Team Second Report

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Flow Visualization MCEN 4151

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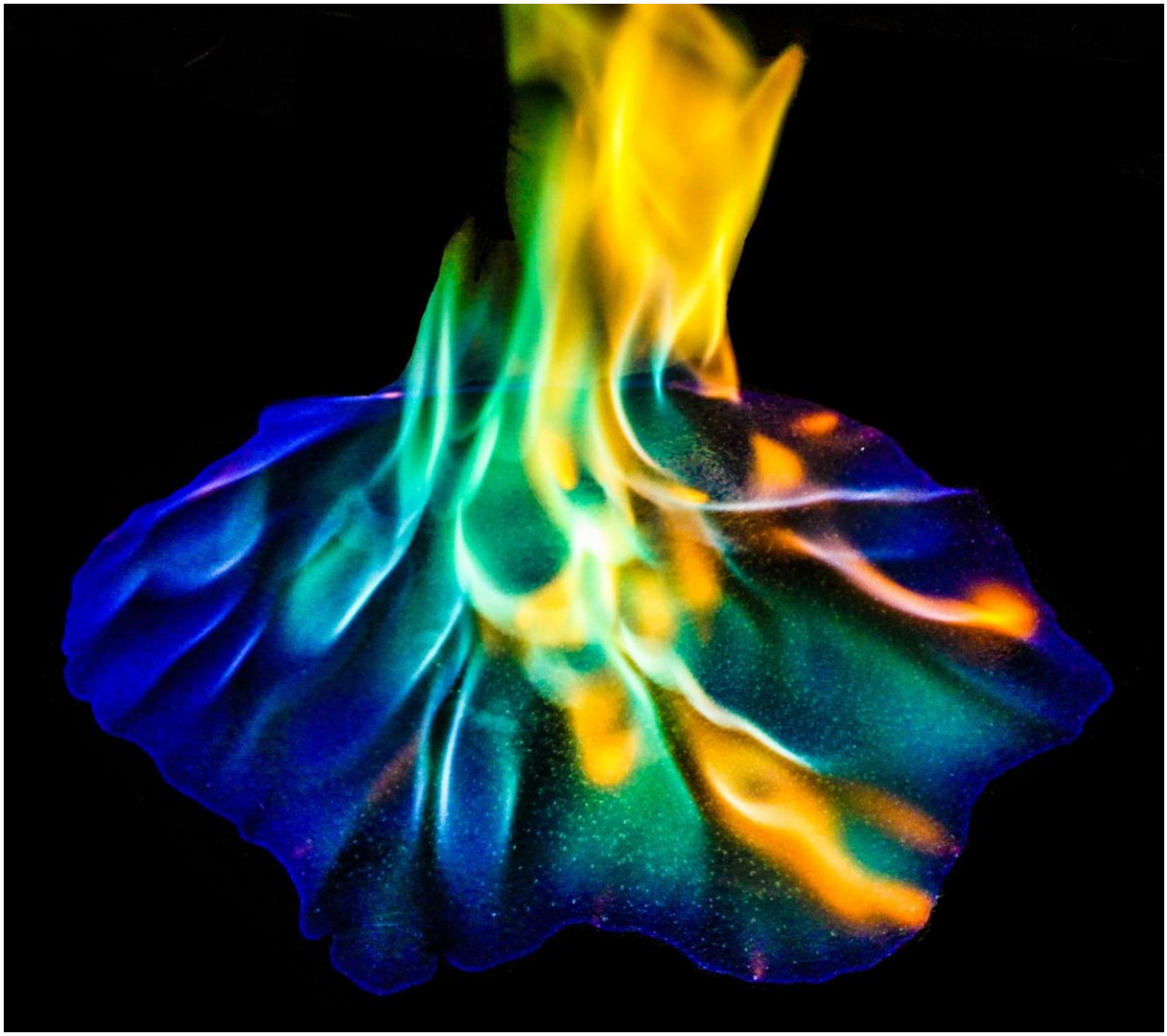
11/28/2016

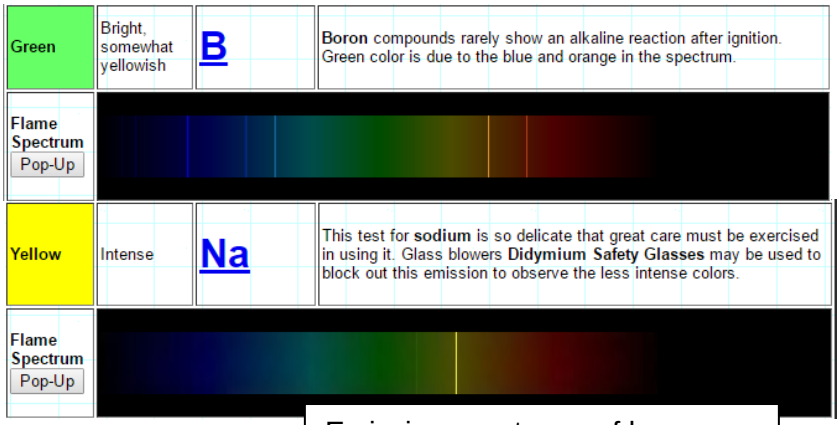


I. Introduction

This photograph embodies my group's attempt to capture green fire. We used rat poisoning which contains boric acid to give it the green flame and salt to create the yellowish-orange flame. These were added to methyl alcohol which burns blue in order to get a good flame. The flame is truly beautiful and the color that the different molecules emit when burned is magnificent. We hoped to get a great photograph and I believe we succeeded. I would like to thank my teammates Michael Lloyd, Ryan Daniel, and Schuyler Vandersluis for their work in creating and capturing the beautiful flame.

