

Max Kitay

ATLS 4151 - Flow Visualization

Image-Video #1

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This image was captured for the first assignment in ATLS 4151, Flow Visualization. The purpose of this assignment was to get our feet wet in the realm of flow visualization, “the process of making the physics of fluid flows visible.”¹ My original intent with the image was to capture the interesting blending patterns created by mixing food coloring and honey. After capturing a few photos of that phenomenon in a glass, I decided to add some baking soda and vinegar to the glass to observe the reaction. This caused the glass to fizzle up with bubbles and when the bubbles settled I was left with this carbonated vinegar/honey mix seen in the image. I was assisted by my friend, Arden, who helped add various fluids to the scene and hold the glass in place as I was shooting the image.

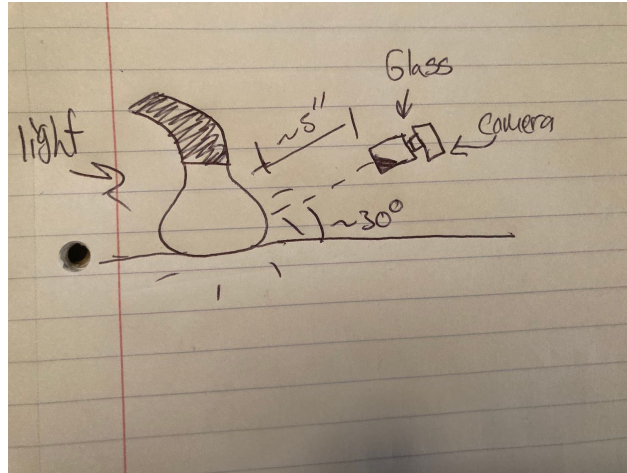
There is quite a lot going on in this image in terms of fluid flow, which is part of the reason why I chose this as my final image. Firstly, you can see the decomposition of the carbonic acid, which formed during the baking soda and vinegar reaction, into water and carbon dioxide gas. This is seen in the bubbles throughout the image, similar to carbonation in soda.² Secondly, in general throughout, but particularly towards the right side of the image, where the bubbles clump together, you can see an example of the Cheerios Effect.³ This occurs as a result of the adhesion of water molecules toward the edge of a surface attracted to the highest point on a meniscus, where the water curves up towards the edge of the glass due to its attractive force. This is why the bubbles clump to each other as well as the sides of the glass once they reach the surface. Lastly, the swirling patterns in the center of the image show the non-diffusive strings of food coloring within the honey. The food coloring does not mix with the honey due to its high viscosity, this allows the food coloring to almost float freely in the honey space without diffusing.

The visualization technique I used to capture these flow phenomena is the use of dye. The distinctive use of color dye is very evident in the honey swirls. I first administered a few drops of purple and magenta food coloring by *Wilton Gel Food Colors*, and mixed it around the *Local Hive Authentic Wildflower Honey* with a knife. When I added in the *Signature Select* distilled white vinegar and baking soda the color dye turned it a dark blue shade. The lighting I used to capture this image was a custom made 3D printed lamp consisting of a white LED strip surrounded by a translucent layer of PLA. My partner held the glass about 5 inches from the light source at a roughly 30 degree angle from the table, as I held the camera lens right up against the edge of the glass.

¹ Hertzberg, J. (n.d.). The Physics and Art of Fluid Flow. Retrieved September 22, 2020, from <https://www.flowvis.org/>

² What Happens When You Mix Vinegar and Baking Soda? (n.d.). Retrieved September 22, 2020, from <https://www.wonderopolis.org/wonder/what-happens-when-you-mix-vinegar-and-baking-soda>

³ Than, K. (2005, September 21). Cereal Science: Why Floating Objects Stick Together. Retrieved September 22, 2020, from <https://www.livescience.com/9350-cereal-science-floating-objects-stick.html>



(Sketch of shot setup)

Holding the camera lens directly to the edge of the glass allowed me to capture what was going on inside the glass without much distraction from its surroundings. Originally the image included the sides of the glass, however I decided to crop that out to focus in on the action and get a closer look at the flow phenomena. The original image size was 6000 x 4000 pixels and the final cropped JPEG measured 1079 x 900 pixels. The shot was taken with a Nikon D3500 camera and an 18-55mm lens set at a focal length of 22mm. The exposure time was set at 1/30 second with an aperture of f/3.8 and ISO of 110. This image was shot freehand, without the use of a tripod. In post production I did quite a bit of editing within Adobe Lightroom Classic including slight adjustments to exposure, contrast, highlights, shadows, blacks, and whites. As well I adjusted luminance values for purple, blue, magenta, and aqua within the image. I used the dehaze function to sharpen the image a bit as well as increased presence with the texture and clarity sliders.



(original image before editing)

This image reveals to me the simplicity of capturing the physics of fluid flow right in your own home! I had no idea the vast array of fluid experiments that could be conducted and captured in an everyday setting and produce such beautiful results. I enjoy the chaotic nature of this shot as well as the unnatural, vibrant colors captured throughout. There is also a really beautiful contrast between the bright pinks and dark blues and the bright white of the background with the dark blue fading to black of the vinegar. I believe the fluid physics are displayed quite clearly as discussed earlier, however a simpler setup may be easier to break down what is actually going on as this scene was quite chaotic. On the other hand, I may not have gotten such a wild image without the mixing of various experiments. Overall, I am very pleased with this piece and am looking forward to capturing more vibrant images moving forward.