Team Project #1

Elizabeth Crumb

Flow Visualization – MCEN 4151

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3/14/13
Team 1

This image was taken for the first team assignment for Flow Visualization, MCEN 4151. The intent of this image was to capture an image of "Boo Bubbles"[1] in some state of their formation, popping or any after effects. Boo Bubbles are soap bubbles that are formed using dry ice and water. Working in at team allowed group resources and knowledge to be pooled to produce more captivating images and allowed a more difficult experiment to be undertaken. Everyone in Team 5, Jon Horneber, Shea Zmerzlikar, Matthew Bailey, and Patrick Cotter, participated in the creation of this image.

The bubbles were created using the apparatus seen in Figure 1. The plastic container was filled with warm to hot water and a chunk of dry ice was added. The lid was then placed loosely on top of the container which forced the vapor from the dry ice through the hose. The end of the hose was then dipped in a soap and water solution and bubbles began to form. The bubbles were then placed on a piece of black velvet to prevent them from popping. The bubbles, once placed on the velvet, can be individual bubbles or they can be stacked in a bubble pile combining several bubbles. The bubbles can vary in size from ¼ of an inch to upwards of 2 inches in diameter based on the content of the soap solution and the velocity of the vapor coming out of the hose and the hose nozzle is approximately half an inch in diameter.

Figure 1: Boo Bubble producing apparatus, Photo Courtesy of Jon Horneber

The vapor is formed when the dry ice is dropped into the warm water in the bucket. Dry ice is the solid form of carbon dioxide and at atmospheric pressure it sublimates, changes directly from a solid to a gas, at -78.5 degrees Celsius[2]. This means that at room temperature, chunks of dry ice will turn directly into a gas. When dry ice is placed in water the rate of sublimation will increase and vapor will be produced at a faster, more visible, rate. The soap in the water reduces the surface tension for the water and thus the bubbles can be formed and sustained. A molecule in a fluid interacts with all of the other molecules around it. Molecules on the surface of the fluid, however, don't have the molecules above them to interact with and thus they interact more strongly with the molecules on either side of them. This creates the phenomenon known as surface tension where it is harder to pass an object through the surface of a liquid than the body of the liquid. In this case, surface tension allows the bubbles to form and be sustained.

The image was formed by using the smoke from the carbon dioxide to produce bubbles when forced through the hose in Figure 1. The soapy water mixture reduced the surface tension of water enough to allow bubbles to form. The image was taken inside of a "white box" as seen in Figure 2. A

black sheet was put down and the bubbles were lit using the built in strip lights attached to the top of the white box. The soapy water was a mix of Ivory dish soap and water in a small Tupperware container. The photo was taken with no flash and was lit with the built in overhead lights in the white box as well as the overhead florescent lights in the room in which the white box was located.

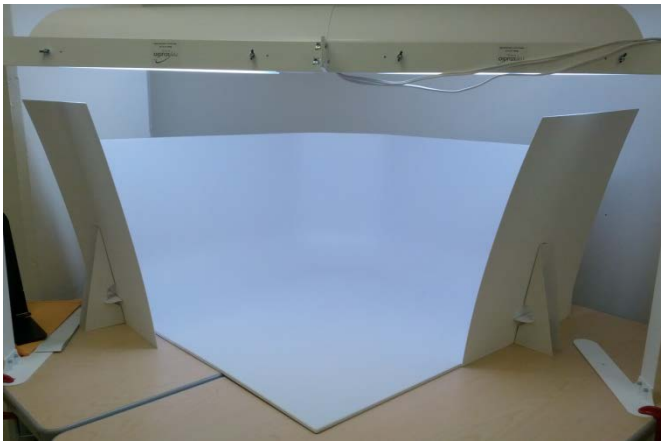

Figure 2: White box used in the photograph, Photo Courtesy of Jon Horneber

In the photo I was trying to capture the clearest most in focus image possible. To accomplish this I used a high ISO, 1600, a fast shutter speed, 1/80 sec., and an f-stop of f/8. The camera lens was approximately six inches from the bubbles and the larger bubbles were approximately an inch in diameter. The image was taken using a Canon EOS Digital Rebel XS at a focal length of 39 mm. The original and edited images were 3888 by 2592 and 3888 by 1770 pixels respectively. The original image, seen in Figure 3, was cropped to bring attention to the bubbles in the upper half of the image. I also used curves in Photoshop to darken the black portions of the photo and to brighten the white in the bubbles.

Figure 3: Original Image

The image reveals how the bubbles interact when they are combined and stacked on one another. It also demonstrates how decreasing surface tension allows the bubbles to form. I like how there are so many bubbles together in the image and how you can see several different sizes. The physics of the surface tension acting on the bubbles is very well demonstrated. The image, especially when projected on a large screen, is a bit noisy and if I were to do this again I would use a lower ISO value to reduce the noise in the image. This image fulfills the intent of capturing Boo Bubbles and the way that they interact. This idea could be developed further by creating bubbles mounds using different sized bubbles to see the various effects size has on their interaction.

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References

1. "Dry Ice Boo Bubbles." *YouTube*. YouTube, 14 Oct. 2009. Web. 28 Feb. 2013.

2. "Dry Ice." *Wikipedia*. Wikimedia Foundation, 03 May 2013. Web. 12 Mar. 2013.