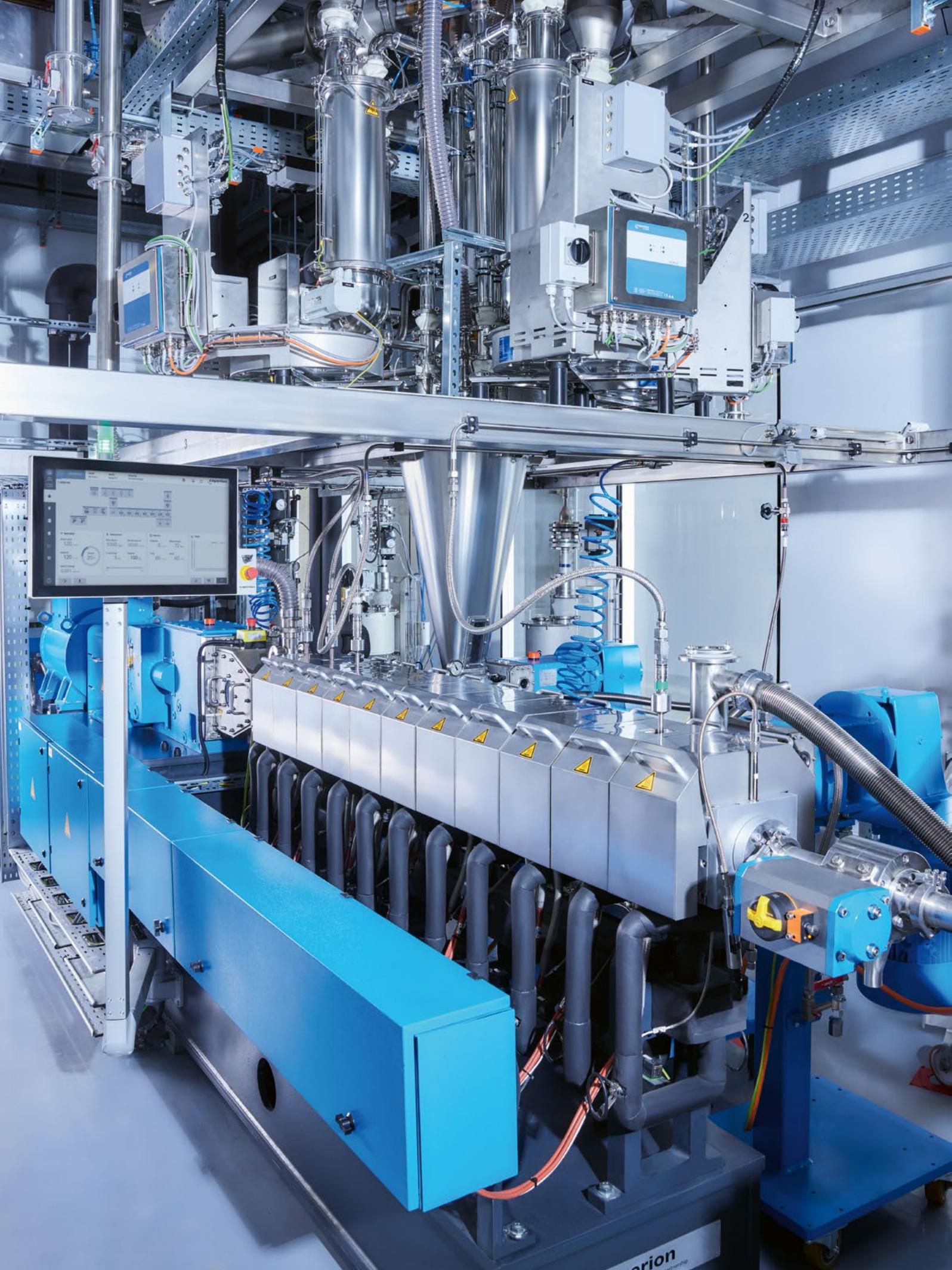




Battery manufacturing.  
Powering the electric economy  
with cutting-edge technology.





Control panel displaying various data points and graphs.

arion  
Partnership

# Driven by revolutions in energy storage and mobility, the demand for batteries is projected to rise steadily. Coperion is dedicated to supporting battery manufacturers in achieving high-quality, efficient and cost-effective production.

Our comprehensive portfolio of reliable, top-tier technologies and products – ranging from individual components to complete systems – combined with our expertise in custom machine design and years of process experience, are essential for the successful planning and construction of systems across various battery manufacturing sectors. With a blend of reliable partnership, proven first-class technology, and extensive experience, Coperion stands out as the ideal partner for the battery industry.

