The risk of EV battery fires should not be downplayed

They can be hotter, more toxic, quicker to spread – and possibly more explosive. Most experts agree that lithium battery fires are different and that the risks for people on board are serious. The industry needs to align and collaborate more to address the issue.

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Lithium batteries and the potential fire hazard they pose in electric vehicles (EVs) during transportation by sea, have become a “hot topic” in the industry. Awareness is increasing, but discussions remain as to how risky this cargo really is. In this article, we give an overview of the main concerns and reasons behind them.

A rising trade

The rapid increase in demand for EVs is a game-changer, not only for the car industry itself but also for shipping segments involved in transportation. As far as we know, there is no research suggesting that EVs are more likely to catch fire than other vehicles. To the contrary, some research suggests that EVs are in fact *less* likely to catch fire than fossil fuelled cars. However, the significant potential for harm and damage when EVs are involved in fires on-board should be more than enough cause for concern.

Furthermore, it is important to consider the projections for ships carrying vehicles: Currently, EVs account for just over 4% of new cars globally. This number is expected to increase to 30% or 40% by 2030. This means that no matter how infrequent EV fires are, the law of averages is against us, and the industry and regulators need to accelerate and align their efforts accordingly.

A parallel could be drawn to the container shipping segment (although container shipping has additional challenges when it comes to regulations and mis-declared cargo). In this segment, we see a clear correlation between the rise in transported batteries and the increase in container fires. Charcoal has long been identified as the number one cargo causing fires in the container shipping sector, but there is a shift occurring, with lithium batteries now becoming the predominant source.

Why EV fires are different

Self-sustaining: The characteristics of a lithium battery fire are quite unique from a chemical standpoint. Unlike traditional fires, EV fires are self-sustaining and do not require external oxygen to fuel them. This is because the cathode material in the battery generates its own oxygen source, enabling the fire to persist for a long time, even in environments with limited external oxygen supply.

High temperature: Depending on circumstances, the temperature in a lithium battery fire can be considerably higher compared to other types of fires. This may present a variety of challenges in terms of access to the fire, escape routes, firefighting, and possibly more rapid spread of the fire on a vessel. Higher temperatures can also have an impact on the different materials onboard: for instance, aluminium will melt if exposed to temperatures of 700 degrees Celsius or higher.

Vapour clouds: Lithium battery fires emit toxic fumes, including lithium oxide, lithium hydroxide, and other hazardous chemicals. This poses a significant challenge for crew and fire-fighters. Additionally, lithium battery fires can release flammable gases like hydrogen. In confined areas like car decks, these gases can become trapped, creating an explosive environment that further endangers firefighting efforts and limits access to the scene and escape routes.

Firefighting methods: From the container segment, we have observed that extinguishing burning batteries in containers requires a significant amount of time and a large volume of water. Generally, it appears to be consensus that water is the best medium for extinguishing a battery fire but getting directly to the battery and the sheer amount of water needed is a challenge on-board as ship stability may be compromised. Furthermore, salt water has been reported to cause short circuits in EVs affected by flood water. Some ships have CO_2, some are looking at increasing CO_2 supply on-board, and some may have foam systems instead of water for firefighting. These mediums have their advantages and may be effective for suppressing fires but

may have limitations when it comes to extinguishing an EV fire that is self-sustaining for a long period. Foam and CO_2 also comes in a limited quantity, so once used up there is no more extinguishing agent left on the ship.

What starts a lithium battery fire?

Thermal runaway is a commonly used term in this context, but what does it actually mean? Essentially, it refers to a situation where a battery experiences a series of reactions that cause its temperature to rapidly increase, potentially leading to a fire or explosion. There are several factors that can trigger thermal runaway, such as overcharging or physical damage to the battery. Therefore, used EVs, damaged cars or waste batteries creates an additional concern. Additionally, if the battery design is flawed and the separators that keep the positive and negative electrodes separate fail, it can start a chain reaction. High temperatures can also initiate thermal runaway, which becomes particularly problematic if multiple electric vehicles are stored closely together, as fire can easily spread in such situations.

Fortunately, it seems there is consensus that thermal runaway is a rare event, particularly for new EVs. However, fires onboard ships will happen, and the risk of an EV battery being *involved* in a fire increases with the growing number of EVs carried on car carries and Ro/Ros.

We need a different approach

Based on the characteristics mentioned above, it is apparent that most firefighting methods can only suppress battery fires to some extent. Therefore, it is crucial to prioritize fire suppression, boundary cooling, and fire containment as effective measures for managing a fire until professional assistance is available. The safety of passengers and crew is of utmost importance, which means that the unique risks posed by lithium battery fires must be thoroughly addressed during training and when dealing with actual incidents on board. Routines for evacuation will have to be re-assessed, particularly for ferries.

Using fixed firefighting installations is always the preferred choice in terms of ensuring crew safety. However, existing systems may have limitations when it comes to EV fires, so additional control measures may be necessary, especially when it comes to early detection. Containing the fire before escalation should be a focus area through smarter systems and rapid response.

Many operators are already adopting additional control measures and the opportunity to share best practices across the EV carrying sector should not be lost. The industry, and more importantly, crew and passengers can ill afford to wait for regulation.

Higher demand, more concern for risk

Gard and the insurance sector still lack data to make meaningful and precise insurance statistics on EV fires. This lack of data is actually a positive sign, indicating that there are not that many incidents occurring. Moreover, ongoing investigations into recent cases mean that conclusions have yet to be reached in many instances. However, it is crucial to highlight that the current infrequency of cases does not translate to low risk: The number of lithium batteries present on-board any Ro/Ro or ferry voyage is steadily rising, and the potential for harm should be a concern for all of us.

Useful links and resources

- Lithium-Ion Batteries in Containers Guidelines (Cargo Incident Notification System, CINS)

- Lithium-ion battery fires: industry guidance and conference address risks (Gard)
- Lithium-ion battery fire risk (Burgoynes)
- DCV Safety Alert 02/2023 – Risks Associated with the Carriage of Battery Electric Vehicles (Australian Maritime Safety Authority, AMSA)
- Guidance on the carriage of AFVs in RO-RO spaces

  (European Maritime Safety Agency, EMSA)
- Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles (National Safety Board, US)
- Lithium Battery Guide for shippers (US Department of Transportation)