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MCEN 4151 Flow Visualization
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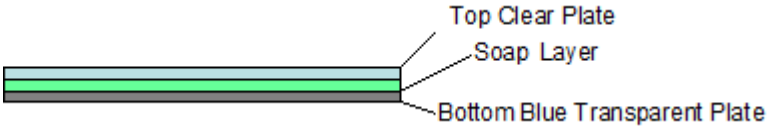
Team One Image: Fingers

The purpose of this image was to capture the fingering phenomena in a dish soap liquid between two acrylic plates. The objective was to use alternative means to draw a second liquid into a more dense liquid to create a fingering effect. In this image, I put the soap between the two plastic plates and pulled them apart, which forced air in and caused unique patterns to arise in the dish soap. This image was fun and challenging due to the nature of this particular fingering. Each attempt would create a different pattern, and after the plates were moved, the soap would move relatively quickly forcing images to be taken quickly. After a little bit of playing and experimenting, we were still able to come up with a good image.

This image captures a Saffman-Taylor Instability that I created in a unique way. This instability occurs when a less viscous fluid is injected to a more viscous fluid causing the fingering as seen. Instead of injecting air in between two closed plates with a syringe or straw, I simply peel the 2 plates apart. This increase in volume in the soap between the plates caused a pressure gradient that forces the outside air into the soap causing this instability.



"Hele-Shaw flow is the flow of a fluid between two plates with a very small gap between them, and is typically slow and high in viscous forces. In order to create Saffman-Taylor Instability, a low viscous fluid is injected into a higher viscous fluid, which generally results in "fingering," where the less viscous fluid tends to jet out from the injection point in a way that resembles fingers." (Van Amberg) I was able to peel the plates slowly enough to keep the inflowing air as laminar as possible for this particular image.

In order to make this image pop, I chose to use a semi-transparent blue piece of acrylic as the bottom plate, and a clear one as my top plate. This allowed the soap to be differentiated from the air and the top plate while the image was being taken. I used extra fluorescent shop lights to provide more light and clarity in my image. The image was then cleaned up in photoshop do the focus was just on the instability and nothing in the background. I intensified the blues in the picture as well as increasing the clarity so the finger boundaries were as clear as possible.

This photo was shot with the following specifications;

CAMERA	Canon EOS Digital Rebel
SHUTTER SPEED	1/640 sec

F-STOP	f/5.6
APERATURE VALUE	f/5.6
ISO	800
FOCAL LENGTH	49.0mm
LENS	18.0-55.0 mm
PIXEL DIMENSIONS	2016 by 2048

I really like the focus of the instability in the image. I like that the surrounding area is out of focus so you are drawn to the blue and the almost ice like fingers that give this image a very cold feel. I think that since this is the sole focus of this image, that the physics of this instability are portrayed in a revealing way. The only thing I would have done differently was to make a video that traveled along the long piece of plastic as I peeled the two apart, but I am still very pleased with this image.

Sources:

Mei, C.C.. "Notes on 1.63 Advanced Environmental Fluid Mechanics." . MIT, 2002. Web. <http://web.mit.edu/fluids-modules/www/porous_media/6-3SaTay.pdf>.

Van Amberg, Joseph. "Saffman-Taylor Instability." . University of Colorado, 3/31/09. Web. <http://www.colorado.edu/MCEN/flowvis/galleries/2009/Team-2/Reports/VanAmberg.pdf>.