

A Study on Mechanisms of Fire Suppressors for Octocopter Drone

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Abstract

The fundamental purpose of this research is to employ suitable extinguishers to put out various types of fires that occur in diverse areas, so preventing further damage of lives and property. The drone is linked to the extinguisher via several techniques detailed in the paper, which assists in fire management. The article depicts the notion of an emerging technology that uses a drone to extinguish flames. Furthermore, it enables us to distinguish extinguishers and compare them to others.

Keywords: Mechanism, Fire Extinguisher, Octocopter Drone, Fire

INTRODUCTION

Fire is an exothermic chemical method of ignition that creates heat, light, and a range of reaction products by rapidly oxidising materials.

PHYSICAL PROPERTIES OF FIRE

When combustible matter is combined with an adequate amount of an oxidizer, such as oxygen gas or another oxygen-rich compound, exposed to a source of heat or ambient temperature above the flash point for the fuel/oxidizer mix, and is capable of

withstanding the rate of fast oxidation that results in a chain reaction, fire begins. FIRE TETRAHEDRON is for you.

Fire cannot develop unless all of these elements are present and in the correct proportions. In a few cases, a chemical known as a catalyst is required, which permits the reactants to burn faster while remaining unconsumed.

Convection is caused by gravity, which removes combustion products while also

delivering oxygen to the fire. Fire quickly surrounds itself with its own combustion products and non-oxidizing gases from the air, depriving the fire of oxygen and extinguishing it. As a result, the danger of a starship catching fire is negligible.

FLAME

It is a combination of reacting gases and solids that emit visible, infrared, and

occasionally ultraviolet light, the frequency spectrum of which is determined by the chemical makeup of the burning material and intermediate reaction products. The entire combustion of gases exhibits a brilliant blue colour due to the emission of this wavelength. Inadequate gas combustion produces incandescent particles known as soot, which emit the distinctive red orange glow of fire.

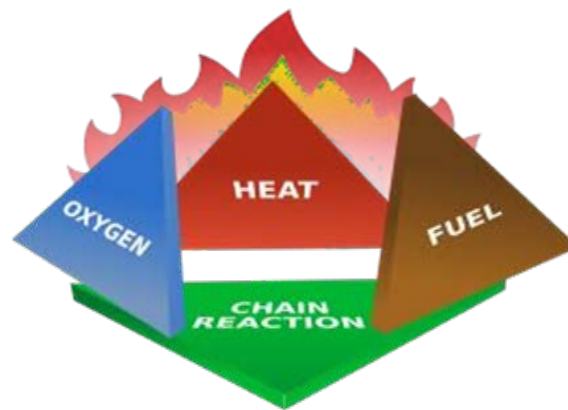


Fig. 1: Fire Tetrahedron

Table 1: Fuel and Oxidizer Pair.

Fuel and oxidizer pair	Flame temperature©	Flame temperature (F)
Oxy-dicyanoacetylene	4990	9000
Oxy-acetylene	3480	6300
oxyhydrogen	2800	5100
Air-acetylene	2534	4600
Blow torch(air-MAPP gas)	2200	4000
Bunsen burner(air-natural gases)	1300-1600	2400-2900
Candle(air-paraffin)	1000	1800

IGNITION SOURCES

Open flames, sparks, static electricity & hot surfaces are all possible ignition sources.

Types of Ignition Sources

1. Hot surfaces
2. Flames and hot gases
3. Mechanically produced sparks
4. Electrical equipment
5. Transient currents
6. Static electricity
7. Lightning strikes
8. Electromagnetic waves
9. Optical radiation
10. Ultrasound
11. Chemical reactions
12. Human (indirectly)

CLASSIFICATION OF FIRE

Class A

Fire involving solid materials such as wood, paper/textiles

Class B

Fire comprising flammable liquids such as petrol, diesel or oils

Class C

Fire comprising gases like hydrogen, butane/methane

Class D

Fire involving metals like Mg, Al or k

Class E

Fire involving live electrical apparatus (technically class E doesn't exist however this is used for convenience here).

Class F

Fire involving cooking oils such as in deep fat fryers class F (combination of all types of fires).

TYPES OF EXTINGUISHERS [1]

Water Extinguishers

Water extinguishers are one of the most cost-effective methods of combating Class A flames produced by solid items such as paper, wood, and textiles.

There are four types of water extinguishers: water jets, water sprays, water with additives, and water mist or fog. All water extinguishers have a red label.

- Water jet extinguishers work by directing a stream of water towards the burning materials, forcing them to cool and prevent them from re-igniting. They should not be utilised in close proximity to live electrical equipment.
- Water spray extinguishers use a tiny mist of water droplets surrounded by non-conductive air. Water spray fire extinguishers frequently carry a 35 kV dielectric test consent that seems to

have been confirmed at one metre on a 35,000 Volt electrical source.

