Electric Vehicle Fires – Part2

Why in news?

The Union Government has constituted an expert panel to probe the recent series of battery explosions in electric vehicles (EVs).

What are EVs?

- EVs are vehicles that are either partially or fully powered on electric power.
- While some EVs used lead acid or nickel metal hydride batteries, the standard for modern battery electric vehicles is now considered to be lithium ion batteries.
- But, the recent incidents of fire involving electric two-wheelers (ETWs) have raised concerns over quality and safety of these vehicles.

To know more about EV fires, click here

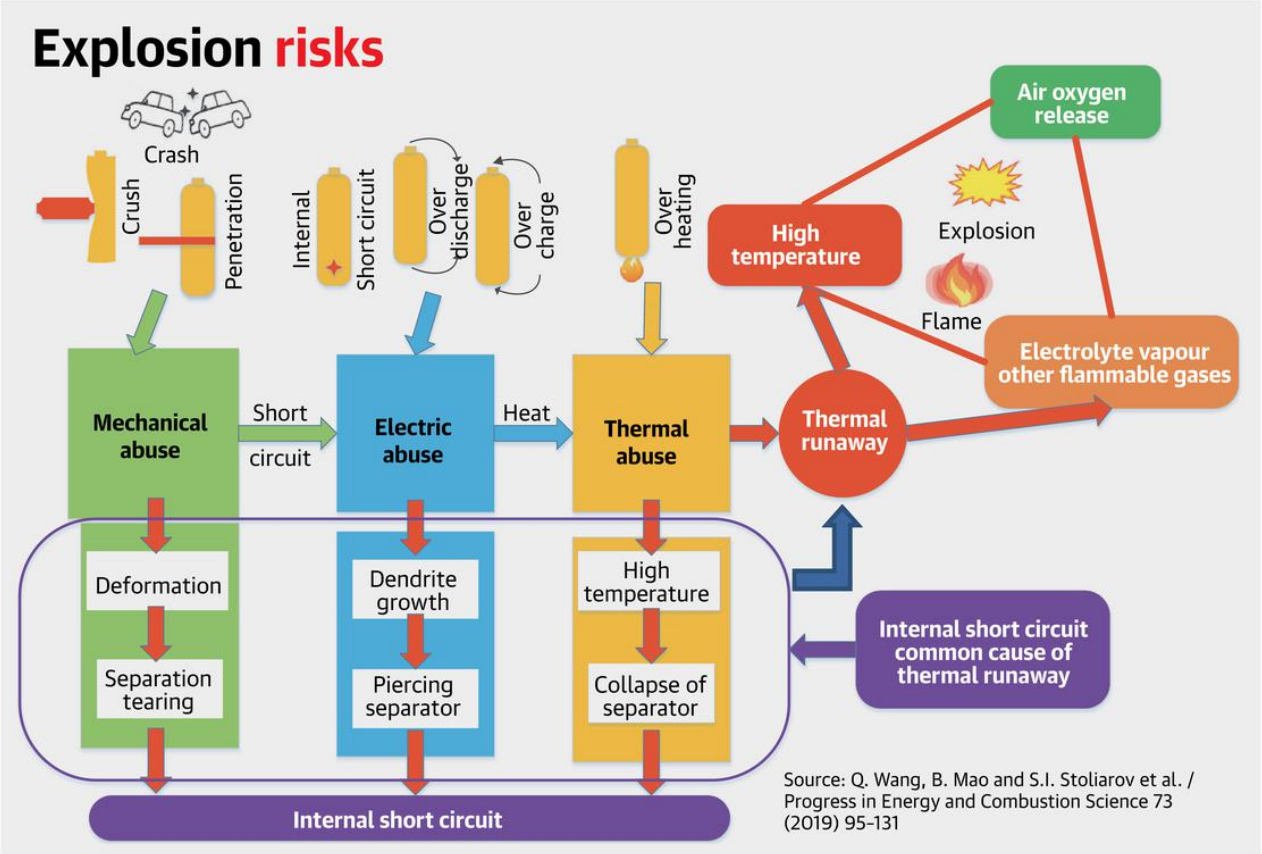
What goes into a Li-ion battery?

- Every Li-ion battery consists of three active components
  - **Anode**- Typically graphite
  - **Cathode**- Typically based on a nickel, cobalt, and manganese-based oxide
  - **Electrolyte**- Typically a salt of lithium in an inorganic solvent
- The sheets of the anode and cathode are assembled into a sandwich structure held apart by a thin separator (about 15 microns in thickness) to prevent shorting.
- Accidental shorting of the electrodes is a known cause of fires in Li-ion cells.
- Safety features, such as thermal switches that turn off if the battery overheats, are added into a battery cell.
- Battery cells are assembled into modules and then further assembled into packs that are designed to ensure uniform temperature profile with minimal thermal variation during operation.

What causes battery fires?

- Battery fires occur due to the convergence of three parts of the “fire triangle” - heat, oxygen, and fuel.
- **Heat**- If an adverse event such as a short circuit occurs in the battery, the internal temperature can raise as the anode and cathode release their energy in an uncontrolled manner, along with oxygen.
- **Oxygen**- Such events also rupture the sealed battery further exposing the components to the second part of the fire triangle, namely, oxygen.
- **Fuel**- The final component of the triangle is the liquid electrolyte, which is flammable and serves as a fuel.
- **Trigger for battery fires**
  - **Internal shorts** - manufacturing defect that results in sharp objects penetrating the

separator
- **External events**
  - puncture of the cell and shorting of the electrodes
  - overcharging the battery
  - faulty battery management system
  - bad thermal design at the module and pack level



Are battery fires inevitable?

- **Battery Cathodes**- Since battery cathodes are a leading cause of the heat release, the one with lower nickel content or moving to iron phosphate can increase safety.
- **Manufacturing**- Tightly controlled manufacturing will prevent accidental shorts in the cells, eliminating a leading cause of fires.
- Adding a ceramic layer on the separator mechanically prevents shorts.
- **Design-**Sensing the state of the battery and integrating this data into sophisticated battery management systems is important.
- Protecting the cell with robust thermal management is critical, especially in India where ambient temperatures are high.
- Battery packs need to be protected from external penetration.
- **Current developments**- Companies are developing internal switches that turn off parts of the battery that undergo thermal events to stop them at their inception.
- Research is underway to replace the flammable liquid electrolyte with a solid electrolyte and nonflammable liquid electrolytes to eliminate one part of the fire triangle.
- **Role of regulators**- Regulators play an important role, providing the testing and certification needed to ensure that technology innovations perform at the level that is promised.

References

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