

Designing New Solutions for Grid Storage Battery Production

Today's battery manufacturing revolution is not confined to electric vehicle applications. There is a fast-growing development of large-scale and industrial power storage systems to meet surging electric grid power demand, as well as supporting the expansion of clean energy sources like wind and solar.

Challenge:

Source, configure and deliver a customized, state-of-the-art EV battery production solution within an aggressive 8-week time frame for a fast-evolving and high-demand industry.

Solution:

A linear motor-driven Flexible Transport System (FTS) was developed to meet fast cycle time requirements with high-precision bi-directional capabilities.

A Smart Function Kit (SFK) mechatronic module was also implemented for precision pressing applications, enabling easy programming with plug and play functionality.

Result:

Bosch Rexroth expertise and resources delivered an innovative, reliable and high-quality battery production solution within 8 weeks, meeting the required performance specs and timing.

With the FTS's speed capabilities at 5 m/s, ATS was able to produce 10 times more product in the allotted time required.

Anticipating these needs, a major battery manufacturer sought to quickly ramp up its factory to produce an innovative new energy storage platform. The company selected ATS Industrial Automation, Inc. (ATS IA) of Cambridge, Ontario, an industry-leading provider of factory automation lines to many of the world's most successful companies, to design and build its new production line in a highly compressed time frame.

A key section of the new line involves stacking cells that make up the core of the new grid-scale battery. Here, ATS IA worked closely with automation technology supplier Bosch Rexroth (www.boschrexroth-us.com) to combine multiple transport and mechatronic assembly tools into a complete, high-speed automated cell stacking solution.

BATTERY DEMAND DRIVES TIGHT PRODUCTION SCHEDULE

A key driver for new grid-scale batteries is the increased use of renewable energy sources. In addition, data centers, cryptocurrency mining and EV vehicle charging stations are straining electric utility generating and transmitting capabilities. New ways to store and deliver electricity are vital. Focusing on a novel grid battery product design, ATS IA's customer set extremely tight time frames to begin production. While sharing some basic features with other battery types, the new design and tight build-out schedule presented multiple automation engineering challenges, according to ATS Industrial Automation Sales Manager Christopher Spayd.

"Whether it's a cylindrical, pouch or prismatic cell, most batteries on the market are very similar in the way they're manufactured, and there's lots of standard equipment on the market to do that," he said. "However, the form factor for this cell is quite unique, so our manufacturing approach was to combine different pieces of proven technology together into a unique production line."

NOVEL CELL STACKING ASSEMBLY LINE

Cell stacking is a key production step that required an innovative automation concept. In cell stacking, multiple cathode and anode materials are punched from a web and layered on top of each other in a high-speed process.

Although ATS IA has extensive experience building automated battery manufacturing lines, the grid storage battery line had features and requirements specific to this battery type. "The configuration of the customer's electrodes in the cell stack are unique," Spayd said. "Because the anodes and cathodes are different materials, they are run on separate production machines prior to stacking and are deposited onto pallet conveyors."

Rather than transporting the anodes and cathodes to high-speed stacking stations, ATS IA developed a different approach: integrate the anode and cathode stacking directly on the conveyors, using the horizontal transport as an automation x-axis. To achieve this design, they turned to a unique combination of Bosch Rexroth's proven TS 2plus pallet conveyors and linear motor-driven Flexible Transport System (FTS).

SMART TRANSPORT TECHNOLOGIES

Most of the transport on this part of the production line uses the TS 2plus pallet conveyor, a robust, versatile and highly modular setup that can carry loads up to 240 kilograms. It supports transport speeds up to three meters per second and features a complete series of pallet-based transfer, positioning and control components.



A key section on the new line uses the Rexroth TS 2plus pallet conveyor (like the one shown here), a robust, versatile and highly modular setup that can carry loads up to 240 kilograms. It supports transport speeds up to three meters per second and features a complete series of pallet-based transfer, positioning and control components.



Bosch Rexroth's Flexible Transport System (FTS) is a specially developed linear motor transport unit suitable for easy integration into the Rexroth TS 2plus conveyor. A main benefit is that the FTS features omnidirectional transport where every carrier's movement – direction, speed, start and stop rates – can be individually programmed.

