Team Project 1

Flow Visualization

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March 15, 2010

The image is the first of three team projects to be completed during the semester. The project allowed for team members to mesh, brainstorm ideas, and choose a concept to be photographed and studied. The phenomenon being explored during this particular image was surface tension, through the use of soap bubbles filled with fog.

The apparatus that was used for this experiment used two fog machines, pipe cleaners as bubble wands, laundry soap and water, and ambient lighting. The two fog machines were placed on a box about two feet off the ground. The water and soap mixture was in a large container on the floor in front of the fog machines. The bubble wands were made from pipe cleaners; this allowed for a variety of bubble sizes to be tested. The lighting was back away from the set-up; a halogen lamp in the corner of the room was kept on to allow for the shutter speed to be increased. Lastly the bubbles were made in front of a black back drop to increase the contrast and allow for better visualization. Below in figure 1 the set-up is shown:

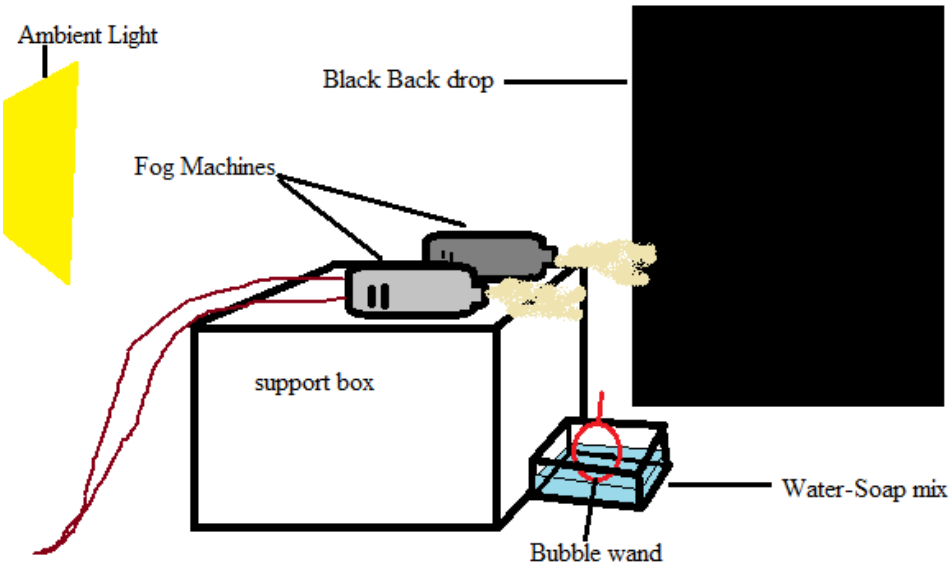

Figure 1: Flow Apparatus

This set-up allowed for bubbles to be created and the phenomenon of surface tension to be visualized. Bubbles are a thin film in a perfect spherical shape; a sphere has the smallest surface area per volume and bubbles always take a shape with the smallest surface area. Though water and other pure liquids can make bubbles they are highly unstable and a surfactant is needed to provide stability. In the set-up soap acts as the surfactant, this decreases the surface tension within the water by about one-third stabilizing the bubbles made. As the soap and water mixture

stretches the soap strengthens the weak points preventing excessive stretching and allowing the bubble to hold its shape without popping [1].

To create the visual effect the bubble wand was dipped in the water-soap mixture filling the wand; the mixture being 1 cup of Dawn soap, 13 cups distilled water, and 2 tsp Karo syrup. The fog machines were turned on and the wand placed in front of them. This allowed the fog to be blown directly into the bubble; the only force used to blow the bubbles was the force the fog machine "puffed" fog and air out at. This kept a consistent pressure for each trial as opposed to the operator blowing the bubble or dragging the wand to fill it with air. Initial trials used a wand about 8 inches in diameter, however it was found that the fog machine did not have enough force to create a complete bubble so a smaller wand was made. The smaller wand was made to have a diameter of about 2 inches and is the one seen in the image. The bubbles generally were blown free from the wand, however as the fog machine reached the end of a cycle the force would become slightly weaker and bubbles would partially form or as in the case of the image would form and be stuck to the wand its self. The fog would remain trapped within the bubble as it sat on the wand until the surface tension was lost and the bubble popped. As the bubble was stuck to the wand a laser pointer was aimed directly at the bubble surface. The laser used was a red keychain laser pointer, a wavelength of about 600-700nm and an output of about 3-5mW [2]. The other lighting used in the image was a duel halogen lamp with two separate bulbs each of 40W [3]. The lamp was in the corner of the room, in front and to the left about 10ft away from the set-up with both lights facing the corner not shining directly into the room. Lastly the camera flash was used while capturing this specific image.

The image was captured using a Nikon D50 digital camera. The field of view was 2256 x 1496 pixels. The camera was held about 10-12 inches from the bubble when captured. For this image the focal length was 22m with an aperture of f/3.8. The shutter speed was manually set to be 1/500sec. The flash was allowed to stay on auto mode and fired during the capture of this image. The image was edited using Picasa 3 where the contrast was highly increased; washing out the detail of the pipe cleaner bubble wand. The image was cropped down to 487 x 449 pixels, cutting out excessive distractions allowing for the focus to be on the bubble.

The image is a single bubble attached to the wand from which it was created with. The bubble is filled with stage fog and has a laser light shining on it to add a slight color effect. I personally like how the images colors are very bright and highly contrasted. The pipe cleaner detail being washed out so it appears as a solid color I like, I believe it complements the color of the laser nicely without being a distraction. The flow is visualized fairly well, as the image is of a bubble and the phenomenon to be seen is surface tension. I also like the effect the fog adds however if I were to redo the experiment I would adjust the lighting, possibly using a black light and removing the ambient light that was needed for this image to be taken. Overall I would like to improve upon lighting of images and be able to adjust and adapt the lighting to the specific images to be captured. In the end although the image was more difficult to capture than planned the intent was fulfilled and a pleasing image produced.

References

[1] *Wikipedia*. Web. 14 Mar. 2010. <http://wikipedia.org/wiki/Soap_bubble>

[2] "Keychain Laser Pointer." *Physics and Astronomy Links - PhysLink.com*. Web. 15 Mar. 2010. <http://www.physlink.com/estore/cart/KeychainLaserPointer.cfm>.

[3] "Halogen Lighting Fixtures, Kitchen, Cabinet and Desk Lamps from LAMPS PLUS." *Home Lighting and Light Fixtures by LAMPS PLUS - Offering Quality Lamps and Lighting Fixtures*. Web. 15 Mar. 2010. <http://www.lampsplus.com/htmls/categories/halogen.aspx?cm_mmc=GOO-SE-_-Type%20Exact-_-Halogen-_-halogen%20lamp%20e&sourceid=SEGOO0809112634&gclid=CNSz--LFu6ACFSgnawodjSF1A>.

[4] "Bubbles - A to Z Home's Cool Homeschooling." *A to Z Home's Cool Homeschool Website*. Web. 15 Mar. 2010. <http://homeschooling.gomilpitas.com/explore/bubbles.htm>.