2021 Fall - Image Third Report

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I. Intent of Image

The original intent of this project was to visualize the flow of wax dripping down a vertical surface. I was preparing to do this by melting crayons over a stove top and then dripping the wax down the surface of a vertical sheet. I completed this task, but realized in the process a different flow which was much more visually interesting.

The flow I chose to use for my final image was that of the crayons melting together in a foil tin over the stove top. This image shows seeded boundary layers, surface tension and potential difference caused by the flow of the melting wax. This final image is shown in figure 1.

Figure 1: *Final Photo Image, showing mixture of colored liquid wax.*

II. Flow Description

The flow of the liquid wax was created on top of an aluminum foil tin, which was placed in a heated skillet on the stove top. Different colored crayons were placed in this tin and melted due to the heat. This set up is shown in Figure 2. As they melted, they maintained their color, but flowed together into seeded boundary layers, and blended together.

Figure 2: *Experimental set up includes this foil tin setting inside of a heated skillet. The crayons have begun to melt, and will continue to liquify until completely liquid.*

The difference in mixing levels and shapes can be accounted to the fact that some crayons were placed at different times, and had slightly different compositions. If some of the wax was less hot, it would have a lower viscosity and would not mix as freely. The viscosity of melting wax can range from about 4 to 6 mPa-s. As the viscosity changes, the density also varies, and these factors are both dependent on temperature [1]. Similarly, some crayons of colors with more dense wax (I cannot determine which crayons, however), would take a different amount of time to heat and might be more or less viscous than the other crayons around them.

One more interesting part of this process is the molecular effect of the solid to liquid phase change on the crayons. When wax melts, the hydrocarbon molecules break down into carbon dioxide and water vapor [4]. These molecules are released as the wax melts. This phenomenon is the reason that candles lose wax when they burn. During both heating and cooling, the streams of heated wax were very dynamic in flow because of these molecular changes.

III. Visualization Technique

The visualization technique was to create seeded boundaries by melting different colors of crayons. Because of the surface tension and molecular similarity, the dyed colors remained distinct as they swirled together. While the colors were rapidly mixing and bubbling, the same general shapes were maintained unless touched by an outside force. This allowed great visualization for flow patterns during heating and cooling. If left on the heat, after a long time, the colors began to mix. If the heat was removed while the colors were still distinct, the crayon wax formed a marble sheet with the colors remaining separate.

IV. Photographic Technique

The built in light of the stove top, with white walls around it created a perfect light box for this experiment. To ensure minimal reflection in the liquid, a flash was not used, since the other surrounding light provided enough visibility. For this experiment, I chose to use my roommates iPhone 11. Since I had had trouble focusing nicer cameras for previous experiments, I wanted to try this iPhone since it is very user friendly and has good focus for up close photos. Certainly, these were the clearest photos I have captured of flow up close, so it was a success.
Here I provide the camera specifications for the photo [2].

Camera: iPhone 11 back dual lens camera 4.25 mm
Field View: 12 x 12 cm wide
Distance from object: 3-5 in
Size: 3024 x 4032
File Size: 1.7 MB
ISO: 200
F: 1.8
SS: 1/60 s

After taking the photo, I completed some post processing. I decided to darken the photo to further define the boundaries. This had a dramatic effect and caused the color to pop much better. Lastly, I changed the black point, causing a stark contrast in some areas with deeper coloring. This created a drastically improved image, as shown in Figure 3.

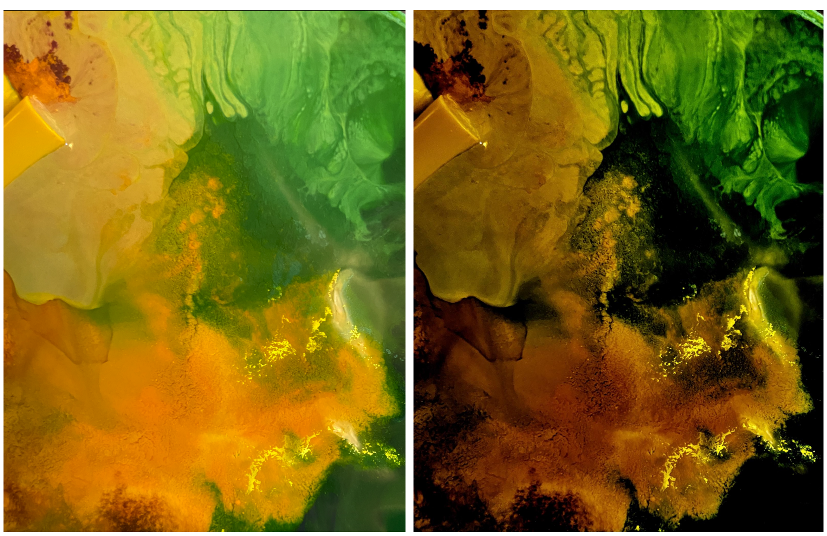


Figure 3: *Before and after postprocessing of the photo.*

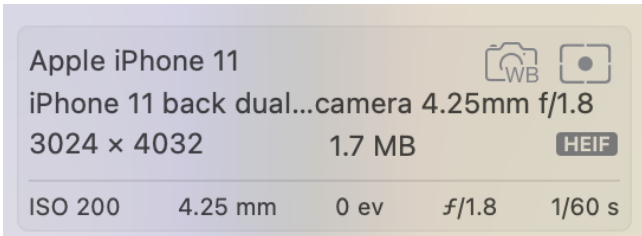
V. Image Commentary

This Image turned out really well. I really liked the coloring of the wax and the post processing made night and day difference. Multiple people thought it looked like outer space nebula because of the black background with colorful explosions mixing together like space images. My favorite part of the image is how dynamically the colors mix together. Though it is only a photo, the flow potentials can be seen, which adds to the significance of the visualizations.

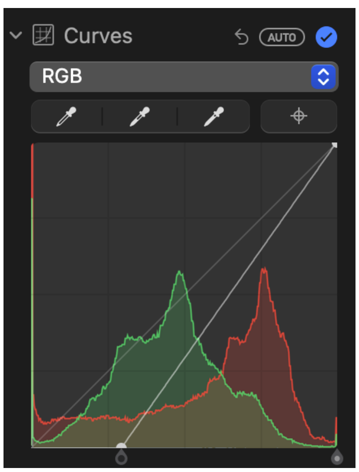
VI. Appendix and References

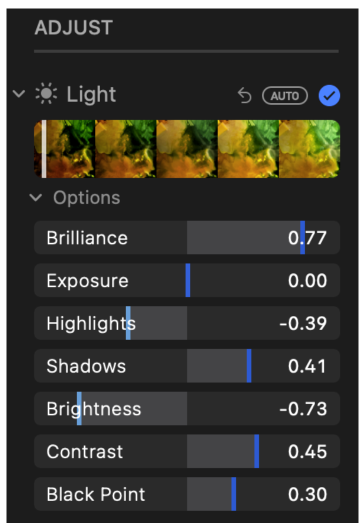
1. Anne Marie Helmenstine, Ph.D. “Find out Where Candle Wax Goes When a Candle Burns.” *ThoughtCo*, ThoughtCo, 28 July 2019, https://www.thoughtco.com/where-does-candle-wax-go-607886.

2. Camera Specifications from final photo:



3. Post Processing Specifications:





4. Anne Marie Helmenstine, Ph.D. “Find out Where Candle Wax Goes When a Candle Burns.” *ThoughtCo*, ThoughtCo, 28 July 2019, https://www.thoughtco.com/where-does-candle-wax-go-607886.