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Rate Equations for the Shear-Jamming Process[1] EDWIN FAICAN, Brandeis University, DONG WANG, ROBERT BEHRINGER, Duke University, BULBUL CHAKRABORTY, Brandeis University — Shear jamming is a process in which an assembly of grains transform from a fluid-like to a solid-like state without a change in density. This occurs through an evolution of the contact network and a steady buildup of contacts per grain. Analysis of experimental data shows that the trajectories in contact space, projected on to subspaces such as the space of 2 and 3 contact grains, resemble a spiral approaching a fixed point as the system approaches the shear-jammed state. We propose that the evolution of contacts can be modeled by reaction kinetics in which n-mers can be transformed to (n+1)-mers or (n-1)-mers, where the n-mers represent grains with n contacts. Using this model, we can map the shear-jamming process to a set of rate equations, where the rates specify the rate of change of n-contact grains per strain step. We can determine the rate constants by fitting the complete experimental trajectories to the prediction of the model. We will present results for for a range of packing fractions and a range of friction coefficients. Visualizing the shear jamming process as a set of reactions in contact-number space provides a new perspective into how stable, force bearing structures are created through shearing.

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