Alternative Fire Suppression Equipment for Sustainability

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Introduction

Fire extinguishers and foam agents can generate negative impacts on the environment and human health. Looking at fire suppression alternatives that reduce environmental and human health impacts is a way to make fire suppression more sustainable.

Fire extinguishers utilized today come in dry-chemical, wet-chemical, dry powder, and carbon dioxide agents that are each used to suppress different classes of fire (Table 2). The chemicals that make up these types of extinguishing agents may be harmful to human health and the environment. When extinguishing larger fires, firefighters use foam agents in a mixture with water that is discharged through hose lines. These foam agents generate human and environmental health impacts as well. Illuminating the risks and identifying alternatives to current fire suppression equipment is a way for firefighting to become more sustainable.

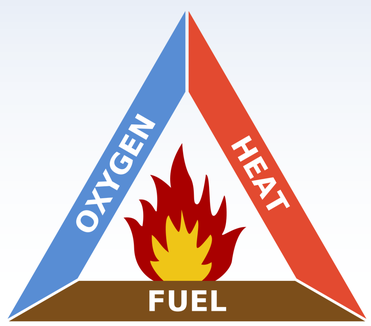

Figure 1. The fire triangle. Each of the three components must be present for the fire to maintain ignited

Fire Class	Types of Fire
Class A	Ordinary Combustibles (Wood, Paper, Plastics)
Class B	Flammable Liquids (Gasoline, Oil)
Class C	Energized Electrical Equipment (Computers, Energized Outlets)
Class D	Combustible Liquids (Lithium, Magnesium, Titanium)
Class K	Cooking Liquids (Cooking Oil, Grease)

Table 1. The four classes of fire and the types of fire that each class consists of.

Methods

This study analyzed why past technologies were replaced by current equipment. Reviews on the different fire suppression equipment utilized today and their impacts on environmental and human health were considered when researching alternatives. Looking at multiple case studies will helped support the thesis of how current fire suppression equipment has created impacts on human and environmental health. Finally, an analysis of the current fire suppression equipment and the alternatives was conducted to conclude findings and possible solutions to sustainable firefighting.

Current Types of Fire Extinguishers and their Chemical Suppressing Agents

Type of Extinguisher	Extinguishing Agents
Dry-Chemical	Mono-ammonium phosphate (Class A,B,C), Sodium Bicarbonate (Class B, C), Potassium Bicarbonate (Class B, C)
Wet-Chemical	Potassium Acetate based Agent (Class K)
Dry-Powder	Copper. Sodium Chloride, Sand (Class D)
CO_2	Carbon Dioxide (Class B, C)

Table 2. The various types of current fire extinguisher and the agents that make up these extinguishers.

Alternatives to Fire Extinguishers

Suppressing fire with sound:

- Low frequency sound waves displace the oxygen as they travel through the air, separating the oxygen from the fuel
- Between the waves of 30-60 Hz has the most impact
- Complication to this alternative is its inability to suppress larger fires as the sonic extinguisher contains no coolant and is unable to prevent large fires from reigniting

Carbon Dioxide Hydrate Crystals:

- Tiny molecular cage of water molecules filled with pockets of CO_2
- Disrupting the oxygen supply as well as absorbing significant amounts of heat as they are under high pressure at a temperature close to -200^{o}C
- Utilize much less water and release far less CO_2 than traditional CO_2 extinguishers
- Hydrate is suppressed and is able to reach the flame base and extinguish the fire due to the endothermic reaction of the hydrate dissociation and the release of nonflammable gasses at the flame base

Analysis of Fire Foam Agents

Property	Protein	Fluoroprotein	AFFF*
Knockdown	Fair	Good	Excellent
Heat Resistance	Excellent	Excellent	Fair
Fuel Resistance	Fair	Excellent	Moderate
Vapor Suppression	Excellent	Excellent	Good
Toxicity	Mild	Low	High

Table 3. The most common foam agent utilized today (AFFF) versus other foam agents that are not utilized as often in fire departments

Conclusion

Fire Extinguishers and Foam Agents are two of the most uprising forms of fire suppression in the fire service. However, discharging these two modes of suppression are harmful to the environment and human health. Reducing these impacts comes with finding alternative solutions to these pieces of equipment to create the fire environment a less harmful and sustainable atmosphere. As these methods of fire suppression have been around for many years, introducing new alternatives may be a slight barrier. Although, set regulations and protocols of scene control and cleanup may be an implementation right around the corner. Even though this mean of reducing impact wont be as effective as introducing alternatives, it will still be aimed in the right direction to sustaining fire suppression.

For Further Reading

Barber, Barrie. Firefighting Foam Linked to Water Contamination, Injuries under Fire. *The Dayton Daily News (*2016)

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