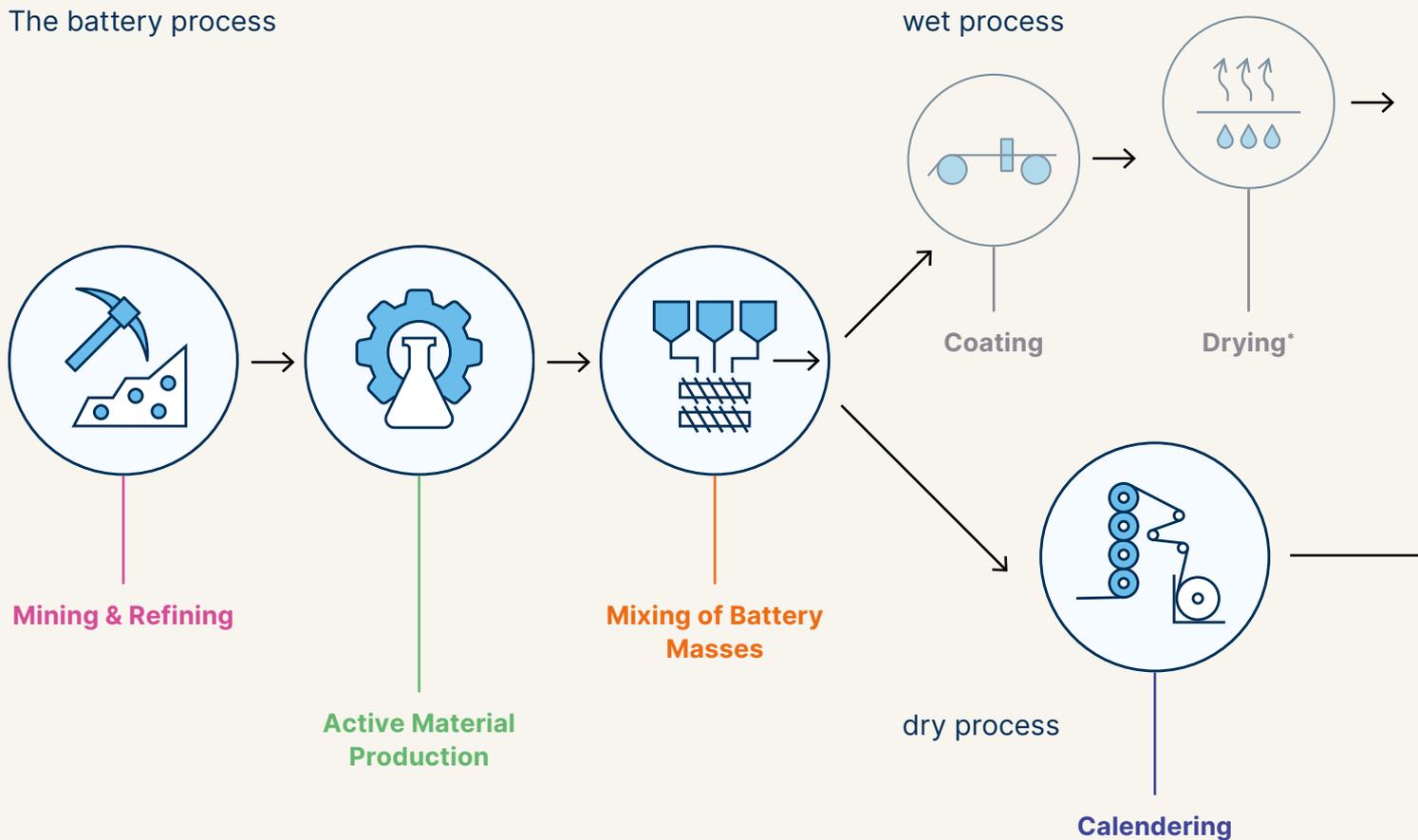
## **The Coperion difference**

- Innovative technologies and processes for optimizing battery manufacturing: high-performance extruders, high-accuracy feeding solutions, optimized conveying systems as well as thermal processing, air filtration/dust collection, sifting, milling and grinding solutions
- Comprehensive systems from a single source: each step is harmoniously integrated, resulting in significantly fewer interfaces
- First-class components and key technologies
- Years of experience in planning, engineering and implementing containment-secure equipment and systems
- Tailored solutions to meet client-specific needs
- Comprehensive project management support for the systems we deliver
- Comprehensive process expertise for developing optimized recipes
- Highly sophisticated control solutions for the management and optimization of production lines
- 50 locations worldwide: we are where you are
- Test Centers located around the world
- Experienced process engineers support you both in-house and at your location
- Shape What Matters for Tomorrow: we help you produce mission-critical products for the future

