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5/8/12

FILM 4200

### Group 3

This was the third, and final, group project done for the Flow Visualization course. For this project, our group decided to capture images of ferrofluid interactions with a magnet.

The bottle that contained the ferrofluid was approx. 1.5 inches in diameter, and 4 inches tall. The ferrofluid was suspended in a suspension liquid which we were not completely sure of the chemical makeup of, but was a mixture of a surfactant and water. For the image that I captured, the bottle was first shaken up vigorously so that all the ferrofluid was dispersed evenly in the suspension liquid, and then the bottle was placed on it's side. Then, a magnet with approx. 70 lb's of force was held about 2 mm away from the side of the bottle so that all the ferrofluid was attracted to the side. What resulted was a current created by the ferrofluid rushing to the side of the bottle, and the suspension being pushed to the opposite side in it's wake. After the magnet is pulled away from the bottle, the ferrofluid succumbs to gravity once again, and drops to the bottom, creating a vortex spinning away from the shear between the falling ferrofluid and the stable suspension liquid.

In order to visualize this flow, the lighting needed to be increased as much as possible. The ferrofluid itself was black, and so this made the job of visualization relatively easy, no dye needed to be added in order to see the ferrofluid itself. However, since the suspension fluid was colored red, there was a little bit of

difficulty in achieving the proper contrast needed. The bottle was placed in front of a white sheet of paper, which was angled so as not to create shadows or to hold the reflections from the glass of the bottle. A strong tungsten light was aimed past the bottle at the sheet of paper so that the flow was lit from behind, and there was minimal glare from the glass of the bottle.

The size of the field of view is a little bit smaller than the bottle, about 1.3 inches x 3.6 inches. The distance from object to lens was about 2 ft in order to have the magnet far enough away from from the camera so as not to affect the machinery, but close enough to be able to see the fine details in the ferrofluid. The focal length was 51mm, taken at f 3.9, 1/30 sec. shutter speed, 29.97 frames per second, and an unknown ISO. The camera used was a digital video camera (Panasonic HMC-AV150) with the original image being 1920x1080 pixels, and the final being 1760x1000 px. I cropped the image in order to get rid of the distracting edges of the glass bottle and the cap on top. The brightness was increased, as well as the contrast, in order for the ferrofluid to stand out more from the suspension fluid, and so that the small grains travelling across the frame could be better seen, as well as the vortex created at the end. The image was also desaturated because I felt that the red was distracting, and that black and white exhibited the subtleties of the flow better.

I am very happy with the way that this image came out. I originally wanted to get close up images of the spikes formed in the ferrofluid, but since the glass distorted the bottom of the image too much, and the amount of ferrofluid was too little to create sufficient peaks, I came up with this idea. I like how this creates multiple flows to be visualized, the attraction of the ferrofluid by the magnet, the

flow created in the suspension fluid, and the vortex created when the ferrofluid is dropped at the end. I would liked to have been able to play with a larger quantity, and preferably on a sculpture, but this was still rewarding. I look forward to creating my own ferrofluid exhibit to further experiment with.