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Flow Visualization
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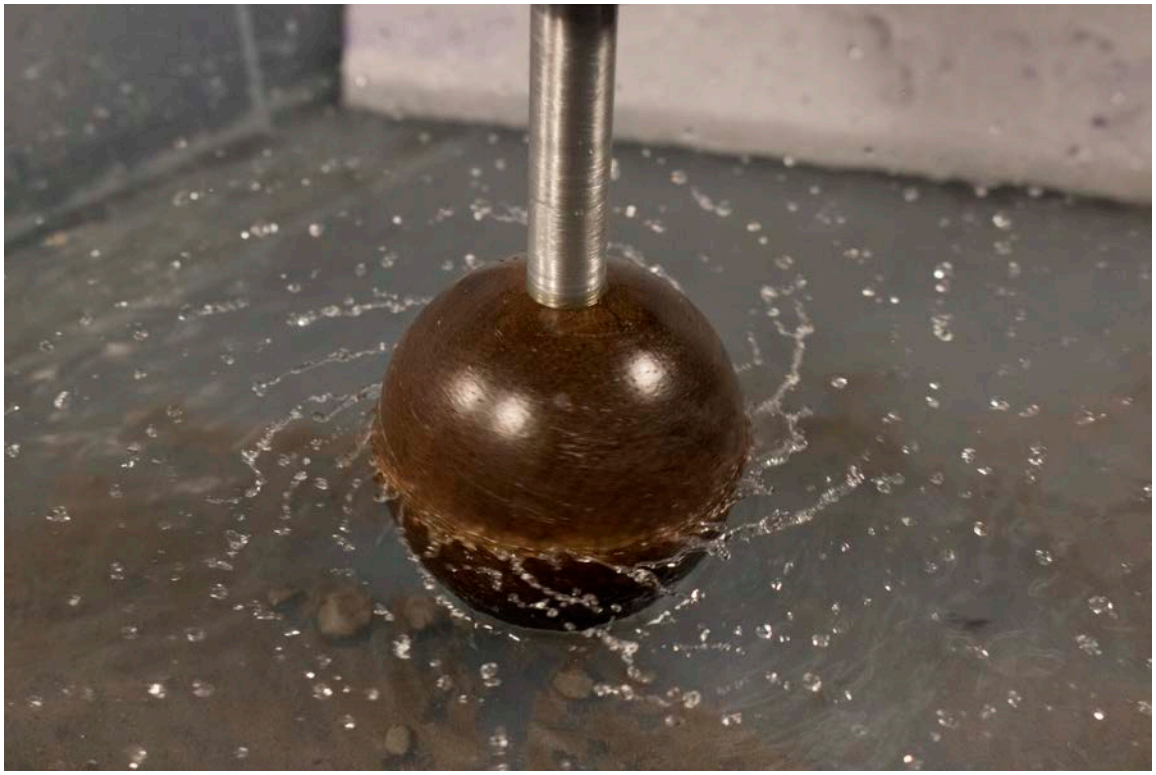

The image shown above was taken for the third flow visualization team project at the University of Colorado at Boulder. It illustrates the motion of water being drawn up a sphere and jetted outward. The primary properties exhibited in this image include the no slip condition, and the Bernoulli principle.

In order to create this image, a spherical wooden ball was connected to a metal shaft that went through the center of the sphere. The ball was also coated in water resistant paint to make sure it was not damaged or waterlogged during the testing phase. The apparatus was created in the Chemistry machine shop at the University of Colorado at Boulder. The shaft coming out of the ball was inserted into a mill collet and slowly lowered into a tub of water while spinning. The rotational velocity was varied until a reasonable phenomenon was capable of being observed. Brown powder was dropped into the water in an effort to demonstrate the flow better, but some of it clumped up as can be observed from the image.

The sphere had a 4 inch diameter and was spinning anywhere from 200 – 1,500 rotations a minute. When the wooden sphere reached the water after being lowered down, the water began churning as a result of the no slip condition. This condition states that a liquid on the surface of an object will stay almost exactly on that spot due to friction. The physics behind the liquid rising up the ball to the point with the greatest diameter are very interesting. The liquid at the very bottom of the sphere has a slower velocity than the liquid that rises up the sphere. This is because it is all rotating the same number of times, but the circumference at the sphere's equator is much larger than at the bottom of the sphere. This increase in velocity always goes with a decrease in pressure as the Bernoulli principle demonstrates[1]. Thus there is a higher pressure at the bottom of the sphere than at the sphere's equator. This imbalance causes the water to be drawn up the sphere until it is finally coming off in droplets, jets and sheets from the central axis of the sphere.

The original image spanned an approximate twelve-inch wide by ten-inch high area and was never tampered with, nor did it require post processing. This is because the beauty in the image is from all the various water droplets, and removing the powder clumps would affect the droplets clarity so they were left in. The image was shot using a Canon EOS REBEL T3i. A focal length of 33 mm was utilized in order to best focus on the subject of interest. Alongside the focal length, an F-number of 5.6, an exposure time of 1/4000, and an ISO of 3200 were selected to illustrate the best clarity of the situation. The image was lighted with 3 spotlights in order to achieve the desired brightness. The final resolution of the picture is 5184x3456.

For future attempts at recreating the image, a ball would have to be machined that could somehow be attached to a mill in order to allow for the rpm's to be high enough for the phenomenon to take place. It would be nice in future images to not add anything to the water since the blue is very deep and beautiful. Also, the background would be unnecessary if the camera was pointed at more of an angle so that everything was just pure water. Nevertheless, I am very pleased with the image I got and find it to be a visually stimulating picture that resonates with the soul.

References:

1) "Cracking The Egg Sprinkler Mystery." *Science Friday.* 28 April 2014 http://www.youtube.com/watch?v=s5XVqWA1mj4