# Comprehensive solutions: individual components to complete systems for efficient battery manufacturing

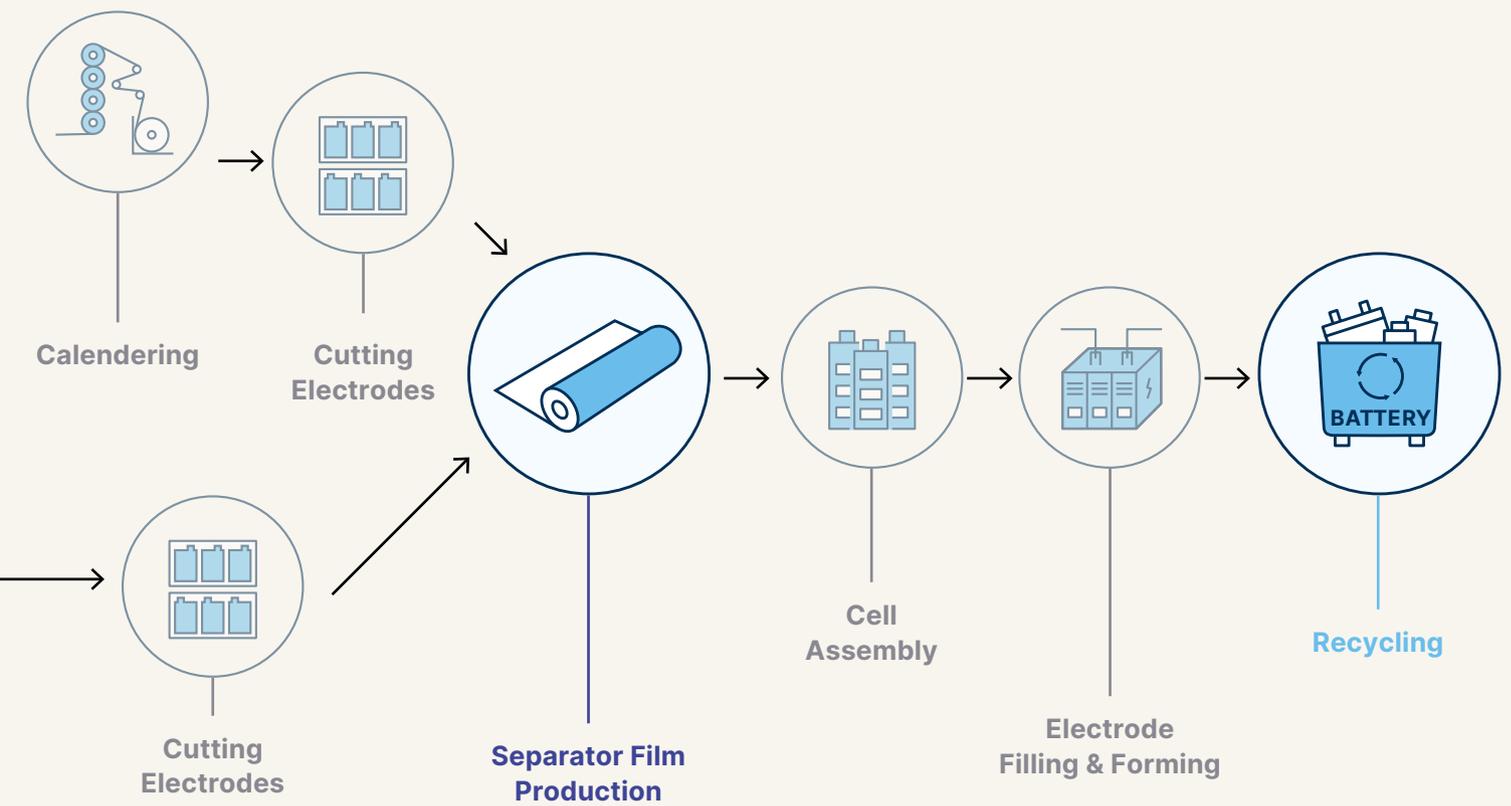
Coperion offers an extensive range of products, allowing us to provide equipment and system solutions for various stages of battery manufacturing. We specialize in feeding, conveying, mixing, milling, dust collection and extrusion, ensuring efficient production in the battery processes of mining & refining, active material production, mixing of battery masses, battery separator film production, and battery recycling.

## The battery process



\*This step is omitted in the dry process

○ Coperion offers reliable solutions for these process steps



# Individual plant concepts and customized systems

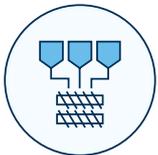


## Mining & Refining

Coperion designs and implements complete systems for various stages of battery manufacturing. In mining and refining as well as active material production, Coperion provides **entire transfer systems** where all process steps are seamlessly integrated.



