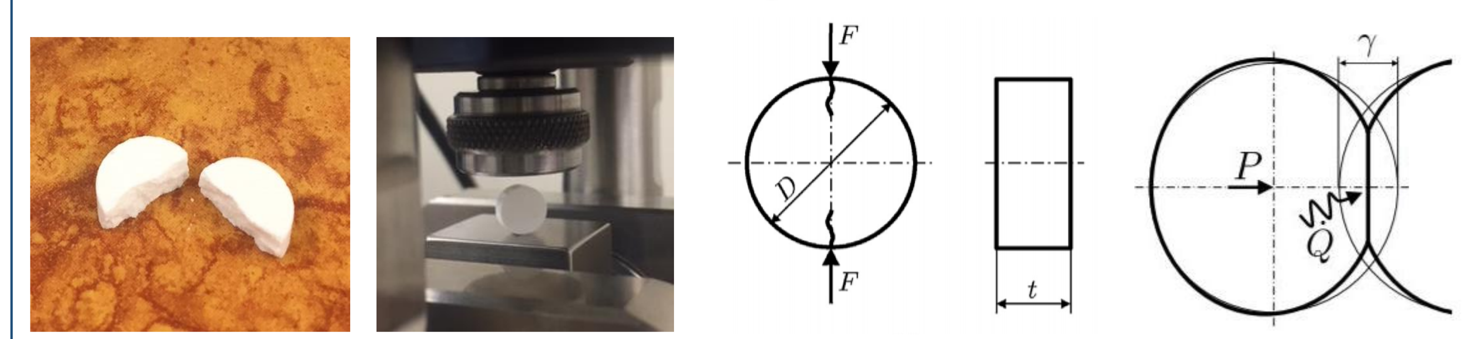
Motivation

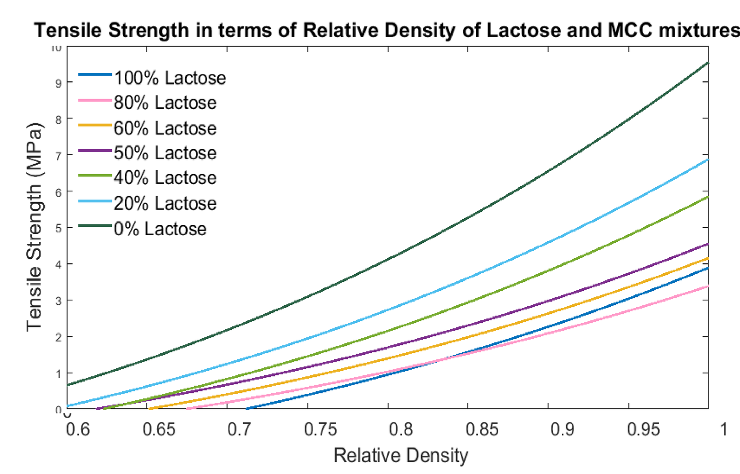
- The purpose of this study is to test tablets containing various compositions of microcrystalline cellulose and lactose at several relative densities in order to understand the changes in fracture strength of the tablets.