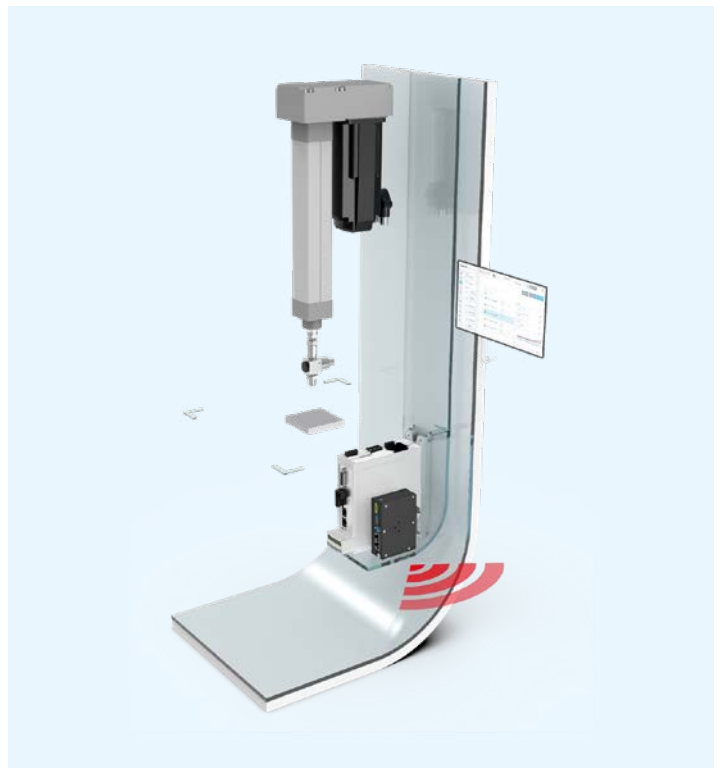
Bosch Rexroth's pallet conveyor is augmented at the anode/cathode stacking point with its FTS, a specially developed linear motor transport unit suitable for easy integration into the Rexroth TS 2plus. A main benefit is that the FTS is an omnidirectional transport platform where every carrier's movement – direction, speed, start and stop rates – can be individually programmed.

The FTS supports product weights from 1 to over 1,000 kilograms, acceleration up to 40 meters/second² and pallet-to-pallet positioning accuracy of ± 0.02 millimeters. According to Bosch Rexroth Regional Sales Manager Matthew Brown, both the speed and the multidirectional capability of the FTS made it the right fit for solving the electrode stacking challenge.

“The total cycle time for layering the anodes and cathodes, with the FTS carrier moving back and forth multiple times, is very quick,” Brown said. “We couldn't have accomplished that speed, precision or back-and-forth motion with any other kind of conveyance. Since the FTS is designed to be integrated into the TS 2plus conveyors, it also made it that much easier to use it for solving for the stacking step challenge,” he added.

PLUG AND PRODUCE COMPRESSION KIT

After anode and cathode stacking, the next step is to compress the stacked materials before laser welding the cell stack end cap and placing the completed stack in the battery housing. It's critical here to apply a precise amount of force for an exact time period to properly configure the electrode stack. To carry out this key task, ATS IA chose to use the Rexroth Smart Function Kit for pressing mechatronics system. Part of Rexroth's Smart MechatroniX portfolio, the Smart Function Kit is designed for many pressing and joining applications requiring forces up to 70 kilonewtons.



The Rexroth Smart Function Kit for pressing is a “plug and produce” mechatronics module combining linear motion components, servo drive, controller and software in a single, fully assembled package for pressing and joining applications. Finished electrode stacks are delivered to the Smart Function Kits where a defined compression cycle is applied precisely across a specific time frame.

Like all Smart MechatroniX offerings, it is a “plug and produce” mechatronics module that combines proven Rexroth linear motion components, servo drive, controller and software in a single package. Online tools support quick and easy kit design, selection and configuration, and all the elements are ordered and delivered as a single, fully assembled package, including pre-installed operating software and automatic parameterization of the servo drive. There are multiple electrode stack compression stations outfitted with Smart Function Kits. Fully automated and integrated with the conveyors, finished electrode stacks are delivered to the Smart Function Kits for a defined compression cycle that’s applied across a specific time frame.

“The Smart Function Kit for pressing lets us precisely control and track each pressing cycle,” Brown said. “It provides real-time display of force-displacement curves, visualization of compression results and the ability to analyze every completed stack.”

According to Christopher Spayd at ATS IA, the Smart Function Kit provided the right performance for the stack pressing cycle. Equally important, Bosch Rexroth could commit to delivering the kits, ready for integration, in an extremely tight time frame.

In addition to the TS 2plus and FTS, ATS IA also opted to use the Rexroth modular and versatile VarioFlow plus chain conveyor system to transport end caps to a laser welding station. The end caps cover the container that holds the completed battery stack and is one of the final steps in the battery stack production step.

CONCURRENT ENGINEERING FOR ULTRA-TIGHT TIME FRAME

The grid battery company is targeting a fast-growing and competitive market. As a result, the company challenged ATS IA to build the new line in the shortest possible time frame. Bosch Rexroth committed to source, configure and deliver all the conveyors and multiple Smart Function Kits in a four- to eight-week window.

ATS IA worked with Bosch Rexroth to apply a concurrent engineering approach, replacing sequential design, engineering and integration procedures with overlapping planning and implementation. “Battery projects are extremely dynamic, with frequent updates and design modifications,” Spayd said. “We pursued a very aggressive execution strategy that went beyond product and equipment build and into procurement, debugging and installation.” To carry this out, ATS IA needed confidence that Bosch Rexroth had the products, engineering resources and organization to keep the project on track.

“We’ve worked successfully with Bosch Rexroth on multiple automation projects, so we knew the quality and performance of their technology, as well as their transparency and ability to keep commitments,” Spayd said. “That, combined with the single-point-of-contact we established with the Bosch Rexroth team, was critical to meeting all of our commitments on this project.”

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