Grenadine and Sprite

9/17/2025 - Get Wet

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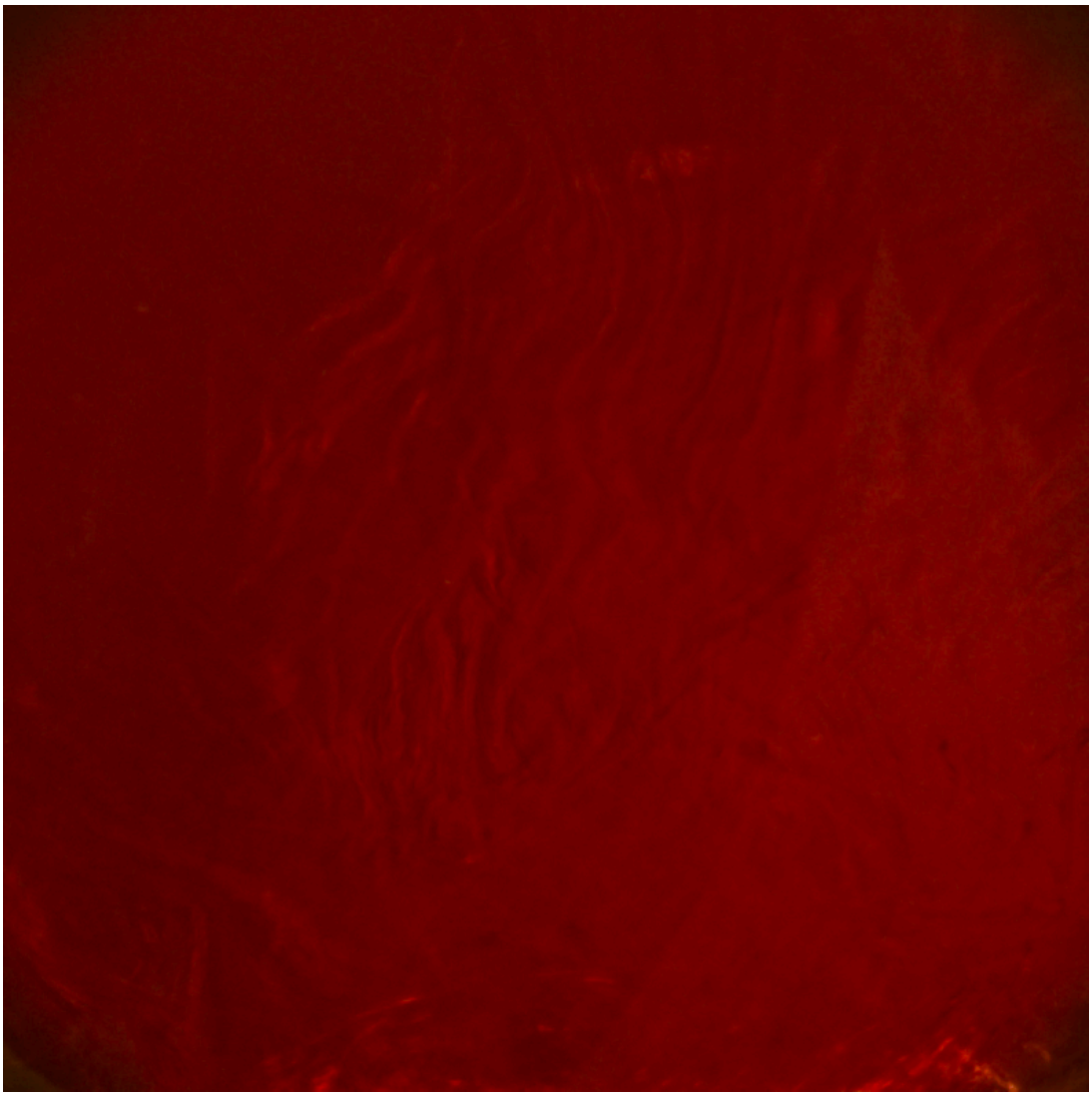
Flow Visualization - 002



Introduction

The primary purpose of the image I created is to visualize the swirling eddy currents that occur at the boundary between Sprite and grenadine. The image uses the difference in color between the two liquids to highlight the phenomenon, but because of the difference in densities and the Sprite being a clear medium the effect looks similar to a schlieren imaging technique. Because the setup did not include a knife edge or other object to increase the contrast it doesn't count as true schlieren but it is similar. The denser grenadine sinks and swirls, creating distinct visible patterns against the lighter Sprite, which allowed me to visualize the flow in a manner analogous to a schlieren image.