- Water extinguishers with additives are the same as those using foaming chemicals. Water loses its usual surface tension, allowing it to infuse more effectively into the burning materials. Because chemicals are added to the water, a smaller extinguisher may offer the same fire rating as a bigger, water-only extinguisher.
- Water mist or fog extinguishers employ mist or fog to extinguish fires, and the dews created are substantially lower than those produced by water spray extinguishers. The bigger the surface area of a droplet in contrast to its size, the faster it evaporates and absorbs heat energy. The drawback is that the smaller the droplet, the less weight it has and hence the smaller the water cloud.

Foam Extinguishers

Foam fire extinguishers are used in Class A and B fires. They are most suited for extinguishing liquid flames like gasoline or fuel, and they are more versatile than water jet extinguishers since they may be used on solids like wood and paper. The

foam extinguishes liquid flames by closing the surface of the liquid, preventing flammable vapour from accessing the air and devouring the fuel fire. They should not be used on liquid flames that are free-flowing. On foam extinguishers, the label is cream in colour.

Powder Extinguishers

Powder extinguishers are a superior multi-purpose fire extinguisher since they can extinguish flames of Class A, B, and C. They can also be used to extinguish fires that have engulfed electrical equipment, allowing the fire to re-ignite. Powder extinguishers can also decrease sight and interfere with breathing. They should not be used in liquids such as paraffin or gasoline. CO₂ extinguishers work by smothering the flames and keeping air out.

Carbon Dioxide Extinguishers (CO₂)

Because CO₂ extinguishers are safe to use on fires involving electrical apparatus, they are perfect for spaces with electrical equipment, such as workplaces or server rooms. Carbon dioxide extinguishers, unlike foam extinguishers, leave no residue. Carbon Dioxide Extinguishers (CO₂) are identified by a black label.

Wet Chemical Extinguishers

Wet chemical extinguishers can be used to extinguish Class F fires containing culinary oils and fats such as lard, olive oil, sunflower oil, maize oil, and butter. They have a significant impact when used correctly.

The wet chemical cools the burning oil and chemically reacts to form a soap-like solution, effectively sealing the surface and preventing re-ignition. They are, however, intended for use with Class F flames, frying oils, and deep fat fryers. They worked on flames classified as Class A (wood, paper, and textiles) and Class B (other materials) (flammable liquids). Wet chemical extinguishers have a yellow label.

Fire Blankets

Fire blankets are often used to extinguish hot oil fires produced by frying pans or small deep fat fryers. They are applied on garments with the potential to catch fire. They work by suffocating the flames, preventing oxygen from entering and extinguishing them.

Properties Advantages & Disadvantages of Extinguishers

Water

They can also be used to extinguish Class B fires, which contain flammable items. A

plunger mechanism and a 57 gramme CO₂ cartridge are included in the head cap assembly. CO₂ can be used to pressurise the extinguisher and push water down the discharge tube via the cartridge.

Advantages

1. Often quickest for 1st attacks.
2. Requires only 1 person to operate it
3. Self-contained
4. Reliable
5. Instantaneous

Disadvantages

1. Conductors of electricity
2. Not idle for inaccessible fires

The Chemical Foam Extinguisher

These consist of an inner container within an outer extinguisher. When the contents of the 2 are mixed together, a chemical reaction occurs producing foam and CO₂.

Also available in the form of mechanical foam i.e. Foam is created by means of small foam- making branch at the end of extinguisher hose. Foam is expelled by gas cartridge or stored pressure.

Advantages

1. Coats surface and exclude oxygen.
2. Heat resisting qualities act as insulators, preventing re ignition.

3. Not affected by draughts
4. Floats on liquids

Disadvantage

1. Some fires require alcohol resistant foam.
2. Some foam reacts with dry chemical and are broken down.
3. Chemical and mechanical form have harmful effects on each other

Carbon Dioxide Extinguisher

Gas is maintained in liquid form at a pressure of 50bar.

Advantages

1. Rapid in action, independence of atmosphere temperature
2. It is an inert gas which quickly disperses leaving no trace.
3. It is non-conductor of electricity.
4. Can be used in the first stage of highly flammable liquid fires.
5. Penetrates inaccessible places

Disadvantages

Total weight in relation to the contents is considerable.

There is no visible way to check the contents.

DIFFERENT TYPES OF FIRE FIGHTING SYSTEMS

Fire Sprinkler Systems

This system consists of a number of devices attached to the rooftop of each story of a building or residence, and they are connected to water. When the fire sprinkler detects smoke, it activates and sprays water.

Wet and Dry Chemical Agents This fire fighting tactic works by limiting, isolating, or lowering the fuel or heat. reducing or isolating oxygen, or stopping the components' chain reaction This technique does not cause as much damage as water, although some substances can be harmful after prolonged exposure.

