

Get Wet

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Flow Visualization
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The purpose of this photo is to get familiar with fluid flow and how to capture it using an imaging technique. This image was trying to capture fluid flowing out of a nozzle. The fluid behind the nozzle was at a much high pressure than the outside air, so it was forced through the small exit at a high velocity.

A 2-liter bottle of Diet Coke, 5 mint Mentos candies, a sheet of paper, and a digital camera were used to capture this image.

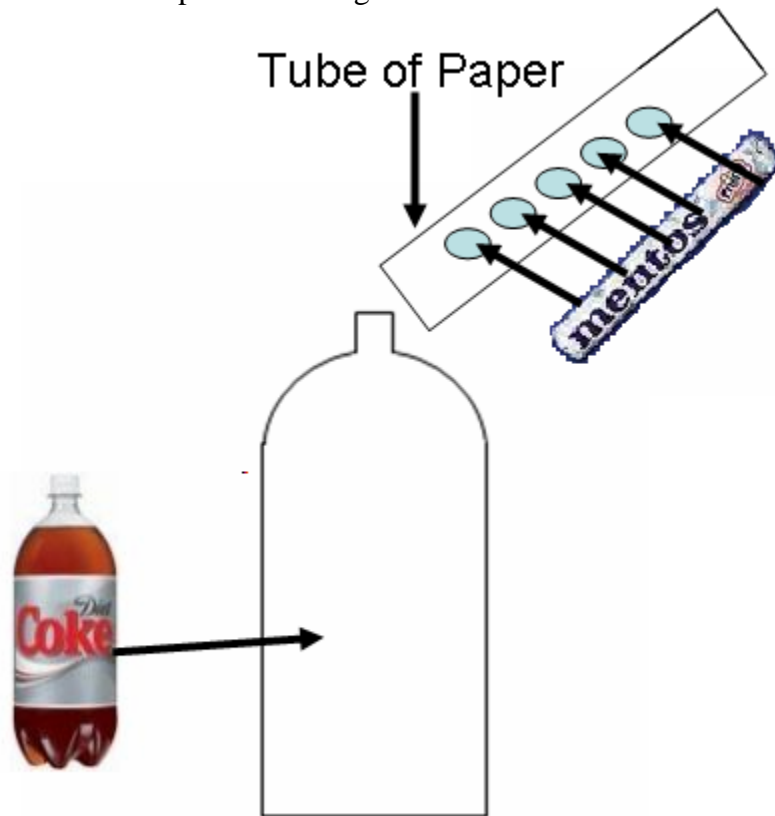


Figure 1: Aparatus Set-up

The Mentos are wrapped in a sheet of paper, than the top is taken off the Diet Coke and the Mentos are quickly poured in. The camera was set up about ten feet away from the soda bottle about two and a half feet off the ground. The CO_2 gas, caffeine, aspartame, and potassium benzoate in Diet Coke combine with the gelatin and gum arabic in the Mentos react to cause the pressure inside the bottle to rise and jet to spray out of the nozzle^[1]. The jet spraying out of the nozzle shows a laminar flow transitioning into a turbulent flow as it accelerates upward. The jet is about 10 feet high (chatacteristic length) and starts out being about an inch wide and three inches wide at the top. The flow took about one second to reach a height of ten feet, which makes the average

velocity 10 ft/sec. The density of Diet Coke is 1 g/mL^[2]. The dynamic viscosity is about 1 g/(cm*s). This makes the Reynolds number of the flow about 93000. The image shows that the bottom part of the flow is laminar, while the top is turbulent, however more measurements are needed to find the Reynolds number as it changes.

The image shows a liquid (Diet Coke) flowing through a gas (Air). Both the air and the Diet Coke were at a temperature of 55 degrees F. It was a very sunny day, so no flash was used on the camera. This experiment should be conducted outside, or else the jet will hit the ceiling and make a mess.

The field of the camera was 2592 x 3888 pixels. The focal length was 29mm. The Camera used to capture the image was a Digital Camera, a Canon Rebel XS. The shutter speed was 1/4000 of a second and the F-Stop was 5.6 and the ISO speed rating was 400. The exposure composition was 0EV. Photoshop was used to remove some clouds and tree branches using camouflage brush that were a distraction in the background and curves was used to lighten the image to bring out some more details in the flow.

The image shows the discontinuity in the flow as it reaches the peak of its jet. It also shows that the liquid splatters at the peak and falls in smaller drops. I like that the image clearly shows the fluid jet and that there are no distractions in the background. I like the flow breaking up as it climbs higher and the shape it forms at the peak. I think the image shows a clear transition from laminar to turbulent flow, however if I were to do it over I would like to find a way to take more images of one flow. The camera I have only takes 2 pictures a second with storage time, and I would have liked to be able to capture more. It would have given more detail and I may have been able to find a cleaner shot.

References:

1. Myth Busters <http://www.zap2it.com/tv/news/zap-mythbustersmentos,0,4325641.story>
2. <http://www.elmhurst.edu/~chm/vchembook/121Adensitycoke.html>