

## Team Project 2

### Flow Visualization

Jessica Lucia, Ben Maples, Jon Fragoso

April 5, 2010

The image is the second of three team projects, however due to scheduling conflict the team worked individually for the assignment and therefore has a wide range of images. The phenomenon being explored in the image presented is the physics of a flame while burning a liquid.

The apparatus used for the experiment was relatively simple in set-up and involved enamel paint, tinfoil, a lighter, and the kitchen sink. The sink was lined with tinfoil to give a protected and reflective background for the image. Four different colors of enamel paint were poured onto the foil; each color spot was about .5-1 inches in diameter. The paint was ignited using the lighter and allowed to burn until all of the petroleum distillates had burned off, extinguishing the flame naturally. In figure 1 the set-up is shown:

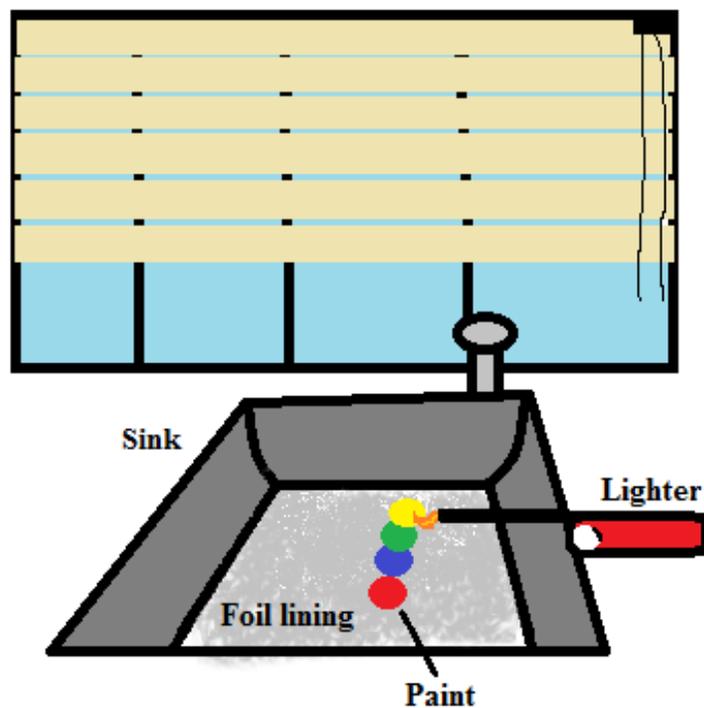


Figure 1: Flow Apparatus

The set shown allowed for a very controlled burn which in turn allowed for the flame to be captured clearly in the image. A flame is the gaseous part of fire that can be seen as a

combustion reaction takes place. The combustion that was happening in the set-up was due to the enamel paint containing petroleum distillates; hydrocarbon solvents that are produced from crude oil as it's refined. A hydrocarbon will react with air which fuels the combustion [1]. The hydrocarbon will vaporize creating a gas mixture with air which is what actually burns; liquids can catch fire but the temperature must be at or above the liquids flash point. The enamel paint was boiling as the combustion was happening, boiling being the phase change from liquid to gas – the liquid is vaporized which in turn mixes with the surrounding air and is able to burn. Once the combustion happens there is the production of heat which is released and generally produces light, the light is seen in the form of a flame [2].

The visual effect captured in the image was created by pooling the four colors of enamel paint in a line on the tinfoil then igniting each color separately with the lighter. The enamel paint used was blue, red, green, and yellow from a Testors 9 bottle paint set purchased from a local craft store. The lighter was a long nozzle refillable BBQ lighter with an adjustable flame height; the flame height was turned to high during the experiment, however it should be noted the lighter was almost out of fuel so the flame was not as large as possible. The base layer of foil was just standard kitchen tinfoil purchased from a grocery store; it lined the bottom of the kitchen sink to prevent the paint from staining the surface while still providing a reflective backdrop. The lighting for the image was natural ambient light that came in through the window behind the sink; the sun was setting it was about 7:30pm so the light was minimal. The window is west facing, however it doesn't receive direct light due to other apartments blocking the setting sun's path. The only other lighting used in the image was the camera flash which is fixed above the lens on the camera.

The image was captured using a Nikon D50 digital camera. The field of view was 2256 x 1496 pixels. The camera was held about 6-8 inches away and at about a 30-40 degree angle to the flame. The focal length was 42mm with an aperture of f/5.6. The exposure time was .004s as the camera was on rapid fire taking multiple pictures as the "shoot" but was held down. The original image was edited using Picasa 3. The image was cropped to 160 x 120 pixels as well as the contrast was adjusted, the shadows and highlights were increased slightly to allow the flame to stand out while still seeing the other details of the image.

The image is of a flame as four different colors of enamel paint burn. Each color of paint was lit individually which allowed the flame to rise and come together as one flame once the combustion was underway. I really like the uniqueness of the flame; it looks much like a mushroom cloud with a hole through it. Also, I like how the paint is visible which allows the viewer to see the boiling that is occurring within it as well as brings color to the image. The paint is also running together which adds an interesting element below the flame. The last part that I think enhances the image as a whole is the tinfoil backdrop which creates the reflection of the light from the flame but still allows for contrast of highlights and shadows. I believe the image showcases the flow well; the focus is good as well as the contrast to the background. The boiling paint which is a secondary flow phenomenon shown is also clear and complements the

image in my opinion. The overall intent of the image was to capture the physics of a flame which I think I was successful at doing; however, this image was a secondary idea after the failure of another experiment so my overall artistic effect was not accomplished. After completing this project I realized I would like to improve upon my skill of working with minimal light - to adjust the camera and lens to be able to best capture an image with minimal outside lighting. To further develop the idea there could be the addition of a pouring flaming liquid or a variety of burning substances that burn in an array of colors which would create a more dynamic and interesting image.

## References

[1] "Petroleum Distillates - Overview." *Pollution Prevention (P2) Pays - N.C. Division of Pollution Prevention and Environmental Assistance*. Web. 04 Apr. 2010.

<<http://www.p2pays.org/ref/19/18161/alt.cfm-id=pd&cat=ov.htm>>.

[2] *Wikipedia*. Web. 04 Apr. 2010. <<http://wikipedia.org/wiki/Combustion>>