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MCEN 4228
Project 1: Get Wet

CONTEXT

The first assignment in flow visualization is meant to outline the basics of fluid photography. This initial assignment: Get Wet showed how to use the cameras setting in a manner that would create the desired image. This particular image is supposed to illustrate the concept of fluid flow impingement. Unlike most common flows that impinge a flat surface the photograph shows a flame impinging a spherical body (grapefruit).

Photo Shoot Schematic:

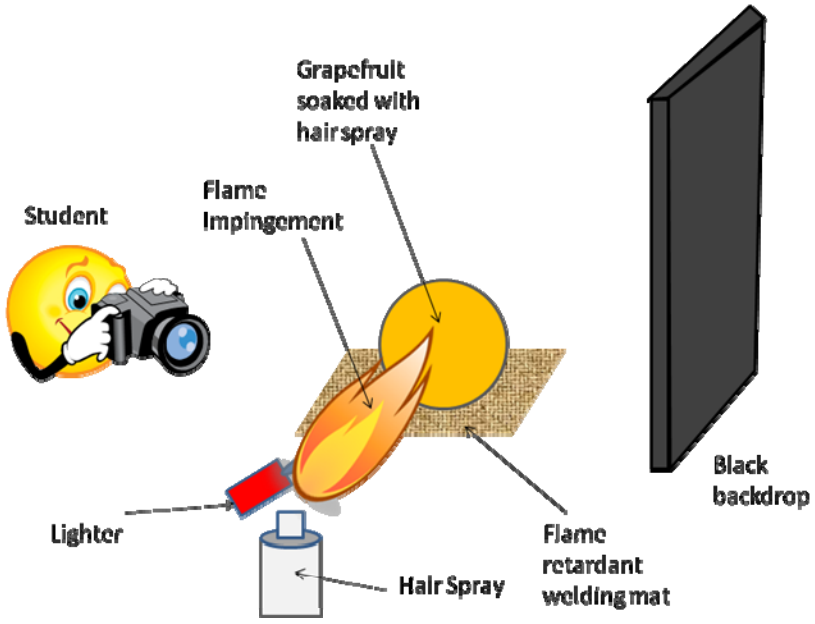


Figure 1

PHYSICS

The focal point of this image is the turbulent flame impingement on a grapefruit. The image shows the plume of fire first hit the face of the grape fruit then proceed to wrap around it. The flames are able to envelope a large surface area of the grape fruit because beforehand we had completely soaked it hair spray. The hair spray provided the extra fuel needed to burn once the impinged flame front reached around the face of the fruit. The burning hair spray produced a flame with a blue tint to it. The blue flames of course have the highest temperature relative to the surrounding yellow ones. It should also be noted that this turbulent flame impingement has the same characteristics as a laminar candle flame. Much like a candle that has a blue flame outer layer and a yellow flame inner layer, the photograph shows the blue flame burning on the outer edges of the impinging yellow flame. The blue flame resides on the outer layer because its temperature is higher than the surround yellow flame. The temperature difference causes a buoyancy effect pushing the blue flame to the outer limits of the flame.

The flame photographed shares another characteristic with candles because it behaves like a diffusion flame, but only after a pre-mixed flame begins combustion. Since the hair spray effectively atomizes the fuel through its nozzle the air can effectively mix with it. In combustion, the act of air and atomized fuel mixing in stoichiometric proportions before a flame is made is called a pre-mixed flame.

