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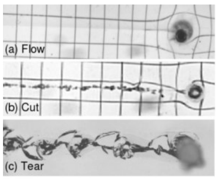


Three responses as a cylinder slices through a viscoelastic fluid. Increasingly the cylinder “rips” the fluid, which does not so quickly close up in the wake of the cylinder.
Gladden and Belmonte

By: Lucian Dorneanu, Science Editor

# How to Cut a Liquid with a Knife

## *Nature's weird behaviors*

What happens when you stick a knife into a solid material and drag it through? A cleavage splits the two sides of the material, leaving a visible trace of the knife. And when you do that to a fluid? Of course, the fluid behind the knife will get back to its original state and the two sides will reunite.

However, nature is full of surprises and always provides materials and processes that don’t quite fit into such neat categories.

Joseph Gladden (Univ Mississippi) and Andrew Belmonte (Penn State) have shown in an experiment that a cylinder dragged through a mixture of water, soap, and certain salts, can produce some unexpected results.

First, when the dragging occurs at small drag speeds, the material - a viscoelastic gel-like substance which is a fluid at these temperatures - does indeed close back on itself, as a liquid normally does. When he moved the cylinder at higher speeds, it created more of a cleft and the material was slower to "heal" itself.

Finally, when even higher speeds, the fluid acted like a solid for a while, being ripped into several parts that took as long as a few hours to close up, and exhibited several "cracks" generated in the cylinder’s wake.

Viscous materials, like honey, resist shear flow and strain linearly with time when a stress is applied. Elastic materials strain instantaneously when stretched and just as quickly return to their original state once the stress is removed. Viscoelastic materials have elements of both of these properties and, as such, exhibit time dependent strain.

In this category of viscoelastic materials, we can find blood clots, the earth's mantle, toothpaste, and gelatin.

Gladden says that the phase diagram (cylinder speed vs. cylinder diameter) for the fluid showed three regions: flow, modest tearing, and outright ripping. "Mapping out this phase diagram should help in understanding other phenomena involving viscoelastic materials in various scientific applications," he said.