Next Generation Fire Suppressants

by

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Spectrex, Inc., located in Cedar Grove, NJ is a manufacturer of fire detection and suppression equipment. Spectrex is one of the original pioneers in high speed fire detection and suppression systems for combat vehicles. Spectrex has installed fire suppressions systems in thousands of combat vehicles and ships throughout the world. Additionally, they manufacture flame explosion detectors, ship damage control systems, and optical gas and vapor detectors.

The culmination of several years of research and development has recently produced an innovative electro-optical continuous monitoring systems called SharpEye 20/20I IR^3 and SAFEYE that provide fast and reliable gas, vapor, aerosol, flame, and explosion detection.

SharpEye 20/20I IR^3 is a self-contained triple spectrum flame detector which scans for oscillating IR radiation (1 to 10 Hz) in the spectral bands ranging from 4.0 to 5.0 microns and uses programmed algorithms to check the ratio and correlation of data received by the three sensors to make the system highly immune to false alarms. It is extremely sensitive as it can detect a 1x1 square foot gasoline pan fire at 200 feet in less than 3 seconds. The sensitivity is user-programmable, offering 4 ranges of detection.

SAFEYE is comprised of a selected number of multispectral ban microprocessors controlled detectors which are in communication with one or more radiation sources that is projected along a 600 feet optical path. The signals from the selected narrow bands are processed and analyzed by highly sophisticated algorithms. It is ideal for high risk, remote, large areas such as petroleum and chemical manufacturing sites, waste dumps, aircraft cargo bays, and ship compartments. The SAFEYE will perform direct readings of the presence or rate of rise of concentrations of gases, vapors, or aerosols at the range of parts per million and provide alarms at various set points at different levels of concentrations.

IN SEARCH OF A HALON ALTERNATIVE

However, without an efficient, environmental friendly extinguishing agent, detection technological advances such as the SAFEYE can solve only part of the fire extinguishing problem. When Halon 1301 was rapidly being taken from our arsenal of agents because of the Montreal Protocol, we began an aggressive search for a Halon Alternative. Spectrex took the philosophical approach *"Don't think you are necessarily on the right track just because it's a well-beaten path"*. Spectrex's research, development, and engineering team went back to the basics of fire extinguishment by looking at the technologies that most efficiently attacked the basic contributors of a fire: fuel, oxygen, heat, and chemical process. The Spectrex R&D team conducted a worldwide technology search for the most promising technologies.

SPECTREX R&D EFFORT

As a result of their R&D efforts, they have registered patents and continue the development of three promising technologies.

1. The first is an Electric Field Extinguishing Method
2. The second is extinguishing by using micron size dry powders.
3. The third method is not an extinguisher, but a method of converting halon/CFCs into non ozone-depleting materials.

1. NOVEL METHODS OF EXTINGUISHMENT (ELECTRIC)

The application of an electric field to a combustion system can produce potentially useful results either increasing the efficiency of the flame or reducing its efficiency to the point of extinguishment. When a strong electrical field is applied to the base of certain types of fires, it will result in extinguishment of the fire.

Electrical Field Extinguishment (Mechanism)

An electric field applies several mechanisms that extinguish fires. The electric field creates an Ion Wind that dissipates the heat, inhibits the oxygen and fuel to support the fire, and interferes with the chemical reaction involved in the combustion. We have extinguished fires from fixed locations for the electric field generator and from portable units which allow us to manually direct the generated electric field to the base of the fire thus causing extinguishment. An intense electric field and/or gaseous plasma is directed at the base of the fire; extinguishment can occur by means of a corona discharge. The most efficient corona device for the extinguishment of pool flames appears to be a thin wire moving parallel to the liquid surface at the rate of about 10cm/s. The remarkable extinguishing capability is explained by the unique sharp velocity profile associated with a maximum high velocity of up to 3m/s which occurs 1 to 2 millimeters above the liquid surface.

Electrical Field Extinguishment (Limitations)

At this point in our development, we know of the following limitations:

- We need to know in advance the configuration of the fire.
- Can only extinguish a limited fire surface area.
- Equipment must be tailored to specific applications.

Electrical Field Extinguishment (Advantages)

However, the following advantages exist:

- It is a non-ozone depleter, clean, fast, safe, and quiet.
- It can be applied in an unlimited number of operations.
- There are no consequences to unwanted activation.
- There is great potential savings in weight and volume.

I see this technology as having great potential for automotive and aircraft engine applications as well as tank farm fires.

2. SFE-NOVEL EXTINGUISHING MATERIAL

The second novel extinguishing material is called SFE or EMAA, Encapsulated Micron Aerosol Agent. EMAA is the product name assigned to SFE by the USAF under a Cooperative Research and Development Agreement between Spectrex and the USAF. SFE/EMAA is a family of agents that are originally in solid, powder, or gel form. When the SFE burns, it forms an aerosol cloud

which has powerful extinguishing capabilities. We have developed various chemical formulations, and it can be manufactured and tailored to meet any shape or size requirements.

