The risks posed by Lithium Batteries

DELIVERED BY DAVID HOLE ACII, CHARTERED INSURANCE PRACTITIONER

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nick thomas + associates

The Insurance Institute of Sheffield
Chartered Insurance Institute

Introduction/housekeeping

Welcome and thank you!

60 minutes webinar format – muted and video off. Q&A

David Hole

- Background in Insurance Claims and Complaint Management
- Subject Matter Expert for CII

Nick Thomas & Associates

- Up to the minute training solutions addressing the challenges of the modern insurance professional
- Technical insurance; sales, communication and soft skills; customer service; management and leadership; performance, resilience and wellbeing training

Objectives

By the end of the session, attendees will:

- understand what lithium is and why it poses such a growing risk for property underwriters
- be aware of the uses of lithium batteries
- be aware of best practice for use and storage of lithium batteries
- know how underwriters can counter the risks presented by lithium batteries

Introduction

- The increasing pace of transition away from fossil fuels to cleaner forms of energy is presenting an increasing risk to property insurers.
- A key element of this transition is the use of lithium-ion batteries
- Initially mass-produced in the early 1990's they now have numerous domestic and commercial applications
- However, lithium can be a volatile substance, and it's use in batteries is not without risk.

Introduction

The increasing pace of transition away from fossil fuels to cleaner forms of energy is presenting an increasing risk to property insurers.

2023 Saw a 43% increase in lithium battery fires in the UK

Lithium

Lithium batteries have been in use since the early 1990s and are now used extensively in both residential and commercial premises

They are used in laptops, electric vehicles, scooters, phones, power tools etc

In 2023, the London Fire Service identified lithium batteries as posing the most significant emerging risk of causing fire damage

Lithium is a form of alkali metal – it is surprisingly soft and can also be used for rocket fuel and even psychiatric drugs and whilst lithium will ignite if exposed to water, lithium-ion cells do not.

Lithium

In common with all alkali metals, lithium is highly reactive and flammable

It is nonetheless a very attractive medium to store energy

A lead-acid battery (that featured in conventional cars), whilst they store much energy, they are heavy and large when contrasted with a lithium-ion battery

Whilst early uses of lithium–ion batteries were confined to small devices, they have developed to power much larger tools/vehicles

Lithium-ion cell failure

It is important to stress that the vast majority of lithium-ion cells will fail over time and this is generally a benign process.

However, some consequences are less benign, namely when the is some form of energic failure causing “thermal runaway”

Why do they fail?

There can be numerous reasons and contributory factors

- Poor design and manufacturing - chemical composition of the cell can be at fault or where the battery is not sufficiently watertight for external use
- Abuse by the end user – careless (dropping, impacts etc), not allowing batteries to cool where recommended, not using the appropriate or recommended charging equipment or replacement batteries, using the batteries in inappropriate environments for which they are not designed, sometimes bypassing the battery management unit (BMU) which negates any safeguards it may have
- There have been instances where mobility scooters or cycles have had a motor upgrade which can cause incompatibility with the supplied chargers

Lithium-ion cell failure

- Begins if heat generated exceeds that dissipated
- Internal cell temperature and pressure increases
- Gas begins to vent from the cell
- Gas ignites
- Cell contents ejected
- Thermal runaway propagation – one cell failing damages others leading to other cell failures
- Contents of cells react exothermically (the release of heat and energy to surroundings)
- This can cause a very intense fire to take hold very quickly

Fighting the fire

Internal controls aim to restrict voltage and current to prevent runaway but once the process begins, those controls are ineffective

Fire fighting needs to not only deal with the resulting flames but also to cool the offending cells to arrest the runaway process

Frequently the packaging of the battery limits the ability to reach and cool the cells

The gas produced is toxic and can be conductive so causing other electrical failures and significant health hazards

Emissions are not limited to gases and can include other particulate matter.