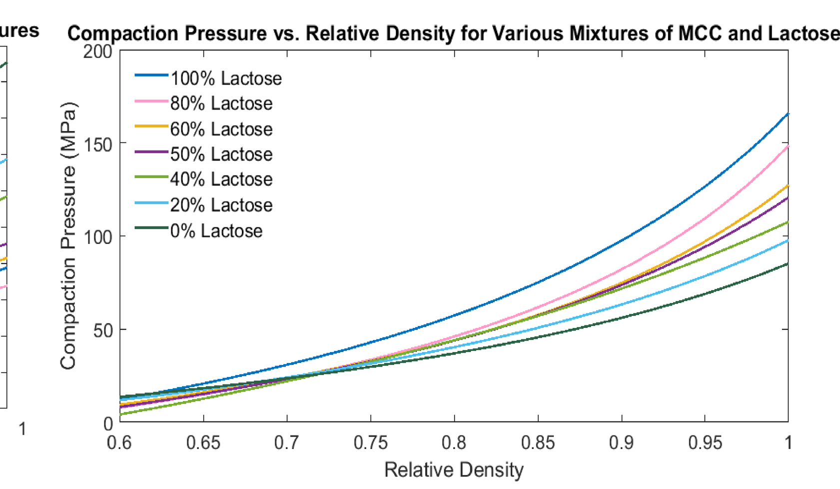
Methods and Approach

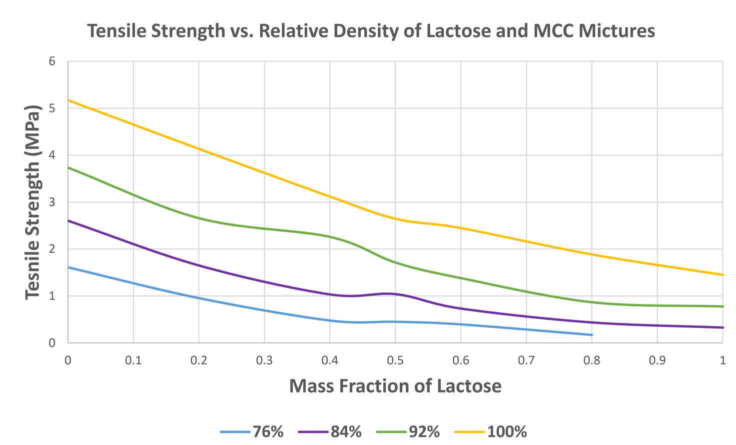


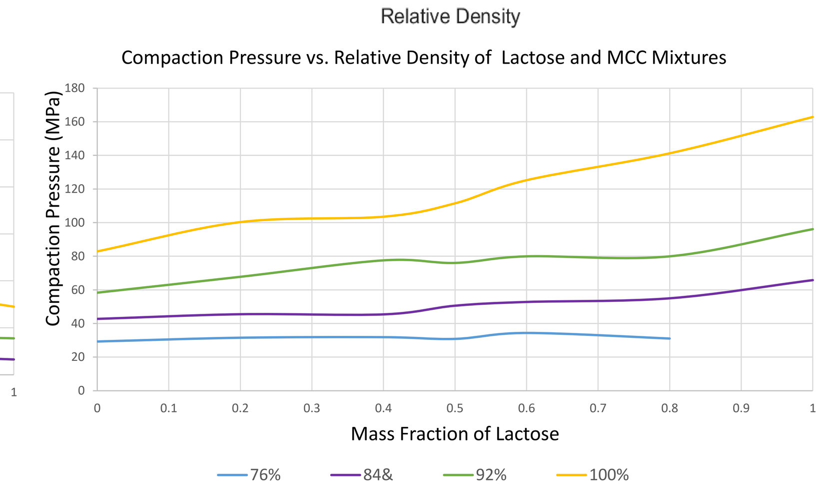
Results and Analysis





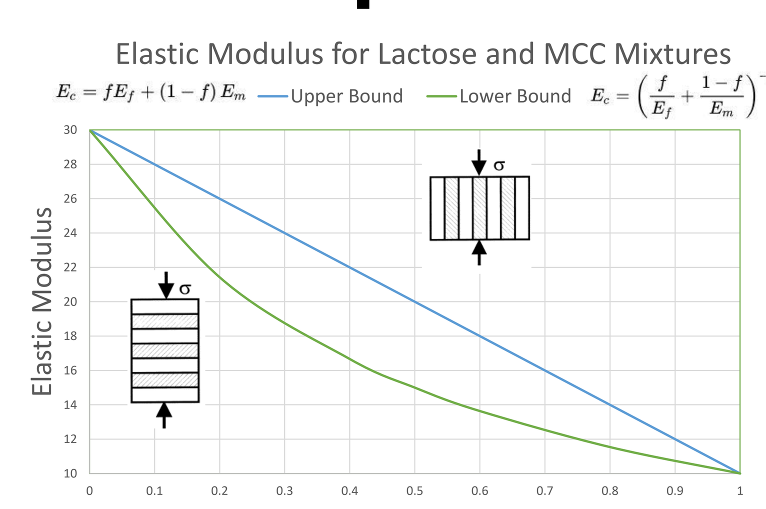


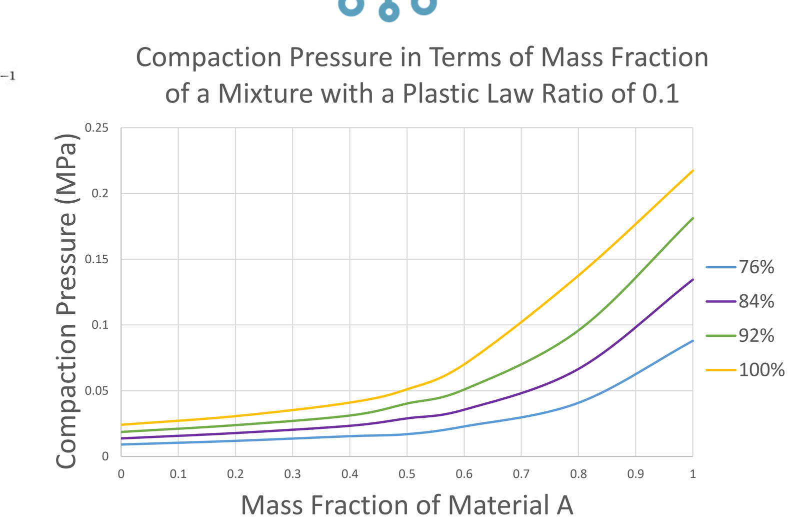


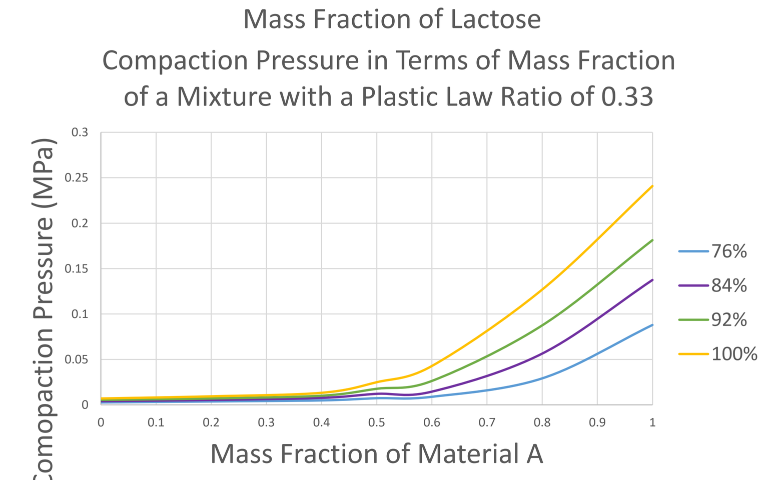


