

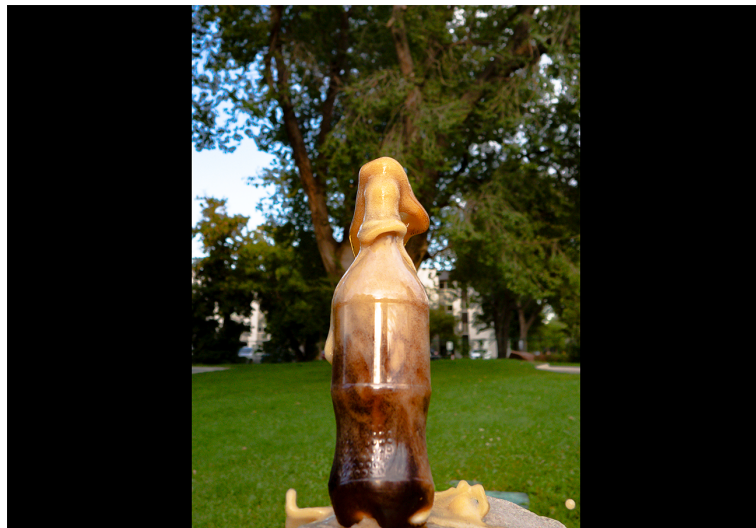
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Help From Brad Busek

MCEN 4151: Flow Visualization

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1 Introduction

This is an image of the reaction created by combining Diet Coke and Mentos. The location of this photo was at a park off , where there was a lot of sunlight and a soft green background. It's pretty well known that, when combined, Diet Coke and Mentos produce a very powerful reaction. It has been shown in many online videos that this reaction will cause soda to fizz right out of the container and produce a tall jet. The phenomenon has been known for years now. The purpose of this image was to capture a snapshot of time right as the Mentos were falling in and causing the soda to fizz. After a single failed attempt, I created this photo.

2 Experimental Setup

The experimental setup for this experiment was relatively straightforward. It involved a coke bottle (label removed), Mentos, and a good sunny area. This is shown in Figure 1. The soda bottle contained 16 oz of Coke, and the top had a nozzle diameter of 28mm.



Figure 1: Experimental set up diagram

3 Fluid Physics

When a Mentos candy falls into Diet Coke, a series of events unfolds to create a mesmerizing explosion. After some research, I found that the main cause of this reaction was the many nucleation sites on a Mento. When it is placed in a carbonated beverage, the CO_2 that is dissolved in the water of the beverage can escape when agitated at these nucleation sites. Given that there is a large rough surface on each Mento, and many falling in at once, the reaction tends to happen quite quickly. This causes lots of gas to be released at once, and a very high pressure withing the soda bottle. This pressure is what forces the liquid out the top entrance to the bottle. Since the diameter of the top narrows into a nozzel shape, the soda is forced to travel at a higher velocity. This is what creates that classic upward jet we've all seen.

Interestingly, there is a reason diet coke was chosen for this reaction. It will create a larger explosion. This is for two main reasons. In regular coke, there is lots of sugar. This sugar increases the density and viscosity of the solution, and it therefore needs more force to push it as high as the sugarless sodas. This is because it's heavier and there are stronger sheer forces between molecules to act against the forces created by higher pressures. Secondly, Diet Coke contains aspartame, a calorie free sweetener. This sweetener was shown to "reduce the work required for bubble formation, allowing carbon dioxide to rapidly escape from the soda"(Coffey). This means that more bubbles will form more rapidly, causing the reaction to occur in a shorter time period. When this happens, more gas is released faster and therefore there is more pressure on the surrounding fluid causing it to shoot up faster. There ends up being a lot of physics behind a simple soda trick.

4 Visualization Techniques

To perform the experiment, the cap of the soda bottle was removed and the Mentos were added quickly. Four Mentos were added for both experiments since it was difficult to add more all at once. Within a second, the soda was exploding upwards in a small jet. This had to be done outside for two reasons. First of all, it's a very messy experiment. It would be difficult to contain or clean up inside. More importantly, however, the natural sunlight outside would provide much better lighting for this shot. The photo was taken in the afternoon, in which the sun was focused at an angle. This made the lighting of one side of the bottle ideal.

5 Photography Techniques

Given that there was adequate lighting from the sun, it was relatively easy to pick the camera settings to use for this shot. I was using an Olympus OM-D mirrorless camera with a 14-42mm zoom lens. I really wanted to have good time resolution so I chose a high shutter speed at 1/1000. This is really what captures the moment I took the shot well. I also wanted to have a relatively short depth of field, because I wanted the background to be pretty blurred so you would focus more on the flow. To do this I kept the aperture large at f/3.5. The ISO was set at 1000 since there was plenty of light but the shutter speed was fast. When I took the photo I was also at full zoom. I did this so I could try to capture as much detail as possible, while still staying far enough back to avoid getting sprayed. I took the photo using a burst mode and picked out my favorite. Post processing was simple in Photoshop, I added a little saturation and made the background a little darker. I like how the background feels so I decided not to edit it out. After all this I came to my final image.



Figure 2: Original Unedited Photo

6 Comments

I really like the warm sunny feeling of being at a park that my picture captures. The background is essential to this. I also really like the unique bulges in the flow of the soda, as well as the slight shimmer that comes off of these bulges. I wish the soda ended up going a little higher. It's hard to say exactly why this happened but it's likely due to the writing on the new Mentos covering parts of their surface. If I were to do this again I'd go with 2 liters of soda and try a different type of Mento. I may also see if I could shorten the shutter speed even more and move closer to get even better detail. Overall I love how it turned out but would like to improve it if possible.

References

T. S. Coffey, "Diet coke and mentos: What is really behind this physical reaction?," *Am. J. Phys.* 76(6), 551–557 (2008). <https://doi.org/10.1119/1.2888546>,