Lithium-ion Hazard Protection with F-500 EA®

EXPLORING

LITHIUM-ION BATTERY HAZARDS

From consumer electronics and electric vehicles to industrial equipment and energy storage systems, lithium-ion batteries can be found everywhere. This is just one reason why shifting towards a safe and effective solution for highly hazardous lithium-ion battery fires is crucial. Due to the materials utilized to manufacture these batteries, the scene of a lithium-ion battery fire can best be compared to a hazmat incident. Although extinguishing the fire is a primary concern, flammability, explosivity and toxicity must be addressed in order to ensure proper protection and prevent re-ignition.

BATTERY FIRE RISK ASSESSMENT

This paper utilizes data from a test campaign at the NASA White Sands Test Facility to highlight the hightened risk factors associated with lithium-ion battery fires.

"Life support and environmental cleaning equipment would be expected in the event of larger fires (4-cell tablet) before the 1-hr limit. The first hazard faced by a crew member is visual impairment within the first few seconds of a fire. Second, asphyxiation from combustion products could pose a threat to a crew member in the first 15 minutes of exposure from concentrations of CO above 800 PPM. Risks to the crew results in loss of consciousness or death if the atmosphere remains toxic at these high concentrations and beyond the 15-minute time of exposure."

Lawrence Livermore National Laboratory (LLNL)

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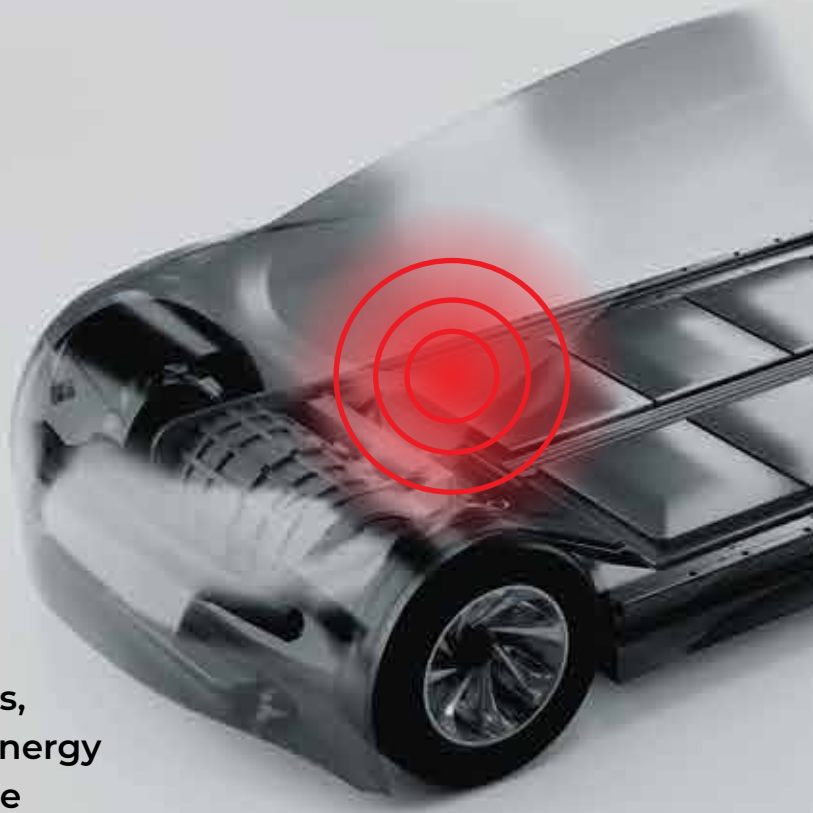
EXPLORING

IGNITION

Ignition occurs when lithium-ion batteries enter a chemical process called thermal runaway. Cells produce heat and emit explosive and toxic gases, developing a self propelling loop that leads to thermal runaway propagation. This chain reaction will continue to impact adjacent cells until thermal runaway propagation is halted.



