Flow Visualization
Fall 2019
Team Second Report
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My team and I decided to make an image of a knife being heated up by a blow torch. The purpose of it is to observe the different color flames that describe the different temperatures, in addition to also describing the flow of the propane. This is also our second team assignment as the team members who helped with this experiment are Austin Ramirez, Jon Cohen, and Julian Cruz. In this report, we will discuss the basic setup, the physics behind the experiment, camera features of the image, and finally a conclusion.

The image in figure 1 below depicts what appears to be a tomato knife being heated up by a propane blowtorch. This technique allows knives to cleanly cut through frozen food. Most blowtorches have an electric igniter that reacts with the released propane gas once it passes through the pipe. Other blowtorches must be lit up with a striker when the gas is released.

Figure 1. Team Second Final Image

The flame of a propane blowtorch is light blue, and its maximum temperature lies around 1995°C (O'Donahue 2019). The curved shape of the pipe allows the blowtorch to concentrate better the flame to emit ("What Is the Difference Between a Butane Torch & Propane Torch?"). The interaction of the blue flame of the propane blowtorch with the surface of the knife make the portion of the flame that is closer to the knife become orange. This responds to a chemical reaction between the burned gas and the metal on the surface, namely, the black-body radiation (Giangrandi). In this reaction, a perfectly opaque body reflects colored light according to the

temperature to what it is exposed. The temperature that is provided by the propane blowtorch corresponds to a reflected orange light.

The flame of a propane blowtorch is shaped as a long teardrop at normal conditions. There is evidence that flames of any kind are indirectly affected by gravity, via the phenomenon of convection. Convection is manifested on Earth with the colder (thus denser) fluid going down and the hotter (thus less dense) fluid going up. On the other hand, flames from any source tend to become bluer and spherical in microgravity, maximizing the efficiency in energy transfer ("Not Just Another Old Flame").

An iPhone XR from Apple was used to capture the image as it was under normal exposure mode with an aperture of F1.8, a shutter speed of 1/16 sec, a focal length of 4 mm, and an ISO setting of 640 without a flash. The distance between the camera and the desired object was approximately about 12 inches. The pixel dimension for the image was 3024 x 4032 and reduced to 674 x 680. The final cut processing was done using Gimp as a photo editor. Gimp was used such that the picture could be cropped, and adjusted in exposure and contrast, and Figure 2 below shows the original picture before it was edited through Gimp.

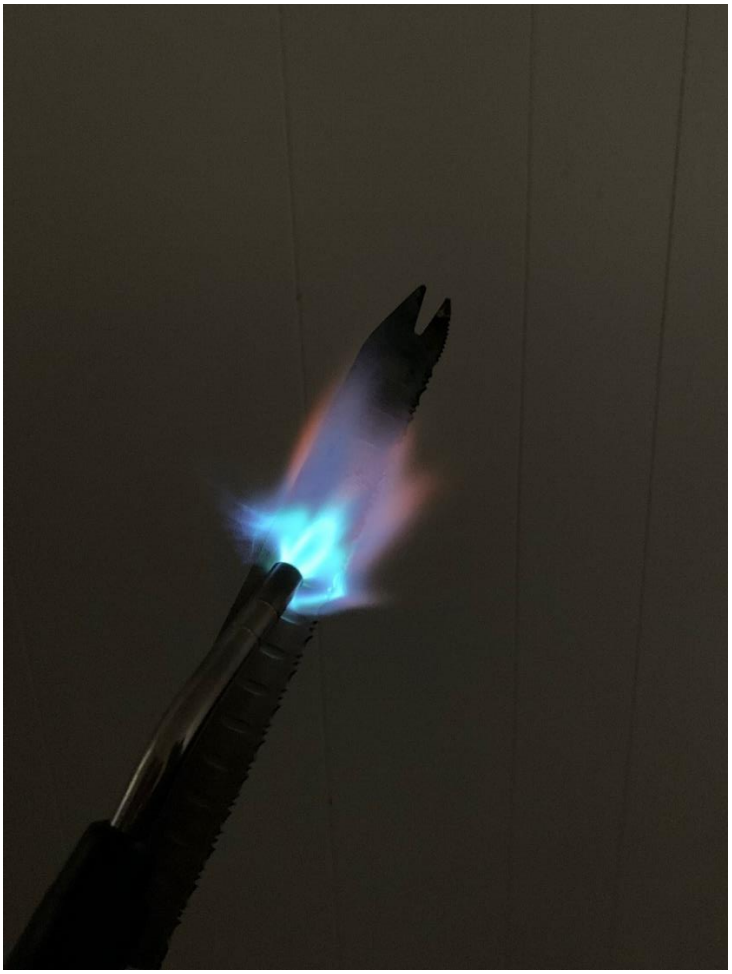

Figure 2. Team Second Image Without Editing

This image reveals the phenomena of having a knife being heated up by a blow torch that depicts the different color flames that describe the different temperatures. The flow is very entertaining and unique as I have never done this experiment before this class which made it so interesting for me personally to learn about the physics behind it and doing the necessary research. What I like about the picture is the editing, the lighting, and the color illumination that reminds me of a rocket lunch. Making the picture a little darker helped exposing the colors even more. What I think needed some improvements is the background. I may have edited the background differently, like having a black (plain) background which would have helped improve the photo and having the entire focus on the object.

References

Giangrandi, Iacopo. *Black Body Radiation and Color Temperature*, http://www.giangrandi.ch/optics/blackbody/blackbody.shtml

"Not Just Another Old Flame." *NASA Scientists Discover Spiral-Shaped Flames*, https://web.archive.org/web/20100319113411/http://science.nasa.gov/headlines/y2000/ast12may_1.htm

O'Donahue, Kelvin. "What Temperature Is a Propane Torch?" *Sciencing*, 2 Mar. 2019, https://sciencing.com/temperature-propane-torch-5911.html

"Standard Blowtorches." *Bullfinch Gas*, https://bullfinch-gas.co.uk/blowtorches/standard-blowtorches

"What Is the Difference Between a Butane Torch & Propane Torch?" *Hunker*, https://www.hunker.com/13408172/what-is-the-difference-between-a-butane-torch-propane-torch