HAZARD CONTROL TECHNOLOGIES, INC.

FIRE, VAPOR, AND CONTAMINATION CONTROL SOLUTIONS

F-500 ENCAPSULATOR TECHNOLOGY

A SAFER GREENER WAY

www.redcardsafetyllc.com

RED CARD SAFETY

A SAFER GREENER WAY

F-500 Encapsulator Agent – Uniquely different than any other suppression product.

1. Rapidly Cools – F500 EA is engineered to provide rapid and permanent heat reduction for quicker extinguishment and significantly decreases chances of secondary flair ups.

2. Interrupts Free Radical Chain Reaction – F500 EA will interrupt the free radical chain significantly reducing the creation of harmful soot and smoke. Increased visibility and rapid fire extinguishment

3. Encapsulation of Fuel – (Hydrocarbon fuels – and derivatives, polar/non-polar solvents, VOC's, Ethanol) The ability to encapsulate flammable liquids and vapors and rendering them non flammable

F-500 Encapsulator Agent
NFPA 18A - New 3rd Category of Agents

F-500 Encapsulator Agent Applications - Expands Your Hazard Mitigation Capabilities

F-500 ENCAPSULATOR TECHNOLOGY

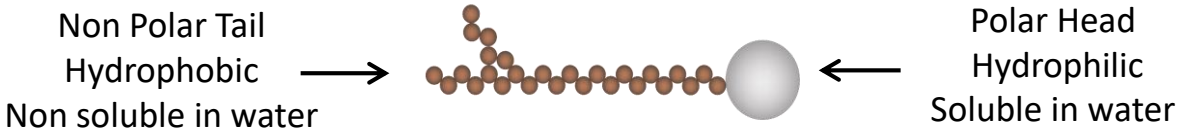
- Class A, 3D Fires
- Class B, 3D Fires (Transformers, Turbine Lube Oil Fires)
- Class B, Flowing/Spraying Fuel Fires (Distillation Columns, Flange Fires)
- Class C Fires (FDNY/ConEdison Testing - SOGs)
- Class D Fires (Magnesium, Lithium-ion Batteries)
- Flammable Liquid Spill Control

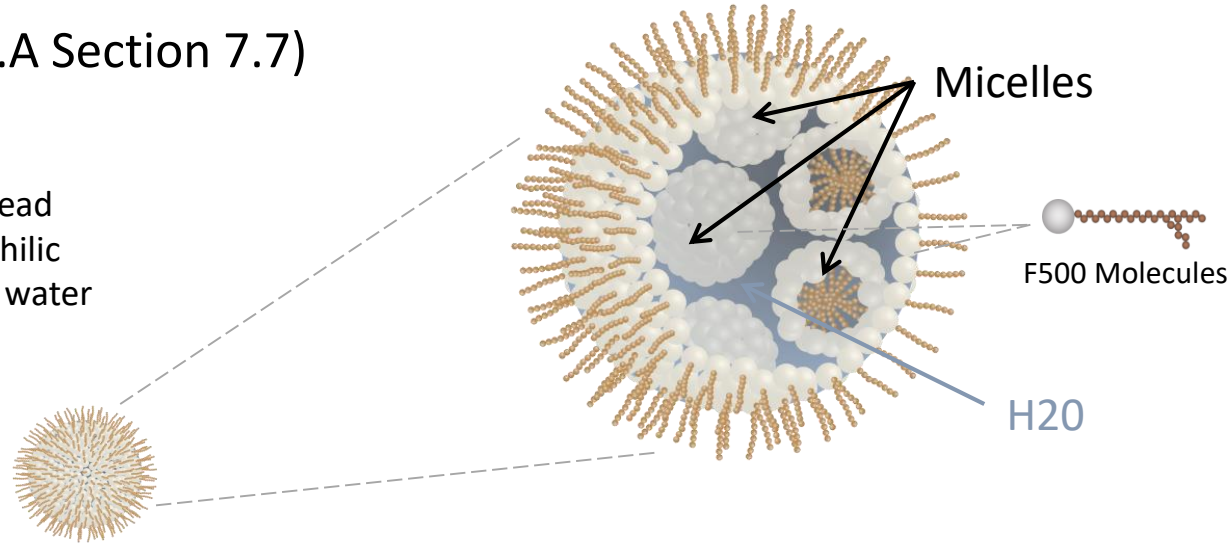
The only agent proven to extinguish lithium-ion batteries, without reignition, and recommended for energized transformer fires.

