



# VACUUM FOR ENERGY STORAGE

## Part 1: Solutions for lithium-ion batteries

An ever increasing demand for quickly available and cost-effective energy worldwide stands opposite the issues of climate change and growing environmental awareness in our society. As a consequence, the demand for improved technologies in the field of energy storage, especially with regard to regenerative energies, is ever rising. This development is a major booster for developing new technologies and innovative production processes in this area. The diversity of the particular applications thereby lets new technologies face various challenges. Depending on the time the energy needs to be stored, and the number of according charges and discharges, different technologies are to be considered – but all of them have one thing in common: they essentially depend on vacuum technology.

### Vacuum technology in lithium-ion batteries

One of the most well-known energy storage devices are lithium-ion batteries. Behind this generic term stands a broad combination of materials for anodes, cathodes, and separators as well as different battery shapes like flexible Pouch cells and rigid cylindrical and prismatic cells. Lithium-ion batteries are used in a vast variety of end products that require lasting energy storage. Thanks to their light weight and high energy density, they are especially popular with mobile devices such as smartphones, tablets, or laptops. Regardless of their type, several of the production steps for the batteries require vacuum technology.



Figure 1: Lithium-ion batteries are used in mobile devices such as smartphones, tablets, or laptops

A usual lithium-ion cell consists of an anode, a cathode, a separator, and the electrolyte. These cells are arranged within a packaging. The tightness of these enclosures is highly important as the electrolyte can strongly react with humidity. For this reason, the batteries are leak tested before they are filled with electrolyte (cylindrical and prismatic cells are welded). To ensure an exact and high-quality leak detection process, helium leak detection with its high sensitivity and repeatable results is predestined for this application (see Figure 2).

#### Pfeiffer Vacuum leak detectors for tightness tests of batteries

With 50 years of experience in leak detection, Pfeiffer Vacuum's broad product portfolio holds the optimal leak detectors for testing the tightness of lithium-ion batteries. Dedicated solutions are available for either research laboratories and prototype manufacturing or the industrial production of batteries. Latter often require fast, automatic leak detection. Modular leak detectors, which can easily be integrated in automated systems, are optimal for this process while research institutes might prefer versatile multipurpose devices.

#### Solutions for generating vacuum in the battery production process

Vacuum is also needed in other steps of the battery manufacturing process (see Figure 2): As humidity inside the battery must be prevented, it has to be taken care that the components are dry before they are assembled. This also applies to the electrodes which are produced as foil material and wound up. The coils are dried under vacuum. In order to achieve a low level of residual moisture, the pressure is reduced to a level below 1·10<sup>-1</sup> hPa while heat is constantly supplied to the coils. When filling the cell with electrolyte, vacuum is crucial as well. It prevents the moisture from entering into the cell and helps to avoid undesirable gas inclusions within it.

Pfeiffer Vacuum offers the matching pumps for each of these production steps: Dry compressing pumps using multi-stage Roots (A4H series) or screw (HeptaDry) technology. The latter can easily be combined with OktaLine Roots pumps in order to achieve high pumping speed. Without these elaborated vacuum solutions, the high-quality and lasting energy storage with lithium-ion batteries and thus the function of mobile electric devices would not be possible.

Are you looking for an optimal vacuum solution?  
Please contact us!

## Electrode production

### Electrode drying

- Dry compressing pumps to keep your process clean.
- Rugged design with high water vapour capacity.
- High and stable performance to support a constant drying process at a low pressure.



**A4H**  
Multi-stage Roots pumps

Mixing of slurrys

Coating

Drying

Calendering

Slitting

Vacuum drying

## Cell assembly

### Leak integrity test

- Flexible modular designed leak detector of the latest generation.
- Easy to integrate in leak detection systems due to configurable interfaces.
- High Helium pumping speed to allow fast response time.

**ASI 35**  
Leak detector

Separation of sheets from coil

Stacking / winding

Joining and packing

Electrolyte filling



### Electrolyte filling

- Dry compressing pumps to keep your process clean.
- High pumping speed at the complete pressure range to keep process time at a minimum.
- Low final pressure to reduce the amount of residual gas.

Figure 2: Pfeiffer Vacuum provides the optimal vacuum solutions for the production processes of lithium-ion batteries.

## **VACUUM SOLUTIONS FROM A SINGLE SOURCE**

Pfeiffer Vacuum stands for innovative and custom vacuum solutions worldwide, technological perfection, competent advice and reliable service.

## **COMPLETE RANGE OF PRODUCTS**

From a single component to complex systems:

We are the only supplier of vacuum technology that provides a complete product portfolio.

## **COMPETENCE IN THEORY AND PRACTICE**

Benefit from our know-how and our portfolio of training opportunities!

We support you with your plant layout and provide first-class on-site service worldwide.

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perfect vacuum solution?  
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