Flow Apparatus

In order to capture the swirls, I first poured a glass full of sprite and used the back of a spoon to gently sink the grenadine along the side of the glass so I had a crisp line. Once the liquids were set up I dipped a spoon to the bottom of the glass as slowly as I could to avoid premature mixing. I then set up with my camera and lighting, and I had my roommate pull the spoon straight upwards to cause the liquids to mix slightly, but not so fast that they mixed homogeneously.

Flow Physics

The fluid dynamics in the glass are governed by several key forces. The primary driving force is the low-pressure area created in the wake of the spoon as it is pulled upwards. This pressure gradient causes the surrounding fluids (both Sprite and grenadine) to rush into the void left by the spoon. The properties of the liquids, specifically their densities, determine how they respond to this force. Grenadine, being denser than Sprite, tends to sink and resist mixing more. Its higher surface tension helps maintain the distinct boundary lines as it is pulled upwards and swirls into the Sprite. The interaction of these forces is what produces the visually striking, swirling patterns that can be seen in the final image. In order to quantify the physics being seen I calculated the Reynolds number for both fluids so that I can know for sure if the flow is turbulent or semi-turbulent.

$$Re = \frac{\rho v L}{\mu}$$

- Characteristic length (L): 8cm
- Characteristic velocity (v): ~0.1 m/s.
- Dynamic viscosity of water (μ): 1×10−3 Pa·s (used as an approximation for fluids used)
- Density of Sprite (ρ): 1040 kg/m³.
- Density of Grenadine (ρ): 1200 kg/m³.

Using the numbers listed above I calculated the Reynolds number for the sprite as 83200, and 9600 for the grenadine. Both of these numbers are well above 4000, which means that they are solidly in turbulence. This is consistent with the swirling patterns that can be seen in the image.

- Time resolution = 1/80 second
- Spatial resolution = (0.1 m/s) / (1/80 s) = 0.00125 m = 1.25 mm

Visualization Technique

The visualization technique used in this project is dye visualization, with Roses Grenadine serving as the dye. The experiment was conducted indoors under climate-controlled conditions with minimal airflow in the vicinity.The surface the glass was on was measured to be level and once the experiment was set up the table wasn't touched again. There were no dilutions of the grenadine or sprite. For lighting, two desk lamps were used. They were positioned at opposing angles to illuminate the glass and minimize shadows, which helped in clearly capturing the swirling patterns of the grenadine in the Sprite.

Photographic Technique

To take this photo the Olympus OMD E-M5 MKii was used, along with the M.Zuiko 14-42mm f/3.5-22 lens from Olympus. The list below includes all of the specifications and settings used to take this image. These settings were chosen because the flow was decently slow, but the lighting setup wasn't ideal so more light needed to be let in.

- ~55° FOV
- 18 inches from the lens to the glass
- Digital Mirrorless, 4639 x 3471 px, 1000 x 1000 px
- f/5.6, 1/80 s, ISO 100
- Crop, Vignette, Exposure, Red RGB curve, Tone Equalizer

(Figure 1: Unedited image)

Analysis

This image reveals the turbulent flow present when stirring a drink, specifically a shirley temple. I really like the overall mood of the image, I'm very partial to darker images with a chaotic or otherworldly look. I think my editing style adds to that feel, since I really like to use a vignette and increased contrast/tone to make the shadows pop. I think the physics are shown decently well, but could be improved. One piece of advice I got in my critique was to zoom out the crop so that you can see the size of the glass and have a scale for the flow. I would like to improve the overall quality of the image, I took the photo from farther away than I needed to and zoomed in with my lens but I still had to crop the image a lot to make it look how I wanted. To develop this further I think a better lighting setup and taking the photos closer would improve it greatly. That would allow me to make the shutter speed faster and freeze the flow even more, as well as have much greater detail in the image.

References

1. Van Dyke, M. (1982). *An Album of Fluid Motion.* Parabolic Press.
2. Smits, A. J. (2012). *Flow visualization: techniques and examples*. World Scientific.