Safe handling of lithium batteries

For the development, production and transportation of lithium ion batteries, many rules and regulations from global, European and national legislations have to be complied with. Jauch Quartz offers comprehensive advice and support throughout the entire project phase.

In the current "Federal Government Report on Research and Innovation", the Federal Ministry for Education and Research (BMBF) has, once again, stressed the major importance of lithium technology to reinforce Germany as a high tech location. The German Ministry specifically highlighted the current "Innovation Alliance Lithium Ion Battery LIB 2015". Within the Innovation Alliance LIB 2015, an industrial consortium has committed itself to invest 360 million Euro in lithium ion battery research and development. The BMBF will, at the same time, allocate 69 million Euro for this area.

Also in scientific and technological cooperation with the US, the BMBF named research in the areas of lithium sulphur batteries and lithium air batteries as important new fields of cooperation.

The strong demand for lithium based batteries reflects the above-mentioned development: more and more producers of battery-operated products are focusing on energy sources with lithium ion technology. But what challenges do producers of battery operated products and battery assemblers face at design-in stage and during the production and transportation of lithium ion batteries?

Lithium technology

The advantages speak for themselves: Lithium has a much higher energy density and voltage than any material used up to now. Thus, it can be used for a much longer time or at a higher power. The batteries are considerably smaller than others with comparable performance data. The higher number of charge cycles as well as the extreme durability of the batteries argue in favour of the use of this technology. However, due to their higher power density, the use of lithium ion batteries also carries a higher risk. This affects the battery production as well as the transportation of the battery as well as the finished product respectively, including the battery and its use.

Cell production

Intrinsic safety is an issue even at the cell production stage: This begins with the choice of suitable anode and cathode material for the application. Multi-layered separators with shut-down function are partially used. These melt at about 130°C and interrupt the ion flow, or the cells are already produced with a PTC. In addition, predetermined breaking points are located in the housing. In a case of gas formation, these enable a controlled leakage of gas before an explosion occurs.

Furthermore, an integrated protection unit safeguards the lithium ion batteries against deep discharge, external short circuits and especially against overcharging. Additional functions of the integrated protection unit turn something simple into a smart battery: Cell balancing and communication via SMBus and I²C can be integrated into the battery management systems.

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Assembling

We shouldn´t forget the mechanical stability: The layout of the individual lithium ion cells and correct assembling are responsible to provide the highest possible level of safety of the battery pack.

Quality management system

Every battery producer worldwide should work towards a quality management system for process safety reasons, to guarantee a consistently high quality in the production of single samples and complete series of batteries. In the meantime, the globally applicable UN38.3 transportation test has made this management system mandatory. This affects not only the cell producers but also the assemblers.

Tests and Certification

Even at the design-in stage of the finished product, it is important to collaborate closely with a battery assembler who understands the opportunities and risks involved and can keep a sharp eye on the producer´s project from the battery prospect. This means not only advising the producer on safety and battery performance but also offering guidance on statutory requirements, the transportation of the finished product and also the specific particularities of individual sectors where the product will be used. Apart from the UN38.3 transportation test, there are further, in part obligatory tests but also optional ones which are not uniformly in force worldwide. Regulating this presents the producer with another very responsible undertaking, which can only be met together with an experienced battery assembler.

Transportation tests

The UN 38.3 transportation test is the mandatory transportation test of the United Nations. Successful testing is a worldwide requirement to allow a product to be carried by road, rail, sea or air. This test checks any underlying potential hazards associated with the battery: The battery for example, is exposed to mechanical or thermic changes and its reaction to overcharging and short circuit is being tested. The supplementary rules (ADR, IATA, RID, IMDG) about shipment with various modes of transportation also control which special provisions regarding transportation have to be complied with and how the batteries are packed.

Sector-specific tests

These are basically safety tests, in addition to the requirements of the UN testing, that are conducted on the battery in order to verify its safety beyond the typical risks of transportation.

When a product is distributed in the US, the cells could require testing in accordance with UL 1642 and for the battery according to UL2054 (or other UL-standards), which are carried out according to the specifications of Underwriter Laboratories.

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For worldwide market access, a CB-procedure could make sense. It is completed with the CB-report, which is accepted in 53 participating countries and can either be used directly or at least, without additional tests, be converted into national certification marks. The CB-scheme is based on the standards of the International Electronical Commission (IEC), a standardization body for electrical engineering.

The IEC 62133 is a certification procedure of the International Electrotechnical Commission (IEC), a standardization body for electrical engineering. As with UL 1642, here, additional detailed testing beyond the requirements of the UN testing is conducted on the battery in order to guarantee its safety.

The use of the product in special industry sectors requires additional testing. For example, medical technology demands various certifications to ensure that the product in use on or in the human body fulfils all additional safety requirements.

Tests for special requirements

If a product is intended for use in potentially explosive atmospheres, the complete device including battery must pass a certification for the usage in explosive environment. Not each cell is suitable - any danger has to be excluded. Again, the experience of the battery assembler working on such projects, helps.

Statutory requirements

To conclude, today numerous laws and directives from global, European and national legislations relating to the development, production and transportation of lithium ion batteries must be observed. Finally, in Europe, the conformity of the end-product (or of the battery, when sold as a spare part) to the CE-regulations, has to be ensured.

The compliance with these statutory requirements should form a working basis for every battery assembler. The essential, in other words, mandatory or optional certification, should be prepared, together with the producer, during the early stages of the project and can be undertaken by the battery assembler.

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