



Ferrofluid

Sam Lippincott, Kenny Olavarria, Peter Jakubczak, Hannah DelGuercio

December 6, 2023

Flow Visualization: The Physics and Art of Fluid Flow

Project 5: Team Third

Introduction

This project was the third team project by our particular group made up of myself, Kenny Olavarria, Peter Jakubczak, Hannah DelGuercio. We wanted to demonstrate the interesting patterns that ferrofluid produces when in the presence of a magnetic field. The spikes that form from a diverging field I think are fascinating and not something you see in fluids very often, and thus worth displaying.

Despite working as a group, this photo was taken and edited by myself.

Physics Discussion

Ferrofluid is a mixture of ferromagnetic nanoscale shavings suspended in a liquid, in most cases, water. In our case, the ferrofluid we used is a proprietary mixture. Then, in the presence of a magnetic field, the fluid moves to align with the magnetic field as the shavings are magnetic. In this situation there's a magnet in the center of the fluid, causing the liquid to form spikes around the diverging field lines of the magnet. The magnet was a small, household magnet.

Experimental Setup

The setup was very simple; the ferrofluid was placed in a rectangular glass container, with a magnet placed at the center of the container. We placed the magnet in the center to maximize the size of the spikes and the angular spread of the spikes as the fluid is then close to the center of the magnet's dipole.

The ferrofluid itself is a proprietary mixture from Ferrotec Corporation provided by Professor Hertzberg. The photo was taken outside on a sunny day so all lighting is natural light.

Photography

The camera specifications I used are as so:

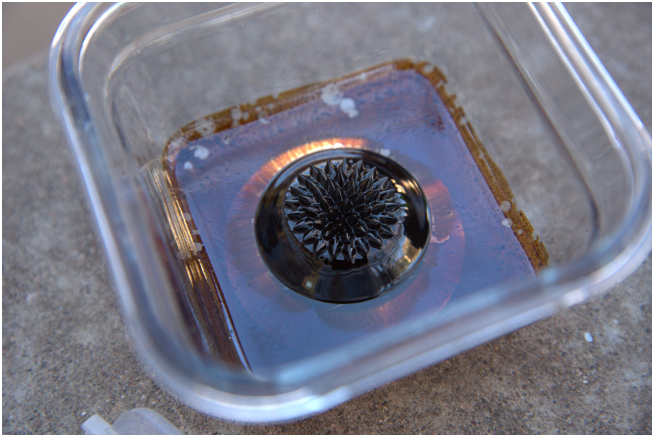
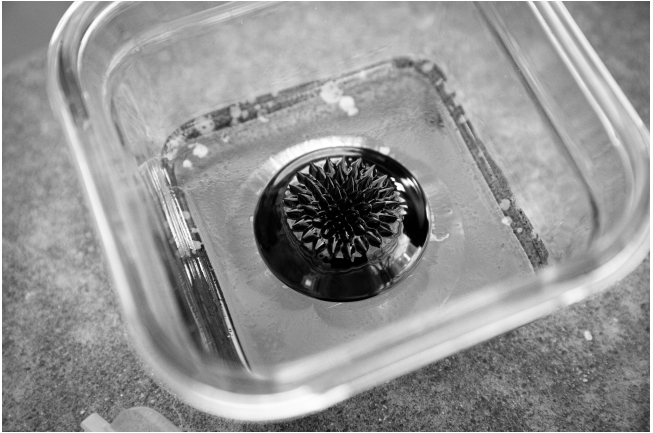

Camera Make and Model	Canon EOS 5D Mark III
F-Stop	F/4.5
Exposure Time	1/350s
ISO	640
Focal Length	70mm

I wanted to try to get as close to the ferrofluid as possible while maintaining focus to try to have the ferrofluid be the only thing in frame. Unfortunately for this instance, my camera has a telescopic lens so I couldn't get too close while still maintaining focus. Thus I had to crop out the rest of the image in post. I would estimate the lens was perhaps 6-8 inches from the subject.

When it came to editing the image, the following settings were used to manipulate the image. All edits were done in Adobe Lightroom.

Setting	Change
Exposure	+1.89
Highlights	+50%
Shadows	-50 %
Whites	+49%
Blacks	-10%
Saturation	0 %
Texture	+15 %
Vignette	-30%

Below are the iterations of the edited image.

Fig.	Notes	Image Iteration
3	The raw image. Dimensions: 5796x3870	 A photograph of a clear plastic rectangular container. Inside the container, there is a circular metal mesh or filter. The mesh has a complex, star-like or floral pattern. The container is placed on a light-colored, textured surface. The lighting is somewhat dim, and there are some reflections on the plastic.
4	Edited. Uncropped. PNG File exported through Adobe Photoshop Dimensions: 1300x1140	 A grayscale version of the image from iteration 3. The image is slightly more processed, with some contrast enhancement. The plastic container and the metal mesh are clearly visible. The background is a textured, light gray surface.
5	Final cropped image. JPEG File Dimensions: 1300x1140	 A high-contrast, black and white close-up of the metal mesh. The mesh is the central focus, showing its intricate, star-like pattern. The background is dark and out of focus, making the mesh stand out prominently.

Conclusion

The image nicely reveals how magnetic fields affect ferrofluid. Comparing our results with that of past groups' projects, I'm impressed by the scale of the spikes the ferrofluid produced. I'm very pleased with how the image turned out; I think it looks almost alien. I personally enjoy when photos make you question whether or not what you're looking at is in fact from reality which I feel is the case with this photo. Something that I would have done had I done the project again is shoot video of moving the magnet around the ferrofluid rather than shooting photos.

*No outside sources used