

MCEN 4228 – Flow Visualization
Group Project 2: Group Alpha

Flow in an *Ooze Tube*

This was the submission for the second group project for Group Alpha; however this particular image was a solo affair on my part. The purpose of the image was to observe the nature and processes of bubble formation within a fluid-flow desk toy known as the *Ooze Tube* [1]. It has been a toy in my possession for many years and I suddenly stumbled upon it thinking some interesting flow could be visualized. I did not know exactly what I was looking for at first but my focus turned toward the slow moving air bubbles that are produced as the fluid drains down the tube. The final image shows the crater that is formed over the drainage hole as soon as the air bubble releases from it. The rim of the crater can be seen clearly along with several of the smaller air bubbles trapped in the “still” parts of the fluid.

The apparatus is really quite simple. It consists of a clear plastic cylinder with a height of 10in and a radius of 2.0in containing a flat plate through its midsection containing a small, approximately 0.25in radius, hole in its center. A simple schematic of the apparatus can be seen below in Figure 1. An unknown, blue, gel-like fluid is sealed within that flows slowly through the small hole in the center much like a futuristic hour-glass. There is approximately 3.0~4.0in of fluid inside relative to the cylinder’s 10in height. There is no information on the fluid enclosed as it may be a trade secret, thus there is no known viscosity in which to calculate a Reynolds Number. Although the Reynolds Number is not known, it is obvious that the flow is laminar. It takes the fluid just about 10 minutes to flow completely from one end to the other. The system is completely contained so it is entirely repeatable under any condition. Approximately 10 air bubbles were formed during the flow which provided ample time to photograph one and its associated effects.

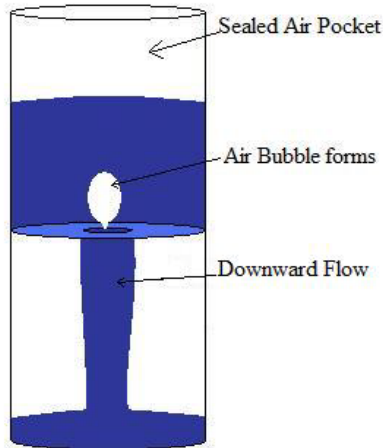


Figure 1: *Ooze Tube*

The visualization technique was to simply flip over the tube and observe what takes place. All of the liquid would flow completely down before the tube was flipped back over allowing a greater amount of air bubbles to form. A small desk lamp with a 60-W incandescent light bulb was used to light the apparatus. The lamp shade was removed and the lamp was set on its side directly behind the tube with the bulb very near to touching the outer surface of the tube. The picture was taken indoors and at night thus there was no natural light. The flash on the camera was not used in order to minimize glare. The lighting was very effective in illuminating the dark blue fluid although some glare off the clear plastic walls was unavoidable.

The camera was positioned approximately 1 inch above the mid plane and angled approximately 20 degrees below the horizontal. The camera was placed approximately 1 inch from the outer surface of the tube on the opposite side of the lamp. The camera specs for the image are given below.

- Camera Type: Olympus FE-340, 8.0 megapixel, 5x optical zoom
- Lens: AF ZOOM 6.3 – 31.5mm, 1:3.5-5.6 in a Macro setting
- Field of View: Approx 2 inches high x 3 inches wide
- Shutter Speed: 1/200 sec
- Focal length: 7.7 mm
- F stop: f/4.0
- Aperture: 3.5 mm
- ISO: 200
- Resolution: from camera = 72 x 72, final image = 12059 x 7049 pixels

- No Flash
- No Zoom

A few Photoshop processes were used to produce the final image. The final image was cropped a little to remove some distracting flow out the bottom of the hole. The curves adjustment was used to increase the contrast and give a crisper image. Finally, a green photo filter was applied to interact with the blue color of the liquid which provided, I feel, a very nice final coloring. Care was taken to avoid color washout and blurring while still enhancing the features of the fluid flow.

The image reveals a very unique but very simple fluid phenomenon. I personally like the crisp look of the crater with the smaller bubbles surrounding it. It feels serene and almost magical. However, I would have liked to capture a good and interesting image of the large air bubble. It looks very interesting to the eye but was difficult to produce something with the same level of quality as this image. I wish I could have found more information on exactly what fluid is sealed within the tube. I feel using more/better lighting along with a more adjustable camera could produce some excellent images. In developing this idea further, it could be interesting to see a series of photographs showcasing the flow and bubble formation from beginning to end. I am pleased with this final image and I am really happy that it came from such a simple toy I have had for years.

References:

- [1] *Ooze Tube*, Retrieved 31 March 2009
<<http://www.officeplayground.com/oozetube1.html>>