

SOLUTION TO LITHIUM-ION BATTERIES FIRE



Why do lithium-ion batteries catch fire?

Thermal Runaway

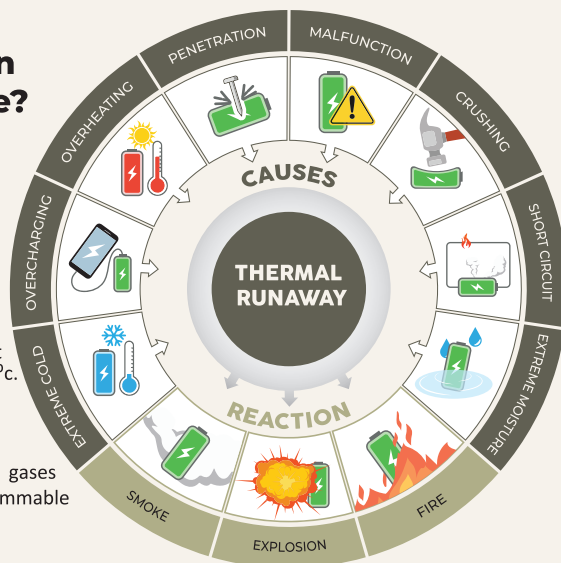
A chemical reaction can trigger thermal runaway, leading to rapid overheating.

Spontaneous Ignition

Overheated batteries can spontaneously ignite & burning at temperature between 700°C & 1000°C.

Hazardous Gases

Burning batteries release hazardous gases that in enclosed space leading to a flammable vapor cloud explosion (VCE)



Key hazardous residues & by-products from lithium-ion batteries fire

Toxic Gases	Carbon Monoxide (CO), Hydrogen Fluoride (HF) and Phosphorus Oxides. HF is not only toxic but also highly corrosive to metals, glass, and human tissue.
Metal Particles & Compounds	Lithium, aluminium, and cobalt, along with other compounds found in the battery. These metals can be toxic and pose environmental and health risks.
Volatile Organic Compounds (VOCs)	VOCs such as benzene and toluene. These compounds are harmful to human health and can contribute to air pollution.
Particulate Matter	Fine particulate matter that can be inhaled deeply into the lungs.

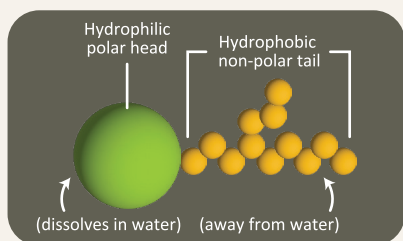
What is F500 Encapsulation Agent ?

Fluorine free, non-corrosive, & biodegradable solution capable of extinguishing three-dimensional multi-class hazards.

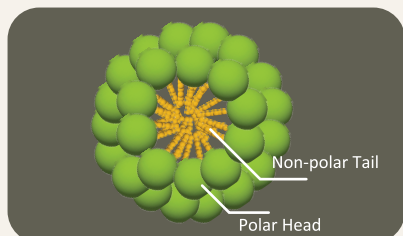


It is not a foam but a type of **water additive** whose basic building blocks are spherical micelles that capable of encapsulating fuels as well as both **polar and non-polar** hydrocarbon vapor and liquid molecules, separating fuel from oxygen on a **molecular level**.

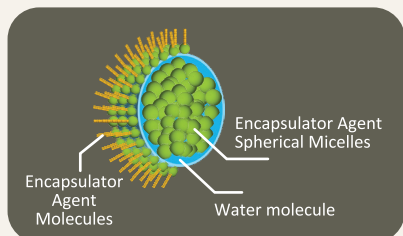
F500 EA molecule



F500 EA spherical micelles (When mix with water)



F500 EA water droplets (when discharge from nozzle)



How does F500 Encapsulation Agent work on Li-ion battery fires?

