Get Wet Report

Visualizing Boundary Layers

Figure1: A capture of the flow

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Helped with the experiment:

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Introduction

For the first assignment of the course, initial thoughts were put in order to start and visualize a fluid phenomenon. While brainstorming with Abdullah and Abduljalil, we came up with the set up first. After that, we put two different layers on the container. The layers were water at the bottom and vegetable oil at the top. Then, we thought it would be interesting if we toss in an egg yolk to see how the layers would react.

Experimental Setup

The experiment was done at Abdullah's apartment. On a table, the container was put in front of an A4 paper. Behind the paper, three phone flashes were held to give more usable lighting. Another floor lamb was providing light from the right side of the container. The setup would have been more professional if there was a tripod to make the video more stable. The container was 3.9 inches tall and the diameter was 4.1 inches. The distance between the camera and the container is around 8 inches.

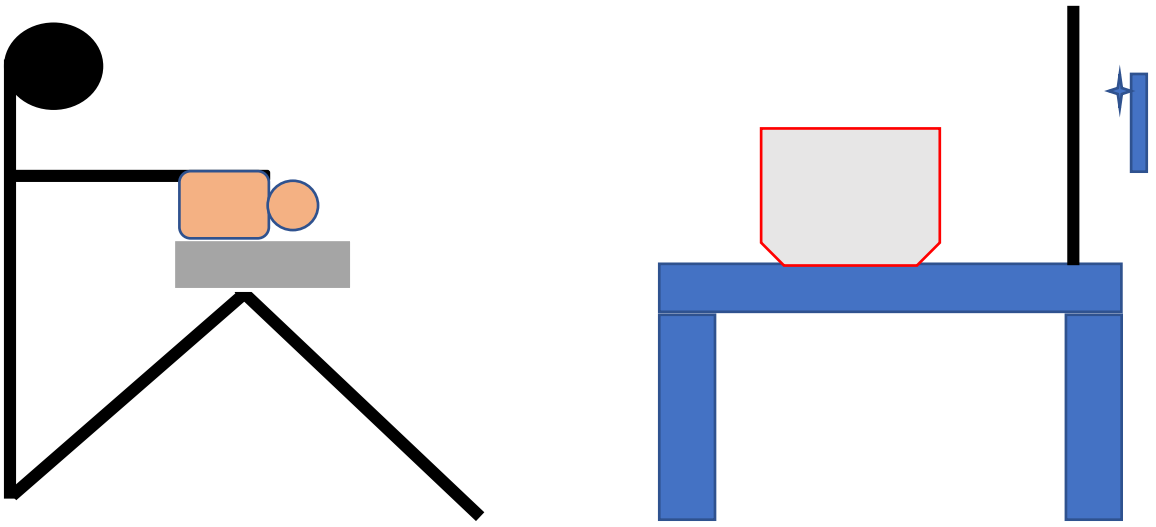


Figure2: Sketch of the setup

The sketch illustrates the setup for the experiment. Since I did not have a tripod, I sat down in front of the container and put the camera on a pillow on my knees to make it as stable as possible.

Flow physics

The experiment showed how fluids would behave under the Rayleigh-Tayler instability. Initially, water at room temperature was poured into the container. Then vegetable oil was poured. As seen from the video, oil and water do not mix due to their chemical nature and that helps with Rayleigh-Tayler instability to last. In addition, oil is staying at the top because it has less density than water. After leaving the fluids to become static, an egg yolk was poured approximately 2 inches from the surface of the oil. Since the egg yolk is denser than the oil and water, it pushed the oil down and stuck with some of it. After the oil was dragged down, the buoyancy force was pushing the oil to go back up. Some of the dragged oil came back up and the rest got stuck with the egg yolk and could not get back up. This due to the force exerted from the egg yolk which is stronger than the buoyancy force of the water. The Rayleigh-Tayler instability occurred after the oil was dragged downward because, the phenomenon happens when a fluid pushes on a heavier fluid (Cook, Andrew. W & Youngs, David 2009). Comparing the densities between the three fluids:

Fluid	Density in g/mL
Water	1 or a little less
Cooking Oil	Around 0.92
Egg yolk	Around 1.025

Techniques Used

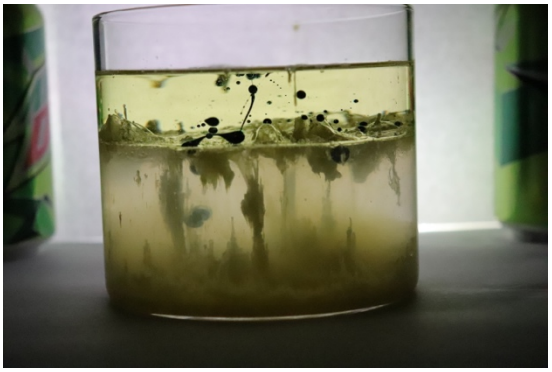
- Camera techniques the camera that was used for taking the video is a Canon rebel SL2. The video was taken at 1080p resolution and 60fps. Those are the highest settings that the camera can go for.

- Editing techniques

The video was edited using iMovie at a MacBook. Cropping from both sides was needed to get rid of distractions. Then a “glow” filter was used to give the video a better contrast and to make the flow clearer. Furthermore, the video was slowed down to 70% of the actual speed. Music was added to give more aesthetics to the video. Lastly, the video was reversed after the actual video ends to make the video longer and more appealing for the viewer.

Conclusion

In conclusion, the experiment had captured good physics phenomenon. The setup was good enough to capture such experiment. Throwing any heavy fluids instead of egg yolk may give a similar result of showing the Rayleigh-Tayler instability. Similarly, other software could be used to edit videos by doing slow motions, add or remove audio, and change the colors to get better results without missing with the physics behind the flow. There were some mistakes that can be avoided for future experiments. For example, camera instability, lighting to show the egg yolk instead of making it look black, and make the video longer.



Just for fun, the container was left for a while and then food dye was added.

Figure3: A capture of the container after a while

References

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