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Effective properties and flow transitions in an annular Couette rheometer for liquid-particle suspensions and gas fluidized beds ARTHUR YOUNG, Harvard University Institute of Applied Computational Science, MELANY HUNT, California Institute of Technology Division of Engineering and Applied Science — Effective properties are extremely important in modeling and simulating multiphase flows. For example, the Krieger-Dougherty (KD) model of effective viscosity is commonly applied to study flows of neutrally buoyant suspensions at low Reynolds numbers. In this work, a coaxial rheometer is used to measure the shear stress of a variety of particulate compositions, including density matched particle suspensions, density mismatched particle suspensions, and gaseous-fluidized particles. We apply KD effective viscosity to the rheological results of the particle suspensions to show that at high shear rates, particle suspensions undergo a similar transition as observed in pure fluids from a circular Couette flow to a flow with toroidal vortices. Similar measurements on gaseous-fluidized particles show that at low shear rates, the shear stress of particles fluidized beyond incipient fluidization evolves as a Bingham pseudoplastic. At higher shear rates, the shear stress increases at a rate comparable to a Newtonian fluid in Taylor vortex flow. These results demonstrate that past critical rates of shear, particle suspensions and gaseous-fluidized particles alike demonstrate rheological behavior similar to that of pure liquids in Taylor vortex flow.

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