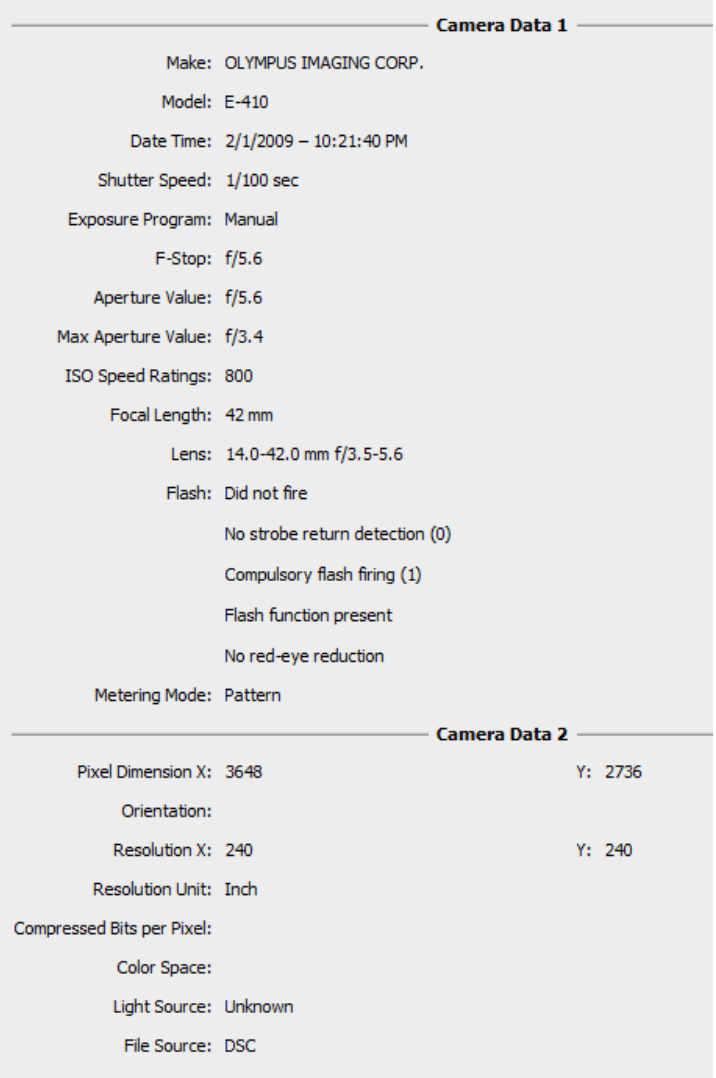
After air and fuel have mixed an ignition source is introduced causing the combustion flame process to initiate. After a steady flame is made the flame will move into a second stage of combustion. That stage is called a diffusion flame. A diffusion flame occurs when a steady flow of atomized fuel is being sprayed into a flame front. Since the flow is heavily turbulent at the face of the grape fruit a diffusion flame won't be as apparent. However when the flame was traced back towards the nozzle of the can we could see the atomized fuel entering the flame front and combusting, keeping the flame alive.

CONDITIONS

The photograph was taken at night under obviously low light conditions. Even though the lighting was poor it wasn't quite pitch black so a back drop had to be used. The back drop brought out the contrast of the flame impingement. It also provided decent contrast to see the silhouette of the grape fruit under the moon light. The flash feature was not used in efforts to avoid over exposure of the flames different colors.

TECHNIQUE

The field of view was approximately 6.65" wide by 8.88" tall. The total area of view is calculated to be 59.1 in^2. The photographer lens was positioned 18 inches from the flaming grapefruit with an 800 ISO sensitivity. Other critical lens specifications are listed below in figure 2.



Camera Data 1

Make:	OLYMPUS IMAGING CORP.
Model:	E-410
Date Time:	2/1/2009 – 10:21:40 PM
Shutter Speed:	1/100 sec
Exposure Program:	Manual
F-Stop:	f/5.6
Aperture Value:	f/5.6
Max Aperture Value:	f/3.4
ISO Speed Ratings:	800
Focal Length:	42 mm
Lens:	14.0-42.0 mm f/3.5-5.6
Flash:	Did not fire
	No strobe return detection (0)
	Compulsory flash firing (1)
	Flash function present
	No red-eye reduction
Metering Mode:	Pattern

Camera Data 2

Pixel Dimension X:	3648	Y:	2736
Orientation:			
Resolution X:	240	Y:	240
Resolution Unit:	Inch		
Compressed Bits per Pixel:			
Color Space:			
Light Source:	Unknown		
File Source:	DSC		

Figure 2. EXIF properties found in Adobe Photoshop CS4