MAE LEADERSHIP

SEMINAR

SERIES
DISTINGUISHED
SPEAKER

THURSDAY,
NOVEMBER 18

4:00 PM

KNOX 04

Dr. Alberto Cuitiño
BS,MS,PhD
Professor and Department Chair
Mechanical and Aerospace
Engineering
Rutgers University

Understanding and Quantifying Powder Manufacturing Processes via Particle Mechanics

ABSTRACT

Modeling powder beds using Particle Mechanics simulations provides a valuable microscopic insight into the physical mechanisms responsible for the observed behavior at the macroscopic level. Accurately quantifying the visible response of these powder beds is essential to design, optimize and efficiently manufacture powder-based products attending to variations in the materials properties and process variables.

Powder beds during manufacturing can experience broad mechanical and thermal loading regimes, which require the development and utilization of proper models to capture the underlying mechanics. This talk describes two cases of powder manufacturing: powder compaction, where a non-local contact mechanics formulation is presented, and calcination, where design and scale-up rules for rotary calciners are advanced.

Powder compaction is a widely utilized manufacturing operation in many industries, including the pharmaceutical one, where it is used to produce medicines in the form of tablets. During compaction, the particles deform significantly and usually develop bonding at contact surfaces. The amount of deformation of each particle and the bond strength created between contacting particles depends on the properties of the particles and the applied compaction pressure. Thus, the evolution of the microstructure during the powder compaction process imparts the critical response of the compacted solid. We have developed a particle mechanics formulation to investigate such a response, which incorporates non-local contact, attendant to particle physical and material properties, including plasticity, elasticity, and inter-particle bonding.

Calcination is also a typical process in powder-based manufacturing, where powder beds are heat-up in rotary calciners. Accurate prediction of the time required to heat these materials to a target temperature is crucial to achieving final products with the desired properties. However, we do not have quantitative models to predict the average temperature or the temperature distribution of the particles. Here, we computationally investigate the scaling of heat transfer in granular flows in rotating drums. Based on our simulations, which include a wide range of system and material properties, we identify the appropriate characteristic time used to derive equations that predict the average temperatures and the temperature distribution.

BIO SKETCH

Dr. Alberto Cuitiño is a Professor in the Department of Mechanical and Aerospace Engineering at Rutgers University and currently serving as Department Chair. In addition, he has served as a Site Leader of the NSF Engineering Research Center for Structured Organic Particulate Systems. He received a Civil Engineering Diploma from the University of Buenos Aires, Argentina, in 1986, and an MS degree in Applied Mathematics, and a Ph.D. degree in Solid Mechanics from Brown University in 1992 and 1994, respectively. His research interests include material modeling and simulations, dislocation mechanics, deformation and fracture in single metal crystals, granular materials, solid foams' mechanical behavior, and folding patterns in thin films.

University at Buffalo
Department of Mechanical and Aerospace Engineering
School of Engineering and Applied Sciences