## Active Material Production

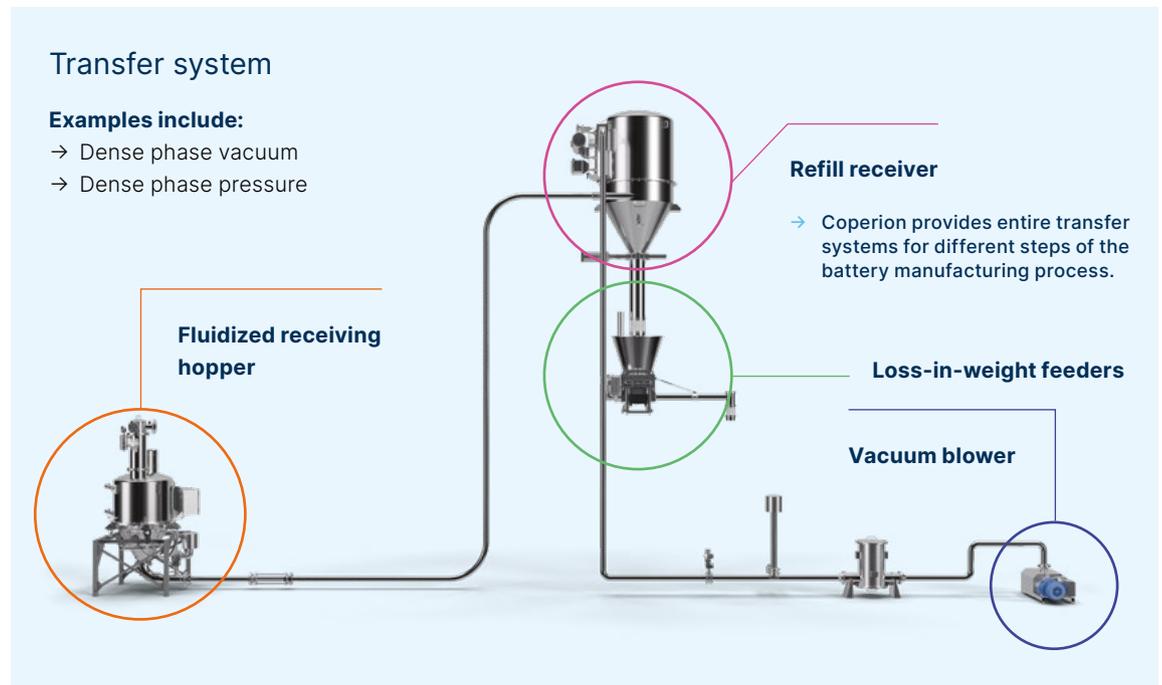


## Mixing of Battery Masses

### Transfer system

#### Examples include:

- Dense phase vacuum
- Dense phase pressure

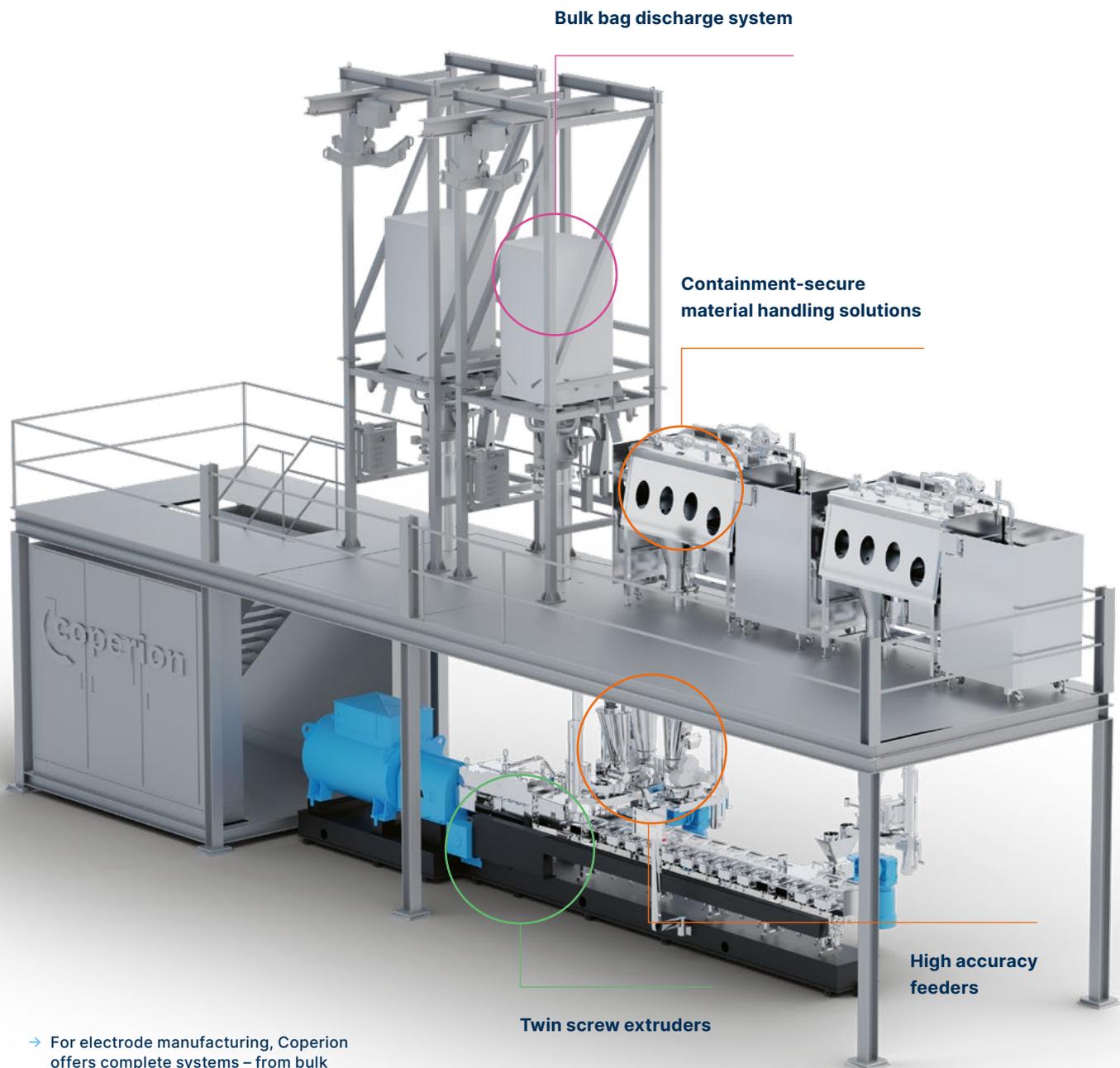


## Why individuality is key to your success

We design and implement all equipment and systems with the utmost professionalism, focusing on reducing complexity and minimizing interfaces for you. Our project managers are dedicated to delivering your equipment on schedule, efficiently coordinating multiple contacts and processes. Transparency and targeted communication are the cornerstones of effective teamwork.

When it comes to **electrode manufacturing**, Coperion offers complete solutions from a single source - including raw material handling, conveying, feeding, extrusion, mixing of battery masses via extruder as well as downstream slurry and dry battery electrode mixture handling.

Many years of experience and comprehensive process expertise in the areas of system planning, development and realization make us your ideal partner. We ensure that a suitable containment concept, up to OEB level 4, is developed, planned, and implemented for the entire system.



→ For electrode manufacturing, Coperion offers complete systems – from bulk material handling to feeding and extrusion.

# Bulk material handling and processing solutions



## Mining & Refining

Coperion offers an extensive selection of bulk material handling and dust collection systems that allows us to deliver comprehensive equipment solutions across multiple stages of battery manufacturing.

### Pulverizing systems: size reduction and classification

Designed for drying, pulverizing and classifying materials.

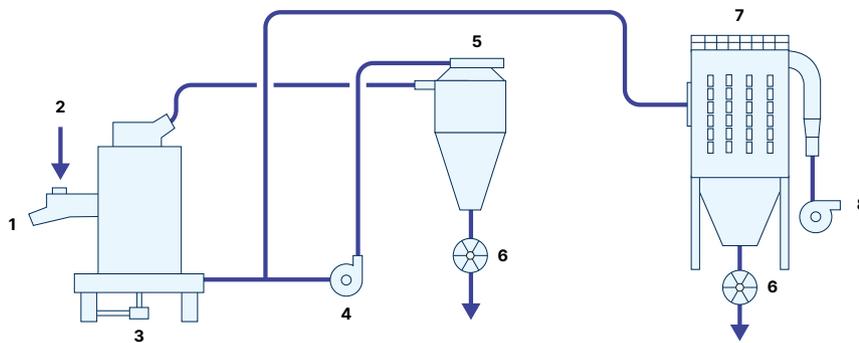
- Offers efficient control of product size with minimal power consumption
- Provides maximum flexibility and control over milling variables
- Custom tailored to meet your specific processing application needs



