KOLLMORGEN
A REGAL REXNORD BRAND

WHITE PAPER

Kollmorgen Direct Drive Technology Enhances the Accuracy and Throughput of Electric Vehicle Battery Production

With the rapidly growing demand for electric vehicle lithium-ion battery cells, manufacturers are under continual pressure to increase production quality and speed. This includes the electrode coating process, a crucial link in the lithium-ion battery production chain.

In order to meet battery producers' requirements of up to 99% yield, manufacturers of coating machines rely on Kollmorgen's direct drive technology. The precision of direct drive dramatically improves coating quality — achieving coating accuracy (dry) of less than ±2 g/m^2 and a layer thickness accuracy of less than ±1 µm — while at the same time increasing production speed from 60 m/min to over 100 m/min.

Kollmorgen's direct drive technology also enables an increase in coating width from 1.5 meters to 2 meters, substantially increasing battery production capacity.

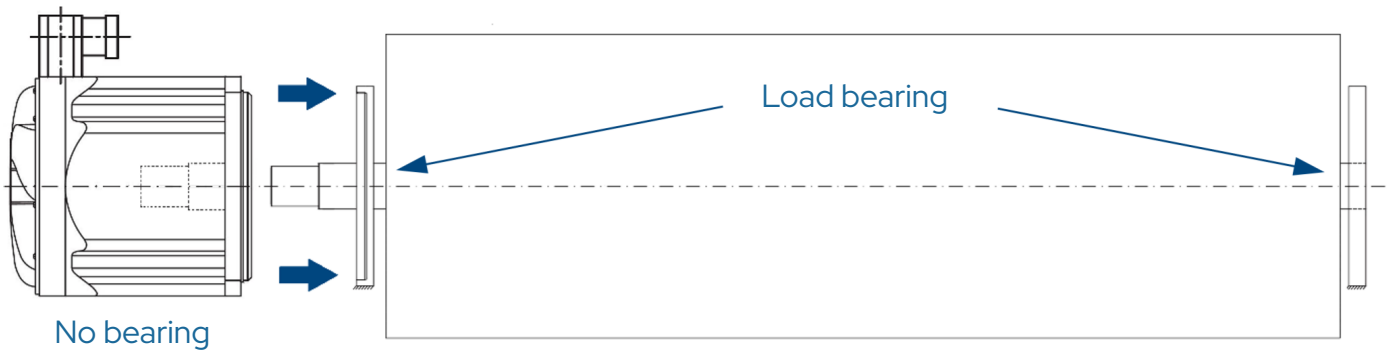
REQUIREMENTS FOR THE COATING PROCESS

Inside each lithium-ion battery are metal foils coated on both sides. Aluminum foil is used as a carrier for the positive electrode (cathode), and copper foil is used for the negative electrode (anode). Electrodes are coated with active material in the form of a slurry. These coated electrodes are crucial for the functionality of the battery, and poor coating results in a faulty battery. For this reason, the entire coating process must be carried out very precisely and strictly monitored.

Roll-to-roll production systems first carry out the coating process on the unfolded film via slotted dies or a squeegee system. Coatings can be one- or two-sided, as well as continuous or intermittent. The coated carrier film is continuously transferred to the downstream dryer and finally rewound.

The advantages of direct drive technology

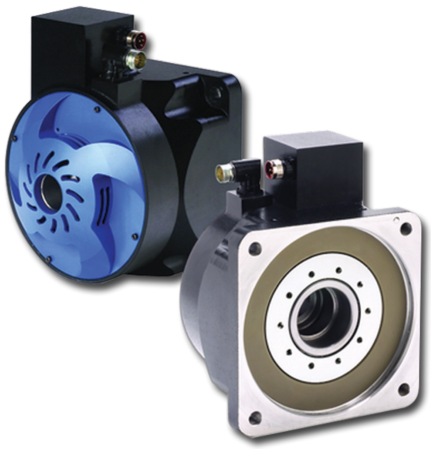
The driven rollers as well as the winding drives play a decisive role in the precision of the coatings. Smoothness and synchronization are largely responsible for the reduction of scrap — a significant benefit of Kollmorgen's torque motors. Mounted directly on the production line, with no need for traditional mechanical transmission systems, this system provides an impressive demonstration of all the advantages that Kollmorgen's direct drive motors have to offer.



A Steel Coating Roller driven by Kollmorgen motor

Direct, torsionally stiff coupling with the load enables these torque motors to drive very high mass inertia ratios while maintaining high quality control. The direct drive motor can handle up to 4000:1 inertia ratio, positioning the load with no backlash. To achieve equivalent torque and accuracy, a classic servo motor would require the use of a reduction gearbox, which would in turn severely limit maximum production speed. The Kollmorgen direct drive motors used in this application can deliver optimum torque at speeds up 1,500 rpm, significantly increasing production throughput.

In addition to the KBM® series frameless direct drive servo motors, Kollmorgen also offers the Cartridge DDR® series, combining the performance advantages of a frameless motor with the ease of installation of a full-frame motor.

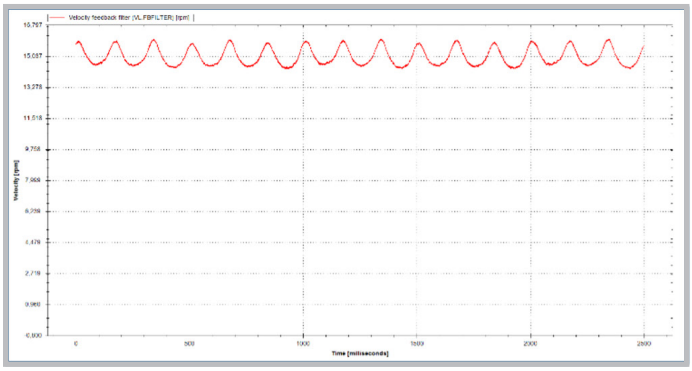


The unique, bearingless design includes factory-adjusted, high-resolution feedback and a simple mounting system for a ready-to-install direct drive servo motor that can be up and running within minutes. Watch this video to see how easy Cartridge DDR installation can be.