SFE-Extinguishment (Mechanism)

SFE agent is at least 5-7 times more powerful than halon 1301 in terms of fire extinguishment, weight, and volume. The reason that SFE is so effective is that it attacks the fire's structure by interfering in the chemical chain, by absorbing heat extremely well, by hindering the flame propagation, and by disturbing the rate of burning. SFE is composed of small particles, less than 1 micron in size mixed with gases, primarily nitrogen and oxygen. The agent consists of about 60% gases and 40% particles. Once ignited the aerosol that is produced stays suspended for substantial amounts of time. It has a superior total flooding capability that allows it to quickly fill the entire volume of an area regardless of obstacles.

Extinguishing Comparison

A comparison of various performance parameters of Halon 1301, Gaseous Replacements, CO2, and SFE shows the many advantages that SFE has over the other agents. SFE is an extremely environmentally-friendly agent, a zero ozone depleter, and practically zero in Global Warming Potential. Although testing is not complete, recent toxicological analysis by the Naval Medical Research Institute has shown SFE to have a low toxicity rating. A post fire analysis shows that the air consists of 78-79% Nitrogen, 18-20% Oxygen, .4-2.3 % Carbon Dioxide, .19-.56% Carbon Monoxide, 1-300 PPM of hydrocarbons, and traces of other elements depending on the formulation. These results strongly indicate that the products produced fall in the range of low to no toxicity. In addition, we have recently received notice from the EPA as a part of its Significant New Alternatives Policy (SNAP) program that SFE is acceptable for use in normally occupied areas, pending medical assessment by a peer review panel.

SFE/EMAA Applications

Even if the environmental issues were not important, the fact that SFE provides substantial reductions in weight, volume, and cost is enough to make this technology very attractive to the marketplace. SFE can be developed and adapted into fire extinguishing systems that can satisfy fire protection requirements of many commercial and military applications. For example, our many experiments have shown that SFE is very kind to electronics, leaving very little residue on printed circuit boards. Another promising application of SFE appears to be with aircraft cargo bay fires where weight and volume are of great importance.

Additional advantages of SFE are listed below:

- SFE can be easily combined with various detection technologies or designed as a simple, stand-alone system.

- SFE helps prevent fire reignition. A common problem with halon and CO2 extinguishing systems is that fires reignite after the agent dissipates. We have not experienced reignition in our tests to this point.

- SFE can be activated while immersed in water or fuel and extinguish a fire on the surface. SFE percolates through the fuel or water to extinguish the flames.

Advantages of SFE/EMAA

DOD needs an efficient agent to meet critical survivability issues. SFE appears to address many of those issues. This is not a technology that represents just a marginal improvement over halon 1301; it appears to be at least five times more effective in terms of weight and volume and thus clearly represents a leap ahead in technology. SFE shows great promise of being adapted to many commercial and defense applications thereby reducing life cycle costs.

And we should not forget the engine that is driving this train, environmental issues such as ozone depletion and greenhouse warming. SFE clearly addresses these major environmental issues and appears to be a solution.

3. CONVERSION OF HALONS/CFCs INTO NON OZONE-DEPLETING MATERIALS

The third technology that I would like to briefly describe is a system aimed at protecting the stratosphere from accumulation of ozone destroying halogen atoms. Upon detection of the release, escape, or discharge of halogenated hydrocarbon into the atmosphere, we can apply concentrated energy sources at the halocarbons which separate the halogen atom from the halon carbon molecule. The separated halogen atom is converted to a halide salt as a result of being energized. The products of such a reaction can be controlled by the amount of energy applied to the material.

Our Halogenated Hydrocarbon Neutralization system can be designed to be portable or permanent, and activated manually or automatically. It can be added to any system that uses CFCs as refrigerants or halons for fire extinguishing agents. For example, the halogenated hydrocarbon neutralization system can be designed so as to continuously monitor the halon carbon concentrations within the air conditioning enclosure and block the flow of ozone-depleting species from leaving the enclosure. We have designed a system that is composed of a detection unit capable of detecting small amounts of halon/CFCs that have been accidently been released into the air and a pumping device which draws the air containing the halocarbons into a cyclone separator where heavy haloncarbons are separated from the air. The haloncarbons are pumped into a dissociation chamber where energy pulses delivered by means of radiation cause complete cleavage of the halogen atom from the molecule. The product of the dissociation are pumped into the reaction chamber where the halogen products of the selected dissociation are scrubbed, absorbed, or treated with alkali materials to produce harmless salts.

CONCLUSION

We believe that there are solutions to many of our environmental problems and some of the technologies presented by Spectrex show promise in making our environment safer and cleaner. The technologies explained above are at the technological forefront of today's fire extinguishing and environmental research and show great promise for improving techniques for extinguishing fires while preventing damage to the environment.