Get Wet Report

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Flow Visualization

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Introduction and Purpose

This is the first flow visualization 'Get Wet' submittal for the MCEN 4151 class. The instructions for the assignment were to capture an image of any flow that displays a physical phenomena. I focused on the physical phenomena of changing the index of refraction in different materials. One of my favorite effects, was the colors that glycerin refracted on a CD.

Flow Apparatus

The flow apparatus that used to capture this image was a new DVD, glycerin, an eyedropper and a halogen work lamp. This photo was taken in my kitchen, with a halogen lamp being used to reflect the light. The lights in my kitchen were off, and the shades were closed. I took this photo in the afternoon, on a gloomy day so that outside light wouldn't affect my photo. An eyedropper was used to drop a few droplets to one edge of the DVD. I wanted to capture the light hitting the glycerin as well as the light hitting the DVD. Another effect I added was a piece of clothing propped on a large cardboard box. Depending on the angle I took the photo, the piece of clothing was reflected on the DVD, which created a pretty pattern.

Flow Generation

To create the rainbow light display a light source was used that was flexible so that the light could be aimed at an angle. The halogen lamp I used had a lamp shade that could be flexed in different positions depending on where I wanted to aim the light. By aiming the halogen lamp at a 90 degree angle I was able to get the most effective photo with the largest streak of a rainbow. When the light hit the CD, the light was reflected in every direction.

Flow Phenomena

In the final photo there are three physical phenomena that are occurring: diffraction of light on the glycerin, reflection of the light on the DVD and surface tension. The force between the glycerin and the DVD is adhesion, which is a type of surface tension.

The reflection of the on the DVD happens because of the mirroring effect the DVD creates. The diffraction of the white light was spread into several spectral components. This separation of the spectrum happens due to the diffraction grating that occurs. The grating acts as a dispersive element which is what is seen in the image. The directions of the beams depend on the spacing of the grating and the wavelength of the light. The memory storage that is on the DVD are separated evenly (about 1.6 micrometers apart) and act as the diffraction grating for the light. The spacing of the grating however is held at a constant, and each color of the spectrum has different wavelengths, which are then sent in different directions. This allows the viewing of the separated colors.

The grating of the object acts as a dispersive element and the directions of the beams depend on the spacing of the grating and the wavelength of the light. In the case of the DVD, the tracks or memory storage on the disk are separated evenly (about 1.6 micrometers apart) and act as the diffraction grating for the light. Since the spacing of the grating is held constant and each color of the spectrum has a different wavelength, the various colors are each sent in different directions allowing the viewing of the separated colors.

Through research I found out that each color is reflected in a different, which shows why each color can be seen across the DVD in rainbow spectrum. Each droplet that is on the DVD acts like a lens, which bends the light in several different directions. This is seen for the individual lines of color that is around each droplet.

Visualization Technique

The DVD was purchased at the UMC bookstore and was a blank disc. The glycerin that was used was purchased from McGuckin's Hardware store. Lastly, the halogen work lamp was borrowed from a friend. However, these lamps can also be found in ITLL. The glycerin was pure glycerin and had no other components in it to create

this effect. The only lighting that was used on the work space was the halogen work lamp. All of the other lights were turned off, and the shades were pulled down, that way the halogen lamp had the greatest affect on the photo.

Photographic Technique

The photographic technique that was used wasn't ideal, although it still successfully took my picture. However, a macro lens would of made this photo more successful than my final results. Instead I used a Nikon D90 with a **42mm** lens, because that is the camera that I have. It put at an f stop of **4.8**. This f stop was used to shorten the depth of field. It also helped place focus on the droplets that were on the DVD. The field of view was approximately **5 centimeters** and the lens was approximately **35 centimeters** away from the DVD. The shutter speed was formatted to **1/100th** of a second and the ISO was **200**. This allowed a lot of light to get in to the sensor while keeping the image free of any noise. The original image was **4288 x 2848**.

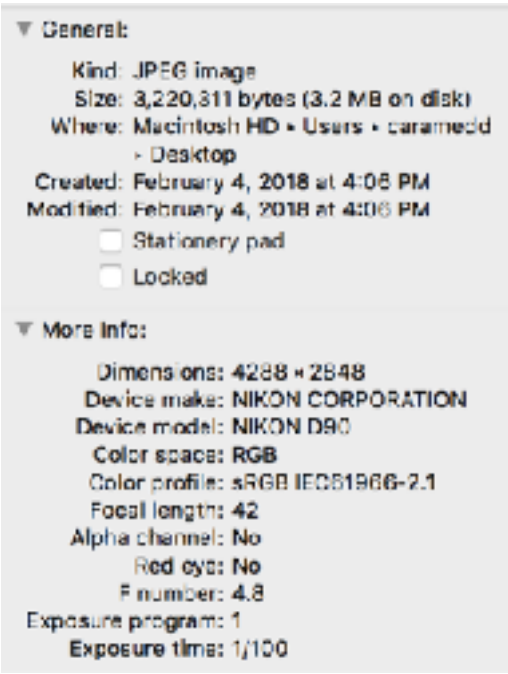
Post Processing

The image was then taken to Lightroom where the image was cropped and the contrast was changed. The image was also blackened to make a more dramatic effect.

In Figure 1, the before and after photo can be viewed to see the comparison of the original versus the final image:

Before **After**

Figure 1.



The final image puts more emphasis on the phenomena, highlighting the surface tension and the diffraction of light across the DVD. It was important to me that the photo looked as crisp as possible, and I like the blackened effect that was added to this photo. Something that I would change is the way I took the photo…I wish I got closer so that it was easier to crop the image without it looking weird so the flow could be more highlighted than it is. In developing the image further I would of liked to play with different lights and backgrounds to see the reflection and diffraction - and see the color changes.

Conclusion

In conclusion, this image might not be the most effective to show the flow that I am analyzing, but it shows the generation well. The glycerin is doing its job as an agent that diffracts light. The DVD is reflecting the light. I how I captured the image and used a piece of clothing to help capture it. The clothing that was reflecting on the image had a cool pattern that is pretty to look at. What I dislike is the lack of a proper lens to take the photo effectively and get a good glimpse at the glycerin. Next time I would of liked to try this.

Work Cited

1. Ansell, Dave. “The Naked Scientists.” *Colors in CDS*. University of Cambridge, 7 Dec. 2008. Web. 13 Feb 2018.

2. “Surface Tension.” *Visual Physics School of Physics*. University of Sydney, n.d. Web. 14 Mar 2013. <http://www.physics.usyd.edu.au/teach_res/jp/fluids/surface.pdf>.