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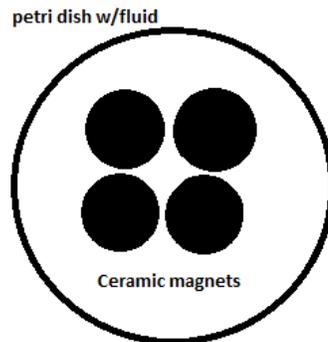
Flow Visualization

**Team Project 2: Ferrofluid**



The purpose of this image was to explore and capture the unique dynamics of ferrofluid. This particular image took a good deal of trial and error to achieve a desirable shape in the fluid. This image was taken without assistance from my group, but the idea was adapted from the setup they used.

The setup for this image was relatively simple. A petri dish filled a third of the way with ferrofluid was used for my series of images. A wide variety of magnets were used over the course of taking images. I used neodymium disc and bar magnets. These tended to be a bit too strong and would crack the dishes holding the ferrofluid. In the end I used four ceramic disc magnets arranged in a square pattern to achieve the shape shown in the image.



Typically when magnets are applied to the ferrofluid a clump of spiky peaks and valleys are formed in the area of the magnet. This is a result of the normal field instability. The corrugated peak and valley formation is what is most energetically favorable in this situation. When the magnet is applied the ferrofluid will be drawn out to a point by the magnetic field lines generated from the magnet. However they will only continue out until restrained by surface tension and gravitational forces also acting on the system. These spikes were not present in this image because after the basic shape was formed, diluted gold acrylic paint was poured over the top of the ferrofluid. The less dense paint fluid filled the cavity in the center of the ferrofluid structure and found its way into the valleys between the ferrofluid spikes and caused the worm like shapes in the image.

Here the paint fluid was used to better visualize the ferrofluid patterns and provide some contrast. The ratio of paint to water in this solution was 1 part paint to 2 parts water. All of the lighting for this image was basic overhead fluorescent lighting. The ferrofluid dish was placed on a black table to act as a background. Some pieces of cardstock were propped up around the dish to prevent reflections of surrounding objects from appearing in the surface of the ferrofluid.

This image was taken on a Samsung Galaxy S6 smart phone camera. The image was taken with auto setting resulting in an aperture of F1.9, a shutter speed of 1/11 sec, an ISO of 200, and a focal length of 4mm. The image was taken from approximately three inches above the surface of the ferrofluid. The original image was 5312x2988 pixels in size and the final edited version was cropped down to 2364x2045 pixels. The original image is shown here.



All post process editing was done in Photoshop for this image. The image was cropped down from its large initial size to remove the edges of the dish as well as all of the background elements and to bring the focus primarily to the ferrofluid structure. The curves were then altered to enhance the contrast of the black fluid and the lighter paint and light reflections. The saturation was also increased to bring out more of a golden color in the paint, since in the original image it looks more tan than gold.

I think this image turned out very nicely and was more unique than some of the other ferrofluid images we saw in class. I really like the four node structure and how the paint creates a different structure than the typical ferrofluid points. It took a good deal of time to get the image to work right. There were a few leaks in some of the petri dishes and the ferrofluid leaking out made a big mess since it stains anything it touches instantly. Using the neodymium magnets also posed a problem as they would attach very strongly to the bottom of the dish and were then very hard to remove, which resulted in a couple spills. It was also difficult to get a nice pattern to show up in the paint. I found that it was easier to get the effect in this image to show up when I carefully poured the paint over the structure. The paint did not really show up in the structure when it was already in the dish when the structure was formed. Overall, I believe the effort was worth it to get the image that I did.