

Size Segregation of Particulate Mixtures with Gaussian Size Distributions

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Size segregation is often observed in industrial granular flows, and can be either beneficial or detrimental depending on the desired properties of the granular product. Hence, considerable interest exists in understanding the segregation phenomenon. Most theoretical and experimental investigations of size segregation have focused on the behavior of binary systems (i.e., flows with two particle sizes). Many industrial flows have particle size distributions that may be adequately represented as continuous distributions (e.g., Gaussian or lognormal distributions), providing incentive for the investigation of granular flows with these particle size distributions. In this study, the size segregation of particles from Gaussian particle size distributions was investigated. Time-stepped, discrete-particle (“molecular-dynamics”) simulations were employed to elucidate information about the steady-state spatial distribution of the particles when a non-uniform temperature gradient was applied to the simulated domain. A wide parameter space was investigated, including a range of distribution widths, coefficients of restitution and solids concentrations. The results indicate that particles of all sizes tend to congregate in the low temperature regions of the flow, but that larger particles have a greater affinity for these low temperature regions. Hence, a distribution of particle sizes can be found throughout the flow domain (i.e., neither full separation according to size nor a uniform mixture are observed). Implications of these observations on the extension of existing theory to continuous size distributions will be discussed.