Integrating F500 EA into Current Fire Suppression Methods

- F500 EA is easily integrated into current systems.
    - Fire Fighting Apparatuses – can use existing foam tanks and proportioner systems
    - Existing Fixed Fire Suppressions systems
    - Pressurized Water Canisters
- F500 EA at a 3% solution will put out any class of fire
    - Works with all water type: salt, fresh and brackish

- F500 Encapsulator Agent
  - New Encapsulating Technology (NFPA 18.A Section 7.7)
  - The F500 EA Molecule

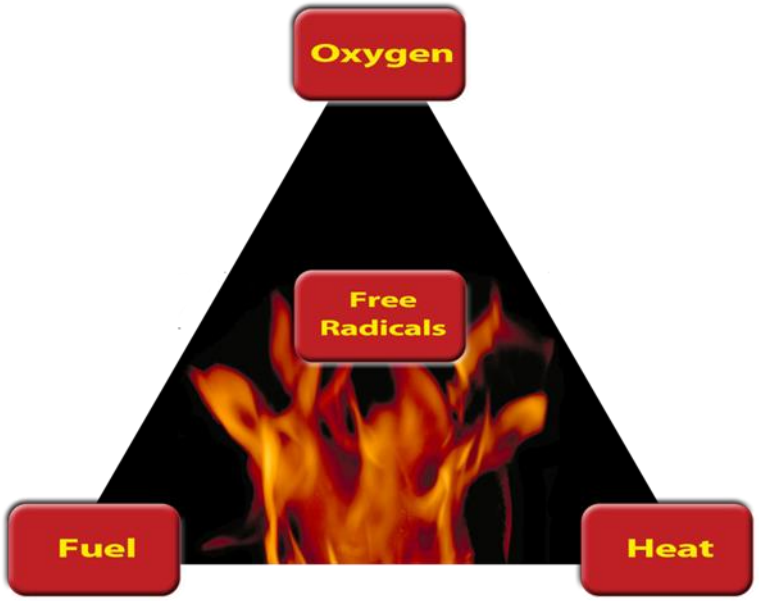




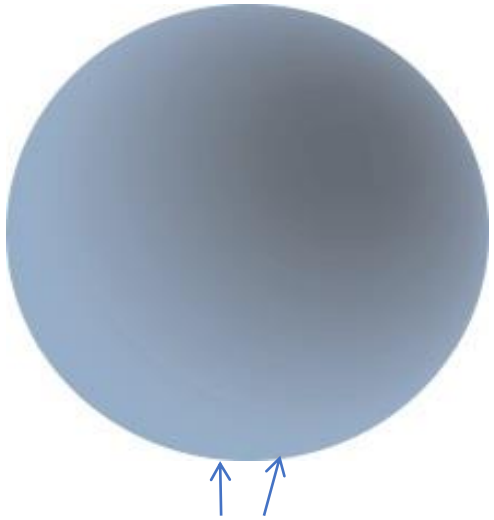
  - The building block for Spherical Micelles
    - The chemical properties of F500 and molecular structure of the spherical micelles provides 3 unique properties/advantages

The F500 EA Advantage

- Ability to attack 3 legs of the Fire Tetrahedron
  - Interruption of Free Radical Chain Reaction
  - Heat Reduction – 8 x's more efficient than water
  - Encapsulation of Fuel – Molecular separation of fuel from heat and oxygen