Type	Class A Combustible material	Class B Flammable liquids	Class C Flammable gases	Class D Flammable metals	Class E Electrical components	Class F Deep fat types	Comments
Water	Yes	No	No	No	No	No	Do not use in liquid or electric free
Foam	Yes	Yes	No	No	No	No	Not suited for domestic use
Dry powder	Yes	Yes	Yes	Yes	Yes	No	Can be used safely up to 1000volts
CO2	No	Yes	No	No	Yes	No	Safe on both high and low voltage
Wet chemicals	Yes	No	No	No	No	Yes	Use on extremely high temperatures

Gaseous Agents

Leaving aside the employment of wet chemical agents for specific purposes such as conserving electrical items in the affected area, dry chemical agents are the best choice for fire fighting. They are faster than any other method.

FIRE EXTINGUISHING MECHANISMS [4]

As previously said, dry powder is the greatest extinguisher since it can be used in practically every form of fire. As a result, there are many techniques for attaching dry powder to the drone, which is utilised to regulate fire, as stated below:

Design 1

The reason for this design is to drop the fireball through the two-door entrance at the bottom of the box. A box was chosen as a means of keeping the fireball away from the fire so that it does not stimulate before being positioned at the target. A computer software attached to the quadcopter through radio signal switches the two doors at the same time using servomotors. The mechanism is made of aluminium, which is lightweight and simple to construct. The disadvantage of this design is the close proximity of the quadcopter to the fire at the discharge point, while not only the ball must be

protected from the fire along the voyage, but the motors and electrical modules must also be protected from high temperatures. Figure illustrates this design.

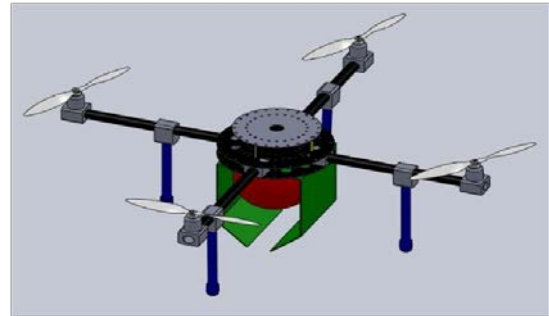


Fig. 2: Design 1

Design 2

As a measure of protecting the mechanism's substantial, an enclosure design may be employed to keep the fireball while also making the releasing procedure easier. Two solid bars are placed on opposite sides of the quad's bottom plate, are surrounded by metallic cords to hold the fireball in position, and are linked to arranged locks at the bottom plate. When the bars are not closed, the lower platform of the mechanism falls with the ball, resulting in the releasing process. The disadvantage of this approach is that the fireball must be reloaded. Because we want an arrangement that can make several journeys if necessary, this sort of technique necessitates having more than one bottom platform to hold the fireball in position, and maintaining the components together can take up to five

minutes. This design is predictable and illustrated in Figure.

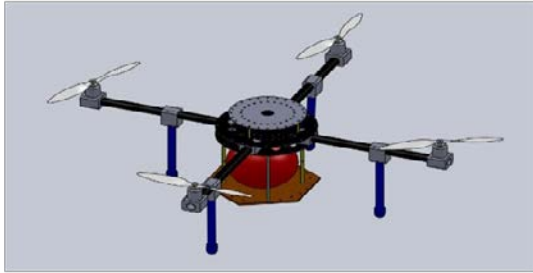


Fig. 3: Design 2.

Design 3

This design has rails attached to the platform's bottom that keep the fire extinguisher ball in place and may serve as the release mechanism. The cage design from the second alternative remains attached to the quadcopter, and only the rails are new. The rails will aid in guiding the fire extinguisher ball to its target while also keeping the quadcopter at a safe distance from the flames. A servomotor controls the angle at which the railing system will accept turns. This gives you control over the speed at which the fire-extinguishing grenade is released. When the vehicle arrives at the designated area for releasing the grenade, the servo motor activates and lowers the railing system while simultaneously thrusting the fire-extinguishing grenade from the back of the cage.

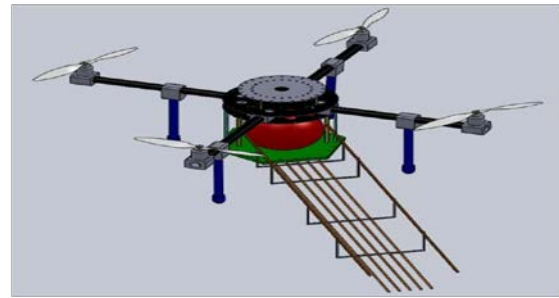


Fig. 4: Design 3

There are many more for other types of extinguisher which are shown below:

CO2 drone



Water drone



Fig. 5: Water Drone.

CONCLUSION

The document contains information about fire and its many varieties, which allows us to select an appropriate extinguisher for

each sort of fire. It also depicts the primary components of fire, and fire may be extinguished by removing any one component from the fire tetrahedron. Provides information on the qualities, benefits, and drawbacks of the many extinguishers available. The device that allows us to connect an extinguisher to an unmanned aerial system and extinguish a fire.

4. Introduction of fire.

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