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Team Third Image/Video
MCEN 5151: Flow Visualization
December 14, 2019

I. Introduction

For my team's final assignment, we decided to revisit the theme of fire. This time, however, I chose to use new materials in order to affect the way the fire acted. Once again, I decided to use a video to capture the phenomenon, due to the fact that it captured the details more effectively than a single picture would. The final video is two videos cut together, in order to maximize the audiences understanding of what is going on. I would like to acknowledge Peter Rosenthal and Conan McHugh as collaborators for my video. Peter provided the butane torch that we used, and Conan provided the grapefruit. Conan is also the one seen in the video holding the grapefruit peel up to the flame.

II. Photographic Setup

The setup for this experiment was done in the same concrete alcove as our team first assignment. The experiment was run after sunset, at roughly 5:15PM. This allowed us to keep the flames and materials isolated from other flammable items, such as plants or debris. Below is a diagram of how the camera, flame, and grapefruit were placed. The diagram is not to scale.

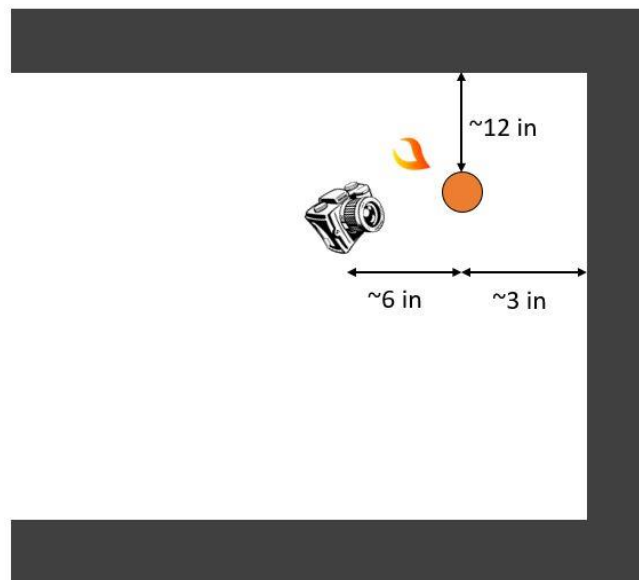


Figure 1: Diagram of Photographic Setup

III. Fluid Dynamics

What we are able to see in the video is the essential oils from the peel of the grapefruit interacting with the flame, causing it to spark and grow. But it is important to understand why this happens. Citrus fruits contain a specific chemical in their peels, known as limonene [1].

Limonene is moderately flammable, with a NFPA 704 flammability rating of 2 out of 4 [1]. This means that the material must be “moderately heated or exposed to relatively high ambient temperatures before ignition can occur” [2].

IV. Visualization Techniques

In order to effectively capture the flame, I found an area that was sufficiently dark. To do this, our team waited until after sunset to take pictures and videos, and also utilized a secluded area away from ambient light. There were no other specific techniques used to capture the flow more clearly.

V. Photographic Techniques

The videos were taken on my Google Pixel 3 phone camera, and was shot at 30 frames per second. The video was filmed using the slow-motion setting of the video recorder.

For post processing, I focused on optimizing the impact of the phenomenon by cutting two videos together. The original videos were relatively short and therefore I felt that they did not leave enough time for the audience to understand what was happening. By playing the two videos back to back in one sequence, it allows people the time needed to fully take in the contents of the video.

After editing the two videos together, I added music to the final video. I did this because, like my first video, I felt that music would add depth to the video. The music used in my final video came from a royalty free music website, <https://www.bensound.com>. The song I chose is titled Summer. Like my first video, I chose an upbeat and happy song to accompany my fire. I did this because I enjoyed the emotion it conveyed. A heavier or darker song would have come off as heavy-handed and over bearing, while a light song complemented the theme without upstaging the phenomenon in question.

Privileges for the song can be found in the figure below, which prompts the user anytime they choose to download or purchase rights from the website. I used the song with the “Free Creative Commons License”.



Figure 2: Right to use from <https://www.bensound.com>

VI. Results

Throughout this semester, I have learned so much about fluid physics, flow visualization techniques, and photography. It feels right to have a final assignment that comes full circle to my

first assignment. I am proud of the quality of work I have been able to produce, especially considering how little I knew about photography before starting. For this assignment specifically, I believe I was able to capture a unique reaction between butane flame and the essential oil from a grapefruit peel. If I were to do this over again, I would like to try using a higher quality slow motion camera, in order to more clearly capture how quickly the flame grows when in presence of the oils.

VII. References

- [1] National Center for Biotechnology Information. PubChem Database. Limonene, CID=22311, <https://pubchem.ncbi.nlm.nih.gov/compound/Limonene> (accessed on Dec. 12, 2019).
- [2] “NFPA 704.” *Wikipedia*, Wikimedia Foundation, 3 Dec. 2019, en.wikipedia.org/wiki/NFPA_704.