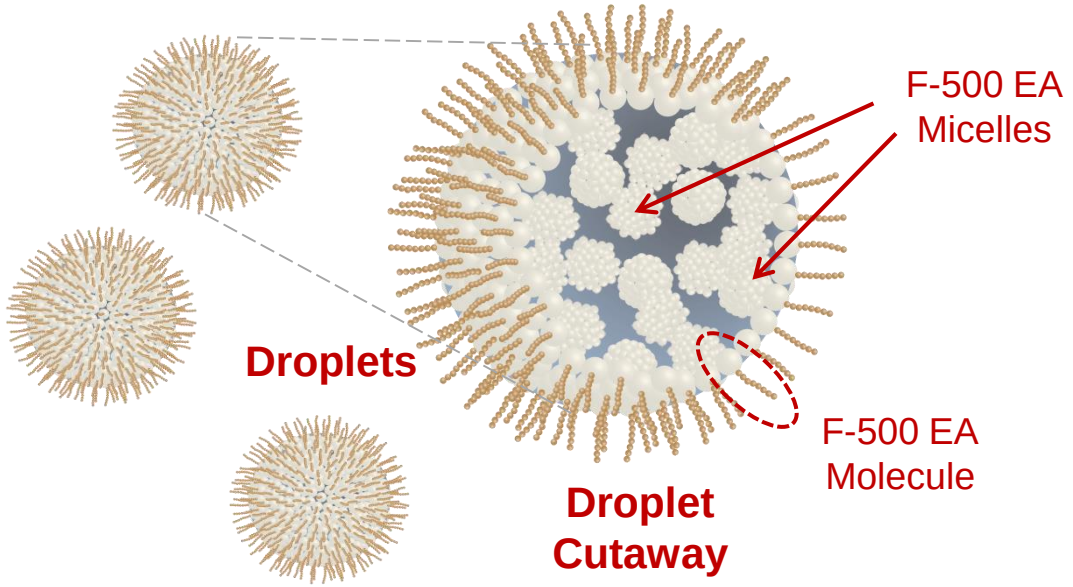
Water Droplet



H_2O Molecules

F-500 EA Droplets

When a droplet is formed, nonpolar tails stick out of the water droplet, pulling the polar heads to the surface to form an F-500 EA skin on each droplet.

