

IV-2 Report

Folding Honey

MCEN 4151 - Joel Carlson 10/10/2021

I. Experiment Purpose

For this experiment, the purpose was to examine and capture the fluid mechanics of honey and how it experiences a version of the liquid rope coiling effect. The motivation was to visualize a fluid that does not integrate into itself immediately and creates ribbons or coils. The inspiration came from remembering this effect when making pancakes or cake batter a while back.

III. Experimental Setup

For this experiment I poured honey from a bottle onto a plate from a height of about 15 centimeters. The opening of the bottle was roughly 3 centimeters and the honey did not flow through the entire opening. This caused the flow of the honey to take more of an elliptical cross-sectional shape rather than circular. Because of this the honey on the plate did not show the normal coiling effect and it was more of a ribbon like folding effect. While I was pouring the honey, my roommate photographed the experience with an iPhone 12 capturing about 20 pictures per experiment. This experiment was repeated 3 times. Each time, the angle of the pour and height of the pour were slightly changed.

III. The Fluid Mechanics

The phenomenon captured is similar to the liquid rope coiling effect, which is very well defined in the scientific community. However, because the cross-sectional shape of the honey being poured was not circular it cannot be described with the equations that would normally govern this effect. At a greater height the surface tension of the honey would eventually pull the stream into a circular cross-section, however, during my

experiment this did not happen. It is much harder to model this effect and the research on it is extremely limited. I was unable to find any equations or papers explaining this specific scenario.

Even though it may be hard to model this with an equation, we still have a general idea of what is happening. Viscosity is a fluid's ability to resist shear or tensile stress which is one of the most important properties of the fluid when conducting this experiment. As the stream hits the plate it is immediately slowed to a stop. However, the honey above still has a lot of momentum and needs to go somewhere. Due to the fact that honey is fairly viscous, it buckles and folds. It resists shearing and essentially wants to stay as one solid stream, like a rope! On the other hand, water has very low viscosity and flows more like sand, nothing between the sand molecules resists shearing so they will easily separate.

IV. Photographic Technique

An iPhone 12 Camera was used to capture the experiment. The camera was held about 10 centimeters away from the point where honey contacts the plate. The picture was taken in the daytime with the blinds open to let in sunlight. In addition, the overhead lights were left on and this created white spots in the honey. I tried removing the white spots but it made the image look flat and took away context from the image. The original image was 3024 x 4032 pixels. The exposure time was 1/60 seconds and aperture was maxed. The post processing was done in GIMP and involved adjusting the exposure, contrast, brightness, colors, rotating, and cropping.



The Original Image above



The Final Image above

V. Image Remarks

If I were to repeat this experiment I would try changing the temperature of the honey as that affects the viscosity. I would also try to create the liquid rope coiling effect by either pouring the honey out of a smaller, circular hole or using other techniques to ensure a circular cross-section. I would also like to repeat this with a much more intentional elliptical cross-section and try to create more symmetry where the honey would fold side to side like a ribbon.