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Flow Vis IV3
MCEN 4151-001
Due 11/7/2022

Automotive Chemicals as an Art

For IV3, my group partner Heider Iacometti and I decided to do something related to one of my passions, fixing vintage cars. I started working at a very special automotive restoration shop when I was 15, and when I moved to Boulder for college, I began work at a new shop of the same nature. I enjoy vintage cars because for me, they are the perfect blend of art and science. Vintage cars look nothing like new cars, and there was more diversity within the industry, both mechanically and artistically, 50 years ago. Flow-vis is a special class for me because it is encompassed in that same space that vintage cars are for me: a balance between art and science. In my garage, I am fixing up my 1973 Alfa Romeo Berlina and 1994 Mazda Miata, and on my workbench I keep a selection of chemicals for repair work. I have been using these same chemicals at work over the past 8 or so years, and I am quite familiar with their properties. Therefore, it was decided that we experiment with these chemicals and see what kind of reactions we can get. The intent of this project was purely experimental, because I have used these chemicals in some combinations (for example using solvents to clean oil off of a metal surface), but I have not combined them in an artistic, exploratory manner. I have seen pictures of and experimented with water mixed with oil, and the magnifying properties of the oil drops on top of the water seemed like a good place to start our experiment.

On my garage workbench, we placed a glass Pyrex Petri dish (¾" deep, 6" diameter) under the lights (standard 36" fluorescent bar x2), which were 3" above the desk surface. Chemicals experimented with include tap water, O'Reilly SAE 30 motor oil, Loctite 274 high strength (red) threadlocker, Redline Engine Assembly Lube, O'Reilly brake cleaner, blue Dawn dish soap, and Home Depot Acetone. The garage door was left open to the outdoor breeze to make sure that any unsafe chemicals would not harm us. We mixed these chemicals in 4 different combinations to test different ratios of each chemical. It was discovered that the brake cleaner created well defined (but hard to photograph) blue-tinged white clouds in the mixture, especially when more water was used. This is likely due to the fact that brake cleaner, which is predominantly hexane, is not miscible with water and tends to float on top. After researching the topic further, I found that because water is a polar covalent substance, it cannot dissolve nonpolar solutes such as hexane. This is because energy is required to catalyze a reaction between a nonpolar and polar substance; in other words nonpolar substances stick with themselves as do polar substances because it is energetically favorable [3]. The water molecule is polar because it has an extra 4 electrons due to covalent bonds between the oxygen and hydrogen atoms, creating electron clouds that "bend" the molecule and form an angle about the oxygen atom [4]. Hexane is a symmetrical hydrocarbon that has no "bending", and is therefore not polar.

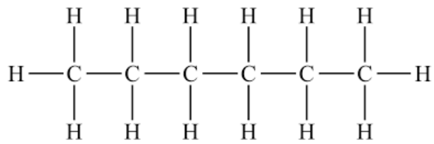

Fig 1: Non-polar hexane molecule [1]

Fig 2: Polar water molecule [2]

The final mixture, used for this project, had approximately 200mL water, 75mL motor oil, 5mL engine assembly lube, and 10mL dish soap. Firstly, the motor oil was added to the water and stirred. After observing large, organically shaped oil splotches, the soap was added with the aim to reduce the size and irregularity of the oil. After stirring, the oil became stratified into very small diameter, circular shaped dishes. Soap allows the oil and water to mix more than they ordinarily would due to adding hydrophobic and hydrophilic bonds between the polar water molecules and the nonpolar hydrocarbon molecules of the oil [5]. Then, the engine assembly lube was added. It was difficult to estimate the volume added, because it is extremely viscous and sticky; it is usually applied with a nylon-bristled brush. The main effect with the engine assembly lube was to create vibrant color, as it did not freely mix with any of the other substances due to being extremely viscous. Interestingly, it behaved similarly to the Loctite, both substances being bright red and not mixable with the other ingredients.