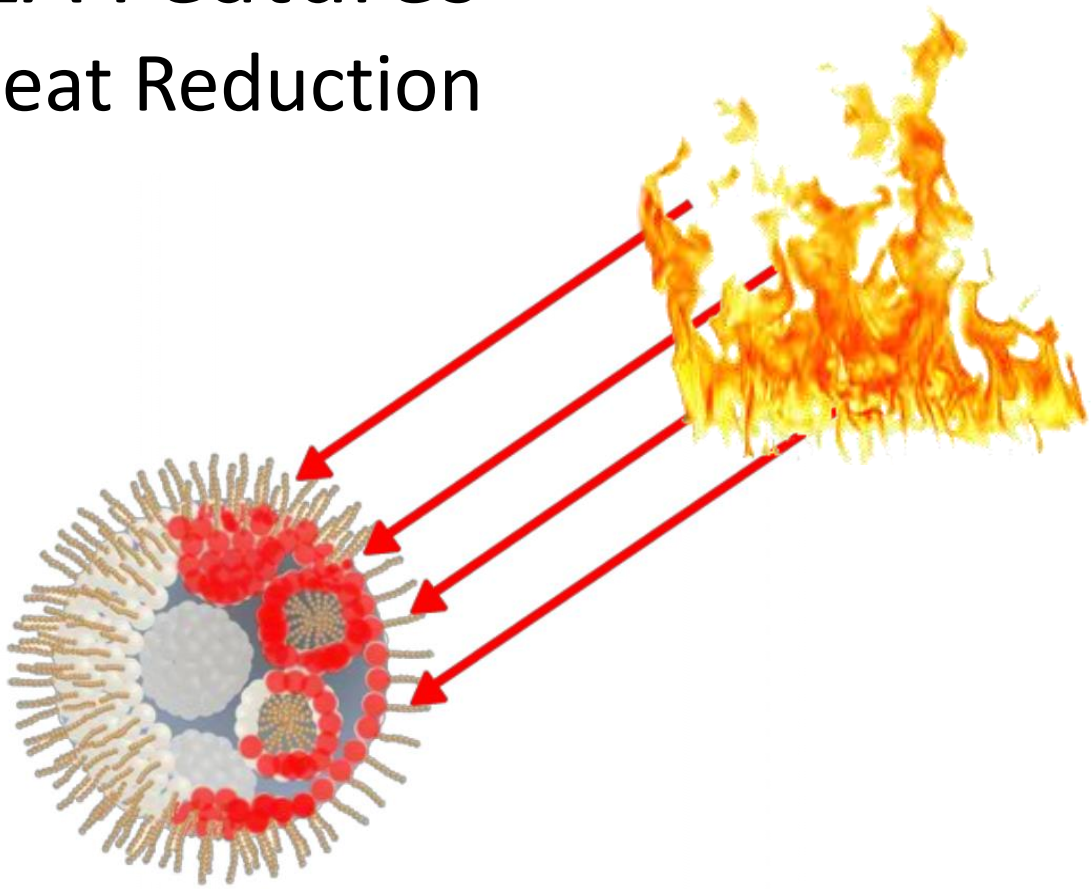


Droplet	Molecular Weight	Boiling Point	Heat Reduction Method	Efficiency
Water	18 g/mol	212^{0}F (100^{0}C)	Steam Conversion	Inefficient
F-500 EA	>1000 g/mol	248^{0}F (120^{0}C)	Thermal Conveyance	Highly Efficient

F500 EA Features

Rapid Heat Reduction

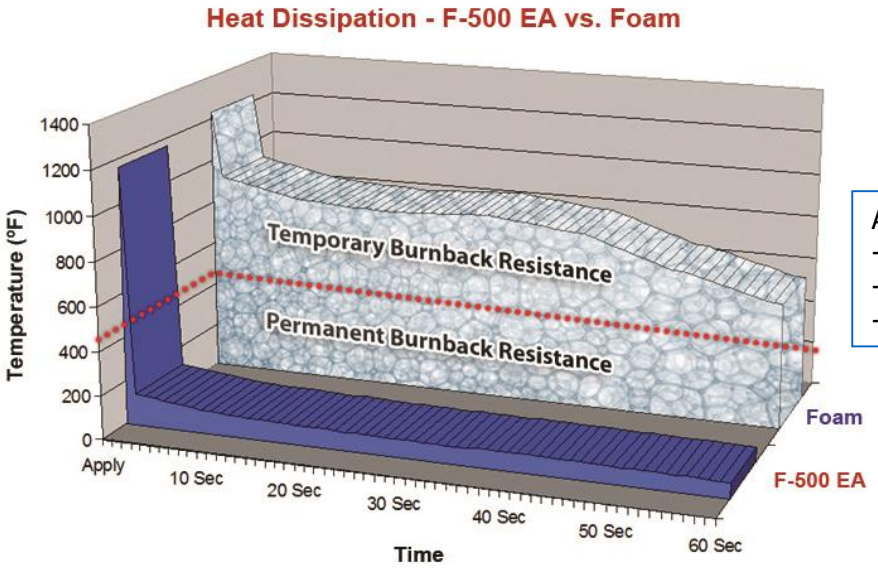
- Thermal conveyance
  - The chemical and molecular properties of the F500EA molecule and micelle is very efficient at absorbing heat.
  - Increased surface area; Heat is not only absorbed on the exterior of the micelle, but also driven internally



F500 EA Features

Rapid Heat Reduction

- Clemson University Cooling Analysis
  - 2 steel plates heated to 1200^{o}F
  - After 1 minute AFFF application was still above 300^{o} C
  - F500 EA dropped temps below 100^{o} C in seconds
- Quicker and sustained knock down of temps below auto ignition of fuels



