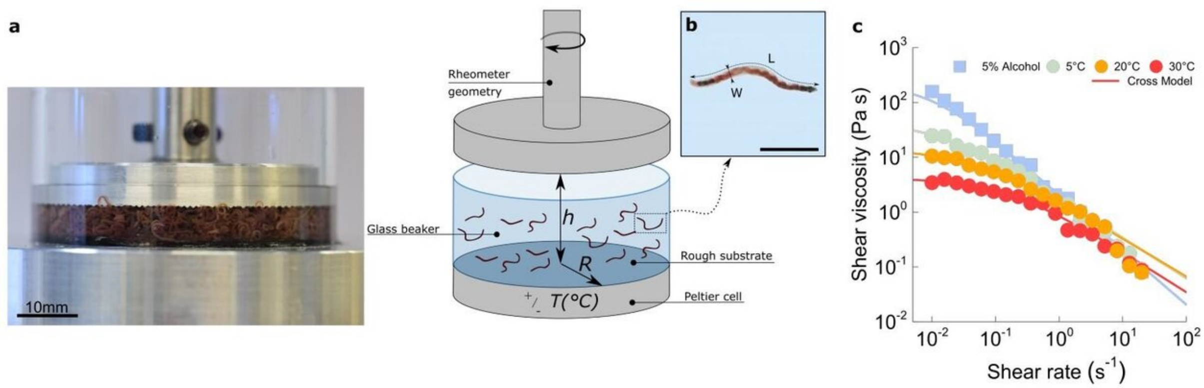
Using sludge worms as a model for active filaments in viscosity tests

May 11 2020, by Bob Yirka



Rheology experiments of living polymers. Credit: arXiv:1910.09612 [cond-mat.soft]

A team of researchers at the University of Amsterdam has found that it is possible to use sludge worms as a model for filaments when conducting viscosity tests. In their paper published in the journal *Physical Review Letters*, the group describes their experiments with sludge worms and a rheometer and what they learned from them.

In active systems, particles move on their own due to stored energy or by making use of other energy in the system. One such class of active system is active polymers, which, the researchers note, are of great interest to biologists due to their prevalence in many biological systems.

Unfortunately, scientists have not been able to develop very many experimental projects designed to study active polymer systems—particularly those aimed at studying flow. In this new effort, the researchers have devised a unique way to simulate the actions of active polymers in a simple way—by putting sludge worms in a rheometer.

Sludge worms (Tubifex tubifex) are a species of tubificid segmented worm similar in size to earthworms. They are commonly used as food for tropical fish, and are sold at most pet stores. A common characteristic of sludge worms is their constant movement. A rheometer is a clear cylinder with plates inside that can apply a shear force to the material inside the cylinder. In their experiments, the researchers filled the rheometer with equal parts worms and water, and used the device to measure the viscosity of the combined material. The team also varied the temperature of the water to change the amount of movement by the worms (and thus the viscosity of the solution), and at some points, placed just enough alcohol in the device to force them to stop moving.

Prior work has shown that a solution with an active polymer will resist a shear force more than a clear liquid—the increased viscosity is due to the tangling that occurs between the polymers. Prior work has also shown that as shearing is increased, polymer filaments tend to align, resulting in a drop in viscosity. What has not been shown, however, is what happens when the filaments move on their own.

The experiments by the researchers showed that at very low shear rates, the active worm solution was 10 times less viscous than a passive worm system. Also, as the shear rate was increased, the solution demonstrated decreasing viscosity, which had been predicted, but the active solution showed less shear thinning than had been predicted. The researchers believe their findings are more accurate than theories because their model allowed for stretching and contracting.

More information: A. Deblais et al. Rheology of Entangled Active Polymer-Like T. Tubifex Worms, *Physical Review Letters* (2020). DOI: 10.1103/PhysRevLett.124.188002 , arxiv.org/abs/1910.09612