Green and Jelly

Get Wet

Lea Mattson

MCEN-4151

Flow Visualization: The Physics and Art of Fluid Flow

2/16/2018

Background

Different fluid flow phenomena are captured in this Flow Visualization class. In this image, the immiscible properties of petroleum jelly were tested by mixing in green food dye and adding heat, and then testing the effect of dish soap. This was the first assignment in the class and there was no collaboration with the fluid experiment and imaging.

Experimental Setup and Process

The petroleum jelly was mixed with green food coloring in a separate bowl. After rigorous mixing, the fluids no longer seemed to be separated. The food dye was and petroleum jelly were manufactured by the Safeway brand. This green jelly was then transferred into the experiment dish, which can be seen in fig. 1. The inner diameter of the dish is roughly 4 in, and the jelly was filled to roughly ¼ in. This dish was placed on a gas stove and heated until the petroleum jelly reached a liquid stage. The heat source was removed, and the fluid photographed in this state. The dish was swirled with no apparent effect, and the fluid mixture remained the same. The dish with the fluid was then tilted and propped up onto a small block, fig. 2. In this configuration, the final image was taken.

There is minimal post processing done to the final image. The edges are improved a bit for clarity, and the contrast is slightly increased. There was no flash used, and the lighting source was ceiling lights. A focal length of 55, and an exposure of 1/40 was used to capture the image. The image was sheltered from direct light, resulting in a lack of reflections. The image was taken at an angle as depicted in fig. 2.

Figure 1: Dish Used to Heat Petroleum Jelly

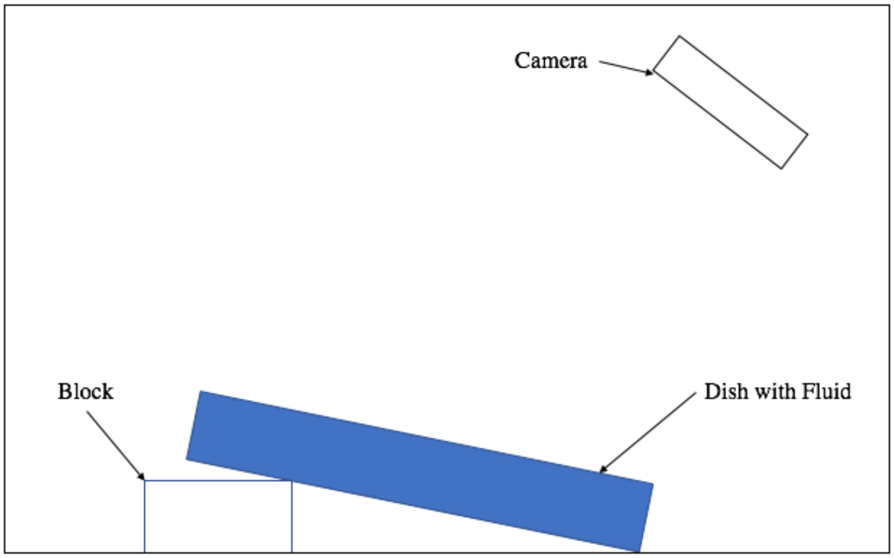

Figure 2: Final Fluid Flow Setup.

Fluid Physics

When the dyed petroleum jelly was heated, the green food dye settled to the bottom and formed small bubbles. This can be attributed to a difference in the densities of the two fluids. The green dye lumped together into small puddles, rather than forming a single layer at the bottom of the dish. The contact angle seemed rather shallow and the puddles flat rather than bulbous. Figure 3 shows the melted jelly with the separated green food coloring settled at the bottom. The circular pattern in the green dye could be a result of the circular geometry of the heat source used.

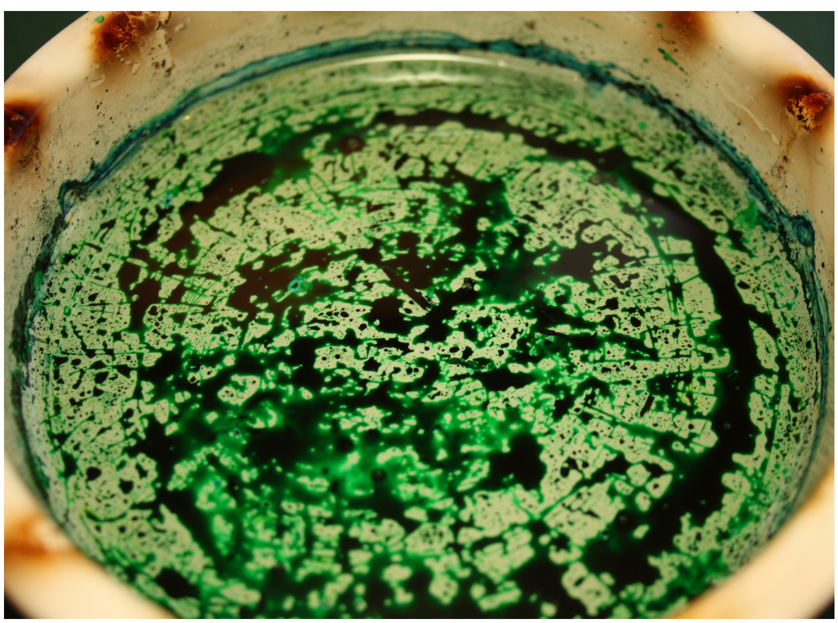
Figure 3: Liquid Petroleum Jelly and Green Food Dye.