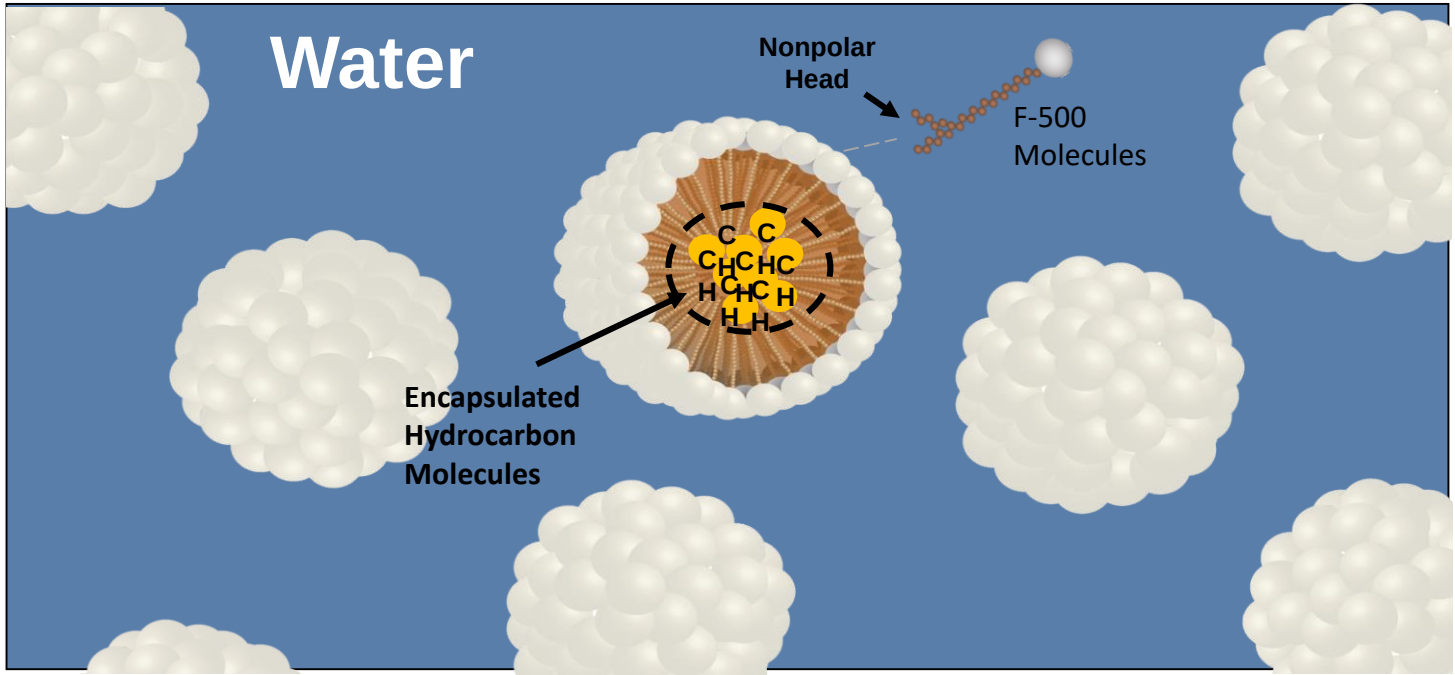
Autoignition Temps
- Gasoline: 477-536^{o} F
- Ethanol: 685^{o} F
- Diesel Fuel: 493^{o} F

Clemson University - Test report
Pendleton, SC – July, 1997

F500 EA Features

Encapsulation

- F500 Micelle Encapsulation
  - The nonpolar heads pull apart and encapsulate hydrocarbon liquids and vapors
  - Hydrocarbons are contained and neutralized inside of the F500 Micelle for bioremediation or safe handling
  - Encapsulates and interrupts free radical chain