When the F500 EA water droplets invade the lithium-ion battery fire:

- 1 It encapsulates the flammable electrolytes within the lithium-ion battery rendering them non-flammable, mitigates reignition of the electrolyte.
- 2 It is chemically changing in the makeup of water droplet to enhance strong cooling effect. The non-polar tails on the surface of F500 EA droplet (away from water) rapidly absorb heat and drive it inside to where the spherical micelles and water are. In this process the heat is slowly absorbed into the water that surrounds each micelle and does not create steam. Each F500 EA water droplet is able to absorb heat more efficiently up to 6 to 10 times more than regular water, while not producing steam. So, with its ability to absorb heat, it is able to rapidly cool the fire and stop thermal runaway.

Advantages of F500 Encapsulation Agent



Harmful hydrocarbon concentration reduction

Interrupts free radical chain reaction and proactively reduce concentration of harmful hydrocarbons present in smoke and soot.



Rapid cooling

Strong cooling effect as compared to pure water and foam



Eco-friendly

Fluorine free, noncorrosive (pH value approx. 7) and 100% bio degradable



High penetration

High penetration of the agent into flammable material

In summary, F500 EA is effective on cooling, controlling and suppressing lithium-ion battery fires whilst mitigating the by-product of poisonous gases.

Kiwa Netherlands B.V. testing concludes F500 EA is the most effective agent on lithium-ion battery fires when tested against foam and dry chemical fire extinguishing agents.

Can blankets extinguish the flames of some electric cars?

When thermal runaway occurs in an electric vehicle's battery:

Acids from the batteries release flammable gases that feed back into the flames, and at the same time, the heat from the flames feeds the chemical reaction of the acids. Thus, a car fire blanket is not sufficient to smother the electric vehicle fire as it will be the gases from the battery itself that continue to fuel the flames.

Solution to prevent secondary damage caused by lithium-ion batteries fire in parking garages, charging station and more

- ▶ controlling the flames
- ▶ minimizing the spread of heat and toxic fumes
- ▶ preventing the advancement and spread of the flames
- ▶ avoiding damage to other vehicles or elements in the surroundings
- ▶ enabling emergency services to work more safely

RESCUE-E PRODUCTS

**Optional: Selectable gallonage nozzle*

EEV 2 / EEV 9

Type
Stored Pressure Type ◀

Extinguishant
F500 EA ◀
(Encapsulator Agent Premix)

Capacity
2 litres / 9 litres ◀

Approx Full Weight
3.9 kg / 13.7 kg ◀

Fire Class
A,B,C + Lithium-ion battery ◀

Designed & Manufactured to
EN 3 ◀

**Various capacity from 2L to 9L available upon request*



**User guide: 9L F500 EA premixed extinguisher is suitable for 4.8KWh Lithium-ion battery fire*

MEM 45

Type
▶ Stored Pressure Type

Extinguishant
▶ F500 EA
(Encapsulator Agent Premix)

Capacity
▶ 45 litres

Discharge Hose
▶ 16 mm x 6m

Approx Full Weight
▶ 91 kg

Fire Class
▶ A,B,C + Lithium-ion battery

Designed & Manufactured to
▶ EN 1866

**Larger capacity up to 150L & Mobile Foam Unit available upon request*



FB34M

Size
▶ 3m x 4m

Approx thickness
▶ 0.45 mm

Approx blanket weight
▶ 480 g/m²

Approx full weight
▶ 4 kg

Material
▶ Double sided silicone coated fiber glass

Heat Resistance Temperature
▶ Withstand: 550°C
Melting: 1,100°C

Test Standard
▶ EN 13501-1:2018



FB68V

Size
▶ 6m x 8m

Approx thickness
▶ 0.45 mm

Approx blanket weight
▶ 480 g/m²

Approx full weight
▶ 26 kg

Material
▶ Double sided silicone coated fiber glass

Heat Resistance Temperature
▶ Withstand temp: 550°C
Melting: 1,100°C

Test Standard
▶ EN 13501-1:2018



FB68EV/ FB68EVL

Size
▶ 6m x 8m

Approx thickness
▶ 0.75 / 0.5 mm

Approx blanket weight
▶ 880 / 560 g/m²

Approx full weight
▶ 43 / 30 kg

Material
▶ Silicone coated high silica

Heat Resistance Temperature
▶ Withstand temp: 1,000°C
Melting: 1,600°C

Test Standard
▶ EN 13501-1:2018