*** Confined spaces such as server rooms, automobiles, aircrafts, spacecrafts, shipping containers, energy storage systems and more can pose an increased risk.**

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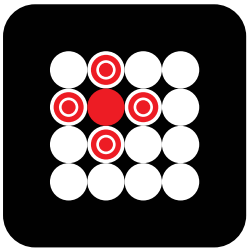
MULTI-LEVEL

MITIGATION

The adoption of an internationally recognized Encapsulator Agent can protect your team during a lithium-ion battery fire in many ways that water cannot. A 3% solution of F-500 EA can halt thermal runaway propagation while reducing the concentration of explosive and toxic off-gases and neutralizing hazardous runoff.

F-500 EA utilizes significantly less water, mitigating lithium-ion battery fires on three levels.



FLAMMABILITY

Encapsulate flammable corrosive electrolyte and rapidly reduce heat three-dimensionally, stopping the spread of cell-to-cell ignition. This halts thermal runaway propagation, preventing re-ignition.

EXPLOSIVITY

Encapsulate explosive off-gases emitted by burning lithium-ion batteries, such as Hydrogen (H2), Methane (CH4) and Ethylene (C2H4). This is especially important within enclosed environments.

TOXICITY

Reduce the concentration of toxic off-gases, including Hydrogen Fluoride (HF), Carbon Monoxide (CO), Carbon Dioxide (CO2) and more. Many burning lithium-ion batteries are capable of emitting dozens of toxic off-gases.

LITHIUM-ION BATTERIES 3%

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CODES & STANDARDS

Encapsulator Technology

Recognized by NEN and NFPA for Lithium-ion Battery Fire Mitigation

NEN

NTA 8133

This Dutch standard is the first of its kind, applying to lithium-ion battery powered electronics such as smartphones, laptops, drones, small appliances and more. Extinguishers that meet its requirements, such as F-500 EA, may use the NTA 8133 marking. F-500 EA is third-party tested on lithium-ion batteries up to 3,400 Wh, far exceeding the NEN minimum of 600 Wh.

NFPA

18A ANX 4.3

Encapsulator Agents conforming to Section 7.7, such as F-500 EA, are recognized for extensive third-party testing by independent institutions. This testing has been controlled, scientific and highly instrumented, documenting lithium-ion battery fire suppression as well as the encapsulation of flammable electrolyte and explosive and toxic off-gases.

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CONCLUSION

> **Water mist suppression with F-500 EA additive can better suppress the fire.**

NIOSH STUDY

Comparison of Fire Suppression Techniques on Lithium-Ion Battery Pack Fires

"Lithium-ion battery pack fires pose great hazards to the safety and health of miners. A detailed experimental study has been conducted at the NIOSH Pittsburgh Mining Research Division to investigate the effectiveness of different fire suppression systems on lithium-ion battery pack fire extinguishment."

Mining, Metallurgy & Exploration

Experiments were conducted within an open-ended shipping container. Two types of battery packs were tested:

1 — 12 V, 30Ah
36 NMC Cylindrical
18,650 Batteries

2 — 24 V, 40Ah
72 NMC Cylindrical
18,650 Batteries

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Ehningen Fire Brigade

Ehningen, Germany

"The use of F-500 EA resulted in rapid cooling and thus prevented the spread of fire, even though the agent only reached the outside of the intact battery housing."

Head of Operations

KIWA

F-500 EA Proves Itself in Rigorous European Testing

Johnson Controls

"Month-long tests were conducted on various types of lithium-ion batteries to address the spread of fire, temperature, emissions and sewage water analysis. The agent additive, F-500 EA, proved to be exceptionally effective."

Type	Result			Remark
DRY POWDER	*Poor*	*Poor*	*Poor*	*Do not apply.*
FOAM	*Moderate*	*Poor/Moderate*	*Moderate*	*Not recommended.*
F-500 EA	*Sufficient*	*Sufficient*	*Sufficient*	*Can be recommended.*

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