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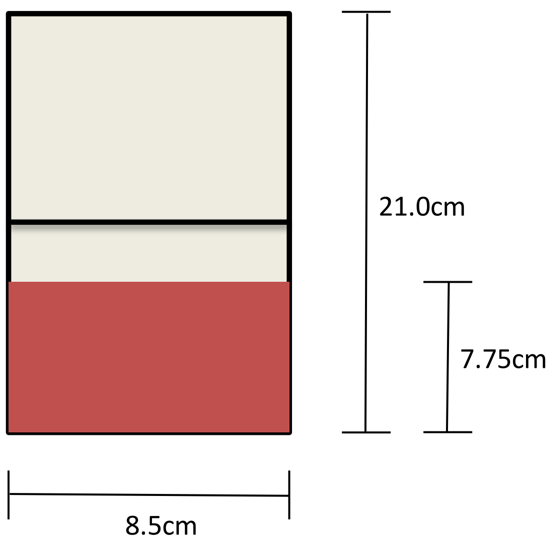
# Ooze Tube

The intent of our first group assignment was to capture bubbles forming in an ooze tube. An ooze tube is a cylinder with a very viscous fluid that travels through a small hole in the middle of the tube as it is turned over. Once flipped over, the fluid starts to flow through this hole into the top chamber where a bubble is created. This happens because of the pressure change that occurs every couple of seconds that allows air to rush up through the fluid. If this is done carefully, two or maybe three bubbles can form simultaneously. We wanted to capture the bubbles forming from the pressure difference as well and try to form multiple bubbles in the top chamber.

The ooze tube has a very viscous fluid in it. From a couple of quick calculations we can solve for the density of the fluid. Here is a rough sketch of the ooze tube.




The height of the ooze tube is 21.0cm, the width is 8.04cm, and the height of the fluid settled is 7.95cm. The ooze tube is made of acrylic with approximately .2cm thick walls. The weight of the entire ooze tube is 491.8g. With all these dimensions and assuming the density of acrylic is .9g/cm$^3$ we can estimate the density of the fluid inside. First let's calculate the weight of the acrylic used in the ooze tube.

$$A_{walls} = A_{outer\ wall} - A_{inner\ wall} = \pi(4.02^2 - 3.82^2) = 4.93cm^2$$

$$V_{walls} = A_{walls}h_{walls} = 4.93 * 20.4 = 100.5cm^3$$

Now let's calculate the volume of the three disks in the ooze tube.

$$A_{disks} = 3 * \pi(4.02^2) = 152.31cm^2$$

$$V_{disk} = A_{disks}h_{disk} = 152.31 * .2 = 30.46cm^3$$

Now we can combine these two volumes and find the weight of the acrylic with the known denstity of acrylic.

$$V_{total} = V_{walls} + V_{disks} = 100.5 + 30.46 = 130.96cm^3$$

$$W_{acrylic} = \rho_{acrylic} * V_{total} = .9 * 130.96 = 117.87g$$

Now that we have the weight of the acrylic we can find the weight of the fluid. From this we can calculate the density of the fluid from the weight and the volume of the fluid.

$$W_{fluid} = W_{total} - W_{acrylic} = 491.8 - 117.87 = 373.93g$$

$$A_{fluid} = \pi(4.02 - .2)^2 = 45.84cm^2$$

$$V_{fluid} = A_{fluid} * h_{fluid} = 45.84 * 7.75 = 355.29cm^3$$

$$\rho_{fluid} = \frac{W_{fluid}}{V_{fluid}} = \frac{373.93}{355.29} = 1.05\frac{g}{cm^3}$$

We were hoping after we calculated the density of the fluid and analyzed the flow to measure the velocity of the flow that we could find the Reynolds number and tell if the flow is laminar or turbulent. We can't actually do this because we don't know the dynamic viscosity of the fluid since the fluid inside is unknown. Even though we can't calculate the Reynolds number, the flow seems laminar and stable.

To capture the bubbles rising in the ooze tube we used a white background so we didn't have any distracting objects in the back ground and so the fluid would stand out. We lit the tube from above with a florescent desk light that shined down directly over the tube. We set up our camera on a small tripod about 6ft from the ooze tube. We used a Nikon D80 camera with a zoom lens. The shutter speed was __ with an f-stop of __. For my image I decided to make it black and white. I altered the contrast a little bit. I also cropped the image so just the ooze tube was in the picture.

The image I choose reveals the bubble as it is forming in the fluid and the air channel through the hole in the center can be seen. I really like how well defined the bubble is and how you can see the stream of fluid falling below it. I originally wanted to capture one of the bubbles exploding. This ended up being very difficult as the bubbles exploded so quickly I couldn't see it with my eyes. I would have liked to improve the clarity of the image the most since we used a self-focusing lens.