

Fluid Movement in a Sink Bowl

Flow Visualization, a course focusing on capturing the natural beauty of fluids with the science of fluid flow, has varying image assignments. This is the second group assignment. Group assignments are designed not necessarily to force group members to image the same phenomenon, but more so to give each student extra resources and encourage them to image more complicated set-ups. Our group had wanted to capture the sinusoidal movement of a stream of water when moved by a speaker. We were unable to do this to our satisfaction, and thus went our separate ways for this project. I chose to focus on the way that a stream of water, when impacting a surface, will move.

In this project I used a simple set up with a standard sink faucet. The sink bowl was rounded, as a bathroom sink, unlike most kitchen sinks. I have approximated this shape in **Figure 1**. The faucet head released the water approximately 5.5" above the base of the bowl, or the drain. To highlight the movement of the water I added about 2 Tablespoons of chili oil to the surface of the bowl. I poured this in about 3 inches from the drain, then turned on the faucet and watched the water slowly eat away at the chili oil.



Figure 1. Solidworks Model of Apparatus

As the water from the faucet falls it hits the top of the drain first. Because of the volume and speed at which the fluid is moving the water does not simply drain into opening. It has kinetic energy and cannot just stop. Instead the water shoots out to the sides upon impact, pushing up the sides of the sink bowl. As more water comes out of the faucet and shoots up the sides, the water that has already moved up the bowl moves back towards the drain (to a lower potential energy position), but must do this by moving around the bowl to avoid the constant water stream.

This video also shows an example of a hydraulic jump. The quickly flowing water from the faucet has to abruptly shift into a lower velocity, causing a vertical rise in the water. The water straight from the faucet drops quickly and impacts the base of the sink. As it rises up the edges of the bowl it is moving against gravity, increased friction, and the water is fanning out over a larger area. Each factor contributes to the sudden drop in velocity, and the subsequent increase in fluid height.

For this assignment I wanted to catch the motion of the fluid so I chose to take a video. I was in a low light situation, and needed to focus rather close to the fluid, but struggled with finding an appropriate angle. The details of the video are given below. The video was taken with a Canon PowerShot G9 camera on March 20th, 2013.

Frame Width	960
Frame Height	720
Data Rate	4271kbps
Length	16 seconds

The video was not edited for content at all, just to eliminate the noise from the faucet. Unfortunately, the editing software added a watermark to the video, so perhaps it was not worth the editing.

I really like the fluid physics the video captured here, but I would improve the execution given the opportunity. The swirling water and the way the flow eats away at the chili oil is shown well here, but the photography does not enhance the fluid flow, which I would like to see more of. Overall, I like the approach I took and the fluid phenomenon I chose, just not the execution.

Reference:

"Hydraulic Jump." *Wikipedia*. Wikimedia Foundation, 29 Mar. 2013. Web. 09 Apr. 2013.
<http://en.wikipedia.org/wiki/Hydraulic_jump>