MCEN 4228 – FLOW VISUALIZATION

Project 2

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Introduction

Often, products on a store's self are overlooked and many consumers are skeptical of the claims on the package. The objective of this project is to explore and capture the physics of the wet-ability of a liquid on a flat surface with a surface treatment. The image shows the change in the surface property of glass after treatment using an automotive product called "rain-X." The image demonstrates the change in contact angle and a collage of photos shows the effectiveness of the product.

Setup/Experiment

To setup the shoot, a regular glass mirror is partially coated with the product per the instructions of the package. The glass with is approximately 1.5' x 6" is placed on top of a table with a camera pointed down or horizontally at it, Figure 1. The camera was placed approximately 5'" away from the top of the mirror first surface on a tripod. There were no extra lights other than a 14W fluorescent bulb lighting the room to enhance the lighting.

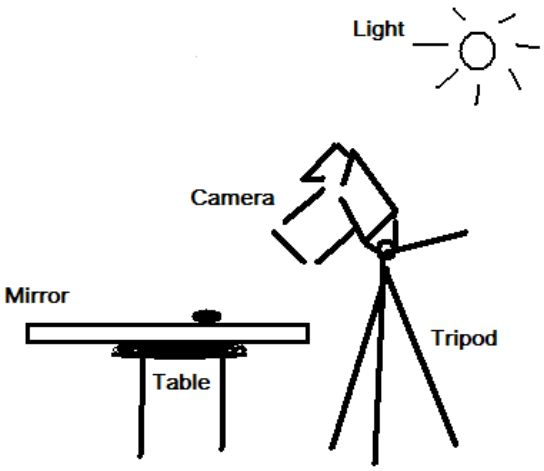

Figure 1a: Photo Shoot Setup (Collage)

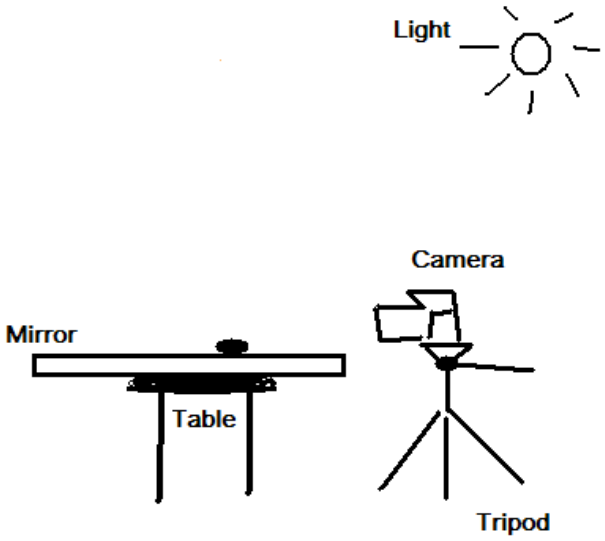

Figure 1b: Photo Shoot Setup (Contact Angle)

The objective of these images is to observe the contact angle between a liquid, water, and a solid, the mirror. The contact angle can be seen in Figure 2. In the image, both droplets contain the same volume but the left droplet is placed on the non treated surface while the other droplet is placed on the treated surface. The contact angle on the untreated surface is much smaller than the treated surface. This can be observed in the image. This means that the liquid and treated surface approaches towards non-wetting. The liquid is free to move and it wants to be in the lowest possible state of energy therefore it exhibits the effects of contact angle. There are three separation interfaces (gas, solid, and liquid) and the liquid moves until it reaches equilibrium state.

Figure 2: Contact Angle

Visualization Technique

The water was plain tap water, the syrup was a generic Albertson's store brand syrup, and the surface treatment product is called "rain-X." The product is produced and distributed by Sopus

Products company and can be found at Autozone and other major automotive retail stores nationwide. Once again, the surface treatment was applied following the packaging. There was no flashed used when taking this picture because of the possible glare from the glass mirror therefore a florescent light was used instead.

Photographic Technique

The image was taken using a 12.2 mega pixel Canon Rebel XSi digital single-lens reflex (DLSR) camera. An 18-55mm image stabilizing lens with was mounted on camera. The distance that the object was away from the lens was approx. 2.5" from the top surface mirror and the focal length of the lens was 55mm for the collage images. The aperture, shutter speed, and ISO setting was F5.6, 1/10 Sec., and 800, respectively for the collage images. For the contact angle between the two different surfaces the camera was placed exactly horizontal to the glass and the camera was placed 8" away from the droplets to obtain a better focus. The camera settings were similar to collage images except for the shutter speed which was set at 1/8sec. The sizes of the original and final images are 4272 x 2848 pixels; the original images was shot in RAW format and converted to a TIFF for the final image and GIF file for the collage of pictures. No Photoshop processing was done to the images.

Conclusion

Personally, I like the images because I like the color contrast between the mirror and the syrup or the collage and how apparent the difference in contact angle is between the untreated and treated surface. The part of the collage images I dislike is that there is a blurry area which was another syrup spot at the corner of the images. I could have cropped the image but then the images might not align properly in the collage.

References

Park, Lakes. Biomaterials An Introduction. Springer, 2007.

Smits, Alexander. A Physical Introduction to Fluid Mechanics. John Wiley and Sons, 2000.