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Unsteady Shearing of a Granular Material in an Annular Couette Cell[1] HAN-HSIN LIN, MELANY HUNT, California Institute of Technology — We study the transition from unsteady to steady state shearing of spherical glass beads and irregular sands in a Couette cell. By initially fluidizing the bed or compressing with a constant force, we ensure the initial state is controlled and repeatable. By comparing to simulations, we are able to capture the structure change inside the bulk. When controlling the torque, the system cannot reach a steady state when it is below a critical stress. When controlling the speed of the boundary, the shear stress at the wall increases slowly over a period of time that depends on the initial state of the bed, wall friction, shear rate, and flow along the free surface. At steady state, the stress decreases at the highest rotation speeds. Simulations with LAMMPS using Hooke's contact model show a recirculation cell driven by gravity and the free surface, which results in the increasing stress observed in the measurements. The relations of wall friction angle to normal stress for different samples have different trends. The effective friction of the inner wall matters. When using the smooth cylinder, the system needs more time to reach a steady state than using the rough cylinder. At steady state, the wall stress decreases more significantly at the highest rotation speeds compared to the rough cylinder.

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