## Active Material Production



## Recycling



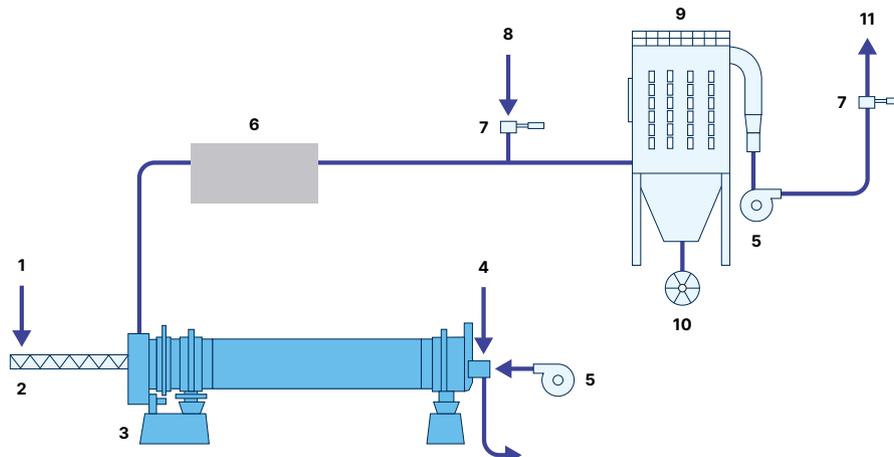
### Lithium Application Typical Pulverizing System

- 1 Feeder
- 2 Feed from upstream process
- 3 Roller mill
- 4 System fan
- 5 Cyclone
- 6 Rotary valve
- 7 Filter
- 8 Fan

### Thermal processing: calcining / kiln systems

Ideal for high temperature processing of granular products and powders.

- Known for high online availability and operational integrity
- Offers an extensive range of systems, components and services



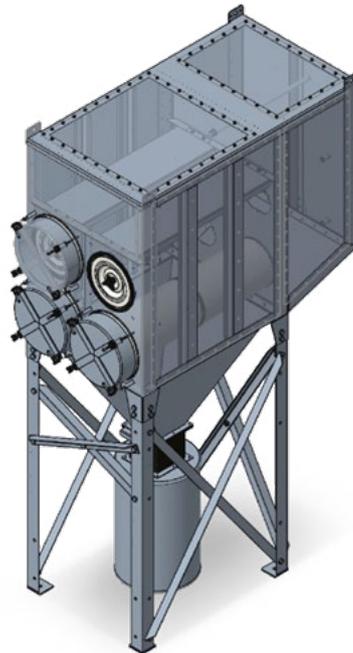
### Lithium Application Typical Thermal Process

- 1 Feed from upstream process
- 2 Screw conveyor
- 3 Calciner
- 4 Fuel
- 5 Fan
- 6 Process gas treatment equipment (scrubber, cooler)
- 7 Damper
- 8 Tempering air
- 9 Filter receiver
- 10 Rotary valve
- 11 Vent to atmosphere



## Mac2Flo® Dust Collector

- Reduced installation, maintenance and inventory costs
- Modular design reduces initial capital cost, and eases future expansion
- Compact design takes up less floor space
- Ultra high efficiency MEGABond filter media is standard
- Cartridge life is lengthened with optimized air distribution



### Filtration systems

Pulse jet filters for dust collection applications.

- High efficiency dust removal systems
- Bags are easily removable for routine maintenance



### Sifting technologies

Industrial units for powder and granule processing.

- Effectively removes fines and extraneous material
- Diverse range of centrifugal sifters and flat deck screeners available
- Easy disassembly for simple cleaning
- Removable screens for inspection and maintenance
- High efficiency designs minimize inspection, cleaning and maintenance time
- Units available that are ideal for black mass separation in recycling



### Milling & grinding solutions

High energy grinding solutions for producing ultra-fine powders and material size reduction in conveying systems, e.g., air classifier mill, cone mill.

- Temperature-controlled and gentle grinding
- Consistent output with tight particle size distribution
- Uniform size distribution minimizes fines generation
- Low dust levels eliminate the need for air filtration
- Ideal for sizing in both wet and dry granulation processes



### Bulk bag discharge system

Bulk bag frame designed for complete bag emptyings.

- Agitation mechanism to eliminate material bridging and promote full bag discharge
- Features two agitation paddles and two pivoting paddles for optimal bag support
- Modular design allows for easy customization and compatibility with existing systems

# Pneumatic transfer systems



## Mining & Refining

Coperion designs and supplies open and closed loop pneumatic conveying systems. Whether transferring battery grade lithium powder from a dryer to a storage silo, from a silo to packaging equipment, or to a bulk truck, we provide complete transfer solutions.

Coperion custom designs the ideal conveying solution for each individual plant. Manufacturer requirements and layout parameters are taken into account during planning as are the properties of the bulk materials, conveying lines, and the materials of construction of the used key technologies.