HAZARD CONTROL TECHNOLOGIES, INC.
FIRE, VAPOR, AND CONTAMINATION CONTROL SOLUTIONS

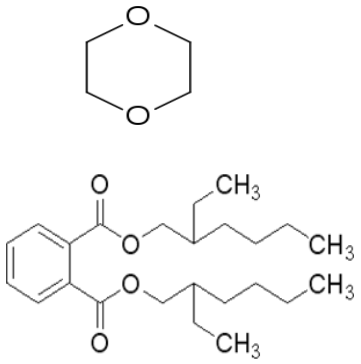
F-500 ENCAPSULATOR TECHNOLOGY

F500 EA Features

Free Radical Encapsulation

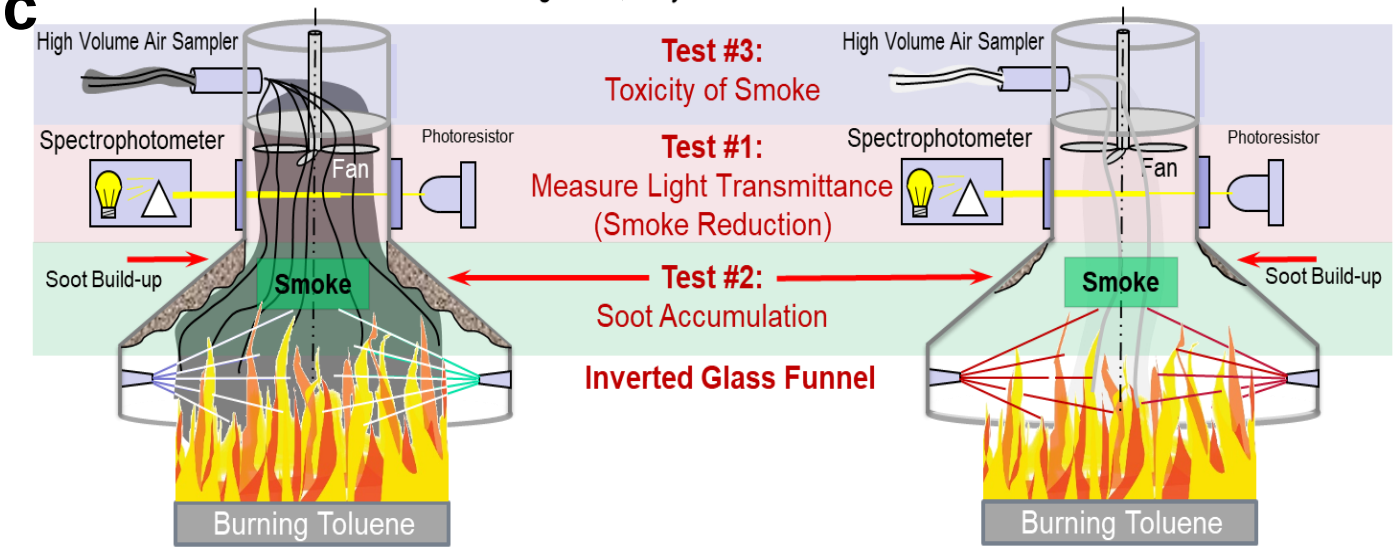
A 98.6% reduction of carcinogenic toxins found in smoke

- Benzo(a)pyrene
- Terphenyls
- Fluorene derivatives
- Indene derivatives
- Bis(ethylhexyl)phthalate
- 1,4 Dioxane
- Cyclohexanols
- Several higher molecular weight polynuclear aromatic hydrocarbons



Clemson University Report – Pendelton, SC
FAI Material Testing Lab – Marietta, GA
Analytical Services – Norcross, GA

** When free radicals combine or "come together", they form soot and smoke*



Water Spray
First Test Series
Water Sprayed
Through Smoke Plume

Plain Water vs. 3% F-500 EA	
1. Light Transmittance	68% Increase in Visibility
2. Smoke and Soot Accumulation	97% Reduction in Products of Combustion
3. Smoke and Soot Toxicity	98.6% Reduction in Toxicity

F-500 EA Spray
Second Test Series
F-500 EA @3%
Sprayed Through Smoke Plume

HAZARD CONTROL TECHNOLOGIES, INC.

FIRE, VAPOR, AND CONTAMINATION CONTROL SOLUTIONS

F-500 ENCAPSULATOR TECHNOLOGY

F-500 Encapsulator Agent
Fire Suppression and Spill Control - Penetrates, Cools and Encapsulates

Pinnacle Foam Concentrates
Highly Effective and Economical Foam Fire Suppression Agent

HydroLock Environmental Agent
Petroleum Storage Tank Degassing and Cleaning Agent

Spill Bioremediation Mitigation Agent
Hydrocarbon Spills/Soil Washing and Odor Control

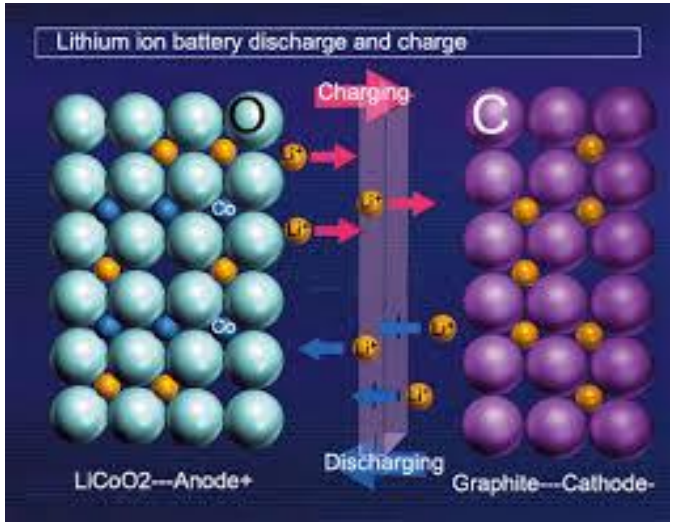
Waterway Spill Dispersion Agent
Disperses and Bioremediates Hydrocarbon Spills

Dust Wash Industrial Concentrate
Safely Penetrates, Lifts and Displaces Combustible Dusts

Lithium-ion Battery Fires

What is a Lithium-ion Battery?

