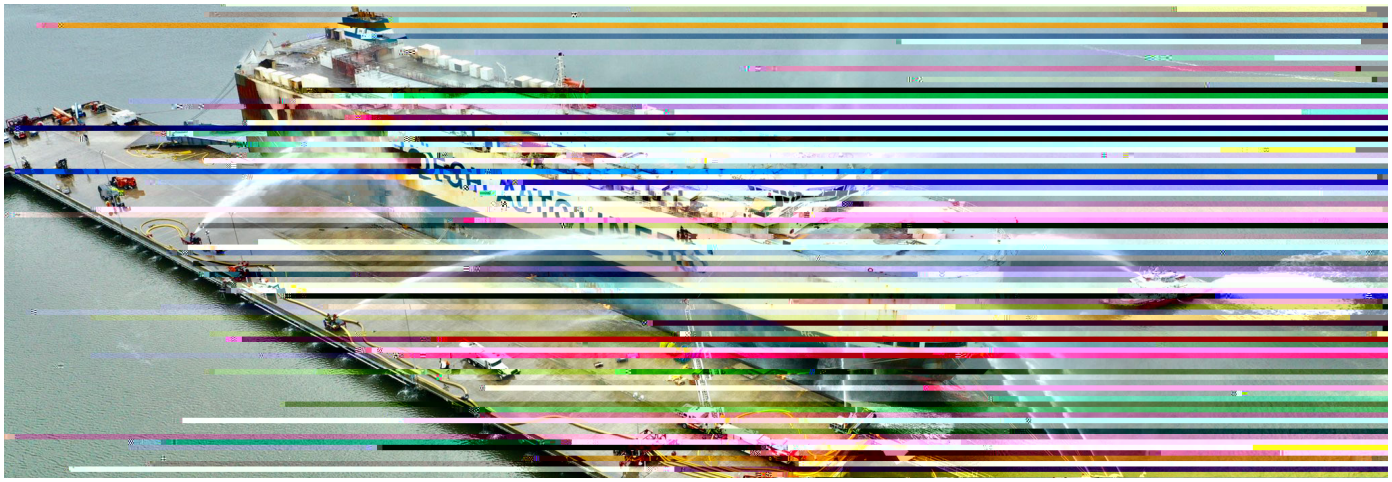
Allianz Global
Corporate & Specialty

Lithium-ion batteries: Fire risks and loss prevention measures in shipping

Allianz Risk Consulting bulletin



Lithium-ion (Li-ion) batteries are increasingly impacting shipping safety with a number of fires. Allianz Global Corporate & Specialty (AGCS) marine risk consultants have long warned about the potential dangers that Li-ion batteries can pose if they are not handled correctly. In this risk bulletin, the AGCS team takes a deeper dive into the hazards and storage concerns associated with newly manufactured Li-ion batteries being shipped on vessels as cargo or already installed in new electric vehicles.

All of the recommendations in this bulletin are technical advisory in nature from a risk management perspective and may not apply to your specific operations. Please review the recommendations carefully and determine how they can be applied to your specific needs prior to implementation. Any queries relating to insurance cover should be made with your local contact in underwra car battery. Photo: Jacksonville Fire and Rescue Department, Wikimedia Commons

However, the overwhelming challenge investigators face in determining the cause and origin of such incidents is the fact that shipboard fires burn at such extreme temperatures, and for such extended periods of time (usually days), that little, if any, traces of evidence remain for them to examine.

carriers (transporters), as well as insurance underwriters,

based on the information and testing currently available.

What we know

Cargo hazards and causes

There are four main hazards associated with Li-ion batteries:

- **Fire**: Li-ion batteries contain electrolyte, an ignitable liquid, and auto reignitions are common
- **Explosion**: this can result from the release of ignitable vapor/gases in a confined space
- **Thermal runaway**: a rapid self-heating fire that can cause an explosion
- **Toxic gases**: the first three hazards can produce irritating, corrosive or p c(n)]Tol-9 0ton

What we know

Electric vehicles on car carriers and within freight containers

The maritime industry continues to be concerned by fires on board vessels that are associated with Li-ion batteries

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Regardless of the cause, the fire conditions encountered on board a vessel at sea can be extreme.

