2018

# Team Three - 2018

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MCEN 5151

## Image Context

For the third team work, we plan to observe viscous liquid fluid performance in a narrow-curved channel. Glue, water and food coloring was mixed together for experiment. A 7 in. x 5 in. transparent acrylic board was shaped by laser in Integrated Teaching and Learning Laboratory of CU Boulder. I'm in charge of taking video under 4K resolution meanwhile Noah and Brandon were recording the phenomenon through still image. Winston was responsible for carrying out the experiment.

## Flow Apparatus

First, we found a 7in. by 5in. acrylic board to sculpture our channel. The prototype design was done through the solid work. A symmetric W-shape channel was created as the figure 1 shows. Following the ITTL official instruction[1], the laser cutter machine was employed for the vector shaping process. Since it's a quarter-inch-thickness acrylic board, we set the EPILOG laser cutting machine at 12% in speed and 100% for the power. One black cardboard was attached on the back the channel and another acrylic board was stuck on the front façade. Then we fixed the channel board on the vise and two syringes were pointed at two entrances to inject the liquid into it. Figure 2 indicates how the experiment looks like.

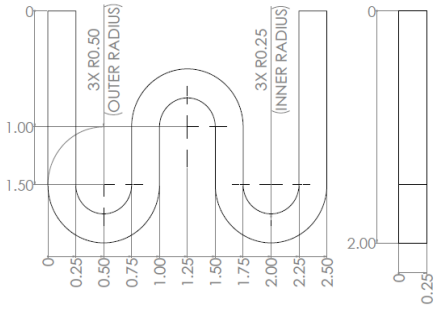


Figure 1 Experiment in process

Figure 2 Experiment in process

Viscoelastic catastrophe[2] is revealed in a vivid way in this video. When certain large molecules is dissolved in a fluid, stretch and orientation will happen in the flow which leads various feedback. Dr. Jensen executed a similar experiment in 2018, his research group established a cross-slot geometry for observing and validating their numeric modeling. Weissenberg number was mentioned to describe the strength of the elastic to viscous effects as equation 1 shows.[3]

$$\mathrm{We} = \lambda \frac{Q_1 + Q_2}{2H^2}.$$

eqt.1

[1] https://itll.colorado.edu/images/uploads/resources/equipment/Laser_Cutter_Instructions.docx

[2] Slemrod, M. "Instability of steady shearing flows in a non-linear viscoelastic fluid." Archive for Rational Mechanics and Analysis 68.3 (1978): 211-225.

[3] Jensen, Kristian Ejlebjerg, Peter Szabo, and Fridolin Okkels. "A Viscoelastic Catastrophe." arXiv preprint arXiv:1802.05739 (2018).

## Visualization technique

We set up the experiment in the Project Depo where have a strong illuminance condition which we believed it would contribute to the quality of the work. However, the strong lighting chased a glare problem. The camera recorded the fluid phenomenon as well as our shadow on the acrylic board. Noah provided his hoodie for hiding the camera and prevent reflections.

## Photographic technique

An iPhone Xs was implied in this experiment. The setting of the video is 4K resolution at the 60 films per second to make sure the video would have the highest quality meanwhile the smoothest playback experience.

iMovie was my video editing tool for this project. Compared with DaVinci, iMovie is more friendly to the entry-level user.

I cut the video into four clips. For the beginning, I freeze the moment for 2 second to show the title card about this work. The playback speed was accelerated in the second and the last clips. During the third clips, I zoomed in the frame to emphasize the catastrophe phenomenon when the liquid came into the curve.

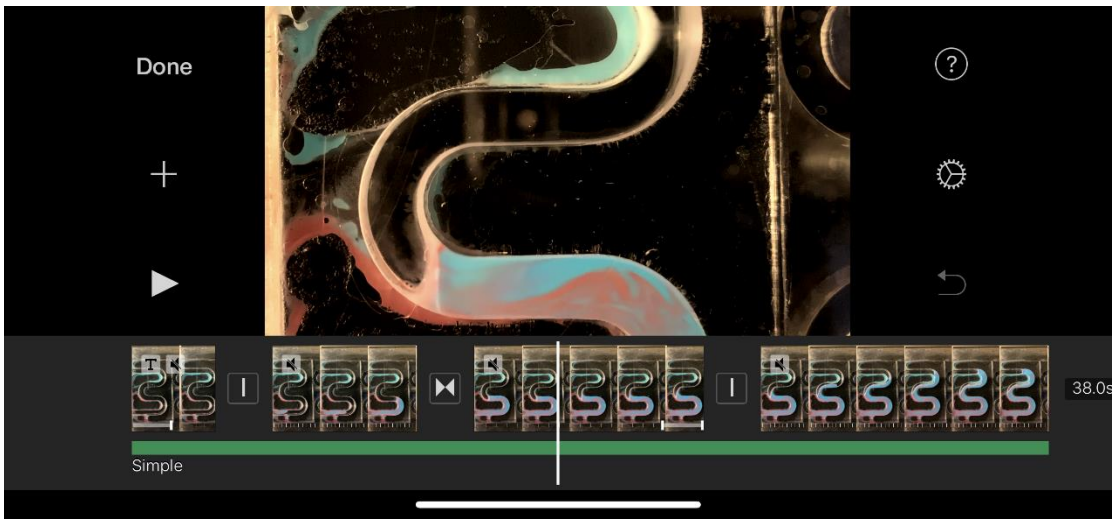


Figure 3 Editing Process in iMovie

## Image reveals

The viscoelastic catastrophe was recorded in a vivid and aesthetic way. Two showy colored fluid added a bright touch on this physical experiment. While the background music is my favorite part during the editing process. However, the blended color in the background was somehow distractive. If it could have been cleared in a better way, the video would become better.