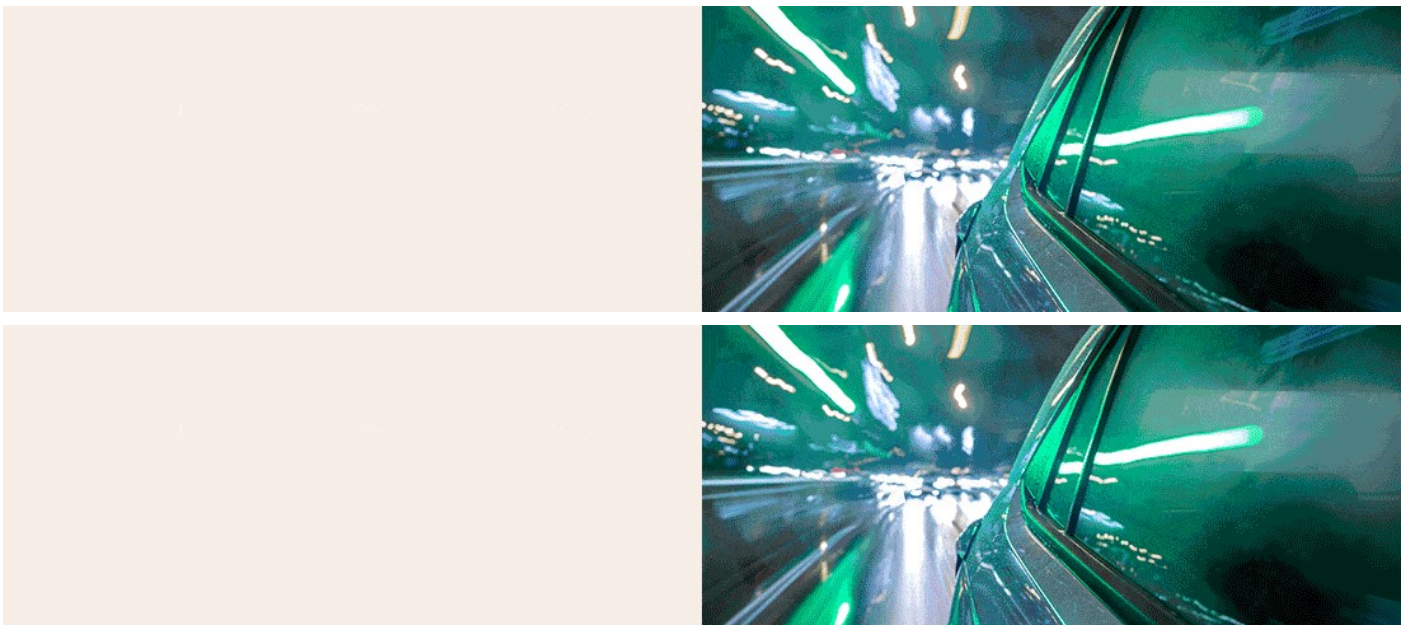




Precise And Automated Filling Machines for Capacitor & Cell Filling



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Electric Vehicle Battery Technology

Precise And Automated Filling Machines for Capacitor & Cell Filling

Ralf Hock

We want to support the trend toward greener batteries to drive e-mobility and other sustainable trends in the near future.” states Ralf Hock, managing director of **IP PowerSystems**.

To achieve this goal, the company did a lot of research on its own and in cooperation with many well-known institutes in Germany like IKTS,

Frauenhofer IPA, Meet Münster and RWTH Aachen. The results were further developed and engineered by IP PowerSystems for advantageous electrolyte filling equipment that is used by customers like BMW and Varta.

Filling machines for all types of lithium-ion battery cells

Using the R&D results as well as trend forecasts, we recognized the rising demand for flexible, precise and automated filling machines.

The company's recent developments include an electrolyte filling machine for hard case battery cells. The unique feature of this machine is the variety of filling options: Thanks to filling modules with different adapters, all kinds of battery cells such as cylindrical or prismatic of varied sizes can be filled on the same machine. Further modules can be added up to the capacity limit (4 or 10 modules) of the machine chosen.

In addition, it has also engineered an electrolyte filling machine for pouch cells with a scale to precisely measure the amount of electrolyte filled. The vacuum chamber enables a short evacuation time, and the gas bag is sealed during the process.

Both these technologies offer a high filling accuracy, traceability, quick homogenous wetting, and high flexibility for the cell types and sizes.

In its drive for greener batteries and flexible cell assembly, the company has invented an innovative technology to fill pouch cells enabling smaller dry rooms, less waste and lower costs.

Smart Battery Innovation – a novel port technology

This innovative technology arose from an in-house R&D project whose aim was to find an efficient and eco-friendly alternative to the conventional production of Li-ion battery cells. Now, for the very first time, electrolyte filling at ambient atmosphere without a dry room is possible. The innovative technology "Method for producing electrolyte pouch cells for electric battery arrangements, corresponding device and electrolyte pouch cells ", international application number WO 2016/198145 A1 is filed for patent.

The novel, patented technology also includes a production process starting with the cell assembly and final sealing before the filling step. The assembly of the cell components – i.e., the electrode-separator-stack with welded-on tabs and the pouch foil – is completed similarly to the conventional production but hermetically sealed. Additionally, closed filling plugs – so called ports – are integrated within the seam of the pouch cell for the sealing process, which can be performed in a dry microenvironment. The sealing machine executes the complete and hermetical sealing of the cell. Due to this novel technology no



Electrolyte Filling Machine

special dry/clean atmosphere is needed for the next steps in the process.

