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Non-Newtonian stress tensor and thermal conductivity tensor in granular plane shear flow MEHEBOOB ALAM, SAIKAT SAHA, Jawaharlal Nehru Centre for Advanced Scientific Research — The non-Newtonian stress tensor and the heat flux in the plane shear flow of smooth inelastic disks are analysed from the Grad-level moment equations using the anisotropic Gaussian as a reference. Closed-form expressions for shear viscosity, pressure, first normal stress difference ($\mathcal{N}_1$) and the dissipation rate are given as functions of (i) the density or the area fraction (ν), (ii) the restitution coefficient (e), (iii) the dimensionless shear rate (R), (iv) the temperature anisotropy [η, the difference between the principal eigenvalues of the second moment tensor] and (v) the angle (ϕ) between the principal directions of the shear tensor and the second moment tensor. Particle simulation data for a sheared hard-disk system is compared with theoretical results, with good agreement for p, μ and $\mathcal{N}_1$ over a large range of density. In contrast, the predictions from a Navier-Stokes order constitutive model are found to deviate significantly from both the simulation and the moment theory even at moderate values of e. We show that the gradient of the deviatoric part of the kinetic stress drives a heat current and the thermal conductivity is characterized by an anisotropic 2nd rank tensor for which explicit expressions are derived.

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