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MCEN 4151: Flow Visualization
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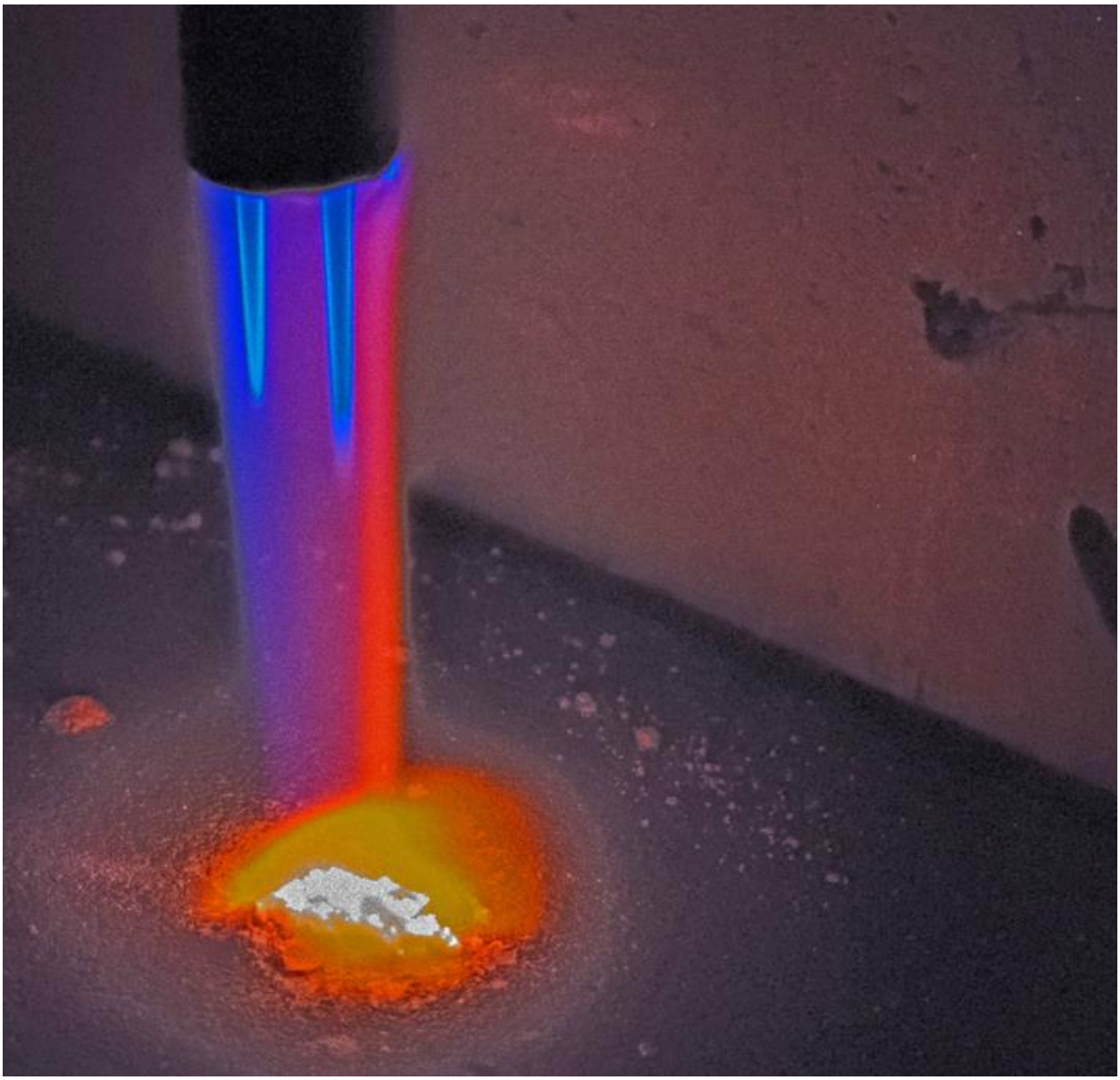
Incinerating Magnesium Carbonate



I captured this image for the “Team First” assignments for the course Flow Visualization. The main purpose of this task was to work as team to create environments to obtain better quality photos. The team decided to have fire as our theme, so we had to be in a dark spot to be able to appreciate all colors of the flame. In order to have the perfect environment for this photoshoot, we decided to meet outside the ITLL. This was a perfect spot because it was dark enough for the flame to be well observed while the environment was fireproof.

