

Friction of granular matter with a wide dispersity

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A simple theory for a constitutive law for steady state dynamic friction in granular matter is presented. Starting from the energy balance equation together with the kinetics of grains, the energy dissipation rate is estimated, which directly leads to a constitutive law. The result indicates that granular matter of lower density is stronger than higher density systems, albeit somewhat counterintuitive. This is a consequence of the fact that the grain rearrangement, which causes energy dissipation, is more frequent in a system of lower density. Thus, the velocity-strengthening nature of granular friction is naturally explained by the negative shear-rate dependence of the density. The present theory also qualitatively explains the experimental observation that a system of smaller layer thickness tends to be velocity-weakening. This theory also applies to systems of fractal size distribution.

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