"Thermal diffusion segregation in granular mixtures"

Abstract

Among the different competing mechanisms involved in granular segregation, thermal diffusion becomes the most relevant one when an external energy input drives the system into rapid flow conditions. In this regime, granular matter flows like a fluid and kinetic theory tools (conveniently adapted to account for the inelastic character of collisions between grains) can be quite useful to analyze thermal diffusion segregation. Thermal diffusion is caused by the relative motion of the components of a mixture due to the presence of both gravity and a temperature gradient. Due to this motion, a steady state is reached where the separation effect arising from thermal diffusion is balanced by the remixing effect of ordinary diffusion. The aim of this contribution is determine the so-called thermal diffusion factor of a moderately dense granular binary mixture described by the (inelastic) Enskog kinetic equation. A segregation criterion is derived in terms of the parameters of the system (masses and sizes of particles, concentration, solid volume fraction and coefficients of normal restitution) [1]. The sign of the thermal diffusion factor determines the tendency of the large particles to drift toward the cooler or warmer plate. To test the reliability of the theoretical calculations, the above factor is also obtained by computer simulations [Monte Carlo (DSMC) and molecular dynamics (MD) simulations] carried out for a granular impurity in a driven low-density granular gas [2]. Theoretical results agree very well in general with computer simulations for conditions of practical interest.

[1] V. Garz\'o, Phys. Rev. E 78, 020301 (R) (2008); Eur. Phys. J. E 29, 261 (2009); New J. Phys 13, 055020 (2011).

[2] F. Vega Reyes, V. Garz\'o, and N. Khalil, Phys. Rev. E 89, 055206 (2014).