



Lithium-ion batteries: storage safety

Recommendations for safely storing Li-ion batteries

Lithium-ion Battery Safety Methodology

Authors:

Suzanne Van Poppel – Flanders' DRIVE

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References

Documents from the 'Recharge Li-batteries storage safety – Working group meeting 1/07/2014'

1. Introduction

This document gives recommendations and guidelines on safely storing lithium ion batteries and on fires protection and management.

The guidelines are based on information from Recharge Li-batteries storage safety – Working group meeting 1/07/2014.

2. Risks of new batteries, separate and mixed waste in storage

2.1 Information

The risk depends on the type of product in storage. The less dangerous categories are new products in their packaging and the mixed consumer waste¹ batteries containing less than 5% Lithium batteries. A more dangerous category is the sorted Lithium batteries waste. The most dangerous category is damaged batteries, especially damaged packs. Next to higher risk on thermal propagation they can leak.

More incidents happen in the take back flow than in the manufacturing. Reason is that more companies are active in the take back flow and that on the manufacturer side knowledge and information is available for each battery type. In recycling Li-ion batteries cannot always be identified by the label (label can be removed during handling, production, ...).

For Lithium ion batteries a thermal runaway is rarely started without a external trigger. It is more common that a hot spot occurs due to a short circuit. This short can ignite plastics and lead to a primary fire. It is this fire which heat up the cells and thermal reaction in the cell will starts leading to the thermal runaway. Measures can be taken to avoid short circuits and hot spots.

It is seen that a big part of the incidents occur after moving the batteries. Collectors and recyclers therefore put a 'timely watch' on moved batteries (example: check temperature every hour for 24 or 48 hours).

It is advised to store damaged electric or hybrid vehicle outside. A situation is known where the battery pack of a EV caught fire 2 days after the accident. When a crash happened, an evaluation of the (history) of the car is needed. Input from the pack producer is necessary to evaluate all the risks and effect of the crash. If evaluation shows that it is safe to remove the pack out of the vehicle this can be done. Information about how to handle these situations should be given in the "Battery training manual".

¹ Definition of waste: everything which follows the path to the recycling plant. These can batteries used by consumers (end of life) but also scrap from production plants.

2.2 Recommendations

The following recommendations on storage facilities, packaging and handling leakages can be defined:

1. Different type of products (new, waste, damaged) should be clearly segregated in the storage area.
2. The storage area should be waterproof.
3. The conditions in which the products are stored should be adapted to the risk they present. Examples: sacrificial buildings² to store sorted or damaged Lithium batteries, dividing the storage area in compartments which have individual smoke detection and sprinklers systems to rapidly detect a fire and prevent propagation.
4. There is a need to specify and control the packaging/protection for the more dangerous categories. At this moment a good practice are:
 - a. Package scrap batteries like new ones.
 - b. Cover damaged batteries with sand for storing and shipping.
 - c. Place sorted rechargeable batteries in metal drums of 210l with liner and after every 10cm a layer of vermiculite
5. Leakage can be recognized by the smell (soapy smell). If possible a leaky cell can be placed in water for neutralization during 6 months, this need to be done in an open atmosphere. Note that this can only be done when the company has the knowledge on this type of reaction process and when it is professionally controlled. This way of working has also technical drawbacks for complete packs.
6. Measures can be taken to avoid short circuits and hot spots leading to primary fire and thermal reactions.
7. Monitor the temperature of the batteries after there are moved more frequently.
8. Store (H)EV which are involved in a crash outside.

² Example: place damaged batteries in sea containers which located further away from the building. In case of a fire, only the containers, and not the building, are damaged.

3. Fire protection and management

Protection and intervention depends on local circumstances. Some recommendations are proposed which are generally applicable:

- A fire of waste batteries should not be treated differently than a fire of new batteries. The chemical decomposition defines the effects of the fire. This is the same for new and waste batteries.
- It is recommended to have dedicated document to give information to the rescue and emergency services about the batteries stored in the facility. Kurt Vollmacher has, together with Recharge, defined a template 'Lithium-ion batteries in a storage facility'.
- Organize a proportional intervention plan with the professionals on the site being in charge of assessing and deciding on the intervention level. This is a determining factor to succeed in early intervention.
- Reduce the risk of fire ignition:
 - o Adapted process controls (monitoring temperature of moved batteries, avoid hard drops of products in drums)
 - o Use detectors like very early smoke detection alert, thermal cameras
- Organize early intervention:
 - o Possibilities to control small fire for the specific local circumstances. This can be:
 - Immersion of small objects in water
 - Non-flammable blankets, extinguisher can be used to (temporarily) extinguish small flames. This provides enough time to move a pallet to an insulated place where further extinguishing systems can be used in large quantities (water, sand, ...)
 - o Early intervention can only be done if the safety of the intervention team is ensured. The following criteria need to be fulfilled:
 - The team has the general knowledge and understanding of the situation
 - The vision is acceptable and the team has breathing apparatus
 - The risk of ejection of projectiles from the burning material is limited.
 - An area is available at short distance for further actions, visual control and monitoring.
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- Fire brigade intervention:
 - o The main way to control a large fire is with the use of large amounts of water. The decision to use large amount of water depends nevertheless on the local circumstances.
 - o Insurances recommend generally sprinkler systems
 - o Good ventilation is recommended to evacuate fumes, allowing an easier intervention.