Electrolyte filling process of Li-ion pouch cells with ports

Subsequently, the hermetically sealed, dry pouch cell is transported to the filling machine under ambient atmosphere. The number and position of ports can be adapted to the required cell size and electrolyte quantity. Access into the cell is realized by penetration of one or multiple ports by dosing needles. All needles are designed for both drawing vacuum and / or injecting electrolyte, enabling a wide range of filling strategies for enhanced and faster electrode

wetting. The technology provides the opportunity to reduce process time and hence production costs. After filling, the ports are sealed off by sealing clamp jaws. The port-needle-system tightness is proven by the HE-leak test. Thus, the cell is hermetically closed at any time. No vacuum chamber is needed in the machine, which enables a simple design and low investment.

Synchronized formatting and degassing possibilities

After activation/formation, the cell is transported to the degassing machine. This machine utilises port and dosing needles to extract the formation gas and to generate the desired vacuum inside the cell. This eliminates the need for conventionally used gas bags for the collection of formation gas. These gas bags are typically contaminated with electrolyte resulting in high disposal costs as hazardous waste. In addition, the novel technology minimizes the contaminated sealing seam, thus reducing negative effects on the battery's lifetime.

Automation makes filling even faster and greener

Automation of cell manufacturing can make a substantial contribution to a lower overall energy consumption of the Li-ion battery cell production, as it is

homogenous,
quickly amortized,
as well as precise
and fast.

A flexible and
module-based
automation system
to efficiently
optimise the
complete cell
production is Robo
Automation Kit,



Smart Battery Innovation: Pouch Filling with Ports

another outstanding in-house development of the IP Group. Robo Automation Kit is a flexible, universally applicable automation kit in which various modules can be combined and existing machines and production lines can be easily integrated. If required, the modules can be re-combined to form a new solution allowing a flexible process adaptation of production lines for pouch, prismatic and cylindrical cells.

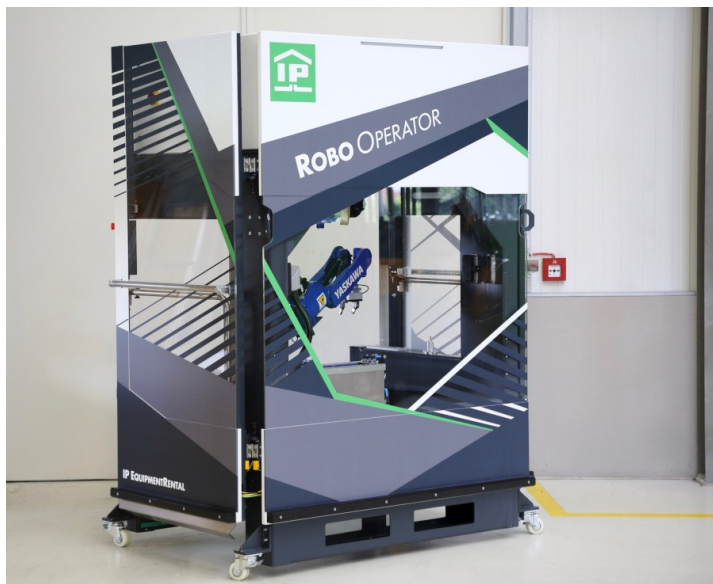
The modules of Robo Automation Kit consist of the same Basic Unit with integrated switch and control cabinet. Due to its very small size, it fits in any place of an existing production line. Equipped with a camera image recognition system and a menu-supported sequence control, no robot programming knowledge is required.

Existing machines can be easily automated by Robo Operator® later. Robo Operator® is a self-working, mobile and flexible automation solution for operating and handling different kind of production machines. Neither mechanical connection to the production machine nor data exchange interface is required. An employee without special robot setup knowledge can commission Robo Operator® on the intended machine within a very short time, so that Robo Operator® can work completely on its own without intervention or supervision. Eventually, the vision of flexible production becomes a reality.

In collaboration with research institutes, it is planned to equip Robo Automation Kit and Robo Operator® with AI and machine learning in order to be able to react flexibly to new circumstances or disruptions in the process chain. The method of machine learning has numerous advantageous aspects in predictive maintenance and predictive process control to reduce ramp-up time.

Sustainable Li-ion battery cell production

In conclusion, the innovative technology proves to have a lot of advantages,



Robo Operator®

especially for mass production of Li-ion pouch cells. The filling at ambient atmosphere results in considerably reduced investment and operating expenses, making dry rooms unnecessary. Due to the elimination of the gas bag, no excess pouch foil is required and cost and effort for the disposal are reduced. Accessibility of different filling strategies allows for the

acceleration of the wetting procedure. Furthermore, the process flexibility is granted for all required process conditions. The requirements and conditions were determined in collaboration with OEMs, manufacturers for niche products and research institutes. This also includes the format flexibility. Nearly all existing pouch cell formats can be produced on the machines based on the novel technology

“We are convinced, the use of our pioneering technologies will pave the way towards the e-mobility revolution.” Ralf Hock concluded.

Ralf Hock MD **IP-PowerSystems**

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