Unlocking jams in fluid materials: A theoretical model to understand how to best avoid jamming of soft matter

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In a study recently published in *European Physical Journal E* (EPJE), a German scientist constructed a theoretical model to understand how to best avoid jamming of soft matter that can be applied in food and cosmetics production.

Thomas Voigtmann, a researcher at the Institute for Material Physics in Space in Cologne, Germany, evaluated the internal friction force, or yield stress, to be overcome before a solid material made of a metallic melt with a glass structure can flow and thus prevent jamming.

These materials have an apparent viscosity that drops if they are forced to flow quickly – a property called shear thinning. They are similar to solid paint that is highly viscous, almost solid, in a bucket and can easily become liquid when applied with a brush. The force applied to the paint by a brush stroke is sufficient for shear thinning to occur.

The properties of these metallic melts are not well understood. Until now, these materials have been studied using models for three classes of materials: soft matter (like toothpaste), metallic liquids, or granular materials (like sand).

However, none of these models accurately describes these materials. Instead, Voigtmann devised two models that take into account the common properties between the three material classes; here the goal was

to determine whether their yield stress is either continuous (it gets smaller with the flow rate) or discontinuous (remains at a constant value regardless of the flow rate) at a decreasing flow rate. He used available data to test the models; however, further data on lower flow rates than currently available would be required in order to be conclusive.

Further theoretical research will help us to understand how to process large amounts of soft matter for the food industry such as mayonnaise (an emulsion), jelly (a colloidal dispersion), or granular materials such as grains or pharmaceutical pills while avoiding blockages as they flow through processing pipes.

More information: Yield Stresses and Flow Curves in Metallic Glass Formers and Granular Systems T Voigtmann, European Physical Journal E (2011) 34: 106, DOI 10.1140/epje/i2011-11106-8

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