Nordson has assembled the most comprehensive portfolio of extrusion and coating technologies available for lithium-ion battery manufacturers. Our technologies focus on two critical components: the anode and cathode slurries that serve as electrodes; and the separator films that keep the electrodes apart to prevent short circuits. Starting with the first of four U.S. government contracts awarded in 2002, Nordson played a role in helping to perfect these components, and today we supply separator film and battery manufacturers around the world.

Beyond today’s widespread use in consumer electronics, lithium-ion batteries are expected to grow rapidly in automotive and energy storage applications. These uses pose great challenges because of stringent requirements for efficient and reliable battery performance. At the same time, global competition forces battery manufacturers to achieve ever higher levels of operational economy and productivity.

Technologies supplied by Nordson to help meet these requirements include Extrusion Dies Industries polymer dies for extruding separator film, Premier™ fluid coating dies for applying electrode slurries onto metal foils, Xaloy® extrusion screws and barrels, and BKG® melt filtration systems and gear pumps. In many cases we can supply you with a combination of components that work together to optimize your production process.
FLUID COATING DIES

Nordson’s experience with electrode application began in 2002 with building and operating a pilot coating line. Today, Premier coating dies are widely used in lithium-ion battery applications by virtue of unmatched flatness and slot gap uniformity, which yield a coat weight uniformity of +/- 1 to 2%.

Premier™ Fixed-Lip Slot Die Systems

- A pre-metered slot coating system offers improved coating fluid yields by applying all of the coating to the substrate via a positive displacement pump and slot die
- Premier™ die positioners are designed for on-roll or off-roll (tension) coating and may be used with Premier™ single layer fixed lip slot dies, multi-layer fixed lip slot dies, or double-sided coating applications

Ultracoat™ Flexible Lip Die Systems

- Ultracoat™ slot dies provide flexibility to adjust for variation in web thickness and process parameters, with manual and automatic lip adjustment versions available
- Ultracoat™ support stations and modular coating stations are designed for use with Ultracoat™ flexible lip dies and feature pneumatic actuation via air cylinders and an optional vacuum box or regenerative blower

EXTRUSION DIES & FEEDBLOCKS

Nordson provides a full suite of extrusion die technology designed to maximize the performance of battery separator films, which require exceedingly precise thickness uniformity. To achieve this, Nordson uses rheological analysis to design a die manifold that provides uniform distribution. In addition, the Autoflex™ automated gauge profile control fine-tunes the flow distribution and is available with ambient cooling instead of the standard air-cooling system. This benefits the film producer as oil from the polymer melt may condense on the air cooling component and subsequently drip onto the film, causing product defects during the wet-process production.

Extrusion Dies & Feedblocks

Multi-manifold Biaxially Oriented Film Dies

- Dies are designed to increased structure versatility by accommodating dissimilar viscosity materials and partial coverage requirements
- The presence of flaws in end products can be minimized with a variety of surface finishing techniques, including laser-hardened lip edges or EverSharp™ tungsten coating

Contour® Cast Film Die

- Designed with a sculpted configuration, which minimizes the differences in die body deflection across the width of the die, thus reducing gauge variation in the end product for a wide range of requirements

Uniflow™ Cast Film Die

- Uniflow™ dies are recommended for applications processing thermally stable materials and provide outstanding mechanical stability which reduces the changeover time between each product run

Ultraflow™ V-T Feedblocks

- Design includes profiling actuators with interchangeable profile bars, allowing for the thickness uniformity of individual layers to be finely tuned during operation
Since 2010, Nordson has supplied its BKG® screen changers and BKG® BlueFlow™ gear pumps to producers of battery separator films in Japan, South Korea, China, and Germany. Applications have ranged from laboratory lines to production lines operating at 1,000 kg/hr.

**BKG® Gear Pumps**

Situated just after the screen changer, the gear pump provides a constant mass flow to the extrusion die, helping to ensure product consistency.

**BlueFlow™ Gear Pumps**

- RP model recommended for extrusion coating & laminating applications with low viscosity polymers
- EP model recommended for standard polymers and low viscosity plastics
- MP model recommended for processes with frequent product changes

**BKG® Screen Changers**

Installed just downstream of the extruder, screen changers or melt filtration systems are the chief line of defense against contaminants that can result in defective separator film.

**NorCon™ Discontinuous Screen Changers**

- Used to filter and homogenize the polymer in film applications
- D-SWE, HS-Y, EH models recommended

**NorCon™ Continuous Screen Changers**

- Used to eliminate contaminants from the melt stream in film applications
- K-SWE, K-SWE-4K, K-SWE-4K-75 models recommended

**Xaloy® Extrusion Screws & Barrels**

**Xaloy® Extrusion Screws**

**Fusion™ Barrier Screw (U.S. Patent 6,672,753)**

- Designed to combine proven barrier screw technology and a low shear metering section that provides chaotic mixing, reducing melt temperatures and improved throughputs

**Efficient™ Barrier Screw**

- Typically delivers 20% more output than conventional screw designs, while offering better melt temperature control and homogeneity

**Stratablend® II Mixer (U.S. Patent 6,488,399)**

- Provides intensive chaotic and distributive mixing with low shear and little to no temperature rise

**Nano Mixer (U.S. Patent 6,497,508)**

- Combines very intensive dispersionary mixing of colorants, fillers, and additives with excellent temperature control

**Xaloy® Extrusion Barrels**

Bimetallic barrels designed to meet the application needs for wear and corrosion resistance in a variety of compositions:

- X-800®: Tungsten carbide particles uniformly dispersed in a corrosion-resistant nickel alloy matrix
- X-102®: Nickel-rich iron-boron alloy
- X-220™: Higher-chromium iron-boron alloy
- X-306: Nickel/cobalt base for the most corrosive atmospheres
RESEARCH & DEVELOPMENT

Nordson has years of experience working with separator film producers, slurry coaters, and battery assemblers and maintains a global network of engineering and support capabilities. We can custom-design a package incorporating some or all of our extrusion and coating technologies. Customers can come to Nordson for support with budget-sensitive applications as well as those that require the most sophisticated and advanced equipment.

Nordson technology is available globally. We carry out R&D, design, manufacturing, rework, and aftermarket services at hub facilities that serve as “centers of excellence” in Europe, Asia, and the Americas. In addition Nordson maintains sales and support offices in more than 30 countries. Our mission is to provide local service for world-leading technologies.

Let us work with you on your next battery market initiative. At our technical centers we operate laboratories for product development, proof-of-process trials, and customer training. We can help to identify an equipment package with the precision and efficiency necessary for maximum productivity, consistently high quality, and minimum consumption of the raw materials that account for so much of battery production costs.

**BKG® Technology & Training Center**  
**Muenster, Germany**

Focused on underwater pelletizing applications, the test center provides customers with an opportunity to simulate production conditions with throughputs of up to 1,200 kg/h.

**Xaloy® Technology & Training Centers**  
**Austintown, Ohio, USA; Hickory, North Carolina, USA; & Chonburi, Thailand**

The polymer laboratories include comprehensive process analysis for injection molding, extrusion, and pelletizing applications.

**Extrusion Dies Industries**  
**Technology & Training Center**  
**Chippewa Falls, Wisconsin, USA**

Extrusion processors and web converters can carry out product development and process testing without the high raw material costs and lost output of trial runs on their own commercial-scale equipment.

**PPS Technology & Training Center**  
**Shanghai, P.R. China**

Providing localized lab trial and training capabilities to Chinese customers, the PPS Technology Center in Shanghai offers a variety of tooling options for testing pelletizing and slot die coating processes.

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