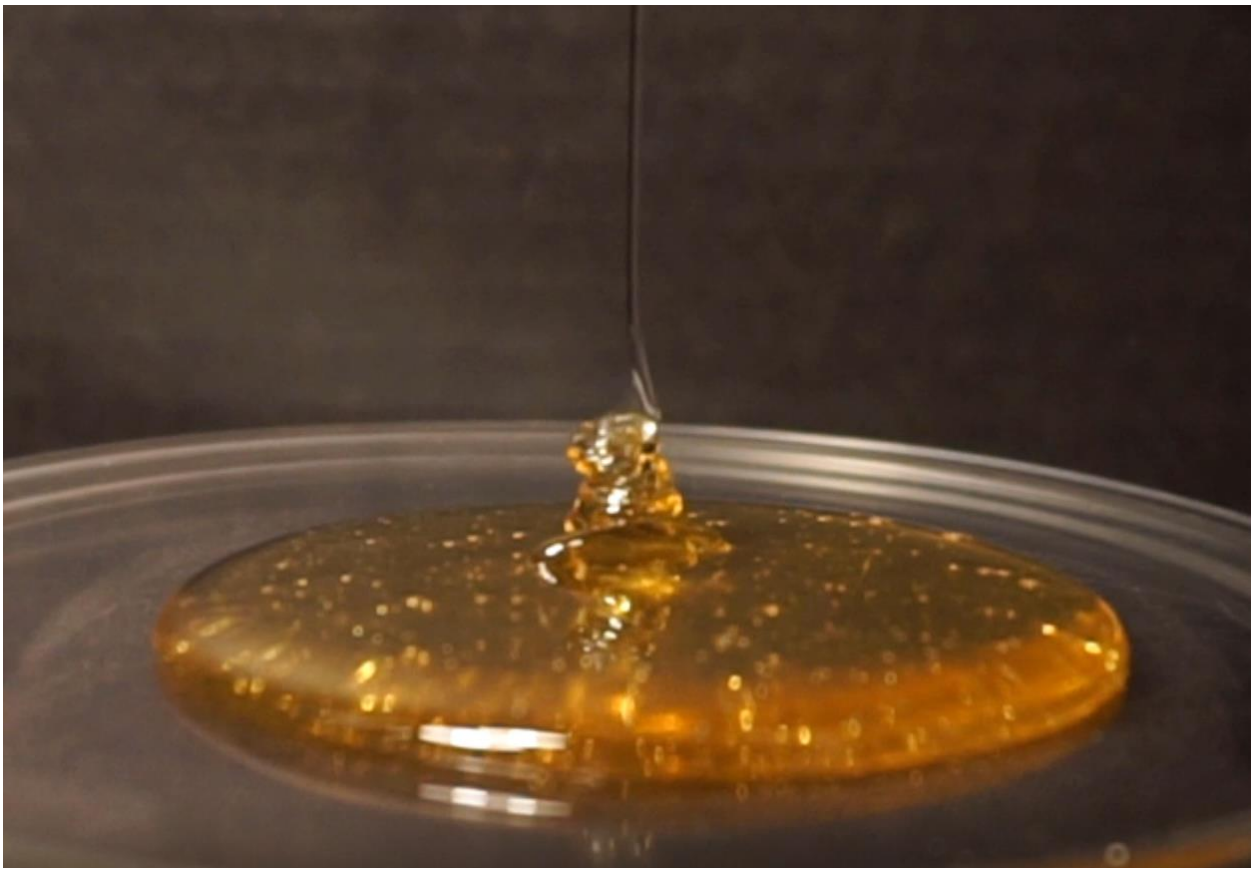

Sydney Levy

Honey Coiling Video Submission

IV4

MCEN 5151

12/7/2020

INTRODUCTION

This report is in addition to the video submitted for IV4. The title page shows a screenshot of the video. The video depicts honey being slowly poured onto a plate. The purpose of this video is to capture a rope coiling instability phenomenon on video. The rope coiling phenomenon is characteristic of viscous fluids.

FLOW APPARATUS AND ANALYSIS:

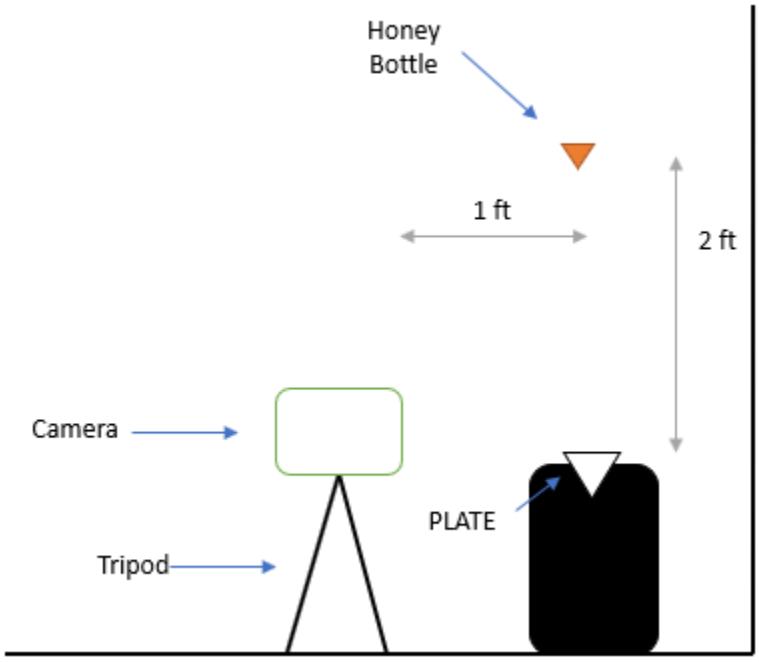

Figure 1: Schematic of Flow Apparatus.

A schematic of the flow set-up is provided in Figure 1. The honey drizzle had a diameter of 2 mm. During flow. Estimating the velocity at impact to be 1 m/s and the kinematic viscosity to be 7.36e-5, we can estimate the Reynolds number to be

$$Re = \frac{UD}{v} = \frac{0.1*0.002}{7.36e^{-5}} = 2$$

which is squarely laminar. The fluid phenomenon studied in the video is a rope coiling instability. The coiling effect is caused by the interplay between the rotational momentum of the flow and the viscous property of the fluid. If the fluid is viscous enough, a rebounding force from when the fluid impacts the solid surface propagates up the fluid stream. This force is enough to cause the stream to buckle. As it folds, it folds in a direction that preserves its angular momentum, which is unstable [3]. This phenomenon is not just found in fluids, but also happens in spaghetti and rope [1]. The frequency at which the rope coils is dependent on the rotation in the stream before impact. The fluid coils at the same frequency the fluid rotates while in the stream [2]. This phenomenon is leveraged by engineers at MIT to create a 3D printer that pours heated glass, which behaves like a viscous fluid, onto a solid plate. As the glass coils, intended structures can be built because the glass coils at a predictable radius and frequency from the input temperature of the glass.

VISUALIZATION TECHNIQUE:

The visualization technique was straight forward. A 16oz bottle of Kroger® *Clover HONEY* was squeezed by hand just out of frame of the camera. The plate which the honey was squeezed on was made of hard plastic and was chilled to 30°F before honey was poured on it. The reason the plate was chilled was it made the honey spread more slowly, which in turn made the resulting coil higher. The camera distance to subject was optimized to get the honey coil as large in the frame as possible. A 60W 800 lumen desk lamp was placed near directly behind the camera to illuminate the honey coil without creating a shadow. The incandescent bulb was selected to give the video a warm, golden color, which fit well with the honey.

PHOTOGRAPHIC TECHNIQUE:

The primary focus of the photographic technique was to get the honey coil as large in the frame as possible. This resulted in the honey coil being about a foot from the lens. The original field of view was about two feet wide but is cropped to a single foot in postproduction for the final result. The highest resolution possible was selected (1080p) to get the most detail, and the highest frame rate (60fps) was selected to allow for the slowest motion. In post, the video was zoomed in by 100% and the sound was removed. No music was added. This was an intentional decision made by the creator to keep the focus of the video on the honey coil. The focal length was manually set to f/3.5 in order to blur the background so the focus is kept on the honey coil, and the ISO setting was set to 800. This ISO level was chosen after experimenting with other ISO levels that either proved too bright or too dark given the lighting. The camera was a Sony α6000 with a 35 mm lens.

CONCLUSION

The image reveals the rope coiling instability in viscous fluids. I like the lighting in the image. I think it glints off the honey well and does not wash out the image. The fluid physics (the rope coiling phenomena) could be shown better. Although the focus was spot on, zooming the video in so much in post made the video too grainy and undetailed. I would like to improve this aspect by using a macro lens or buying a lens flipper to be able to increase the zoom of my camera. I would like to develop this idea further by focusing more on the aesthetics of the video instead of only capturing the coiling phenomena. Perhaps I could dye the honey different colors, or poor the honey over a white plate with a shallow layer of milk, and watch the coil emerge from the liquid. That being said, I do like how the video clearly captures the honey coiling with the rope coiling instability.

Works Cited

[1] Habibi, Mehdi. (2007). Coiling Instability in Liquid and Solid Ropes.

[2] Ribe, N. M., H. E. Huppert, M. A. Hallworth, M. Habibi, and Daniel Bonn. "Multiple coexisting states of liquid rope coiling." Journal of Fluid Mechanics 555 (2006): 275. Print.