Yang, Hyunjin; Aubry, Nadine; Massoudi, Mehrdad

Heat transfer in granular materials: effects of nonlinear heat conduction and viscous dissipation. (English) Zbl 1273.76031

Summary: We study the heat transfer in a one-dimensional fully developed flow of granular materials down a heated inclined plane. For the heat flux vector, we use a recently derived constitutive equation that reflects the dependence of the heat flux vector on the temperature gradient, the density gradient, and the velocity gradient in an appropriate frame invariant formulation. We use two different boundary conditions at the inclined surface: a constant temperature boundary condition and an adiabatic condition. A parametric study is performed to examine the effects of the material dimensionless parameters. The derived governing equations are coupled nonlinear second-order ordinary differential equations, which are solved numerically, and the results are shown for the temperature, volume fraction, and velocity profiles.

MSC:
76A05 Non-Newtonian fluids
76T25 Granular flows

Keywords:
heat flux vector; non-Fourier heat conduction; granular materials; inclined flow; nonlinear fluids; continuum mechanics; viscous dissipation

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References:

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