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Flow Visualization: The Physics and Art of Fluid Flow
Group Assignment 2

The main idea behind the bubbler pillar shot was to see how unique the bubbling structure would be with just hand soap. The idea of placing dry ice in hot water dates back to antiquity and the notion of adding in liquid hand soap isn't exactly new either. My hopes were to grow the bubble pillar as tall as I possibly could and then get a worms eye shot of it from the bottom of the cup. That would have given the bubble pillar sky-scraper proportionality even though it would only be 7 or 8 inches tall. Unfortunately, the bubble pillar could not be grown very tall- only about 3-4 inches. Due to the shortcoming of the bubble pillar height I decided to take side and aerial shots instead.

Even though all materials used were nontoxic I chose not to make a mess so I set up an apparatus that resided inside a recycle bin. The recycle bin acted as a spill chamber to contain the soapy liquid as it flowed down the side of the cup. See Figure 1 for schematic.

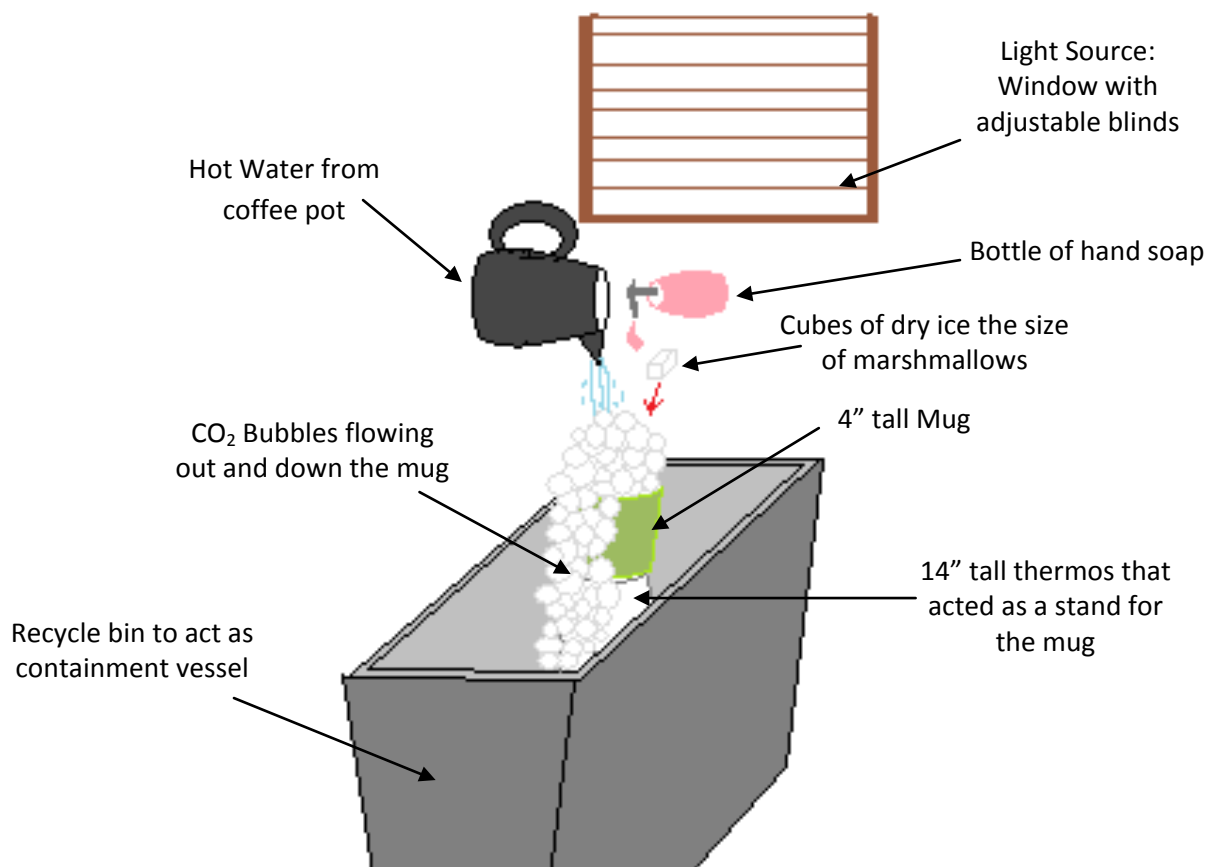


Figure 1. Photography Schematic

First I purchased some dry ice, a mug and a pair of tongs from King Soopers. Then I emptied my recycle bin and placed a thermos inside. The mug was placed on top of the thermos. After waiting for

about 5 minutes the coffee maker had made about 6 cups of boiling water. The boiling water was poured in the mug until it was $\frac{3}{4}$ full. Then the dry ice piece was placed in the mug with the use of the tongs. CO₂ will start to billow out of the mug. At that time squirt about 6 shots of liquid hand soap into the foggy mug. Bubbles will soon start to form at the mouth of the mug. The bubbles will then start to rise vertically because the CO₂ gas that comes from the sublimation of the dry ice is trying to escape from the mug. Since the hand created bubbles when it contacts water the CO₂ gas becomes trapped in these bubbles and is forced out of the top of the mug by other bubbles full of CO₂ gas. The term “forced out” is used because CO₂ is denser than air and the only way that it will move vertically through it is if there is a net force pushing the CO₂ bubbles upward. Again that force is from the other CO₂ bubbles underneath that are trying to escape. The end result was an aerial shot of a bubble pillar that was 3.5” tall. The camera was approximately 2.5 feet away from the bubbling mug. The field of view was approximately 9” x 13” inches. Flash was used even though there was lighting from the window because I was hoping for the reflection of the flash to show up on the bubble surfaces as dots. Those dots I assumed would make an interesting pattern that also highlight where each of the bubbles were on the bubble pillar, giving more resolution to the image.

After the image was taken some Adobe Photoshop manipulations were performed. Since it was difficult to manually focus on the bubbles it was decided that an approach that magnified the contrast between the white bubbles and surrounding would make the image look more interesting. So the exposure, saturation and hue were increased slightly. The resulting image reflects a stark contrast between the white bubbles and the black recycle bin. The back light from the window also made sure that I didn’t have to over expose the image to get the contrast I wanted and overall the image was a success. Camera and shot specification can be seen in Figures 2 and 3 below.



Camera Data 2

Figure 2. Camera Data

Orientation:	Normal	
Resolution X:	480	Y: 480
Resolution Unit:	Inch	
Compressed Bits per Pixel:		
Color Space:	sRGB	
Light Source:	Unknown	
File Source:	DSC	

Figure 3. Camera Data

The overall photograph turned out to be a success. However there is always room for improvements. While browsing the internet I found that some people have dropped a water proof flashlight and have also added food coloring to the bubbling mug. That would allow even more contrast to be resolved because the flashlight would further illuminate the bubbles from underneath and the food coloring would give the bubbles a neon tint to them would be fun to watch and photograph.