

**Team Second: Oobleck**

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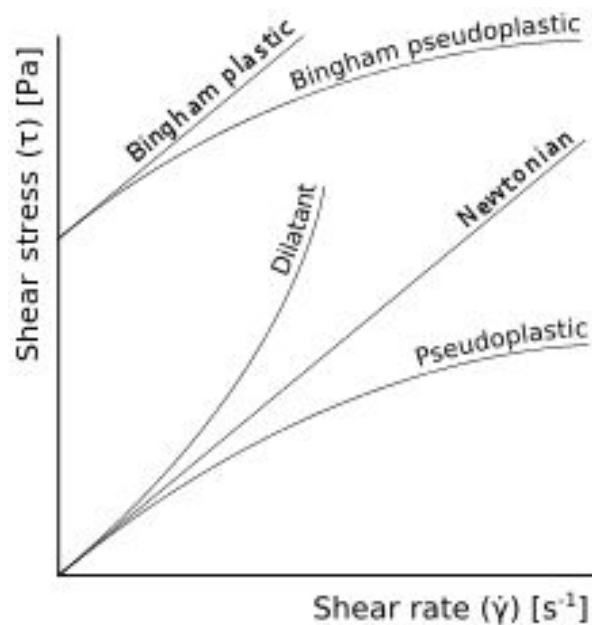


## **Introduction:**

My team and I wanted to see the interactions of a non-newtonian fluid due to other external variables. The non-newtonian fluid that we chose is oobleck. Oobleck is a mixture of water and cornstarch. A bluetooth speaker was used to output sound waves below the fluid. The final image was captured with the assistance of Faisal Alsumairi, Robert Drevno, Matthew Knickerbocker, and Abishek Kumar. Drevno provided the bluetooth speaker and aluminum foil in the experiment. Kumar provided a location for performing the experiment. Knickerbocker provided the india ink used in the final photo.

## **Fluid Physics:**

A non-newtonian fluid is a fluid whose viscosity is dependent on the amount of stress or force applied to it. In this experiment, a mixture of water and cornstarch was used to exemplify this topic. When achieving the final mixture, the more force applied to mix it, it is harder to move the mixing utensil through the fluid is. If you were to slowly mix the fluid, it acts more like the consistency of Elmer's glue.



**Figure 1.** Fluid type shear rate vs shear stress

The oobleck can be classified as a dilatant fluid. As seen in the above figure, we can see that the shear stress increases as shear rate does. This shows the previously mentioned description of mixing the fluid.

The soundwaves that were transmitted from the bluetooth speaker propagated through the fluid, displaying a rupturing effect in the fluid.

### **Experimental Setup:**

A 6" diameter glass pie dish was used as the vessel to make our oobleck mixture. A rough 1:1 ratio of tap water to cornstarch was initially used. Small amounts of water and cornstarch were used and mixed together until a homogenous mixture was formed. When creating the oobleck, there was constant mixing and adding of water/cornstarch. The total prep time for the fluid was roughly ten minutes. The mixture was done when the mixing utensil was hard to move through the fluid quickly. A rectangular bluetooth speaker was then wrapped in tin foil with the speaker facing the ceiling. The oobleck was poured into the speaker well until reaching just below the rim. A 25 Hz sinusoidal sound wave was then outputted from the speaker, causing the oobleck to vibrate. As the speaker was playing, blue india ink was then poured into the mixture. The vibrations caused the ink to disperse into the oobleck.

### **Photography Techniques:**

The camera used to capture the final image was a digital Canon PowerShot SX530HS. A medium shutter speed of 1/2000 was used, with an aperture of f8.0 and an ISO of 3200. This produced an image that was 640x480 pixels. The captured image was when the lens was approximately 4" from the fluid. Post-processing of the image was done in GIMP. The image was cropped to include less of the reflecting light and tin foil. The contrast was turned down, while the brightness was turned up to produce a darker blue color in the ink.



**Figure 2.** Original raw image

### **Conclusion:**

The final image shows a non-newtonian fluid being moved by sinusoidal sound waves. I like the different curves from the oobleck as it is moved around from the sound waves. I dislike how reflective the tin foil came out and I was not able to edit that out. I believe that the main intent of finding out more about non-newtonian fluid was realized especially through the use of pouring ink on top to better visualize the effects. In the future, I would like to repeat this experiment with different contrasting colors, and utilize more than two colors of ink.

**References:**

Oobleck-

<https://www.livescience.com/21536-oobleck-recipe.html>

Non-Newtonian Fluid-

[https://en.wikipedia.org/wiki/Non-Newtonian\\_fluid](https://en.wikipedia.org/wiki/Non-Newtonian_fluid)