

## ABSTRACT

Fernando, Dimuth N., M.S., Purdue University, May, 2001. Size Segregation in Granular Beds Subject to Continuous and Discrete Oscillations. Major Professor: Dr. Carl R. Wassgren, School of Mechanical Engineering.

This thesis investigates the effect of continuous oscillations and discrete "taps" on the rise rate of a single large impurity in an otherwise monodisperse bed of particles subject to vertical oscillations. Laboratory experiments and discrete element computer simulations were used to investigate the rise rate trends of the impurity and the mechanisms causing vibration-induced size segregation.

The experiments and simulations reveal that the rise rate of the impurity is dependent on the method of vibration when side-wall convection effects are negligible. For discrete taps the rise rate of the impurity increases monotonically with increasing dimensionless oscillation velocity amplitude,  $a\omega/(dg)^{1/2}$ , where  $a$  is the oscillation amplitude,  $d$  is the diameter of surrounding small particles,  $\omega$  is the oscillation radian frequency, and  $g$  is the acceleration due to gravity. For continuous oscillations, however, the rise rate of the impurity increases, reaches a maximum at a critical oscillation velocity

amplitude,  $a\omega/(dg)^{1/2} \approx 2.8$ , then decreases with increasing velocity amplitude. Additional computer simulation studies indicate that the rise rate trends correlate, to first order, with the changes in the bed void fraction indicating that the dominant size-segregation mechanism is percolation. When side-wall convection effects are significant, however, the percolation effects are indiscernible and the rise rate of the impurity increases linearly with the velocity amplitude for both continuous oscillations and discrete taps. These results reconcile the seemingly inconsistent results reported previously in the literature.