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Active-passive granular mixtures: shear-thinning flow induced by wiggling larvae[1] SHIH-YUAN CHEN, MELIA KENDALL, KAREN DANIELS, North Carolina State University — Just as heating a viscous fluid causes its viscosity to drop, we observe that the introduction of active particles into a passive granular material can increase its flowability. In our experiments, we examine this effect by introducing flour beetle larvae into grains of various sizes. We use three different measurement techniques to characterize the behavior of the active-passive mixtures: the macroscopic flow rate via the changing angle of repose, the timescale of grain-scale rearrangements via diffusing wave spectroscopy, and the complex viscosity via a rheometer. We find that increasing the percentage of larvae decreases the timescale of microstructure rearrangements, and that the flow rate depends nontrivially on both the percentage of larvae and the grain size. We also find that the mixture is shear-thinning for shear rates faster than the wiggling motion of the larvae. The Cross equation, typically used to quantify the temperature-dependence of polymer solutions or melting alloys, is able to capture the viscosity of the mixtures among all percentages of larvae and grains.

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