Production proven & tailor-made vacuum solutions for Lithium Ion Battery

Vacuum technology is relevant to the quality and safety of various steps in the production of lithium-ion batteries. We at Leybold have been supporting manufacturers of lithium-ion batteries in their processes and technological challenges for many years and, as such, have been heavily involved in the development of electric mobility.

Vacuum technology is used in various process steps in electrode manufacture as well as in research and development. As such, Leybold works closely with machine and plant manufacturers who supply battery manufacturers with production plants. Additionally, Leybold cooperates with battery manufacturers as well as with institutions that conduct research to further develop battery technologies.

The presentation will give guidance how battery producers can achieve highest production yield and lowest operation costs by utilizing Leybold's production proven, most energy efficient and highly reliable vacuum solutions. Leybold offers as well standardized products as also vacuum systems tailor-made for specific usages. Users can benefit from Leybold enormous progresses towards energy-efficient pumps which can significantly reduce their power bill.

Development increasing in Europe

Up to now most of the production continues to take place in Asia. However, from 2021 on the investments in new LIB production sites in Europe will pick up as most of the well know battery producers announced in detail their European expansion plans.

Vacuum technology is used in battery cell production as well as in processes such as the application of active materials to electrodes. In general, air is a disturbing factor in many production environments because its gas molecules and contained particles have a negative influence at most production steps, sometimes even making these impossible.

- When mixing the electrode slurry, particle contamination and the inclusion of gas bubbles must be avoided in order to achieve a high-quality product. Most mixers, therefore, work under vacuum.
- Vacuum is also essential during the drying stage to remove even the smallest remaining amounts of solvents and moisture. Without vacuum, the drying process would need to be carried out at much higher temperatures, would last much longer and would require more energy. Such would have a negative effect on the electrode quality.
- As soon as electrolytes are incorporated into subsequent process steps, vacuum takes on a safety aspect, since many of the electrolytes used are highly reactive and inflammable.

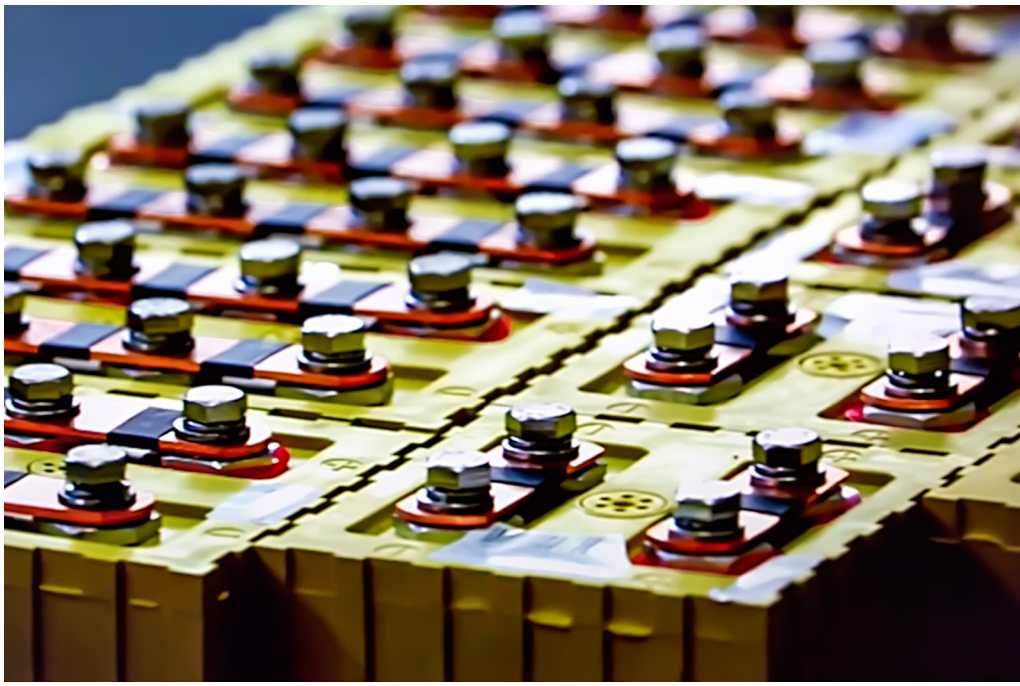
High-quality vacuum is essential during most production steps. On the one hand, it lends purity to the process so that no particles or moisture can enter the cell, e.g. during electrolyte filling and degassing. On the other hand, it provides a low-reaction environment without oxygen or humidity with which the electrolyte could react.

Opportunities for improvement exist in many areas, as there are still no established processes which have proven to be that efficient that they are utilized everywhere. Most producers use their own processes, which could differ greatly from other producers.
Vacuum drying, for example, is a customer-specific process of pressure, temperature and process gases (such as nitrogen). In order to achieve high-quality drying results through the aid of vacuum drying, industry-related research projects are already being conducted under the direction of the VDMA.

Leak detection also plays a central role in production from a safety perspective. The cell must be 100% leak-proof in order to ensure a long battery life and hazards by leakages of flammable electrolytes. A valid leak test can only be performed via a vacuum leak detection system. Even the smallest leaks can be detected with the aid of a helium leak detector or mass spectrometer. On the other hand, undetected leaks greatly shorten the battery's service life and/or lead to highly reactive electrolytes escaping.

Dry pumps save time and money

While mostly oil-sealed vacuum pumps have been used in the process of electrolyte filling and degassing in the past, more and more of them are now replaced with dry-running vacuum pumps. Using dry-compressing pumps as the Leybold DRYVAC or VARODRY, battery manufacturers save time and money as their cost of ownership is clearly lower as that of oil-sealed pumps.



Some components of lithium-ion batteries that are treated in a vacuum are toxic. In order to protect the environment and the vacuum technology from pollutants, the vacuum pump must have the ability to withstand such challenges. Such toxic materials must be confined within the process and discharged in a correspondingly safe manner.
In order to ensure sufficient process reliability when handling toxic gases, hermetically sealed, dry-running vacuum pumps are used, which prevent even the smallest quantities of gas from escaping. This is an important factor, especially in the case of toxic electrolytes, where occupational safety is also important. Oil-sealed vacuum pumps are challenging in such applications, as the pump oil will be contaminated and could potentially leak out into the environment.

Faster and more reliable with vacuum technology

Vacuum technology is essential for mixing, drying, electrolyte filling, degassing and leak testing, but is also utilized in less demanding application as vacuum gripping or packaging.
Modern vacuum products do not only help you to bring your production up to speed with highest uptime but plays also an important role in terms of safety, e.g. enabling the safe handling of toxic electrolytes. Also in the future we will see that production of Li-batteries will only be possible under vacuum conditions.