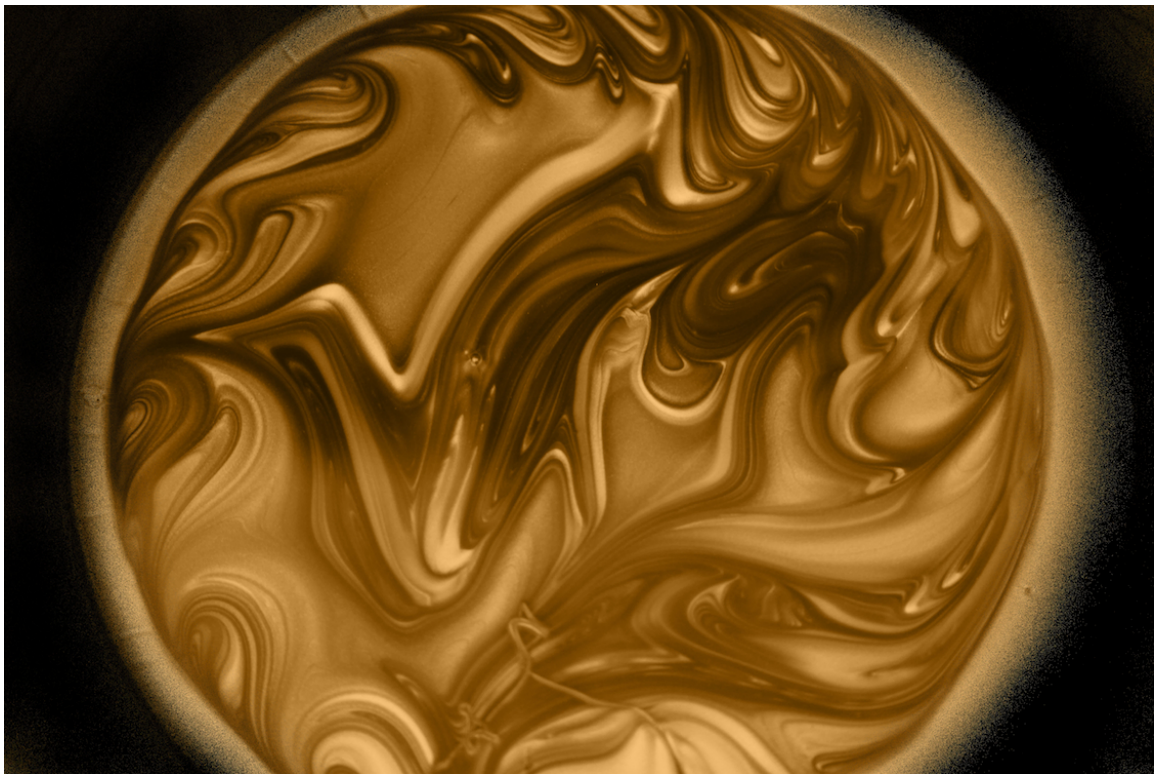
Group Image #3

MCEN 4151: Flow Visualization
Professor Jean Hertzberg



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I. Introduction

This image was taken as the third team as well as final overall submission for the course *Flow Visualization* offered at the University of Colorado at Boulder. My team originally captured many cavitation images of various objects during the moments they struck a pool of water. However, the theme and feeling of these images seemed too similar, so I chose to submit this photo I took of wax melting in a crockpot to offer something a little different. As the wax melted and was stirred, it created the beautiful, psychedelic swirling patterns seen in my image.

II. Flow Apparatus

As mentioned, this image of wax melting in a crockpot was taken after I noticed how interestingly strange it appeared. To capture this phenomenon, I did not plan and set up an apparatus to produce and capture the flow, but came across this interesting flow on accident. I was originally melting wax to use as an airtight seal on the seam of bottles of homebrewed beer when I noticed how stunning the wax looked and decided to take some pictures. The wax seem in the image is silver bottle wax, manufactured by LD Carlson and is sold as small pellets, just a few millimeters in diameter.

III. Fluid Dynamics

As the crockpot heated, the wax beads around the edges making contact with the walls of the crockpot melted the quickest. This image was captured while the majority of the wax had melted, but the center still contained much cooler, and viscous wax. Warmer, less dense wax from the bottom of the crockpot started flowing towards the surface, creating some unique patterns in on the top surface of the wax. This is when I initially noticed the unique and beautiful phenomenon created. To experiment and highlight this effect, I began to disturb the melted wax along the vertical walls of the crockpot with a skewer stick. While the temperature gradient between the hotter and cooler wax remained significant, they failed to mix when disturbed. This explains some of the loopy, curved patterns along the rim, especially at the top of the frame. As equilibrium was reached, the effect subdued and the wax began to mix uniformly.

IV. Camera, Setting, and Post-Processing

This 5616x3744 pixel image was taken using a Canon EOS 5D Mark II DSLR camera equipped with a 24-105 mm lens. It was shot with an exposure time of 1/50 second, and an aperture of f/4.5 at the maximum focal length of 105 mm. The physical size of the frame is about 10”x8”, and was shot from approximately 9” away. Lighting was provided by the lighting fixture in my kitchen, consisting of two incandescent light bulbs dampened by a plastic shade. The photograph was further manipulated in Photoshop. I initially converted the image to black and white, and then played around with dual tones from there. I settled on the dark yellow/orange color seen in my final submission because of the way it reminded me of a planet. I found the

perimeter of the crockpot to be a distraction of the flow happening in the wax, so I used the brush tool in Photoshop to blacken this out. I felt the fade at the edge of the black and the orange furthered the planetary feeling of the image. In the following figure, the original image can be seen side-by-side with the final image after post-processing.

Figure 1: Before and After Post-Production

V. Conclusions

Although this image was not originally planned out, it clearly demonstrates the beautiful properties exhibited by fluids. This image did not require an advanced setup or flow apparatus and leans toward the more artistic side in displaying the awesome effects of fluid properties and fluid flow. For future work related to this phenomenon, I would explore density gradients between two different fluids, or possibly incorporate two different wax colors in the image. That being said, I feel the image is unique and shows that beautiful fluid flow is happening all around us, and sometimes it just takes being aware to see it.