

# Super-hydrophobic Effect

---

Finn Ostrem

Credit: Kyle Samples, Dylan Cook, Andrew Van Der Volgen

**MCEN 5151 – Flow Visualization, Fall 2015**

**Prof. J. Hertzberg**



## Introduction

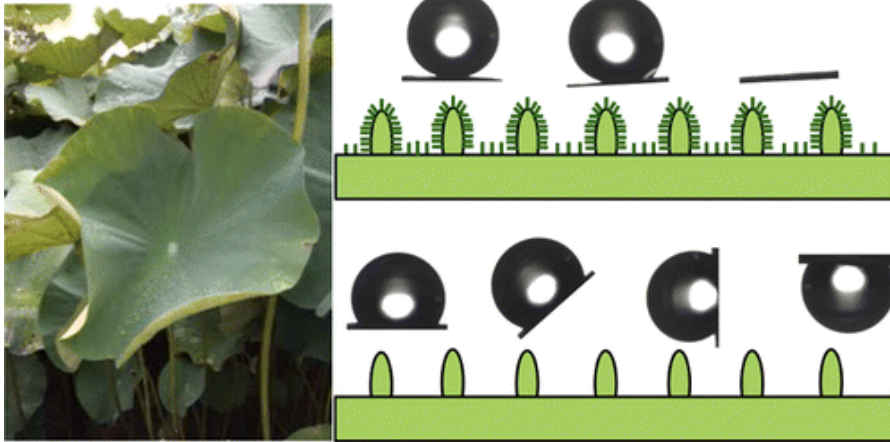
This image was taken for the first group assignment for our Flow Visualization course. There are many different approaches that could have been taken in order to show a phenomenon with fluids. The phenomenon that was chosen for this image was the super-hydrophobic effect of liquids on another surface. There were many mistakes made before this image was created. The mistakes mainly had to do with achieving the correct amount of hydrophobic material in order to correctly show the phenomenon. There were three members that helped create this image with the use of materials and ideas. Credit should be given to these team members who are: Kyle Samples, Dylan Cook, and Andrew Van Der Volgen.

## Understanding the Phenomenon

In order to understand the phenomenon of the super-hydrophobic effect, a description of the image must first be explained. Shown in the image is a droplet of Act Mouthwash sitting on top of a white t-shirt that has been treated with a super-hydrophobic substance. The substance that was used for this experiment is called "NeverWet". This product was sprayed onto the t-shirt and allowed to dry in order to obtain its super-hydrophobic effect.

The super-hydrophobic effect is quite extraordinary. This effect is also referred to as the Lotus Effect, due to the way a lotus leaf repels water naturally. The commercials for a product like this show someone wearing a shirt that has been treated and a glass of red juice poured on their shirt. Because of this product, the water runs right off as if the shirt were made of a plastic substance.

There are many reasons why this happens. The substance itself is sprayed on as a coating to whatever surface is chosen. There are two main parts of this substance. The first layer is an adhesive, and the second layer is a very small roughness. The roughness is made up of small particles consisting of .3-1.7  $\mu\text{m}$  in size [1]. The reason for this is fairly simple. The roughness, in theory, blocks the droplet of water from sinking into the material it is sprayed on by blocking the passages. This is shown in the picture below [2]. While the droplet is prevented from sinking in, the forces from surface tension keep the droplet together to form a perfect sphere. This surface tension creates a contact angle of 90 to 180 degrees between the droplet and this surface that it is placed on. The definition of super-hydrophobic is a contact angle of 150 degrees. This image is right on the edge of super-hydrophobic with an estimated contact angle of 143 degrees.



Recreating this image is fairly simple. First, “NeverWet” must first be purchased [3]. This was then sprayed fairly liberally onto a white t-shirt (Kirkland brand). This took about 35 minutes before it was completely dry to the touch. At this point a test was done on part of the shirt to see if the substance was acting like it was supposed to. Then a small amount of the shirt was pinched and lifted into a hill like shape. This gave the droplet a place to sit on in order to see the full effect. A drop of Act Mouthwash (cinnamon) was placed on top of the hill. Then, a light of 60 watts was placed facing directly down onto the droplet about 2 ft. above the droplet. The picture was taken from about 0.5” away from the subject.

## Photographic Technique

Field of View: 1.5” wide by 3” tall

Distance: This was about 0.5”

Lens Focal Length: 4.3

Camera: Canon PowerShot XS520HS

Aperture: 5.3125

Shutter Speed: 6.3125

ISO: 1600

Image Size: 2052x1392

Post Processing: This image did not require a lot of post processing. The curves were adjusted to filter out some of the noise within the black areas. This made the whole image a bit darker and the droplet redder as well. The image was cropped in order to focus on the droplet.

## References:

[1] [http://link.springer.com/chapter/10.1007%2F978-3-540-77608-6\\_19#page-1](http://link.springer.com/chapter/10.1007%2F978-3-540-77608-6_19#page-1)

[2] <http://pubs.acs.org/doi/abs/10.1021/acs.langmuir.5b00670>

[3] <http://www.homedepot.com/p/Rust-Oleum-NeverWet-11-oz-NeverWet-Outdoor-Fabric-Spray-278146/205160314>