Subsequent fire can develop even after the initial blaze is extinguished

Investigating fires

Ensuring site safety is paramount when investigating an incident

There tends to be an assumption that because a fire involves an items powered by a lithium battery pack, this must be the cause

Sometimes battery cells can be ejected from the pack and fly across a room – this may lead to multiple seats of fire and the assumption that it may have been set deliberately

Whilst other cells may have been damaged in the initial fire, they may enter a state of thermal runaway later, increasing the hazards of fire investigation

Identification marks are often obliterated by the fire making identification of any faulty battery pack problematic

Lithium-ion protections

In the cell battery, device and charger there will be:

- Over-temperature detection
- Over pressure prevention
- Short-circuit protection
- Overcharging protections – both current and voltage
- Over discharge protection (automatic cut off when battery energy levels are too low)
- Charging monitoring
- Cell balancing (perhaps when an individual cell become weak and suffers over-charging in contrast to other cells

Safety Standards

Lithium-ion batteries are classified as dangerous goods

United Nations Transportation testing includes:

- Vibration
- Impact
- Altitude
- Thermal
- Short circuit
- Forced discharge
- Overcharge

Electrical Vehicles

Sophisticated monitoring devices:

“Negotiation between charging devices and batteries that manage the charging process to prevent overcharging between cells and active cooling where necessary, .

One problem lies in the location of the batteries which are at the bottom of the chassis which can inhibit access for fire fighters where a fire occurs

Some Evs remain active even when not in use (sensors, security devices etc) and especially when a vehicle is brand new, the battery pack takes time to properly form and charge effectively

Electrical Vehicles

- There was a 33% increase in EV fires in 2023 to 113 however, with over a million such vehicles on UK roads, this is relatively insignificant
- Over one third of such fires were established as being due to the charging of e-bikes
- Fires involving e-buses and e-trucks are also increasing

Overall lithium battery fires have increased fourfold over the last five years, killing 8 and injuring 130 people.

Best practice

Residential premises

- Landlord should be encouraged to provide external storage and charging facilities for e-bikes, scooters etc
- Such storage facilities should be kept free of combustible materials
- An automatic fire alarm should be installed (ideally a carbon monoxide alarm as well)
- Where batteries can be removed from e-bikes, this should be encouraged when stored
- Prevent e-bikes/scooters being stored in communal areas in buildings which may be used as a fire escape

Best Practice

Commercial Premises

- Batteries should be handled in well-ventilated areas (avoidance of excessive heat and humidity)
- Inspect all batteries delivered for signs of damage and if in bulk, a thermal inspection to detect signs of anomalies
- Quarantine any batteries visibly of suspected as being damaged a safe distance from any building.
- Quarantined batteries should be returned to the manufacturer regularly for disposal
- Careful handling of batteries
- Use only recommended battery chargers and in a separate building which is a safe distance from other buildings (10mtrs recommended)

Best practice

Lithium battery fires should be tackled by professional fire-fighting services

Where stored in bulk, professional advice should be obtained to deal with contaminated run-off following a fire

Lithium-ion battery fires, even small ones, may overwhelm sprinkler systems so effective containment and evacuation procedures are necessary

Underwriting

For owner-occupied residential premises, a greater incident of battery related fires will no doubt see premium rates adjusted however, it would be greatly difficult to exclude such fires and education of the risks is probably the best precaution that can be taken.

Residential landlords may be obliged to implement the previously mentioned precautions however, an absolute insurance of compliance by their tenants may be too onerous to take the form of any condition precent to liability. Nonetheless, such fires tend to be more common within residential properties.

It is more realistic to impose such measures on commercial premises and to make compliance a condition precedent. However, to date not much has been done to differentiate between fires caused in this way and other fires.

Underwriting

There is no doubt that using and storing lithium-ion batteries in bulk is material to the considerations of the underwriter and should be referenced in any risk presentation

Summary

Lithium-ion batteries can be found everywhere, and most are used without incident

There are greater demands to develop larger and more energy efficient batteries, but chemistry developments tends to reveal that there is a trade off between safety and energy capacity

We must be cautious not only with use but also disposal – many waste management sites are suffering fires due to careless disposal.

Standards, education and safety have an important role in ensuring safety.

Useful links

British Safety Council : MC243_Battery-storage-guide-v3.pdf

Fire Protection Association

Need to Know Guide RE2 - Lithium-ion Battery Use and Storage.pdf

Objectives Revisited

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Thank you! Questions?

Contact:

Email: nick@nickthomasassociates.co.uk

Website: www.nickthomasassociates.co.uk

LinkedIn: https://www.linkedin.com/in/nick-thomas-64046113/

LinkedIn Company: https://www.linkedin.com/company/nick-thomas-associates/

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