

## Hexagonal Bubbles

The first assignment for Flow Visualization was to get our feet wet. We were asked to make an interesting image and then describe the physics behind it. When I thought about this assignment the first thing that came to mind were bubbles. I have always been fascinated with bubbles and how they are formed. One day around the beginning of this course, I noticed that there was a pressure difference in my shampoo bottle. When I opened it the air rushing into the bottle created a bubble and then exploded. I first wanted to capture the creation of the bubble inside the shampoo bottle and show the explosion.

I realized quickly that this task was difficult to do solo, because I would open the shampoo container and then have to take an image almost instantaneously. After a couple of tries I experienced an unintended phenomenon. After several openings the shampoo created lots of tiny bubbles that filled a section of the bottle. The bubbles were squished together and pressing up against the container's wall and formed hexagonal shapes. Usually a bubble forms a spherical shape due to the surface tension. Bubbles form a sphere because it is the smallest possible surface area for a given volume. When multiple bubbles are contained in an area they form hexagonal shapes because this is the most efficient way to fill that space.

I wanted to capture the bubbles pressing up against the side walls because of the cool effect they had when they formed the hexagonal shapes. I used an automotive light to illuminate the shampoo bottle from underneath the container. The light has one main bulb and has three legs to prop it up. I placed the bottle directly on top of the light as it was shining upwards. The shampoo bottle was a clear orange color with the same color shampoo inside and had a light green lid. The light diffused through the lid and the bubbles captured some of the green light. The picture on the right depicts this setup with the actual products used. The shampoo used was Herbal Essence Body Envy and the light is made by Stanley and its part number is 95-112.



Since the bubbles were only in a certain part of the bottle I focused in on that area. I was about 3" away with my camera and was looking down at the bottle at a 45 degree angle. I was looking down at the bottle because the green lid reflected a little bit inside of the bubble. The field of view is about 1" by 1". I used an automatic setting on my camera since I am unfamiliar with it. The shutter speed is 1/80 and the fstop is 5.6 with an ISO of 640. The camera I used was an Olympus camera, model E-PL1 and I used the original lens that came with it. I tried using a zoom lens but couldn't get the camera to focus on the bubbles against the containers walls. The original image was 4032 x 3024 pixels and I cropped it down to 2152 x 1472 pixels to focus more on the bubbles. In Photoshop I only edited the image by adding more saturation to bring out the reds.

This picture really shows the phenomenon of what happens when you have a lot of bubbles in a small space. They form hexagonal shapes rather than spheres because that is the most efficient way to fill the confined space. I really like how the image came out but I wish the entire picture was in

focus rather than just certain bubbles. The colors from the shampoo bottle and how vibrant they were without much modification really impressed me. I wish I could have captured my original idea of the exploding bubble, but I lacked the assistance. A high speed camera would have been really cool to show a slow motion of the bubble forming and then exploding due to the pressure difference in the bottle.