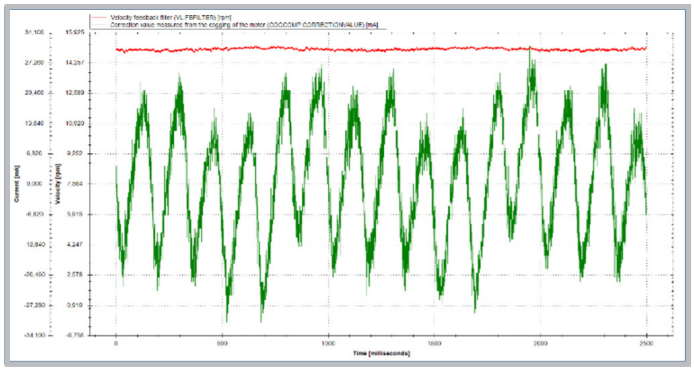
A drive-motor system that virtually eliminates cogging for precise synchronization

The coating systems in lithium-ion battery cell production must process very thin films (between 5 µm and 25 µm), placing extreme demands on the synchronization and winding process. The magnetic design across all Kollmorgen servo motors results in very low cogging (< 3% pp of M_n), which is almost entirely eliminated by the exclusive cogging compensation algorithm built into the AKD2G servo drive family. Precise processing of ever-thinning film presents no obstacle to Kollmorgen's advanced drive technology.

SPEED CURVE BEFORE COGGING COMPENSATION



SPEED CURVE WITH COGGING COMPENSATION



The table below shows the synchronization results achieved at different test speeds on a coating system for lithium-ion batteries. A cartridge DDR motor of type CH063C-13-3305 (M0 = 61.8 Nm, nn = 550 min-1) is used here, which is equipped with a high-resolution encoder (27 bits per revolution) as standard.

Test speed [min-1]	Speed fluctuation peak-to-peak value [min-1]	Deviation [%]
6	0.040	0.667
10	0.028	0.280
20	0.021	0.105
30	0.024	0.080
50	0.039	0.078
80	0.042	0.053
100	0.046	0.046
120	0.045	0.038
160	0.051	0.032

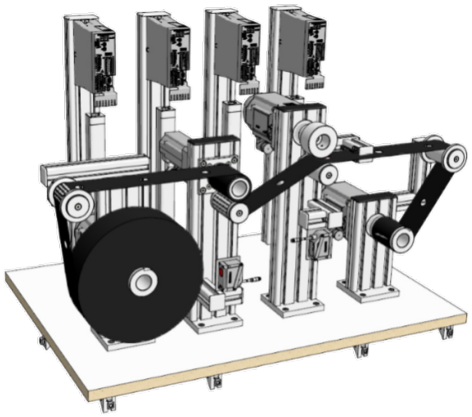
Simple, reliable motion programming

Another building block for the automation of coating machines is the Kollmorgen Automation Suite with the multi-axis PCMM motion controller.

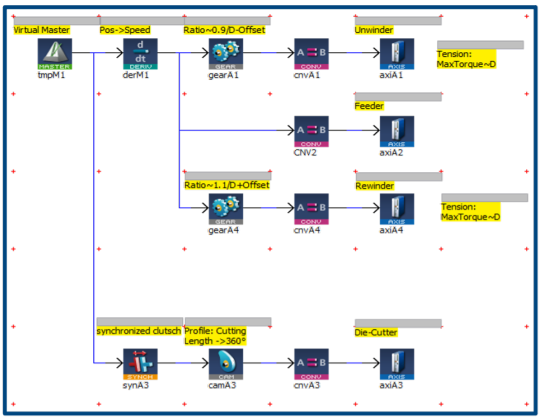
With the intuitive, graphical motion-programming PIPE NETWORK, synchronous motion sequences can be implemented very easily using ready-made function blocks — such as electronic transmission, cams and more — as well as ready-to-use technology modules.

In the free library, for example, building blocks for the most frequently used winding types such as open loop, tension and dancer control are available. There is also a choice of flying saws, sheeters and labelers for synchronized machining, among other items. These modules significantly reduce programming and commissioning time while helping to ensure motion-programming success.

Roll-to-roll application with rotatry die-cutter



Graphical programming with PIPE NETWORK



GREATER PRODUCTIVITY, HIGHER QUALITY AND LOWER COST: PUTTING IT ALL TOGETHER

In addition, the application of highly precise coatings, Kollmorgen's control, drive and automation technology, is successful for numerous related processes in battery production, such as calendering, slitting, punching and stacking. The use of Kollmorgen direct drive technology, as well as the control and drive technology optimized for it, enables lithium-ion battery manufacturers to substantially increase production efficiency and ensure product quality while significantly reducing production costs.

About Kollmorgen

Kollmorgen, a Regal Rexnord Brand, has more than 100 years of motion experience, proven in the industry's highest-performing, most reliable motors, drives, linear actuators, AGV control solutions and automation platforms. We deliver breakthrough solutions that are unmatched in performance, reliability and ease of use, giving machine builders an irrefutable marketplace advantage.

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