Faisal Alismail
Assisted by Team 3
Team First-Fall 2019
MCEN 4151 Flow Visualization
October 14, 2019

Team First Report

Part of this course is working in a group to create a picture or video that demonstrates a fluid mechanics phenomenon. Therefore, this image was taken as a part of the first team assignment this semester. As a team, we decided to do an experiment that involved multi-layers of fluids with different densities. Then we captured the result as a tube was pulled out of the vase that was containing the fluid layers. The people who worked with me in this experiment were Dawood, Sam, Audrey, and Meg. Each one contributed equally to setting up the experiment by getting some equipment from the project depot and filling up the container with the fluids. Then placing the vase on an overhead projector and providing the lightening needed to capture the image.

The phenomenon demonstrated in this image is called immiscible fluid flow. Fluids are called immiscible when they are insoluble upon mixing. That is proven in this picture as we see the five different fluids such as maple syrup, dish soap, water, canola oil, and isopropyl alcohol forming five separate layers. The separation of their layers is due to the fact each fluid has a different density value. For instance, maple syrup has a density of $1.37\,\frac{g}{cm^3}$, dish soap of $1.06\,\frac{g}{cm^3}$, water of $1.00\,\frac{g}{cm^3}$, and canola oil of $0.92\,\frac{g}{cm^3}$ [1]. The isopropyl alcohol has a density of $0.786\,\frac{g}{cm^3}$ [2]. In the original image shown in figure (2), we see a plastic tube that was used to pour all fluids into the vase as will be explained in detail in the next paragraph. This tube was used to test and demonstrate that each flow, when mixed with other layers, would fall back to its zone. Meaning, as we pulled the tube up, the tube dragged some of the heaviest fluid along with it. Then at a certain point, when the fluid started to accelerate downward and leave the plastic tube, it touched the surface of the fluid and then fell back to its layer. Below is a schematic illustrating the experimental setup.

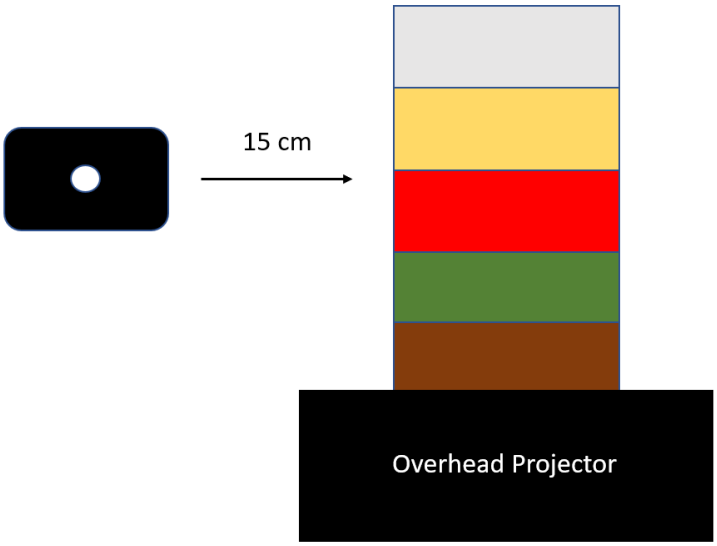

Figure 1. Show the experimental set up.

The team used different materials and techniques to setup and perform this experiment. For the set up, we used a large vase and a tube. The fluids used in this experiment (from bottom to top) were maple syrup, green dish soap, water, canola oil, and isopropyl alcohol. The way we ranked those fluids were from higher densities being at the bottom to lower densities being at the top. To add the fluids, we used a funnel attached to the top of the tube. As the fluid entered the vase, it went straight to the bottom of it, which helped to keep the side walls of the vase clean. Then we removed the funnel and the tube and cleaned them. Next, we put them back and added the next fluid in. The vase was placed on an overhead projector with the flashlight turned on. The lights inside the room were off, to focus the light source on the fluid layers.

The camera used to capture this image belonged to Meg, and it was a Nikon D3300. The lens used on the camera was Nikon AF-S DX Nikkor 18-55mm f/3.5-5.6G VR II. It was placed at an approximate distance of 15 cm away from the vase. The aperture was set to F/4.2, and the shutter speed was 1/500. The focal length and focus distance were 30 mm, and 0.56 m. The ISO was at 900. The width and height in pixels of this image were 6061 and 4016. The editing was done using an application called Darktable, which can process raw format. I cropped the image to focus the attention on the flow as it fell from the tube and each fluid traveled back to its layer. Also, I set the highlight color adjustment at 50% to provide the image with the brightness it needed to show the flow layer inside. Other settings were left as is.