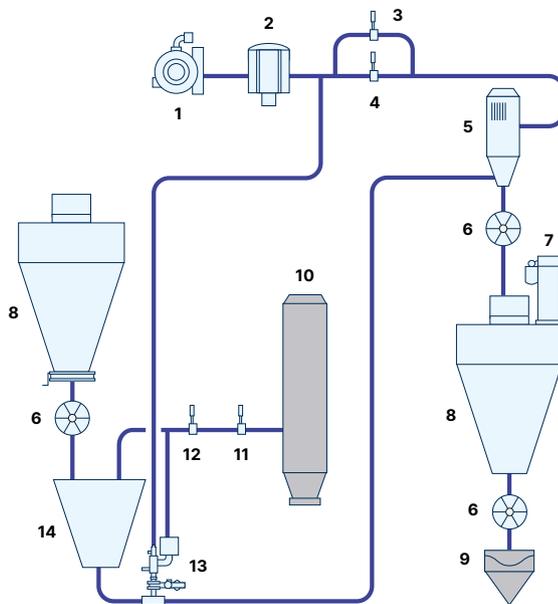


## Active Material Production

→ Lithium hydroxide/lithium carbonate storage & transfer system



## Recycling



- 1 Vacuum pump
- 2 Inline filter
- 3 Butterfly valve
- 4 I/P ball valve
- 5 Filter receiver
- 6 Rotary valve
- 7 Bin vent
- 8 Work bin
- 9 Mixer
- 10 Conditioned air accumulator tank
- 11 Shut off valve
- 12 Pressure regulator
- 13 Valve
- 14 Pickup hopper

Process step covered by Coperion



## Advanced technology solutions

➤ Enhanced Dilute Phase Conveying (EDIP) technology optimizes blower speed to minimize energy consumption while maintaining desired conveying velocities. This innovative approach results in significant energy savings and reduced wear on system components.

E-finity® Dense Phase Pneumatic Conveying: Designed for fragile materials and allows for efficient and gentle material handling, making it particularly effective for granular and pelleted materials used in battery production.



### Rotary valves and diverter valves

First-class handling for first-class products: Coperion's high-performance rotary and diverter valves ensure gentle, reliable and economical ingredient handling. Manufactured with appropriate materials for wear protection, they ensure high machine longevity. Also suitable for use in containment-secure systems.

### Pneumatic conveying

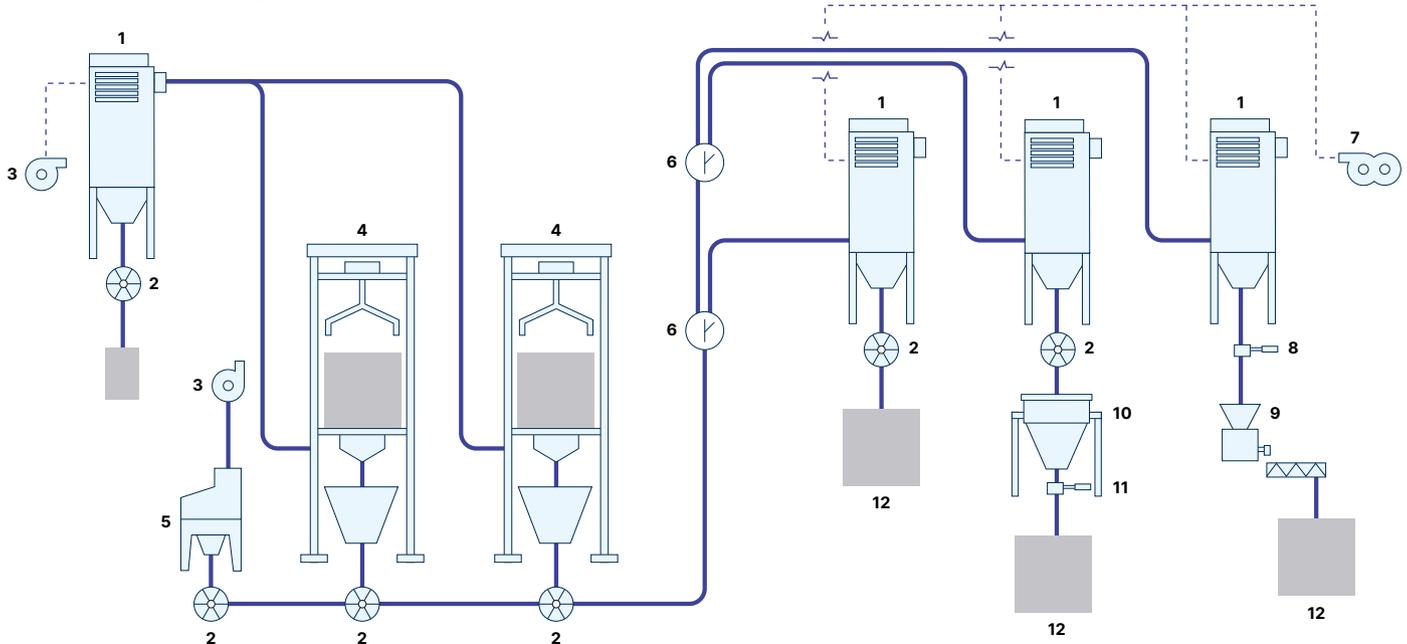
Dilute or dense phase conveying of bulk materials

- Dilute phase pressure or dilute phase vacuum capabilities
- Enhanced dilute phase conveying reduces power consumption, material degradation and system wear
- Dense phase conveying minimizes material breakage and improves energy efficiency
- Operate multiple systems from a single air source
- Conveying over long distances via dilute phase solutions

### Vacuum dense phase conveying

Vacuum dense phase is the ideal conveying technology for light to medium weight materials, that are friable, abrasive or fluidizable. It is applicable for short to medium convey distances. It combines the flexibility and capital cost of a vacuum dilute phase system with minimized degradation of a dense phase system.