- Lithium-ion batteries are popular due to their high energy density, minimal memory effect and low self-discharge.
- A lithium-ion battery is a rechargeable battery in which lithium-ions move from the negative electrode to the positive electrode during discharge, and back when charging.



Why Do Li-ion Batteries Ignite?

- High energy density leads to heat

- Lithium hexafluorophosphate (LiPF6) or other Li-salts containing fluorine
  - Under pressure and flammable

Overheating or over charging leads to thermal runaway and cell rupture.

Safety features have been incorporated in lithium-ion batteries, including shut-down separators, vents for pressure relief and thermal interrupts, but not all cells use these features and contaminants in production and catastrophic events can overide the safety features.

Toxic Fumes in Li-ion Battery Smoke

- Hydrogen fluoride (HF) can pose a serious toxic threat, especially for large Li-ion batteries and in confined environments. The amounts of HF released from burning Li-ion batteries are presented as mg/Wh.

- The immediate dangerous to life or health (IDLH) level for HF is 0.025 g/m3 (30 ppm) and the lethal 10 minutes HF toxicity value (AEGL-3) is 0.0139 g/m3 (170 ppm)

- If extrapolated for large battery packs the amounts would be 2–20 kg for a 100 kWh battery system, e.g. an electric vehicle and 20–200 kg for a 1000 kWh battery system, e.g. a small stationary energy storage

- The release of hydrogen fluoride from a Li-ion battery fire can therefore be a severe risk and an even greater risk in confined or semi-confined spaces

**Nature.com/scientficireports Pubished 30 August, 2017

F-500 EA History with Lithium-ion Batteries

- Bosch tested F-500 EA on li-ion battery fires and makes it their product of choice

BOSCH
Invented for life

- Baden-Wurttemburg Fire School publishes guidelines for fighting li-ion battery car fires using F500 EA
- Dekra (worldwide vehicle testing authority) tests F-500 EA and issues report
- General Motors tested and approved F-500 EA on lithium-ion battery fires
- Tesla specifies F-500 EA in battery charging area and manufacturing facility
- Jaguar performs lithium-ion battery testing and chooses F-500 EA as their agent of choice

F-500 EA Testing on Lithium-ion Batteries

2017 KIWA Testing in Netherlands showed foam and powder were ineffective fighting lithium-ion battery fires. F-500 EA successfully extinguished the batteries and prevented re-ignition.

KIWA Nederland B.V. Testing – Side by Side

F500 EA Benefits

- Environmental Benefits
  - No PFAS or PFOS – MSDS Sheet
  - Product is guaranteed for 15+ yrs with proper storage and testing.
  - Certified EPA Surface Washing Agent – On-site bioremediation of fuel spills
  - EPA NCP Product Schedule – SOP 40 CFR Subpart J Section 300.910
  - Non Corrosive/Hazardous/Toxic – Clemson University Report
  - Easy clean up
- Health and Safety
  - F500 EA Versatility - Extinguishes
    - Class A
    - Class B (Hydrocarbon Fuels)
    - Class C
    - Class D (Metals)
  - No PFAS or PFOS exposure
  - Encapsulates 98+% of carcinogens found in smoke – Clemson University
  - Limit fire exposure time with quicker knock down

- Notable F500 EA Users
  - NNPC (Nigerian National Petroleum Corporation)
  - Italian Navy – Marine and Aviation protection
  - China Military
    - China Municipal FD's (Operated by the China Military)
    - Hong Kong and Beijing Airports
    - China Marine Rescue and Salvage
  - Bosch and Tesla Inc - Lithium Ion Battery manufacturers
  - New York Fire Department – SOG's for fuel spills and transformer fires
  - Wright Patterson AFB

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