Jauch
THE PULSE OF PROGRESS

SAFE HANDLING OF LITHIUM BATTERIES

JAUCH DEVELOPS

OVERVIEW

CONTENT

For the development, production and transport of lithium ion batteries, many laws and regulations from global, European, and national legislation must be taken into account. Jauch Quartz offers comprehensive support and advice throughout the entire project phase.

Lithium is the key raw material for the production of lithium batteries, which are used in smartphones, laptops, electric vehicles, and many other devices. The demand for lithium will continue to increase in the coming years.

To date, lithium deposits have mainly been found in the so-called ‘lithium triangle’, between Bolivia, Argentina, and Chile. For Germany and many other European countries, this means that 100 per cent of the valuable raw material has to be imported. However, this dependency entails a number of risks, particularly in terms of supply chain stability and geopolitical tensions. For this reason, intensive efforts are being made to extract lithium in Germany as well:

Lithium is extracted from geothermal sources in the Upper Rhine Graben and the North German Basin. Compared to mining in the salt lakes and mines of the lithium triangle, this type of extraction is considered environmentally friendly and is to be further expanded in the future.[1]

The constantly strong demand for lithium-based batteries and the challenges in the global mining of this salt described above reflect the major issues that producers of lithium-based cells have to overcome. [2]

In the further development of battery-powered products that rely on a lithium energy source, there are also a wide range of requirements that need to be taken into account during development:
What challenges do manufacturers of battery-powered products and battery assemblers face in the design-in, production and transport of lithium ion batteries?

Lithium technology

The advantages speak for themselves: lithium has a much higher energy density and voltage than previously used materials. The application can therefore be operated for significantly longer or with more power, and the batteries are significantly smaller with comparable performance data. The higher number of charging cycles and the long service life of the battery also speak in favour of using this technology. However, due to the higher energy density, the use of lithium ion batteries also harbours higher risks in terms of both the production of the battery and the transport of the battery or the end product including the battery and its use.

1) https://www.deutschland.de/de/topic/wirtschaft/lithium-deutsche-rohstoffpartnerschaften-und-eigene-foerderung
2) https://www.enbw.com/unternehmen/themen/elektromobilitaet/lithium-umweltfreundlich-gewinnen.html

Cell manufacturing

Intrinsic safety is a critical consideration during cell production: this begins with selecting the appropriate anode and cathode material for the application. In some cases, multi-layer separators with specific functions are used, which melt at approx. 130°C and interrupt the ion flow. Alternatively, cells may be manufactured with a PTC (positive temperature coefficient) device. There are also 'predetermined breaking points' in the housing, which allow gas to escape in a controlled manner in the event of gas formation, preventing explosions.

Assembly

Lithium ion batteries are protected against deep discharge, external short circuits and overcharging by an electronic protection system. Additional functions in the protection electronics transform a simple battery into an intelligent battery:
Features such as cell balancing and communication via SMBus and I^2C can be integrated into the battery management systems. The design of these electronics must be adapted to both the battery itself and also to the application, to ensure that the device operation is not disrupted while maximising safety.

Mechanical stability should not be forgotten: the arrangement of the individual lithium ion cells and the correct assembly are responsible for ensuring that the battery pack is robust and therefore offers the greatest possible safety.

Quality management system

To ensure process reliability, every battery manufacturer worldwide should operate according to a quality management system. This guarantees that individual samples and entire series of batteries are manufactured to a consistently high quality. The globally applicable UN38.3 transport test now makes this mandatory, applying not only to the cell manufacturers, but also to the battery pack manufacturers.

Tests and certifications

As early as the design-in phase of the end product, it is important to work with a battery assembler who understands the opportunities and risks and monitors the manufacturer's project from a battery perspective. This involves advising the manufacturer not only on safety and battery performance, but also on legal requirements, the transport of the end product and the special features of individual industries in which the product is used. In addition to the UN38.3 transport test, there are other tests, some mandatory and some optional, which are not standardised worldwide. Ensuring safe regulation of these tests is a significant responsibility for the manufacturer, which can only be solved together with an experienced battery assembler.

Transport tests

The UN38.3 transport test is the mandatory transport test of the United Nations. Successful testing is a global prerequisite for a lithium cell or battery to be transported by road, rail, sea or air. During this test, basic potential hazards posed by the battery are checked with regard to transport safety: For example, the battery is subjected to mechanical tests, thermal changes and tests for reactions to overcharging and short circuits is tested. Further regulations (ADR, IATA, RID, IMDG) on shipping with the various modes of transport also dictate which special regulations must be observed during transport and how the batteries must be packaged.

Industry-specific tests

As a rule, these are safety tests that go beyond the requirements of the UN test. Tests are carried out on the cell and/or the battery to confirm safety beyond the typical transport hazards.

If a product is sold in the USA, the cell may require testing to UL1642 and the battery to UL2054 (or other UL standards), which are conducted in accordance with Underwriter Laboratories' specifications.

If global market access is the aim, a CB procedure makes sense. The final CB report is now accepted in 53 participating countries and can either be used directly or converted into national test marks without further testing. It is based on the standards of the International Electrotechnical Commission (IEC), the standardisation body for electrical engineering.

The use of the product in special industries requires further optional tests. In medical technology, for example, various certifications are mandatory to ensure special product safety in or near humans.

Tests for special requirements

If the product is used in potentially explosive atmospheres, a test for use in such environments must be carried out with the device, including the battery. Not every cell is suitable, as all hazards must be ruled out. Here too, the experience of the battery assemblers, who have already supervised similar projects, can be invaluable.

Legal requirements

To summarise, it should be noted that a large number of laws and regulations from global, European and national legislation must be observed in the development, production and transport of lithium ion batteries. Finally, in the European Union, care must be taken to ensure that the battery fulfils the requirements of CE conformity. This is because the new European Battery Regulation imposes numerous of new regulations on battery manufacturers, which are designed to ensure overall safety and sustainability. Compliance with these legal requirements should be the foundation of every battery assembler's work. The necessary, whether mandatory or optional, certifications should be developed together with the manufacturer during the project phase and can be carried out by the battery assembler.

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