#### → Typical additive handling system



#### Typical additive handling system

- |                   |                     |                    |                |
|-------------------|---------------------|--------------------|----------------|
| 1 Filter receiver | 4 Bulk bag unloader | 7 Vacuum blower    | 10 Weigh scale |
| 2 Rotary valve    | 5 Bag dump station  | 8 Knife gate valve | 11 Slide gate  |
| 3 Fan             | 6 Diverter valve    | 9 LIW feeder       | 12 Mix tank    |

# Twin Screw Extruder: continuous manufacturing of battery masses for greater efficiency



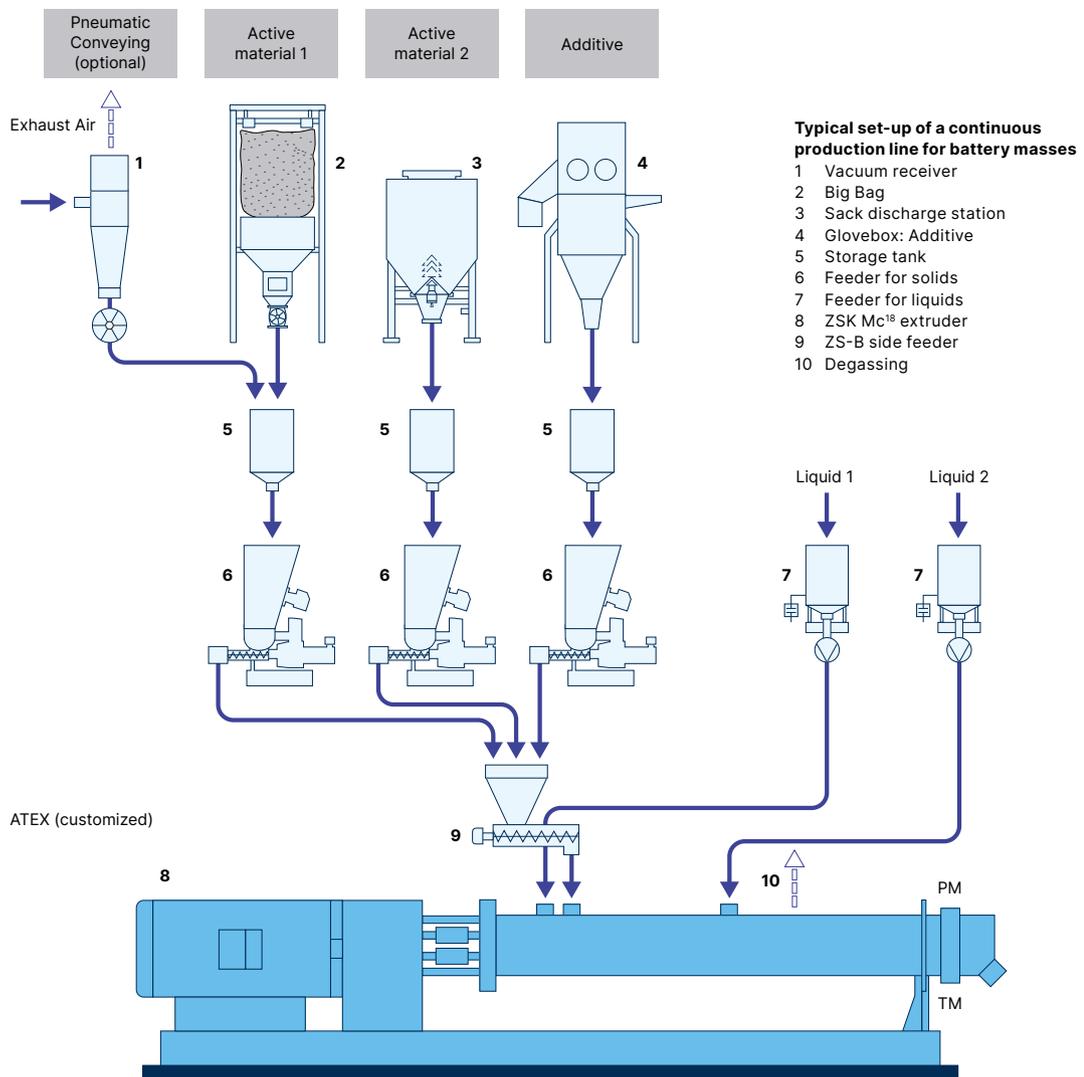
## Mixing of Battery Masses

Continuous production of battery masses using extruder technology can significantly optimize the Li-ion battery manufacturing process. The Coperion twin screw extruder, paired with high-accuracy Coperion K-Tron feeders, delivers high process stability and precision, ensuring excellent and reproducible end product quality. Our systems are highly reliable and designed for a long service life. Greater material efficiency as well as more cost-efficient battery cell production can be achieved using continuous production in comparison to conventional batch processes.

Coperion's ZSK Mc<sup>18</sup> or STS Mc<sup>11</sup> twin screw extruder is the ideal extruder for maximum reliability and profitability, achieving the highest quality and meeting tar-

geted requirements. It offers highly dispersive mixing capacity, breaking up solid agglomerates very effectively. Subsequent distributive mixing ensures the homogeneity required for high end product quality in battery masses.

The process sections of all Coperion extruders feature a modular design which allows our process engineers to tailor the configuration of the barrel and screw elements to your individual application. Additionally, the intermeshing twin screws of the extruder deliver consistently high conveying efficiency together with an optimal self-cleaning function within the process section, which minimizes residual material in the extruder and reduces waste.