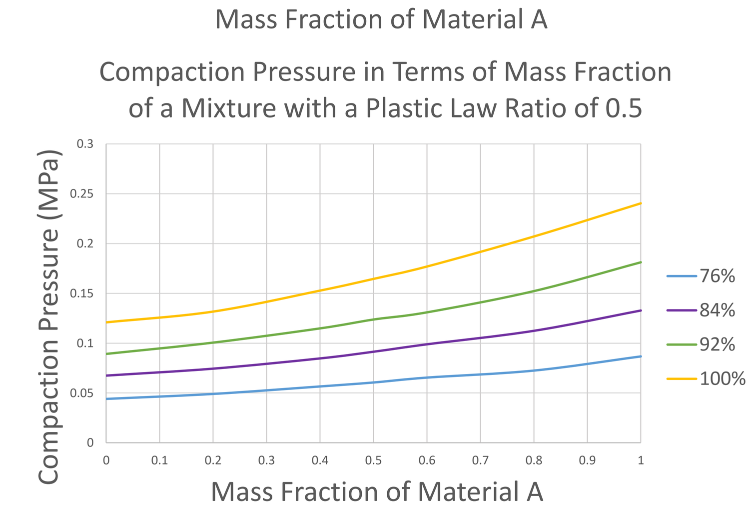
- As the mass fraction of lactose increases in each tablet, tensile strength and fracture strength decreases.
- These increasingly brittle properties are attributed to lactose being unable to form solid bridges with other particles [7].

