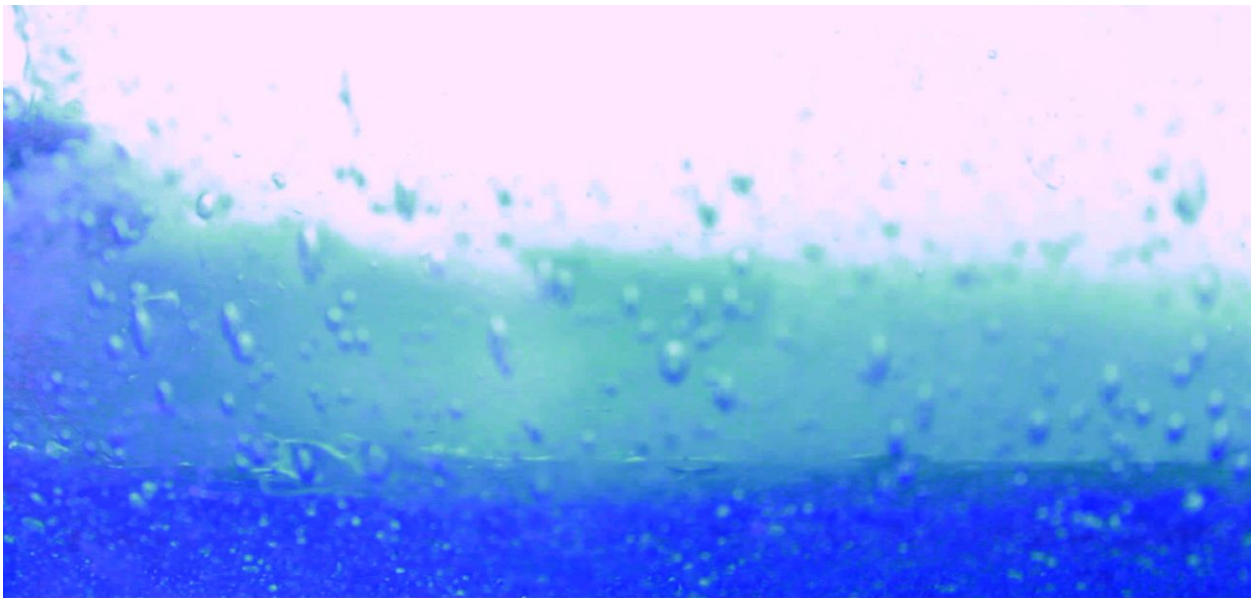


MCEN 4151: Flow Visualization

Section 001

Image-Video 01 Report

Abdul Dawlatzai



The image-video one assignment allowed us to dive into the flow-visualization world and experiment capturing different phenomena. The experiment being run is a super viscous fluid mixed with water being poured down the side of a clear container. An individual can see the elongated bubbles being stuck to the side of the clear bottle from the surface tension and viscosity of the actual fluid. The intent of this experiment was to capture how having a high viscosity distorts fluid flow.

Link to video of set up: <https://vimeo.com/456062961>

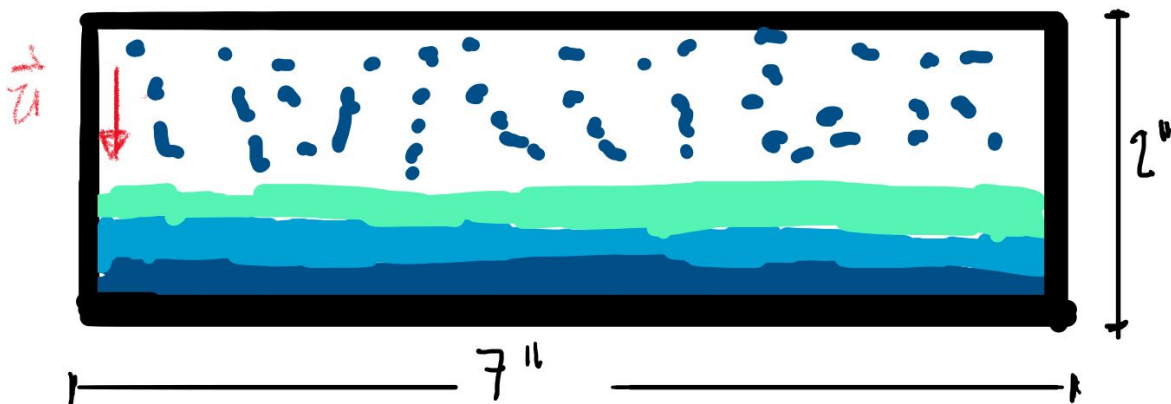


Figure 1: Fluid Apparatus sketch

The overall flow of the fluid starts off turbulent due to gravity but then slowly turns into a laminar flow when it works its way towards the bottom. The bubbles being shown have an elongate middle section because of the curvature of the clear rounded container. The Reynolds number throughout the duration of the whole experiment changes as a function of height. The fluid starts off rapidly which causes a turbulent flow but as the fluid goes further down, the viscosity and friction play a bigger role which slows down the flow.

$$Re = \frac{UD}{\nu}$$

Figure 2: Reynolds number Equation

The visualization technique I used was using letting fluids go in freefall due to gravity. The exact fluid being used was Softsoap for Men Active Moisturizing Body Wash Ocean Fresh which contains Sodium Laureth Sulfate, Cocamidopropyl Betaine, Decyl Glucoside, Sodium Chloride, Fragrance, DMDM Hydantoin, Polyquaternium-7, Tetrasodium EDTA, Citric Acid, Benzophenone-4, FD and C Blue No. The combination of all these ingredients create a highly viscous fluid. There was no flash on the camera but I used direct sunlight with a blank white background to obtain the lighting that I did for this photo.

At first, the photo had a large field of view, I decided to crop it for aesthetic reasons and having too much view turned my attention to the bubbles and that is what I was aiming for. The distance from the object to the lens was very close, within inches. It was challenging to get a good focus at such a short distance but lowering the ISO and using manual focus helped. The image was captured using a canon camera, the original image had a size of 5184x3456 pixel. I use darktable to add sharpening to the pic using a filter. I also changed the saturation to a green tint to the image.



Figure 3: Before picture, note: this is not the exact picture due to technical problems but it is in the same environment that was used for the main picture above.

This image reveals how viscosity affects friction and surface tension. The higher the viscosity, the smaller the Reynolds number. I did not like the focus and sharpness of the picture. I believe that the fluid physics being shown is good because it tells the story of the fluid. At the beginning, the bubbles are short and slowly get longer in the middle then back to short when the fluid approaches the end. I fulfilled my intent on this picture, to improve this picture I would like to use a camera with better focus, being able to get a crystal clear image. To expand this idea, I would like to use different color fluids (each having their own viscosity) to better demonstrate how viscosity affects fluid flow.

References

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2. Rehm, B. (n.d.). Reynolds' Number. Retrieved September 20, 2020, from <https://www.sciencedirect.com/topics/engineering/reynolds-number>
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