

Milk and detergent experiment

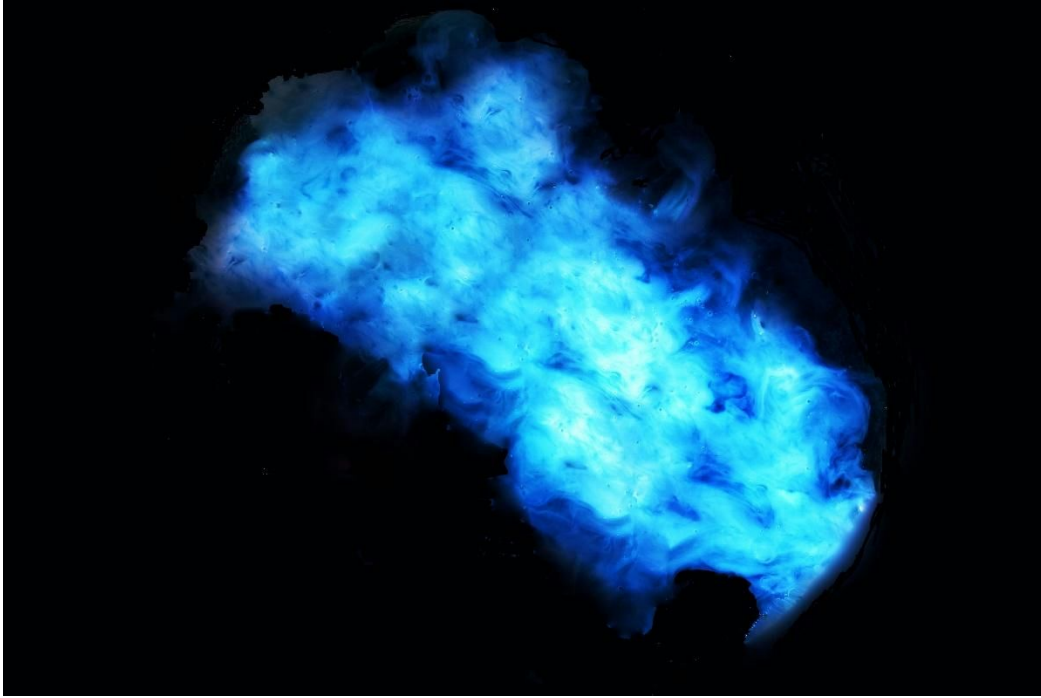


Fig 1. Final image

Introduction

The first assignment is to take a picture of fluids. In order to get a beautiful picture, it is important to familiarize with the photographing techniques and some fluids knowledge. I choose to take a picture of the milk poured into the detergent. Usually, people like to perform this experiment in the opposite way. The reason for me to pouring milk into detergent is that I think the dark color of the background is closer to galaxy, which is more aesthetically pleased.

Materials

Material	Amount
2% reduced fat milk	100 ml
Tide detergent	30ml
500ml Container	1
Camera	1

Table 1. Materials list

Procedure

The procedure is straight-forward. First, I poured 100ml milk into a container and I also poured 30ml detergent into milk. Then I placed the container into the balcony outside of my house and take a photo of the interesting fluids reaction on the surface between milk and detergent.

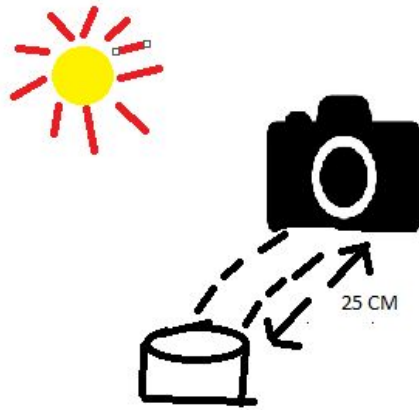


Fig 2. Set-up

Camera Settings:

The medium ISO setting was chosen due to avoiding the blurriness and pixelation issues that sometimes happens from high sensitivity settings. The focus is set automatically, since the motion of the fluid is almost stationary, the distance between the container and camera is about 25 cm. The flow of the fluids happens slowly, which is easy to capture.

Camera model	Canon EOS Rebel T5
Lens	EF-S18-55mm f/3.5-5.6 IS II S/N: 000058e20
Focal Length	55 mm
Shutter Speed	1/250 sec
Subject distance	25 cm (roughly)
ISO	100
Image Size	5184 x 3456
Resolution	72 pixel per inch

Table 2. Camera information

Physics background

When the detergent poured into the milk, it reacts with the milk-fat molecules and reduce the surface tension of the surface. When the surface tension is lowered, the fore balance of this region is broken, the flow from high surface tension region will flow to the low surface tension region.[1] This phenomenon is called "Marangoni effect", which is captured during the experiment. In general, surface tension is determined by both temperature and chemical composition at the interface. So one way to cause Marangoni flow is to generate temperature or concentration changes.[2] Additionally, the reaction between the detergent and milk forms micelles, which is how detergent get rid of the dirt.[3]

Image Post-Processing

In order to make the picture galaxy-like, several photoshop post-processing is performed. First of all, the contrast is adjusted by using curve tool so that the flow of the milk can be viewed more clearly. And the background of the original picture is cut and replaced by a pure black background by using lasso tool. The bubble on the surface is erased by using eraser tool.

Although this procedure might affect the view of the chemistry shown in the real picture, it is still worth to do since the main purpose of this image is to illustrate the effect of changing the surface tension of the surface of the detergent.



Fig 3. Original picture

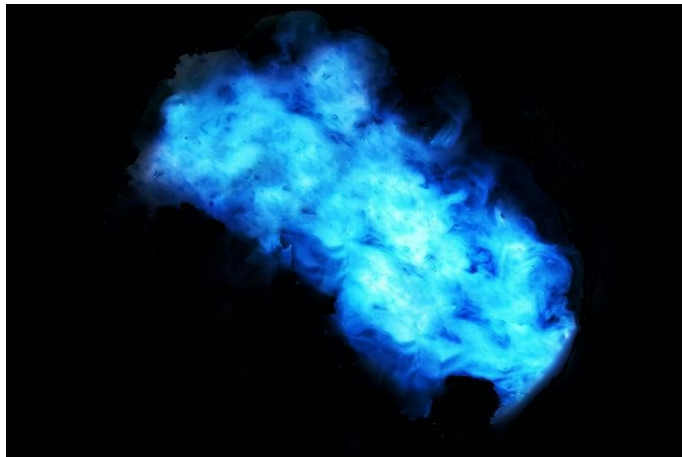


Fig 4. Final image

Discussion

This picture is taken successfully especially for the engineers who knows nothing about photographing techniques. The flow of the milk is clearly captured and the post-processing makes the image more aesthetically pleased. However, there are still some improvements can

be made. For example, the contrast is too over, which influences the detailed flow visualization in the surface. Also, preserving the bubbles may be a good idea, since it represents the real mechanism occurred during the fluid mechanics.

Reference:

Acheson, D. J. Elementary Fluid Dynamics. Oxford: Clarendon, 2006. Print. [1]

X. Fanton * and A. M. Cazabat ,Spreading and Instabilities Induced by a Solutal Marangoni Effect,Langmuir, 1998, 14 (9), pp 2554–2561[2]

<http://chemistry.about.com/od/chemistryhowtoguide/a/magicmilk.htm> [3]