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Towards a universal description of cohesive-particle flows[1] CASEY LAMARCHE, PEIYUAN LIU, KEVIN KELLOGG, AARON LATTANZI, CHRISTINE HRENYA, Univ of Colorado - Boulder — A universal framework for describing cohesive granular flows seems unattainable based on prior works, making a fundamental continuum theory to predict such flows appear unachievable. For the first time, universal behavior of cohesive-grain flows is demonstrated by linking the macroscopic (many-grain) behavior to grain-grain interactions via two dimensionless groups: a generalized Bond number Bo_G ratio of maximum cohesive force to the force driving flow and a new Agglomerate number Ag ratio of critical cohesive energy to the granular energy. Cohesive-grain flow is investigated in several systems, and universal behavior is determined via collapse of a cohesion-dependent output variable from each system with the appropriate dimensionless group. Universal behavior is observed using Bo_G for dense (enduring-contact-dominated) flows and Ag for dilute (collision-dominated) flows, as Bo_G accounts for the cohesive contact force and Ag for increased collisional dissipation due to cohesion. Hence, a new physical picture is presented, namely, Bo_G dominates in dense flows, where force chains drive momentum transfer, and Ag dominates in dilute systems, where the dissipative collisions dominate momentum transfer. Apparent discrepancies with past treatments are resolved.

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