

Team First
Fall 2019

MCEN 4151-001: Flow Visualization

Date: 11/11/2019



By: Abduljalil Almashama
Instructor: Jean Hertzberg

Contributors: Abdullah Alsaffar, Salah Ammar

INTRODUCTION

For the "Team Second" assignment, I wanted to change things up and instead try to demonstrate a special fluid phenomenon using video rather than a still image. This was my first time doing something like this and served as a good introduction to the video editing world for me. The team decided to explore dry ice interactions this time, while adding food coloring and water to explore different results and effects. Since I'm utilizing video footage, I included a number of different reactions in the final results rather than just showing one interaction. I showed a total of different 5 shots of the dry ice interactions using food coloring and water. This experiment was done collaboratively with Abdullah Alsaffar and Salah Ammar.

EXPERIMENT SET UP

For this experiment, we mainly used dry ice and food coloring which were submerged into warm water. The used dry ice chip was approximately 1 inch by 1 inch, while the glass that was filled with water is an average/normal size glass. A dark blue piece of cloth was used as a background for this experiment. I wanted to change things up for this assignment since up until now I have been mainly using white light background for my images. For lighting, we used an iPhone X camera flash to light up the glass from the bottom as shown in the image photo below. Furthermore, a lamp light was used to induce a very strong and bright lighting from above. All of the other lights in the room were turned off. A sketch of the experiment set up along with the actual picture of it is shown in Fig. 1.

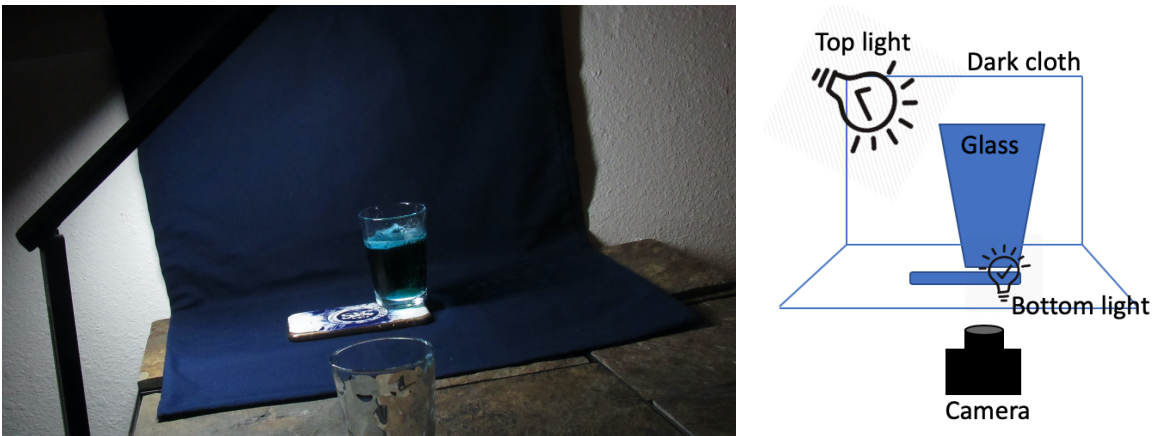


Figure 1. A sketch and a photo of the used setup.

Through a different number of experiments, various food coloring were dropped while submerging the dry ice in water in order to observe different artistic looks and flow visualization. All of the shots in the video were taken using my Canon PowerShot SX530 HS camera, with lens 4.3-215.0 mm. Since there are more than one shot, the settings were varied slightly with each experiment. All of the videos were shot using 30 frames per second at FHD. The FOV also varied, but it was averaged to be approximately 2 inches between all the shots. The distance from the glass to the camera lens was also varied depending on the shot, but none with farther than 5 inches (maximum approximation). The camera settings were as follows: ISO:400, f stop (aperture) was F5.6. The SD card had a write speed of 130 MB/s.

FLOW PHYSICS

There are a variety of different flow phenomena experienced in the various shots of this video. These include the fake fog effect, the simulation of "boiling" water, and finally the gradual state transform of dry ice as shown in the fourth image. To understand all of these we must first know what dry ice actually is. Dry ice is basically a frozen carbon dioxide (CO_2). However, under the extremely low temperatures and high pressures, it gets solidified to the shape we are all familiar with. To get the fog-like effect, the dry ice must be heated until it converts back to the gaseous state in a process known as sublimation. Sublimation is when a solid transform directly to gaseous state without having to enter the liquid state in between ^[1].

For sublimation to occur, a significant amount of heat must be transferred to the dry ice. The heat source can be any liquid, which in our case was chosen to be water as it was readily available but also is good at storing heat. The water's reaction to all of this heat being transferred to is a probable cause for the boiling effect observed in the third image. Another explanation for the "boiling" can be due to surface tension, which forms carbon dioxide bubbles of the rising gas ^[2]. The continuous increase of pressure due the rising gas is what causes these formed bubbles to pop releasing even more gas which was trapped inside. This also be the reason of those ring vortices observed in the first and fifth shot of the video ^[3]. Since there observed vortices are smooth as we can see, we call the flow Laminar.

