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Kinematics of segregating granular mixtures in quasi-2D heaps[1]

YI FAN, PAUL UMBANHOWAR, JULIO OTTINO, RICHARD LUEPTOW, Northwestern University, Evanston, IL — Segregation of granular mixtures of different sized particles in heap flow appears in a variety of contexts. Our recent experiments showed that when bi-disperse mixtures of different sized spherical particles fill a quasi-two dimensional (2D) silo, three different final heap configurations – stratified, segregated, and mixed – occur, depending on either 2D flow rate or heap rise velocity. However, since it is difficult to measure the kinematic details of the segregating granular mixtures in heap flow experimentally, the underlying mechanisms for how 2D flow rate or heap rise velocity influences final particle configurations have not been well understood. In this work, we use the discrete element method (DEM) to simulate heap flow of bi-disperse mixtures in experimental scale quasi-2D heaps. The final particle distributions in the simulations agree quantitatively with experiments. We measure several key kinematic properties of the segregating granular mixtures including the local flow rate, velocity, and flowing layer thickness. We correlate the characteristics of these kinematic properties with the local particle distributions of the mixtures. This provides new insights for understanding the mechanisms of segregation and stratification in heap flow including the linear decrease in flow rate and maximum velocity down the heap as well as the relatively constant flowing layer thickness along the length of the heap.

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