CASE STUDY

Top global lithium-ion battery machine builder debuts two-sided simultaneous electrode coater for world's battery-cell OEMs

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As the demand for electric vehicles grows worldwide, auto manufacturers will need to boost their battery-making capacity dramatically. Dürr Systems Inc. is ready with their game-changing GigaCoater, a new two-sided simultaneous electrode coating machine — the world's first, adding to their portfolio of simultaneous two-sided coaters. Using Siemens technologies to support tension-controlled coating capabilities, this new Dürr model takes its industry-leading electrode coating equipment to new levels of precision, efficiency, and quality, all with big OPEX reductions for its customers.

By respected estimates, electric vehicles (EVs) will account for as much as 86% of global vehicle sales by 2030 and, from that year to 2035, the number of EVs will double to 525 million.[1]

That growth will require the world's automakers to expand their battery manufacturing capacity and efficiency much more than what they have today for both new EVs and after-market replacement needs.

Dürr Systems Inc. is poised to help them do just that with its revolutionary, two-sided simultaneous electrode coating machines. The company is part of the Dürr Group, one of the world's leading OEMs across many diverse industries with vast expertise in mechanical and plant engineering as well as automation and digitalization.

In recent years, battery cell OEMs have turned to Dürr for comprehensive turnkey systems to produce coated materials for lithium-ion battery electrodes. OEM batteries are also seeing a growing demand for use in all-terrain vehicles (ATVs), motorcycles and bicycles, even short-range electric vertical take-off and landing (eVTOL) aircraft.

According to CTS Sales Director Jim Hartnett, Dürr provides a solution tailored to the customer needs for a complete electrode coating process with integrated solvent recovery and onsite refining along with state-of-the-art roll presses. Our value to customers are better yields with greater quality, efficiency, and sustainability along with reduced waste and costs."

- **Challenge: Improve customers' electrode coating capabilities to expand production capacity — and drive down costs, enhance efficiencies, and boost yields**

Hartnett explains that the forecasted growth in EV sales — 23.5% compounded annually[2] — has auto manufacturers looking for ways to rapidly increase their battery production to fully capitalize on this demand. "The average price of lithium-ion battery packs for EVs has dropped by nearly 90 percent in the past 10 years, helping EVs become ever more price-competitive with cars powered by internal combustion engines," he says.[3] "Still, for our customers to effectively monetize this opportunity and expand their margins and bottomlines, they need to continue improving their battery production cost structure without sacrificing quality, safety, or sustainability."

Customer: Dürr Systems Inc., based in De Pere, Wisconsin
www.durr.com
Challenge: Improve customers' electrode coating capabilities to expand production capacity — and drive down costs, enhance efficiencies, and boost yields
Solution: Simultaneous, two-sided electrode coating and drying for more output but with significant space- and cost-savings
Results: Better quality, lower TCO, and big OPEX savings

So Dürr can support customer preferences, they also offer Tandem Coater equipment with integrated solvent recovery. Dürr's team assess the customer needs to recommend Tandem or simultaneous two-sided coating machines to support the project objectives.

"While the Tandem Coater remains the industry's preferred means of battery electrode production and still a viable OEM option for our customers with many, many years left in its lifecycle, we wanted to leverage our engineering know-how from it to give our customers another way to elevate and expand their production," Hartnett says. "So, our R&D team went to work on completely rethinking our system's architecture, with greater coating precision, quality, efficiency, and sustainability as their design points."

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[1] Eric Walz. "EVs could reach 86% of global vehicle sales by 2030." Automotive Dive. October 2, 2023.

[2] Electric Vehicle Market Size, Share, and Trends 2024 to 2034. Precedence Research.

[3] IBID.

- **Solution: Simultaneous, two-sided electrode coating and drying for more output but with significant space- and cost-savings**

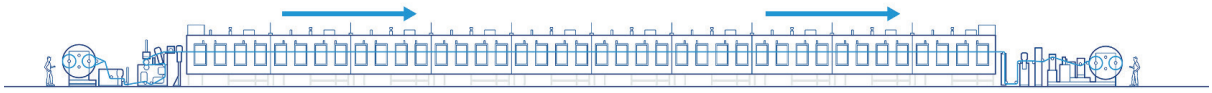
The Dürr Research and Development group, led by Director Eric Maki, gave careful consideration to their own insights to how their battery cell OEM customers produced battery electrodes as well as input and feedback from the customers themselves. "Electrode edge curl, for example, has been a big, ongoing quality concern that we want to flatten, literally and figuratively, for them," he says. "Quality yields also depend on a consistent application of the electrode coating at speed. Our team was determined to reimagine our approach to these challenges."

This led Maki and his engineers to develop the Dürr GigaCoater machine for simultaneous, two-sided electrode coating. As shown in Figure 1, it has a straight-path product flow with just a single coating station. It consists of a slot-die coating on a backing roll immediately followed by a tensioned-web slot-die coating to coat both sides of the current collector in one pass. An air flotation dryer enables simultaneous two-sided coating as the foil is running through a non-contact drying process.

Figure 2. The GigaCoater coating station delivers the same quality top and bottom coating in a single pass with an ultra-precise +/– 1% coating weight.

- **SIMATIC S7-1500 Programmable Logic Controllers (PLCs)**, which oversee the ProCoater's two-sided simultaneous coating processes, precisely managing the movement, alignment, and timing of numerous servo motors as the copper foil substrate rapidly moves through the machine and its float-drying modules.