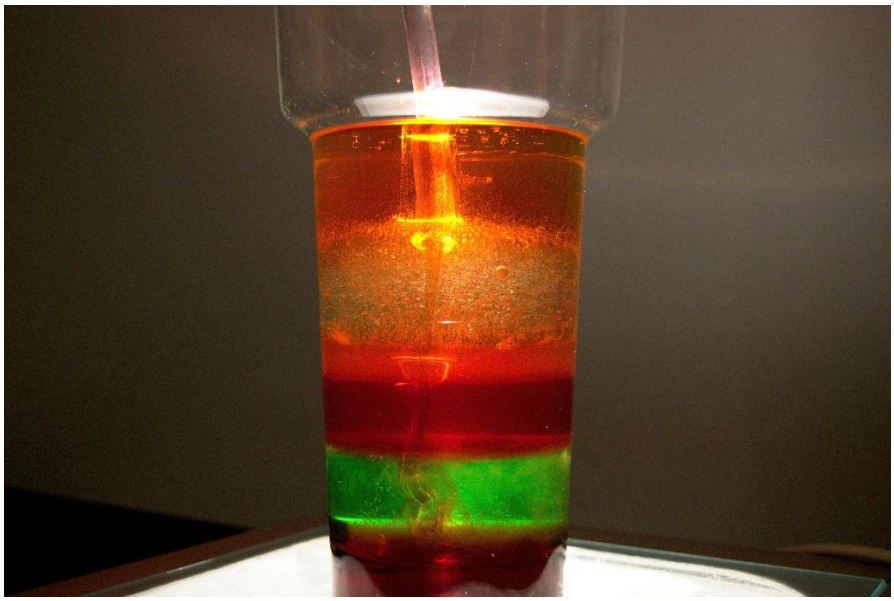

Figure 2. Shows the original image.

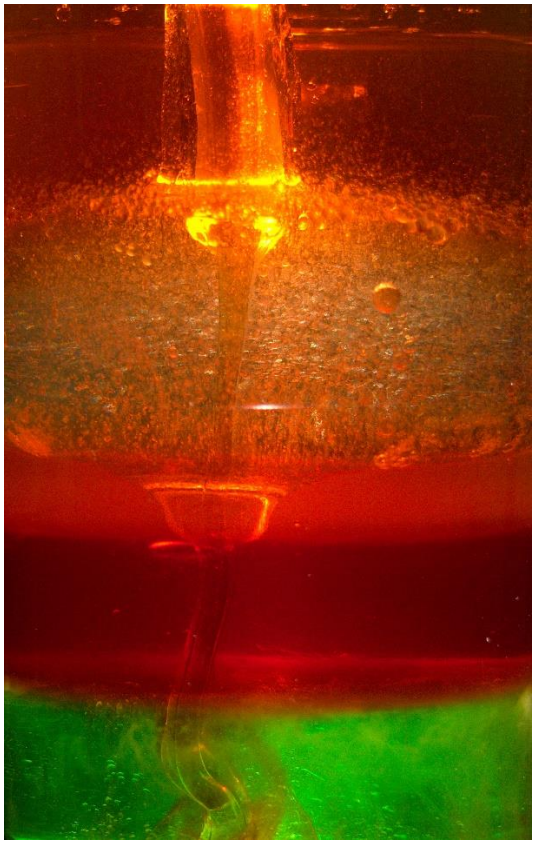

Figure 3. Shows the edited image using Darktable.

In conclusion, this image reveals the phenomenon of immiscible fluid flow and how fluids of different densities do not mix. I like this image because of how colorful it is and how we managed to demonstrate the phenomenon on a transparent vase. In my mind, this image fulfilled its intent and what it needed to deliver which makes me happy. Regarding the aspects of improving this image, I wish that I had better photoshop skills to edit it more professionally.

References

Amazing 9 Layer Density Tower - SICK Science!: Experiments: Steve Spangler Science. (n.d.).

Isopropyl alcohol. (2019, October 11).