Additionally, we experimented with several different backdrops for the Petri dish, as it was totally clear. I had seen pictures of bright, colorful backgrounds, which seem to highlight the interface between the oil and water. Using a colorful magazine spread directly below the Petri dish was distracting, as the depictions in the magazine took away a lot of the highlights of the mixture. After testing with the colorful magazine spreads, I came to the conclusion that these pictures had been taken with the background far from the surface of the water, because they had become zoomed in due to lens settings (camera far from surface, heavily zoomed in, focused on surface). This was not desirable for our setting due to lighting and fixturing limitations: I only had a trio of 36" standard fluorescent lights around the garage, 2 small windows and the open garage door letting in dim late afternoon light. So, we used standard white paper towels and blue Scott shop towels, which are a heavy-duty non-textured disposable paper towel. The texture on the standard white paper towels also proved to be distracting, as did the textured wood finish of my workbench, so the blue shop towels became used in the final image. Having the blue shop towel was also a compliment to the gold motor oil, which are near-opposites on the color wheel.

The camera used was my Canon EOS Rebel T6 with a Canon EFS 18-55mm, 0.25m lens, taken approximately 1.5 feet from the surface, looking almost directly down at the surface to avoid reflections from the light. The original image was 5184x3456 pixels, with an f/8 aperture, 1/160 second exposure time, 3200 ISO, and 55mm focal length. The cropped image was 4671x2260 pixels, with an approximate field of view being 4x2 inches. Cropping was done to create a very wide image, and also to eliminate some blur and curve of the Petri dish. The post-editing was done to increase the contrast and especially the saturation, so the viewer can more clearly see the interfaces between the oil, water, and red engine assembly lube. I played with the RGB curve, yellow-blue contrast, saturation, sharpness, and vignette settings.