II. Flow Apparatus

Fire is a very interesting phenomenon. When the methyl alcohol (methanol) is burned, the heat gives electrons in the molecules enough energy to excite them into a higher energy level. It is the emission of this energy as they drop back down to their ground state that gives off light. Different types of molecules give off different wavelengths of light as they reduce from this excited state back down to their ground state. Boric acid, which is made up of 17.5% boron, burns green due to the boron molecule emitting a green wavelength of light. Although we initially hoped to have a purely green fire, the presence of the methyl alcohol's blue flame gave the flame a two-color appearance. In which case, we decided to add a third color to the flame by adding table salt to the mixture. Sodium in the table salt emits a yellow color of wavelength but it became fairly orange when added to the blue-green flame already there. The phenomenon of the fire chimney is caused by the temperature difference between the air and the flame. The flame near the edges is more exposed to cooler ambient air while it becomes hotter as we move closer to the center. This hot air rises quickly in the middle and leaves a void of low pressure. The cooler ambient air is pulled into this void due to the Bernoulli Principle causing the flame to be sucked towards the middle of the ring creating a chimney of sorts.



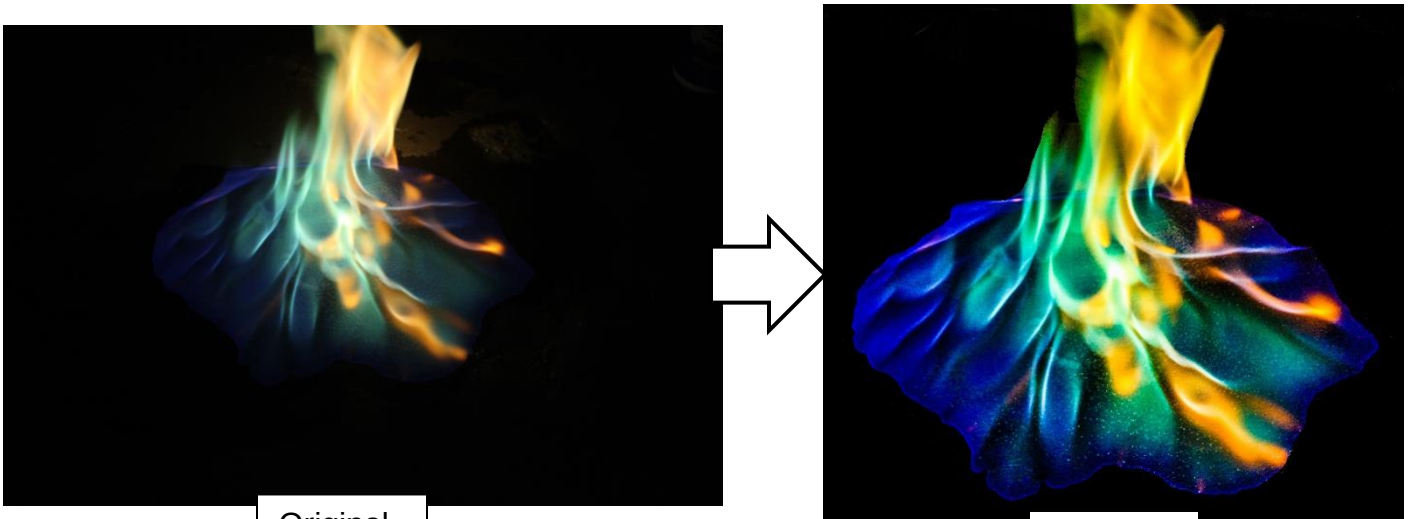
Emission spectrums of boron and sodium (Web Mineral, n.d.)

III. Visualization Technique

The flow apparatus used in this project were the chemicals of methyl alcohol found in lighter fluid, boron/boric acid found in rat poisoning, and sodium chloride found in normal table salt. We captured the photo from about a meter away at about a 45-degree angle, using safety precautions so as not to breath in the fumes. We first poured some of the rat poisoning on the ground and then added the lighter fluid to where the rat poison was located. After lighting the lighter fluid, we then sprinkled the salt onto the flame to add the yellowish-orange color to the already blue and green flame. This was all done outside on concrete and we used a large piece of cardboard to block surrounding light so that the flame would be the only light in the photograph.

IV. Photographic Technique

We used a Canon EOS Rebel T3i to photograph the color and flow pattern of the flame. We shot the image about a meter away and used a focal length of 18mm in order to truly focus on the fire and remove any unnecessary background. The fire was hard to capture cleanly so we used a shutter speed of 1/40 sec and an F-stop of f/3.5 with an ISO of 800. The edited version of the photo is 3034x2688 pixels while the original was 5184x3456 pixels. The photo was first edited in paint to make the parts of the background that weren't black darker and then edited using Adobe Photoshop Express through which I was able to increase the contrast and bring out the blue, green, and orange colors more vividly.



Original

Edited

V. Conclusion

This was probably the most fun project that we did all semester. Flames are absolutely beautiful to me, and I believe we captured an amazing photo. The clarity and vividness of the colors are extraordinary and the way the concrete ground sparkles through the flame gives an almost cosmic tone to the photo that I wasn't expecting. Using black paint around the sides was quite difficult and I wish I had known another way to do that darkening without changing the color too much, but I think it turned out perfectly and I wouldn't change a single thing about it.

VI. References

Douma, M. c. (2008). Flame Tests. Retrieved from Causes of Color: http://www.webexhibits.org/causesofcolor/3BA.html Web Mineral. (n.d.).

Flame Tests. Retrieved from Web Mineral: http://www.webmineral.com/help/FlameTest.shtml#.WDvKDuYrJPb