Some of the food coloring adhered to the edge of the dish and appears to be blue. There is a slight blue shading that can be seen in the final image as well. It is unclear where this is coming from. When the dish was tilted and propped at an angle, the petroleum jelly flowed to the bottom of the tilted dish. The green food coloring stayed, and streaked down the dish, fig. 4. Small bubbles of the green food dye can be seen in the lighter parts of the image where there is a petroleum jell residue. This is likely caused by the viscous forces being larger than the buoyancy forces of the small particles of dye. The dark portions of the image are food coloring, which bonded to the bottom of the ceramic dish, similar to water. The petroleum jelly did not bond to the dish as much as the green food coloring, which resulted in the large patches of green flow across much of the dish. A few small bubbles of the petroleum jelly can be seen in the upper and mid regions of the picture where the petroleum jelly was trapped between the pools of food coloring.

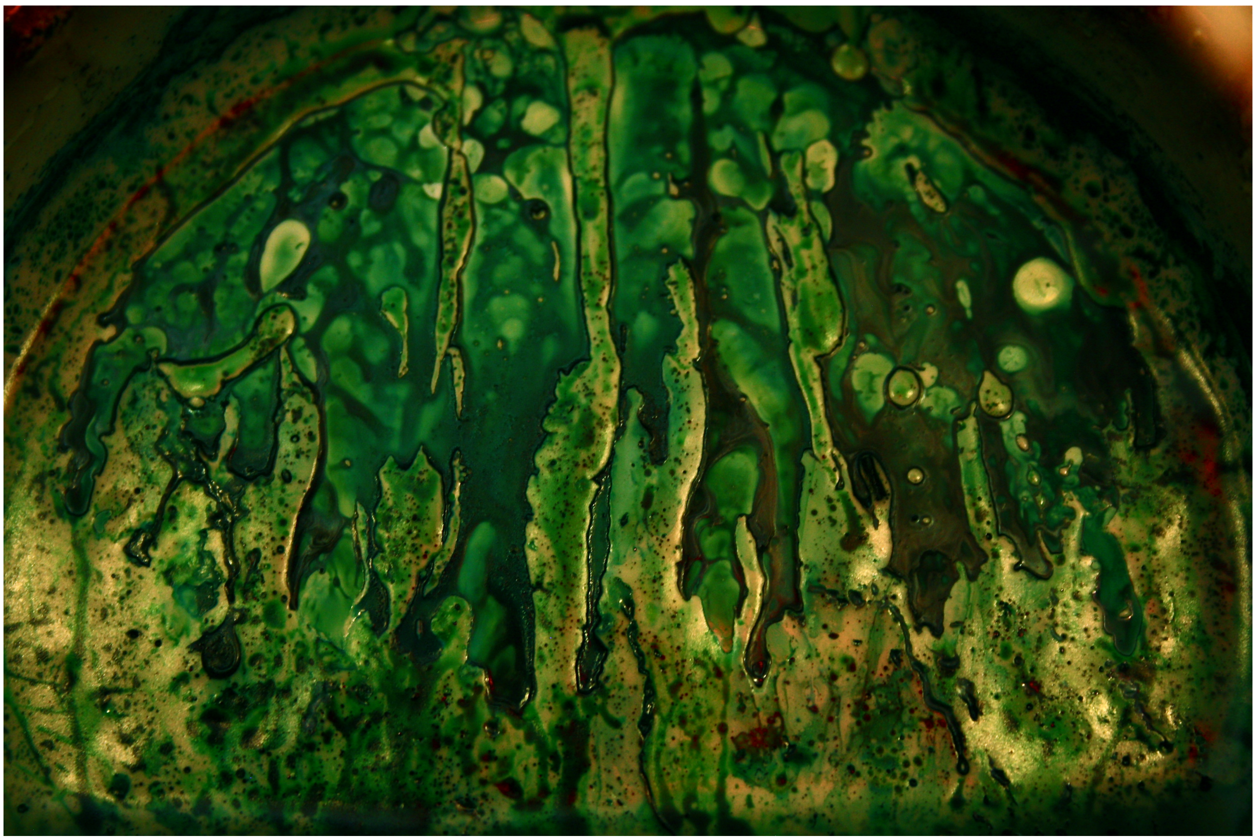

Figure 4: Final Flow Image, Green Food Coloring and Petroleum Jelly.

Conclusion

There were a lot of steps that eventually led to this final image. The intermediate steps were interesting, as can be seen in fig. 3, however the final image really captures the fascinating difference in flow behavior to the green food coloring and petroleum jelly. The two immiscible fluids interacted in a way that formed a captivating image. Things that do not mix well can sometimes work together to create something unexpected and beautiful.

Original Image