

This assignment deals with how a vortex forms. A number of different setups were performed in order to capture a wide variety of pictures. Different sized holes, breather holes and inserting floating foam pieces were photographed to see how it would affect the visibility of the flow. Four images were selected that were taken in succession to form a collage of the fluid flow.

This experiment used a two-liter bottle full of water with a white poster board as a backdrop for the setup, see figure 1. The camera was placed fairly close to the sink that the water emptied into for easy cleanup. A two-liter bottle was rotated around a few times to get the water circulating and the plug was removed in the bottom of the bottle. After about 5 seconds a vortex would form and the water would drain out. The vortex is partially formed due to the initial rotation of the bottle, the bottle is tapered near the bottom and there is a pressure gradient. A free (irrotational) vortex is formed in the bottle. The speed is greatest in the vortex but there is also the least pressure in the bottle. The velocity decreases as you move further away from the vortex and inversely the pressure increases causing the vortex. The Reynolds number in the vortex is around 3000. I estimated the speed of the water in the vortex to be around 0.3 m/s and the diameter of the bottle to be 10 cm. The values for density and viscosity can be found and in turn the Reynolds number is easily calculated.

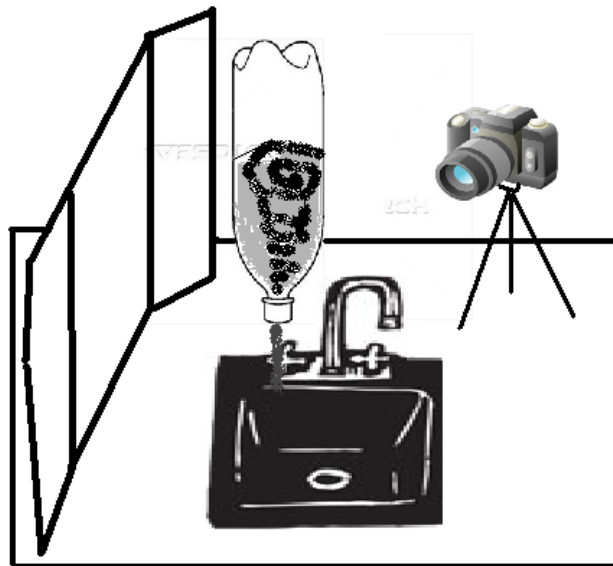


Figure 1

The only materials used to show the fluid flow as water in a two-liter bottle. Just spin the bottle a few times and let it go. There was overhead fluorescent lighting and the flash on the camera was used at 1/16 of full power. This gave just enough lighting to show the detail but not over saturate the image.

The field of view and distance from the object are both about one foot. All other camera specifications can be seen in figure 2. The image was altered some in Photoshop using a few different tools. The colors were enhanced using the curves tool. A small section of white space was cropped out and the brightness/contrast of the image was changed to give the photo more clarity.

Camera Data 1	
Make:	OLYMPUS IMAGING CORP.
Model:	E-410
Date Time:	2009-04-26T19:59:28-06:00
Shutter Speed:	
Exposure Program:	Shutter priority
F-Stop:	f/4.1
Aperture Value:	
Max Aperture Value:	f/3.5
ISO Speed Ratings:	100
Focal Length:	20.0 mm
Lens:	
Flash:	Fired
	No strobe return detection (0)
	Compulsory flash firing (1)
	Flash function present
	No red-eye reduction
Metering Mode:	Center weighted average
Pixel Dimension X:	942
	Y: 1151
Orientation:	Normal
Resolution X:	314
	Y: 314
Resolution Unit:	Inch
Compressed Bits per Pixel:	
Color Space:	sRGB
Light Source:	Unknown
File Source:	DSC

Figure 2

These are very clear images for being in motion. This image clearly shows the spiraling motion of the water as it exits the bottle. The image has better focus than most of the previous images I have taken. If more time was possible I would try to find a larger container to better show the vortex but this is pretty good for just a two-liter bottle. The bottle does distort some of the clarity on the outer edges. A larger container may not have done this as much as well.

Sources

<http://en.wikipedia.org/wiki/Vortex>

http://en.wikipedia.org/wiki/Reynolds_number