Figure 1. The Dürr GigaCoater machine provides ultra-precise, simultaneous two-sided electrode coating at speeds up to 80 meters per minute with up to a 50-meter non-contact, flotation dryer, all in a simplified and space-saving one-direction workflow.



For help with automation and controls, especially motion control, Dürr chose DMC, Inc. a Siemens partner and systems integrator.

"While our own team handled most of the ProCoater's design and engineering, we wanted to engage with Siemens for the quality and reliability of their advanced component technologies, their expertise, and their global support and service footprint," Maki says. "The collaboration, communications, and responsiveness by both Siemens and DMC with our engineers was truly exceptional and a critical factor in the GigaCoater's successful development."

The GigaCoater's automation and control system comprises numerous Siemens components from its Totally Integrated Automation (TIA) portfolio. Principal among them are:

- **SIMATIC HMI TP900 Comfort Panels**, which provide a nine-inch diagonal touchscreen for ProCoater operators to manage all steps in the coating and drying processes with complete visibility of all work-in-progress.
- **SINAMICS S120 Drives**, which are closed-loop vector drives that offer integrated safety, energy savings, and network connectivity with a wide range of power ratings.

The Siemens TIA Portal was used to program the automation and controls system. It's an intuitive, all-in-one software engineering platform with a drag-and-drop interface that unifies control programming, HMI visualization development, and parameter settings while also providing industry-specific libraries of proven code that can be used as-is or customized for a particular application.

Notably, the project team chose to deploy the Siemens SIMATIC WinCC Unified System for HMI and SCADA programming. It's the most advanced visualization system from Siemens that acts as an integration platform to link data from production with a customer's IT enterprise systems. "WinCC Unified will enable us to configure our ProCoater systems for our customers specific needs much more quickly and provide them the flexibility to add future functionality, too," Maki points out.

- **Results: Better quality, lower CAPEX and TCO, and big OPEX savings**

Dürr's Business Development Director David Ventola considers the benefits of GigaCoater machine's two-sided simultaneous electrode coating capabilities to be a game-changer for EV battery production. "For starters, it eliminates the vexing problem of edge curl with its float-drying process that dries both sides of the electrode at same time balancing the forces of both sides," he says. "There's no edge curl even at high coating weights. That alone can enhance yields substantially to increase production outputs."

Ventola notes many other key advantages the GigaCoater machine can provide Dürr battery cell OEM customers. "With its extremely precise coating capabilities, it can help them consistently achieve the highest-quality yields possible, while also reducing waste, labor and energy costs, and saving plant space," he says. "Waste reduction is especially critical because electrode material is production's primary cost factor."

Another big benefit is the GigaCoater machine's potential for saving CAPEX because it requires a smaller plant footprint, a lower ceiling height, and its float-drying system needs just one dryer, not two.

Significant OPEX savings

The GigaCoater can also potentially reduce production OPEX in several ways. "Compared to conventional single-sided coating and drying processes, the GigaCoater's two-sided simultaneous electrode coating and float-drying model can generate significant OPEX savings," he says. "It cuts dryer energy costs in half, needs fewer operators, has less thread-up waste, and reduces the length of its slurry pipe by 80%. All this means our customers can expect a fast payback on their investment, with a continuing ROI thereafter."

Because the Dürr GigaCoater machine's physical architecture and logic in its automation and controls system enables them to be effectively pre-engineered, customers can expect to procure, configure, and deploy them much faster. During the machine-build period, Dürr provides customer-specific process development trials, making it possible to reduce the period between commissioning and full production by weeks if not months.

Going forward, Dürr is discussing with Siemens how to best employ digital twin simulation software to assist customers in siting and sizing not just the GigaCoater on the plant floor but also the HVAC and critical ancillary systems, such as for distillation, solvent and heat recovery, and pollution control.

Key Benefits of Dürr Lithium-Ion Battery Electrode Manufacturing

Dürr can offer a turnkey battery electrode plant to optimize battery electrode production with simultaneous two-sided coating and float-drying made possible by the GigaCoater tensioned-web coating system.

- **Improved quality**

Two-sided coating coupled with flotation drying offers:

– Improved side A to side B alignment
– No edge curl after drying
– Drying consistency for improved yield
– Reduced wrinkles due to flotation drying

- **Integrated solvent recovery and refining**

– Collects the NMP with condensation to minimize contamination
– Purifies on site to the highest standard of quality
– Closes the loop for solvent recycling

- **Lower total costs**

The simplified process design can lower CAPEX. In addition, simultaneous two-sided coating with inline calendering/roll pressing can reduce OPEX in these ways:

– Heating only one dryer
– Fewer operators
– Less material waste
– Increased yield

Integrated solvent recovery and refining:

– Includes heat recovery to reduce demand for utilities and lower energy costs
– Minimizes waste
– Provides cost savings by capturing >99% of NMP

- **Simplified factory layout and material flow**

With a straight-path product flow and single-level machine:

– The factory layout can be linear
– Direct slurry piping to a single coating station
– Reduced floor space for the coating area

"We want to be able to use sophisticated 3D simulations in collaboration with our customer engineering teams to help them optimize all of these systems and save CAPEX, then simulate full production processes to reduce their OPEX even more," Ventola says. "Eventually, we envision enabling our customers to use AI for monitoring production end-to-end and alerting operators when process anomalies occur, so they can investigate and prevent costly disruptions."

Legal Manufacturer

Siemens Industry, Inc.
100 Technology Drive
Alpharetta, Georgia 30005
United States of America

Telephone: +1 (800) 241-4453
usa.siemens.com