Get Wet Image Report
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CONTEXT

The purpose of this image for the get wet 2016 gallery is to illustrate the effects of a Worthington jet. This image shows a droplet of water hitting the pool beneath and the resulting phenomenon from the droplets impact with the water. Initially this image was meant to be captured with a droplet of oil hitting the water, however, it was found that the droplet size and frequency was too difficult to control for an accurate photo. The image ended up being captured by having an assistant drop water from the corner of a sponge about one foot above the pool below.

DISCRIPTION OF FLOW

The flow pictured in this a demonstration of a Worthington jet that I believe is coming in from an angle. The Worthington jet is formed when an object interacts with a liquid air interface. There is a cavity formed from the object (in this case a water droplet) impacting the surface, and when the cavity closes it forces the water up into the jet that can be seen in the image. The energy from this jet comes from the radial energy contained within the walls of the collapsing cavity (Gekle 2009). The jet is approximated to leave the pool at 20x the rate of which the object impacted the water (Gekle 2009). If the droplet is coming from .5 m above the surface of the water the final speed at impact will be 9.8 m/s.

$$vf^2 = vi^2 + 2 * a * d$$

$$Vjet = 20 * vf$$

If the drop hits the water at 9.8 m/s the initial velocity from the collapse of the cavity will be approximately 196 m/s according to the findings from (Gekle 2009). Based on the image scale I would estimate that the height of the jet is approximately 1.5 cm high. Since it is thought that the droplet may have impacted the surface with some horizontal aspect of velocity instead of just vertical this could lead to the

$$Re = \frac{UD}{v}$$

$$\frac{\left(9.8\frac{m}{s}\right)(.003)}{1.004 * 10^{-6}} = 29280$$

The high Reynolds number. Calculated when the droplet is impacting the water suggest turbulent flow. From the image the flow looks to be laminar, however, since the subject matter is clear and limited to the focus of the image it may be difficult to

tell and the flow could be transitional with aspects of both laminar and turbulent flow.

VISUAILZATION TECHNIQUE

The visualization used in this photo is purely water on water. The color was introduced in post processing of the image. A white background was used below to allow the ripples of the water to be seen and make sure that they didn't get lost in a dark background. The apparatus was a clear bowl, which contained the pool of water below. A sponge that was being squeezed above the bowl produced the droplet and creates the impact for the Worthington jet. The lighting comes from a flash on the camera as well as a fluorescent light. The light is above a cabinet in the room so it is not directly impacting the water. The fluorescent light was reflecting off of the ceiling before illuminating the flow.

IMAGE DETAILS

For this image there were several factors that played into making the image what it is now. The field of view of the original image is about one foot across. This allowed the camera to be able to focus on the jet, as any closer to the water would have caused the image to be out of focus. The distance from the jet to the lens is about eight inches and the focal length of the lens was 18mm. This image was captured with a Canon EOS Digital Rebel XS with the aperture set at f/4, the ISO set at 400 and the shutter speed set at 1/60 seconds. The overall original image width is 4272 x 2848 pixels, however, the final image has been cropped down to 1936 x 509 pixels. The blue of the photo was brought through in post processing by increasing the blue value in the curves. The below image is the capture before the blue was added to the image and after it had been cropped.

Image after cropping and before editing.

CONCLUSION

The image reveals a flow that can be seen in everyday applications from a cannon ball into a pool to a simple drop of water hitting a bowl below. In this photo the physics are shown quite well as the jet can clearly bee seen suspended above the water with and the ripples seen on the surface surrounding the impact zone. I am still curious as to the exact reason that the jet itself is coming out at an angle. The intent of the photo was captured, to see the Worthington jet suspended above the water with the ripples around the bottom was the original idea of the photo. In the future I would like to improve the contrast of the photo and have a more consistent

starting background. To further this image I might also consider adding some dye to the water to bring some more color into the image. Overall I am happy with how the image turned out.

CITATIONS

Gekle, Stephan. *Impact on Liquids: Void Collapse and Jet Formation*. Enschede: Universiteit Twente, 2009. Stephan Gekle, Physics of Fluids, University of Twente, 2009. Web. 22 Sept. 2016. <http://doc.utwente.nl/68374/1/thesis_S_Gekle.pdf>.