International Journal of Advances in Science Engineering and Technology, ISSN: 2321-9009, Volume- 3, Issue-3, Special Issue Sept.-2015

PROPELLANT ANALYSIS USING COMBUSTION DRIVEN POTATO CANNON

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Abstract — A potato cannon was designed to accommodate several different experimental propellants. Both combustion chamber and barrel were made of polyvinyl chloride (PVC). Five experimental propellants were tested: propane (C3H8), acetylene (C2H2), ethanol (C2H6O), methanol (CH4O), and butane (C4H10). Cylindrical projectiles were cut from raw potatoes so that there was an airtight fit, and each weighed 50 (± 0.5) grams. This prototype of potato cannon is used for the hydrocarbon fuel analysis means which fuel burns more drastically, which burns moderately and which burns inefficiently means using different fuels we get different velocity of projectile as well as different recoil velocity of the barrel and combustion chamber. In this way by performing this experiment we can have a general idea about which fuel is good at combustion and have high calorific value.

Keywords - Barrel, Combustion Chamber, Propellant, Stun Gun, Aerosols, Socket Reducer.

I. INTRODUCTION

The potato cannon is a relatively small scale projectile launcher often used for physics demonstrations, projectile launching experiments and recreation. In this potato cannon the potato is driven by expanding gases caused by the burning experimental propellant which actually accelerates the projectile (potato).

In our prototype, the combustion chamber is filled with a propellant. Ignition may be achieved in several ways; such as a lantern sparker, a model rocket igniter, or an electric switch, but we have used a stun gun having a 7.8 Million Volts of STOPPING POWER. As the propellant burns, the reaction creates rapidly expanding gases, and the pressure from the gases forces the projectile down the barrel. Many different propellants are possible, but aerosol hair spray or mosquito repellant can also be used as a fuel.

A. Constructional details

1. Length of barrel: - 36 inches.
2. Length of combustion chamber: - 14 inches.
3. Diameter of barrel: - 2.5 inches
4. Diameter of combustion chamber: - 3.5 inches.
5. Socket reducer of diameter: - 3.5- 2.5 inches.
6. End plug: - 3.5 inches.
7. Screw length: - 2 inches.
8. Stun Gun: - 7.8 million volts of stopping power.

In our potato cannon model we have used the PVC pipes in which a pipe of length 36 inches and diameter 3.5 inches is taken as a combustion chamber in this pipe we have created two holes and inserted 2 screws of length 2 inches at the diametrical opposite ends and also we have ensured that there is a little gap between these two screws for the production of spark. Now this combustion chamber is connected to the barrel with the help of a socket reducer.

Now the barrel which is connected to the combustion chamber with the help of a socket reducer has a dimension of length 36 inches and diameter of 2.5 inches. At the same time at the center of the barrel we have fitted our stun gun having its wire connected to the screw.

B. Methodology

The experimental propellants were propane (C3H8), acetylene (C2H2), ethanol (C2H6O), methanol (CH4O), and butane (C4H10) were put into the combustion chamber and the amount of propellants that were put into the combustion chamber were poured to moderate amount such that the necessary amount of oxygen to support combustion has to be present in the combustion chamber.

If we add more amount of propellant than the process of combustion inside the chamber will not take place hence the prime condition is that there must be necessary amount of oxygen for the combustion process in the chamber.

And ratio of oxygen to fuel in %

Oxygen 80% and fuel 20% of the total volume of the combustion chamber can be there for the required combustion to take place.

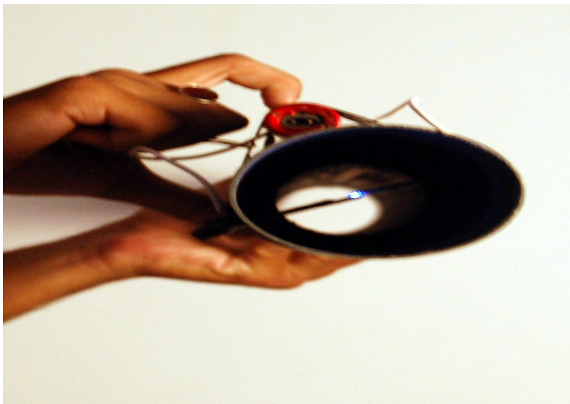
Now we have put the sufficient amount of fuel in the combustion chamber satisfying the oxygen- fuel ratio percentage and we press the button of stun gun as a result of which spark is being produced between the two screws which we have fitted into the combustion chamber and hence the gases expand as a result of which the projectile which is present in the barrel experience some force now there is a static frictional force which is acting on the projectile by the inner surface of the barrel as soon as the force exerted by the gases exceeds the static frictional force the projectile starts to gain some acceleration although the projectile still experience kinetic frictional force. The projectile inside the barrel attains a maximum velocity at the outlet or exit end of the barrel.

Vertical view of potato cannon

Horizontal view of a potato cannon

SPEED CORRESPONDING TO DIFFERENT PROPELLANT

SNo.	Propellants	Velocity at .5m (in m/s)
1.	Acetylene	78.8
2.	Propane	16.5
3.	Ethanol	27.9
4.	Methanol	38.1
5.	Butane	28



Spark being produced in the potato cannon

CONCLUSION

The purpose of the experiment was to quantify velocities of potato cannon using different propellants. The hypothesis that acetylene would accelerate the projectile to the highest velocity was confirmed. For every propellant tested except acetylene, pressures became negative before the projectile left the barrel, thus decreasing the projectile's velocity. However, if a shorter barrel had been used, these propellants could have reached maximum velocity at the muzzle. If a longer barrel had been used, acetylene would have kept accelerating the potato for some additional distance, before finally also becoming subject to negative pressures. Careless handling of potato cannon could cause serious injury or death (Frank 2012). Potatoes launched with acetylene were also destructive to wooden boards and plastic objects initially employed as backstops before transitioning to 6mm thick steel plate. Adult supervision and due care regarding safe firing directions is imperative when using these devices.

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