Get Wet

Flow Visualization

Jessica Lucia

February 8, 2010

Fluid flows are a great phenomenon which people encounter on a daily bases. The purpose of this photo was to capture one of these phenomenons as it was occurring; showing the physics as well as the artistic effects that can be created. This particular image illustrates laminar flow while depicting surface tension.

The apparatus used to capture the image was a bathroom sink faucet and a Nikon digital camera. Shown below in Figure 1 is the set-up:

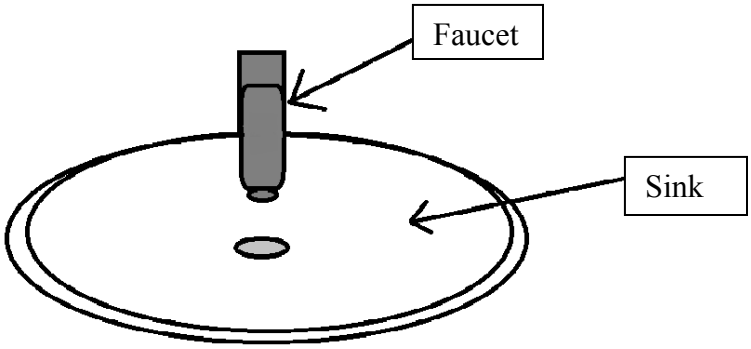

Figure 1: Apparatus Set-up

The faucet was turned on to a medium pressure which allowed for a steady flow of water. A steady non-turbulent flow is considered laminar and will have a low Reynolds number:

$$\mathrm{Re} = \frac{QL}{\nu A}$$

The equation above is used to calculate Reynolds number; Q is the volumetric flow rate, L is the traveled length of fluid, A is the pipes cross-sectional area, and υ is kinematic viscosity [1]. The faucet produced a very low Reynolds number of about 150 and therefore a laminar flow. Along with laminar flow the surface tension of the water was captured. As the water exits the tap it plummets down to the sink in a column shape; the surface tension of the water allows for this shape to be maintained the entire way down. Also seen are air bubbles and a shadow from the tap itself, these effects add an interesting element to the final image.

The techniques for creating the image were rather simple; there was no dye or special effects that altered the tap water seen. The faucet was allowed to remain on at a steady flow rate

and photos were taken with various camera settings. The lighting used for this image was also very simple; no additional lighting was brought in, only the bathroom lights, located above the sink, were used. The bathroom lighting consists of four spring lamp 14 Watt daylight N:Vision energy saver bulbs [3]. Though various camera settings where tried the camera flash was turned on for this image.

The image was captured using a Nikon D50 digital camera. The field of view was 2256 x 1496 pixels. The camera lens was between 6-8 inches from the flow when the photo was taken. The lens used has a focal length range of 18-55mm and for this image the focal length was 55mm. The aperture of the lens is 1:3.5-5.6G and for the image was at f/5.6G. The exposure time of the image was .008s or 1/125. The flash was turned on and a normal camera orientation was used. The final image was slightly modified using Picasa 3. The contrast was increased which allowed for a more clear and precise image, with vibrant shadows and highlights. Also, the image was converted to black and white allowing for the contrast to standout further.

The image is simply tap water from a running faucet; it captures the surface tension of a laminar flow into a sink. I like the simplicity of the image; there were no modifications to the sink or flow to add color or excessive complication. The beauty of the running water can be seen in its purist form. Also, I like the air bubbles within the flow they create nice texture in contrast to the smooth water around them. Lastly, the dark black shadow within the flow, created from the faucet and lighting from above, again adds to the image in my opinion, by increasing the contrast and texture of the flow. The physics are depicted rather well in the image and are easily seen in the final image with enhanced contrast. The image although it did capture the physics and flow rather well creating a nice image that I liked it was not the image I had initially intended to create. I had plans to make a much more elaborate set-up that would have shown varying types of flows but was intrigued by this image and so decided against it. In the future I could go back and create a grander image by adding color or adjusting the lighting and even modifying the flow to create various effects.

References

[1] *Wikipedia*. Web. 07 Feb. 2010. <http://wikipedia.org/wiki/Reynolds number>

[2] "How to determine your faucet flow rate." *Shamrock Plumbing | Indianapolis | Cloverdale | Affordable Pricing*. Web. 07 Feb. 2010. <http://shamrock-plumbing.com>.

[3] *N:vision | Home of Energy Efficient Compact Fluorescent Light Bulbs, Lamps and other lighting products | Manufactured by TCP*. Web. 07 Feb. 2010. <http://nvisioncfl.com>.

[4] *Wikipedia.* Web. 07 Feb. 2010. <http://wikipedia.org/wiki/Tap_(valve)>