VIDEO EDITING

All the video editing for this assignment was done using Adobe Premiere Pro CC 2019. Whereas all of the original videos were shot using my Canon PowerShot SX530 HS camera. Most of the edits were aiming to have more focus on the actual glass and flow and trying to isolate the background by increasing the contrast and some other options. The used setting for each of the five segments were as follow: For the first segment, the blacks setting in the basic correction menu was adjusted to -100. Furthermore, the video was reversed since I thought this would create various observed shots instead of having them be really similar. The second shot had its temperature and shadows values be changed to 100 and -100, respectively.

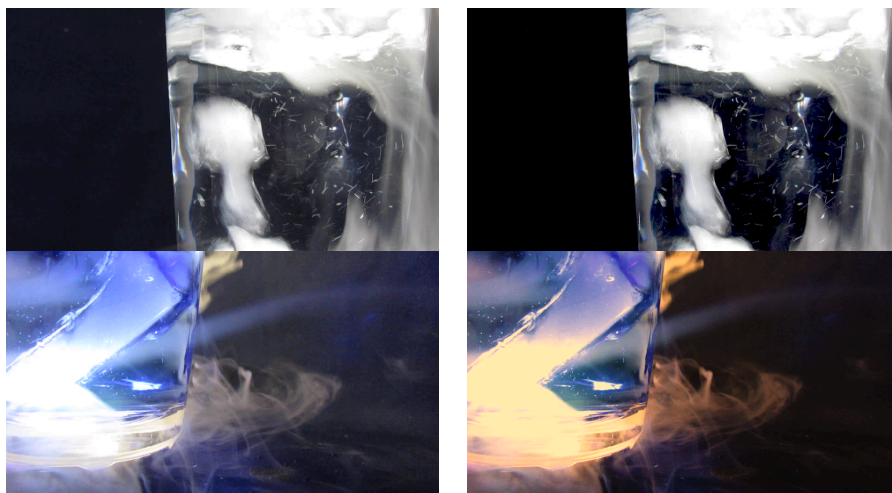


Figure 2. Comparison for 1st and 2nd shots of the video. Original is left and edited is right.

The third section received the most corrections since I really didn't like the original contrast with the background. I changed the setting to make the colors as vibrant as possible and make the flow more recognizable. The settings were: Shadows and Blacks to -100, and saturation to 200. For the fourth image, I wanted to focus more on the sublimation changes to the ice while it changes phase inside the glass, therefore I increased the video speed to 400% and had the colors be just black and white. The final shot didn't receive any color corrections since I was already satisfied with the result, but I reversed it to play backward.

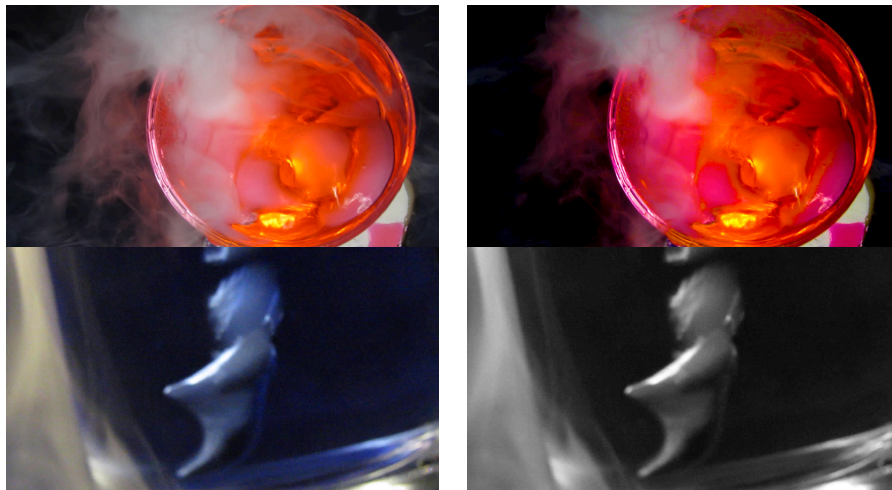


Figure 3. Comparison for 3rd and 4th shots of the video. Original is left and edited is right.

CONCLUSION

In this assignment, I had my first experience being exposed to video editing. I started by downloading Adobe Premiere Pro CC 2019 and learned the basics along the way as I was editing the video. This got me excited to try doing more videos in the future and expanding my horizon in that field instead of solely relying on photos. Sometimes video can really be significantly more effective in explaining the flow and showing the phenomenon being studied. I hope that I was able to highlight how beautiful and interesting this flow experiment was through my video editing.

REFERENCES

- [1] <https://sciencing.com/happens-put-dry-ice-water-6318058.html>
- [2] <https://www.chemedx.org/blog/dry-ice-water-cloud>
- [3] <https://www.thoughtco.com/why-dry-ice-makes-fog-606404>