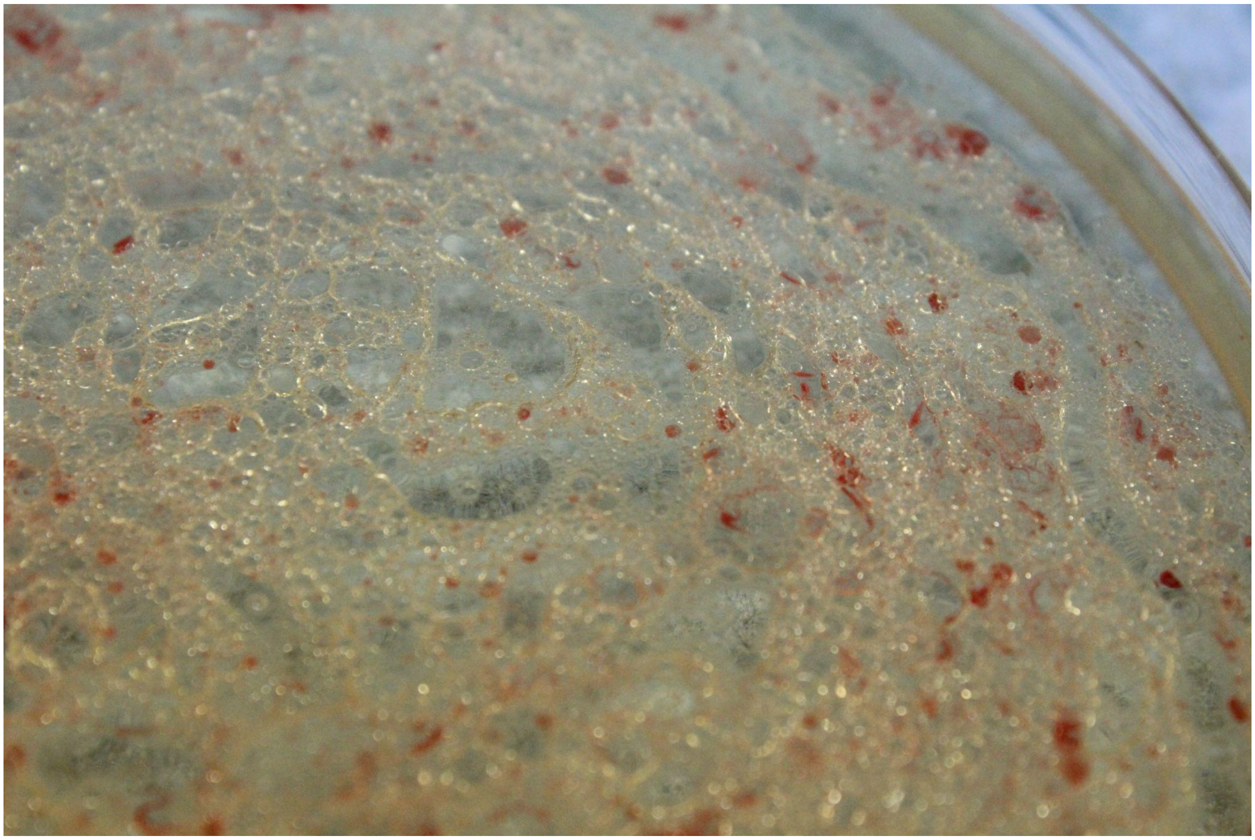

Fig 3: Original, unedited image

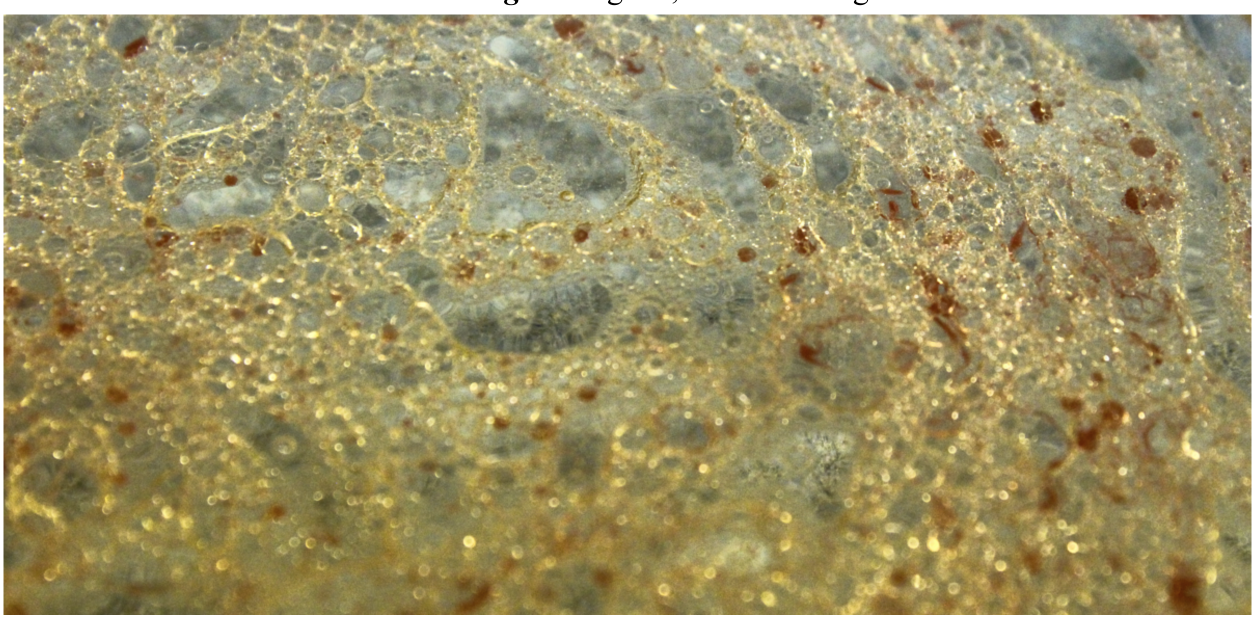

Fig 4: Edited image

This image reveals that the interactions between polar and nonpolar chemicals, even in a stationary setting, are quite complex and are not homogeneous. This was my goal with the project, so I feel like I accomplished it. All in all, I feel like I learned the most about photo editing in this project. Aside from avoiding reflections and background distractions, the photography was not the most challenging. However, it was a balance in clarity and subtlety to find an edit that I was proud of, so I tried a ton of different settings and manipulations. Even though the project itself was not the most riveting, adding photographic modifications allows us to see further into a simple mixture.

References:

[1] http://www.chem.ucla.edu/~harding/IGOC/H/hexane.html

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