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Segregation of Particles by Size and Density in Dense Sheared Flows: Gravity, Temperature Gradients, and Stress Partitioning DANIELLE TAN, KIMBERLY HILL, St. Anthony Falls Laboratory, Department of Civil Engineering, University of Minnesota — In sheared mixtures of different-sized (same density) particles modestly larger particles tend to go up (toward the free surface), and the smaller particles, down, commonly referred to as the "Brazil-nut problem" or "kinetic sieving." If the larger particles are sufficiently denser than the smaller particles, the segregation reverses. Using theory and simulations, we have recently shown that the segregation fluxes among particles differing *in size only* are driven by two effects: (1) the difference between the partitioning of kinetic and contact stresses among the species in the mixture and (2) a kinetic stress gradient. Specifically, the higher granular temperature of the smaller particles segregates them downward along a kinetic stress gradient toward lower temperatures, and larger particles upward. We adapt the theory to mixtures differing in both size and density and use simulations to show that when the larger particles are sufficiently dense, the theory captures the observed segregation reversal through a reversal in the relative granular temperature born by the two species. In other words, with increasing material density, the larger particles bear increasing fractions of the local kinetic stresses, and the segregation reverses as the larger particles bear a higher fraction than their local concentration in the mixture.

Kimberly Hill
St. Anthony Falls Laboratory, Department of Civil Engineering,
University of Minnesota

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