- Use the optimal SOC for transportation, which ranges from 30% to 50%, depending on the manufacturer's recommendations and the length of the voyage
- Review the safety data sheet or data information card describing a process, and preventive actions to be taken in case of an accident
- All EVs should display clear and precise identification on the windshield detailing the battery type (e.g. BEV, PHEV, HEV)
- EVs with low ground clearance should be clearly labeled as this can present loading and discharging challenges arising from the vessel's ramps, inner slopes, or deck appendages
- All EVs with a Li-ion battery must have successfully passed pressure, temperature, crush, and impact tests as described in the UN Manual of Tests of Criteria – subsection 38.3 for transport of Li-ion batteries
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- There should be no charging of EVs during the passage
- All EVs must be properly secured to prevent any shifting during transport
- Seafarers should have enhanced training and awareness protocols on Li-ion firefighting techniques
- Early detection systems are critical, including watch-keeping and fire rounds, thermal scanners, gas detectors, heat and smoke detectors, and CCTV cameras.

What we know

Li-ion batteries in storage

Generally very stable, Li-ion batteries can store up to four times more energy per unit of mass than other batteries. As Li-ion battery technology improves, battery energy density has continued to increase, which heightens the risk and severity of battery failures. Large-format Li-ion batteries, such as those used in EVs, tend to ignite more quickly in a warehouse fire and present a higher hazard

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If batteries do not meet the above, protect as per FMDS 7-29, Scheme A.

As a precautionary measure, a steel bin partially filled with water should be kept outdoors at least 10 ft (3 m) clear of the building, ready for any packaged Li-ion batteries with elevated temperatures to be placed into by forklift truck. Other fire containment materials such as vermiculite or sand can be used to smother the affected battery. These measures might not stop the chemical fire continuing, even under water, but they will assist with fire containment. Packages placed in such a bin should be left untouched by employees of the warehousing company. The supplier of the batteries should be called in to deal with the battery hazard on site and remove it from the site safely for further assessment.

The chemistry in different types of Li-ion battery behaves differently in fire and this may have to be accounted for in the future, as battery technology is changing quickly. Future developments could include a solid electrolyte instead of a liquid electrolyte. With a solid electrolyte, mass and volume energy density will be much higher than that of current Li-ion batteries, with increased storage capacity and a higher temperature range. In addition, the fire hazard will be greatly reduced.

Summary

With quickly evolving technology and a lack of consistent regulation, evaluation of the risks of Li-ion battery usage will need to develop over time. In this bulletin we have not addressed the transporting of used (privately owned) vehicles with Li-ion batteries, for example, or the transporting of used/expired or waste batteries. As we experience the life cycle of this battery type, both will need to be further addressed.

If the maritime industry is to improve its incident record related to the transport of these battery types, all parties involved in the supply chain must understand the hazards involved, the most common causes and problems associated with transporting in commerce. The regulations, both US domestic (49CFR) as well as the international regulations (IMDG, ICAO), are specific in addressing Li-ion batteries to prevent most incidents but can only be effective if they are communicated and enforced. Only through a concerted effort by stakeholders in the supply chain can we hope to reduce the rate of incidents.

Further information and references

Definitions

Battery electric vehicle (BEV): BEVs are powered entirely by electricity, meaning a BEV has no internal combustion engine (ICE), no fuel tank, and no exhaust pipe. Instead, it has one or more electric motors powered by a larger onboard battery. Users charge the battery via an external outlet.

Battery state of charge (SOC) The battery‘s state of charge (SOC) refers to how much charge, or energy, is left in the battery. SOC is measured in percent, and it is the same measurement as a gas tank fuel gauge in a fuel-powered vehicle.

Hybrid electric vehicle (HEV): HEVs are the most common type of hybrid, and they have been around the loep.4 ()-14.8 (e)-12.72-19 ()-7.3 (13.8 (-18.3o14.7

All parties in the supply chain must understand the hazards.

Reference Sources

- Lithium Battery Guide for Shippers
  Lithium Battery Test Summaries (TS) (dot.gov)
  US Department of Transportation Pipeline and Hazardous Materials Safety Administration, September 2021
- USCGSA_0122.pdf
  US Coast Guard, Marine Safety Alert, Lithium Battery Fire, March 2022

Lithium-ion batteries risk bulletin

This is the second marine risk bulletin AGCS has published on the topic of lithium-ion batteries. The first, published in 2017, can be downloaded here

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