In this image, we can appreciate a butane torch incinerating magnesium carbonate powder (better known as “gym chalk”). A mount of chalk was place on top of a brick and the brick was leaning against the wall. Then, a team member was holding the torch straight up the magnesium carbonate. Once he turned the torch on, we waited for about 5 second to get the bright gray color of the chalk. The camera was pointing on a downward angle where both the torch and magnesium could be appreciated. Please refer to Figure-1 to see a visual representation.

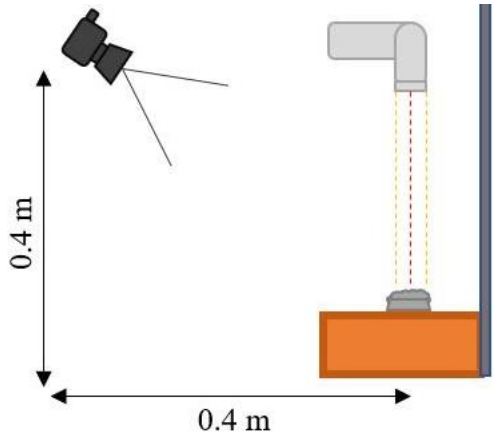


Figure-1: Setup of camera, torch and chalk

As seen on Figure-2, the torch has two nozzles where the butene reaction takes place. The butane inside the tank of the torch is compressed which causes the flame to be very long and stable. We can also appreciate the chemical reaction is rich in oxygen since the flame is turquoise blue. The formula for butane is C_4H_{10}, and when the torch is turned on, it reacts with the atmosphere’s oxygen. The following reaction is present when the torch is on:

$$2\,(C_4H_{10}) + 13\,(O_2) \rightarrow 8(CO_2) + 10(H_2O) + \text{Heat} \qquad \textbf{Eq-1}$$

This hydrocarbon combustion reaction releases heat energy which means it is an exothermic reaction. Its products are CO_2 and H_2O gases that contacts the magnesium carbonate powder. The flame is approximately at 1,430 °C. However, the chalk does not

melt because it’s dried and deagglomerated in a grinder. This allows the chalk to glow vividly when the flame is present as it heats it up past its melting point (825 °C).

Figure-2: Nozzles on butane torch

What was required to create this shot was a blowtorch which brand is unknown and REI magnesium climbing chalk. We also had a fire extinguisher in case things got out of control. The torch exit had a aperture of approximately 23mm in diameter. I used a Nikon D5500 DSLR camera and for this shot I had it set up at f/5.6 aperture, 1/125 sec shutter speed, focal length of 55mm and ISO: 10,000. The image has a dimension of 6000x4000 pixels. For this shot, I specifically focused on the chalk since that’s the brightest area of the image. After I took the shot, I edited my photo on gimp. Using the curve color, I was able to flip the contrast and texture and got a more radiant white for the magnesium. Please refer to Figure-3 to see unedited photo.

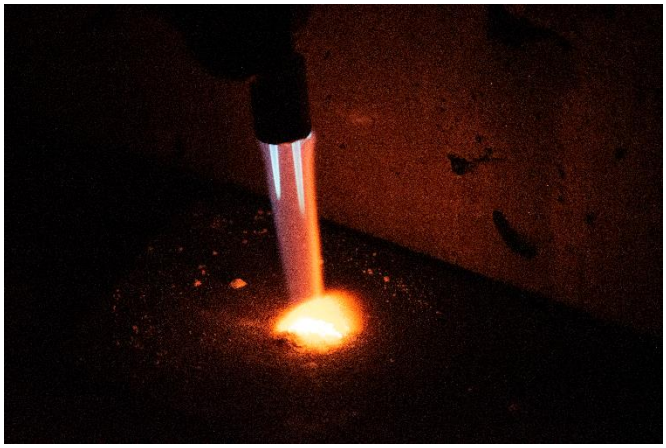


Figure-3: Unedited shot

References

"Butane." *Butane - Energy Education*, https://energyeducation.ca/encyclopedia/Butane.

"Exothermic Reaction." *Wikipedia*, Wikimedia Foundation, 20 Sept. 2019, https://en.wikipedia.org/wiki/Exothermic_reaction.