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MCEN 4151 - 001

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Team Second Report

This image was part of the Team Second Assignment. Being a college student, often around beer, our team decided to photograph some of the commonly overlooked physics from beer flow. My photo was taken with the help of Michael Karns, in his backyard in Boulder, Colorado. Michael and I traded off taking pictures with each of our cameras until we found two final shots, one for each of us. Both final pictures ended up being captured by Michael's Canon EOS Rebel T6i.

One thing that fluid experts might notice is the diameter of the beer as it falls further towards the bottom of the glass. According to the equation of continuity,

$$\rho_1 V_1 A_1 = \rho_2 V_2 A_2 \qquad (1)$$

where ρ is the fluid density, V is the fluid velocity, and A is the fluid area, as a fluid increases its speed, its cross-sectional dimeter should decrease. This means that as my beer pour gets closer to the bottom of the glass, the fluid should become thinner. However, looking at the photo, the stream seems to have a relatively constant diameter all the way into the bottom of the glass. I theorize this is due to the carbonation in the fluid. The gas bubbles try to escape the flow into the less dense air, pushing outwards on the stream, creating a larger cross section. This may also slow the fluid down as the flow is laminar all the way into the glass. You may also know the refraction of the pour thanks to the change of speed of light as it passes through the glass.

The visualization technique used was nothing unordinary. A newly opened bottle of blue moon was poured about 1.5 feet above the bottom of the glass. The glass was just a common, transparent, unlabeled container. The lighting used only came from the mid-day sun. This made the original photo very unaesthetic. However, with the dark-gray background, I was able to manipulate the image into something much more artistic.

The size of the field of view is about 2 feet by 2 feet. The dark background was placed about one foot behind the glass with the camera about one foot in front of the glass. This photo was captures with an F-stop of f/6.3 and an exposure time of 1/1000 seconds. The ISO was set to 6400 with a +1 step exposure bias. The focal length was also set at 37mm to focus the image. Michael's camera is a Canon EOS Rebel T6i DLSR camera. The original image was 6,000 x 4,000 pixels and the published image was 1,300 x 893 pixels. I put a heavy curve edit in post-processing to darken the background and leave only important elements into the photograph. The curve edit and original photo are shown below.

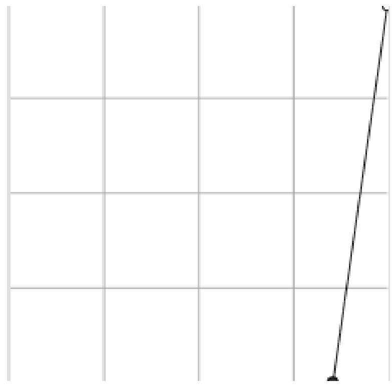

Figure 1: RGB curve edit in post-processing

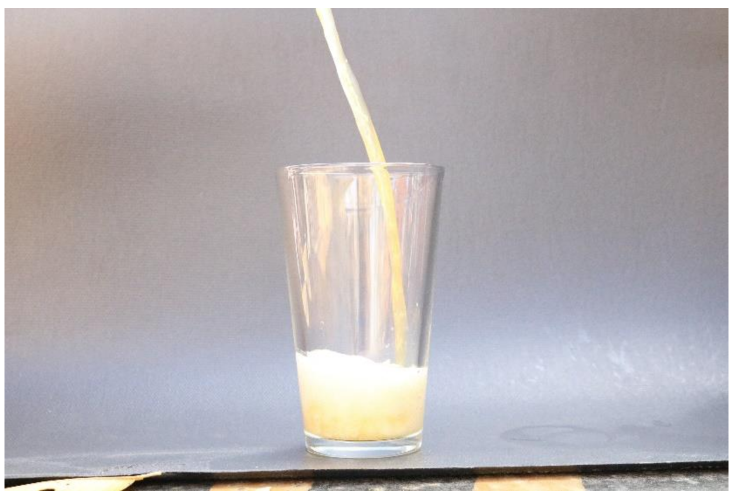

Figure 2: Original image

The image reveals two forms of fluid dynamics, a non-common use of the continuity equation and light refraction. I really like how my post-processing turned out. The image is pure black in the background and the fluid is a fiery color that draws the attention of the audience. I would have liked to capture the image a split second earlier when the fluid first hits the glass, so I could visualize the splash physics. If I could try again, I would try to capture the initial clash of the fluid on the glass, perhaps using unique lighting to give abstract visual effects.

REFERENCES

[1] Continuity equation. (2018, August 27). Retrieved from https://en.wikipedia.org/wiki/Continuity_equation