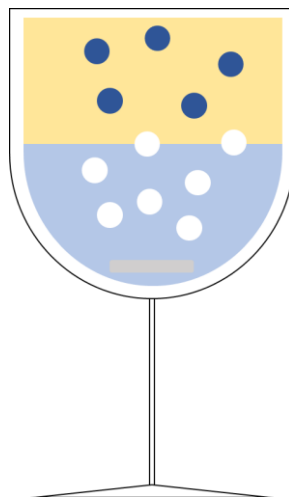# Blue Bubbles

Fluid Dynamics

MCEN 4151

Get Wet

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I produced a video which is named as 'Blue Bubbles'. The reason I chose 'Blue Bubbles' as the title of my video is some blue bubbles are shown in the video. The phenomenon I was trying to see in my video is that effervescent tablet generates bubbles and the bubbles with food dye come up to the top layer of liquid with water and vegetable oil. A wine glass contained half wine glass of water and on top of the water, there is half wine glass of vegetable oil. The blue color of food dye is placed on the layer which is between water and vegetable oil. The bubbles which are come out from effervescent tablet carry the blue color of food dye up to the very top of oil layer. When the bubbles reach at the top, the bubbles are popped up and the blue color of food dye spreads out from the top of vegetable oil to entire liquid in the wine glass.

Figure. 1: The figure of set-up

The figure 1 is showing the flow apparatus with whole set-up. The main flow in this set-up is the motion of bubbles. At the effervescent tablet, the bubbles are generated and they have the highest speed in the wine glass. When the bubbles are in the fluid of water, they deaccelerate due to the viscosity or density of water. After the bubbles pass the layer which is between the water and the vegetable oil, the deacceleration ratio of bubbles in the vegetable oil is larger than when they are in the

water because the viscosity or density of vegetable oil is higher than the viscosity or density of water. Even though there is gravity that is acting on the bubbles, the bubbles go top of the wine glass because the exiting force and buoyancy force is much greater than the gravity. I also have calculated the Reynolds number to see the behavior of bubbles. Here is an equation for the Reynolds number.

$$\text{Re} = \frac{\rho VD}{\mu} = \frac{VD}{v} = \frac{\left(3\frac{m}{s}\right)(.005\ m)}{(1.48*10^{-5}\frac{m^2}{s})} = 1013.51 \quad \text{-----------------------} \qquad \text{Eqn. 1}$$

This Reynolds number is the behavior of only one bubble. I could find that the flow of a bubble is laminar flow because the Reynolds number is 1013.51 which is lower than 2000, I have figured the velocity of bubble by inspecting video with slow motion and a diameter is inspected from a stopped video. I assume that the bubble is consisted of air and the temperature of air is 15 Celsius.

I have used water, vegetable oil, food dye, and effervescent tablet as the visualization techniques. The water is just tap water and the vegetable oil is from Crisco. The food dye I have used is from McCormick. The name of effervescent tablet I have used is Effervescent Antacid & Pain Relief Tablets from Signature Care. The number of lightening source that I have used is three. All of lightening sources is come from Iphone. Two lightening sources is located under the bottom of wine glass, and the other one is located in front of wine glass.

I have tried variety sizes of containers, and I figured out that the size of wine glass is just appropriate for the amount of bubble from one effervescent of tablet. I wanted to show whole wine glass and the frame of video is symmetric, so I have decided the distance from object to lens as about 30 cm. I have used Iphone as my shooting method, and Iphone has two different lenses which are wide-angle lens and

telephoto lens. The wide-angle lens measures 28 mm, and the telephoto lens measures 56 mm. From the EXIF data, we know that the focal length is 3.9 mm. The camera specifications are 1080p at 60 fps, 7 MP, f/2.2 and 32 mm. I reduced video quality to 720p from 1080p due to the size of video by using Premiere Pro.

In my opinion, the video came out well. It captured the behavior of bubbles and the color of food dye is distributed well. I could find that the behavior of bubble obeyed the laws of physics. The bubbles moved up due to buoyancy effect. My question is why the effervescent is not effective on oil. I think that I fulfilled my intent by showing beautiful flow movement. I think that it would be a significant improvement if I put pure white background to see the movement of flow.