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CHARACTERISTICS OF DETONATIONS FOR PROPULSION APPLICATIONS

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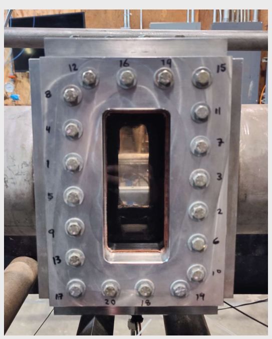
Caption: Detonation tube set up.

INTRODUCTION

The purpose of this research was to determine detonation characteristics for propulsion applications when using liquid fuels at different droplet sizes and vapor fractions.

METHODS

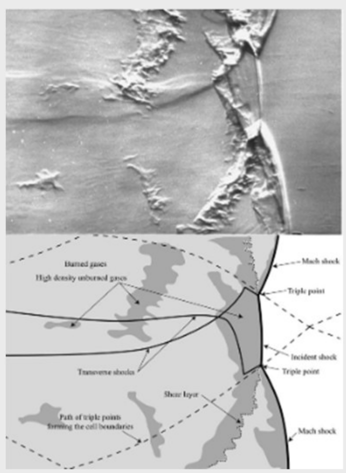
The methods used during this research to determine characteristics of detonations were schlieren and soot foils. Throughout the process of this research, we encounter several problems and had to develop a MATLAB code to see the droplet distribution.



Caption: Viewing section of the detonation tube

SCHLIEREN

Schlieren technique has been used since the 1960s. This technique allows us to measure detonation cells by identifying where the triple points (Mach, incident, and transverse shocks) intersect together in the detonation front. This is possible by bending light in order to make visible fluid density in the detonation.

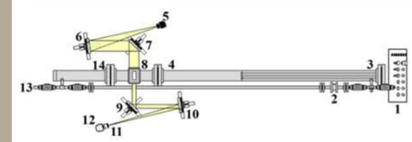


Caption: Detonation front as observed using the schlieren method

SOOT FOILS

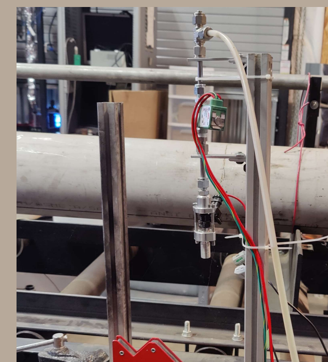
The use of soot foils is another technique used to measure detonation cells. When using soot foils, we utilized galvanized steel flashing of 20 in x 15 in. We used a partially closed vertical cylinder where we put the segment of galvanized steel and burn a piece of rag soaked in kerosine to coat it with soot. We placed the soot foil into the detonation tube towards the end, after the viewing section of the tube. Soot foils were replaced before each detonation. To collect detonation cell sizes, soot foils were photographed, and the image was analyzed using an image processing software.

Caption: Detonation cells using soot foils



Location	Description
1	Gas input manifold
2	Mix fan
3	DDT blockage section
4, 8	Diodes for wave speed measurement
5	Light source
6, 10	Planar (folding) mirrors
7, 9	Parabolic mirrors
8	Schlieren measurement location
11	Knife edge location
12	High speed camera
13	Tube outlet
14	Soot foil measurement location

Caption: Detonation tube set up.



Caption: Set up for droplet measurement

CONCLUSION

When droplet size is bigger the speed of the detonation is slow compared to when the droplet size is smaller. This happens because smaller droplet sizes evaporate faster than bigger droplets allowing the detonation propagation speed to go faster.