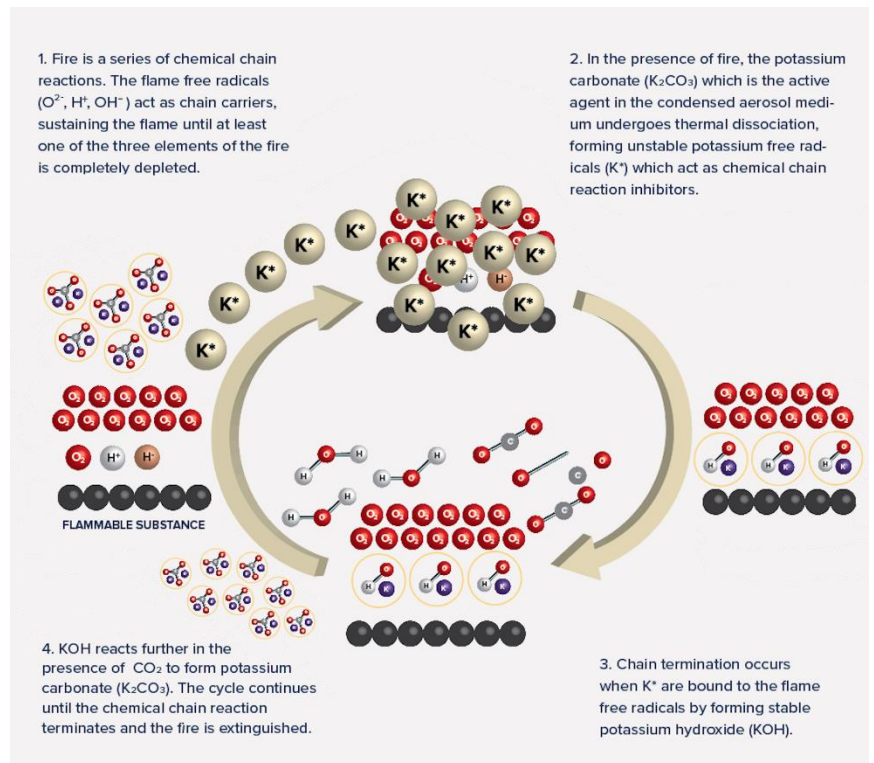


Fire Extinguishing: Traditionally, there were three distinct elements assumed as necessary for combustion: heat, fuel and oxygen, popularly known as the “fire triangle”. Typical fire extinguishment involves either removing the fuel from the fire, limiting oxygen to the fire (smothering) or removing the heat (quenching).

This theory had to be modified as other agents like **FirePro** do not extinguish fire in any of these ways, but instead break up the chain reaction of the combustion process. Upon activation, **FirePro** starts a chemical reaction that in few seconds produces aerosol (i.e. potassium compounds (K₂CO₃), H₂O, N₂, CO₂ and other gases in small quantities. FirePro remains in suspension for a relatively long time in the protected volume allowing it to flow into the combustion core breaking the chain reaction upon flame contact with extremely high efficiency.



How FirePro works on extinguishing the Lithium Polymers batteries Fires

Common electrolytes contain lithium hexafluorophosphate salt (LiPF₆). LiPF₆ is highly flammable and undergoes thermal decomposition when the Li-ion cell is exposed to increased temperatures. The decomposition of LiPF₆ is promoted by the presence of water or humidity, according to the following reactions:

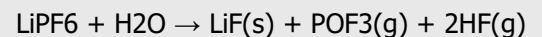
when heated in a dry and inert atmosphere



in the presence of moisture/water, PF₅ is reacted to form POF₃ and HF



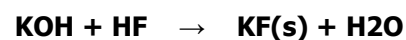
when heated in normal atmosphere in presence of moisture/water



During a battery fire and explosion, the gases formed by the thermal breakdown of LiPF₆ salt solutions are toxic (HF, POF₃). High concentrations of HF were detected in fire tests. The POF₃ concentration was below the detection limit.

Extensive research has been carried out to eliminate the amount of HF or to further neutralize it with alkaline materials. Fire extinguishers that contain aqueous solutions of metal salts have proven to be effective, through a mechanism where the metal ions bind to the HF gas molecules to form stable solid metal fluorides.[*]

FirePro is a promising technology for suppressing Li-ion battery fires; the main components are alkaline potassium salts. Both the active agent K₂CO₃ and KOH intermediate product can react with HF to form stable products, according to the following reactions:



This neutralization allows the room temperature to lessen below 120°C, the threshold temperature below which the thermal reaction within a Li-ion battery will stop.

[*] Patent No.: US20120312562A1 Method for fighting and/or preventing fires in lithium ion polymer cells.