Monodispersed Mixtures

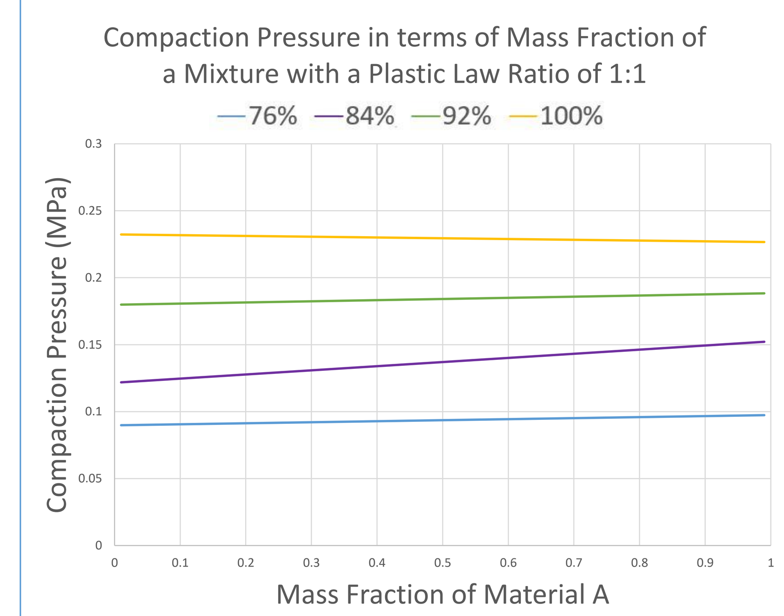


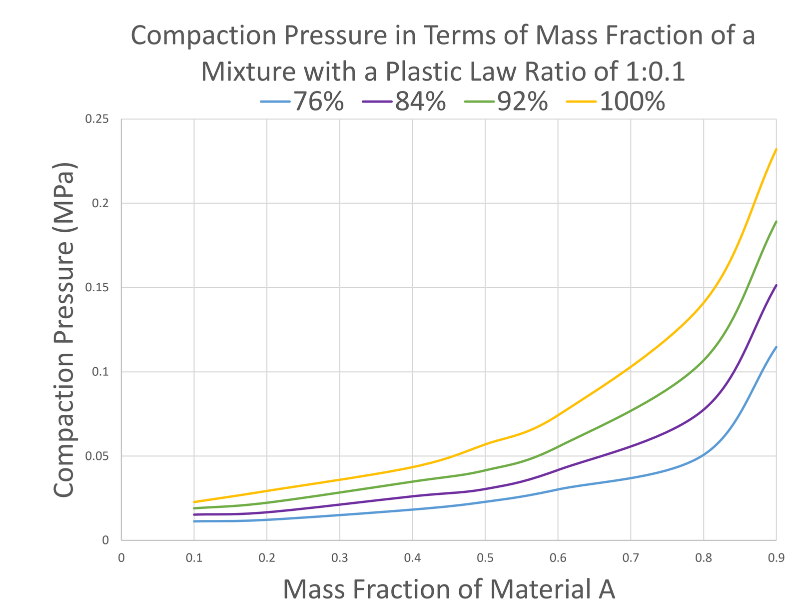






Polydispersed Mixtures





For 1:0.1: K_A=1MPa, K_B=0.1MPa, M_A= M_B=1.5. The mean diameter of A is 300µm and the mean diameter of B is 250µm.

For 1:1 Ratio: K_A= K_B=1MPa. M_A= M_B=1.5. The mean diameter of A is 300µm and the mean diameter of B is 250µm.

Conclusion and Future Applications

- A new understanding was developed about the material properties of lactose and MCC.
- Lactose exhibits brittle properties because it does not form solid bridges.
- Future applications include extending this study to the nanoscale and testing mixtures composed of three or more materials.
- Another goal is including the ejection and fracture process in the tool currently published on nanoHUB.

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