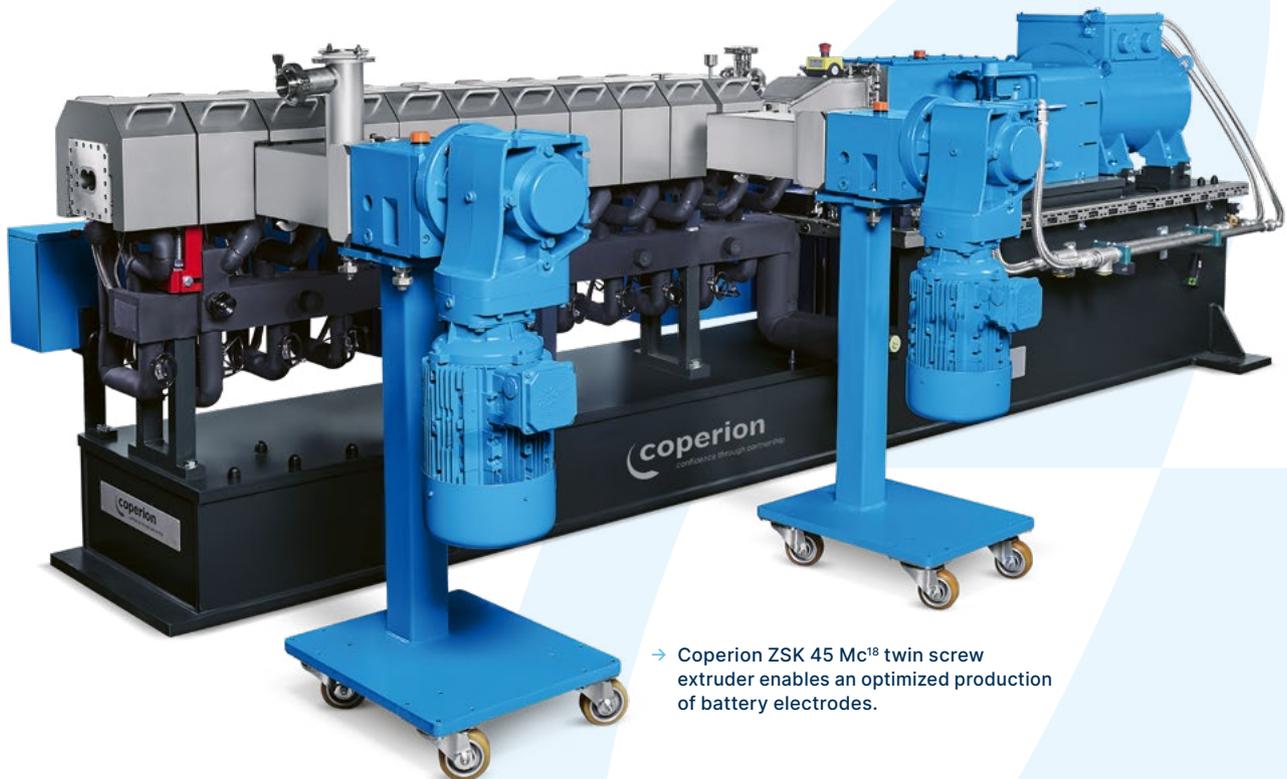




## Your advantages at a glance

- Increased profitability through reduced space and personnel requirements
- High reliability and availability minimizes downtime
- Tailor-made machine design and high flexibility for changes in recipe or production processes, thanks to a modular process section

- Extrusion allows for climate-friendly recipes with high proportions of solid content or dry processing of electrode masses
- Reduced cleaning times and greater material efficiency due to self-cleaning function of screw elements
- Precise dispersive and distributive mixing for superior homogeneity and excellent product quality

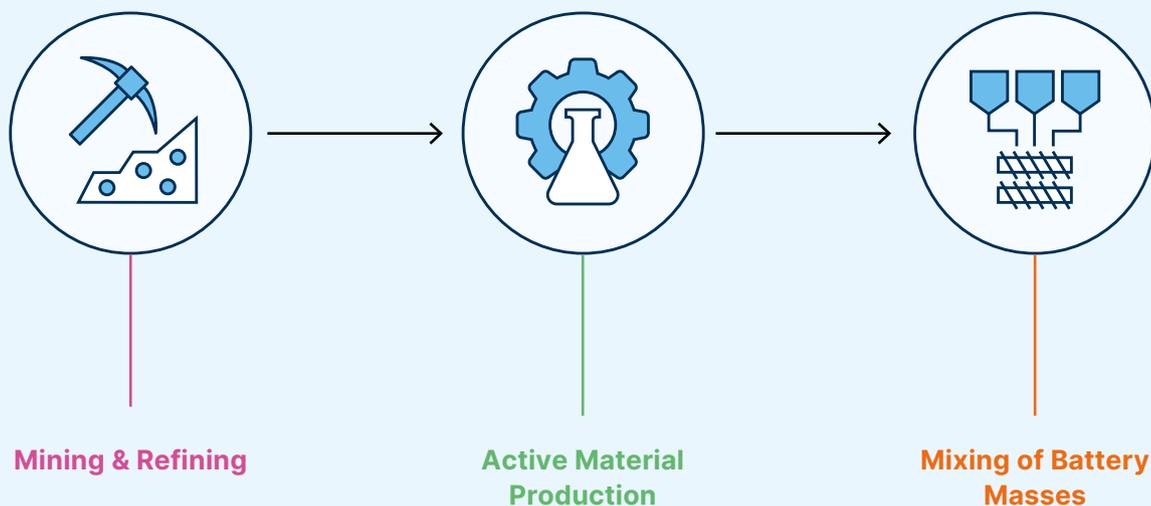


→ Coperion ZSK 45 Mc<sup>18</sup> twin screw extruder enables an optimized production of battery electrodes.



→ The process section's modular construction allows for flexible and individual modifications to recipes and process requirements.

# Dry coating process for battery electrode manufacturing



## Environmentally friendly, energy-efficient and space-saving

The dry coating process eliminates the need for solvents and water, as well as the energy-intensive drying step. After mixing, the powdery coating material is directly fed into a calender to create a thin sheet which is later applied to the electrode film. This approach not only enhances environmental performance and energy efficiency but also reduces costs and space requirements.

## Continuous manufacturing of dry coated electrodes for greater profitability

For the dry coating process, the continuous process using twin screw extruder is particularly fitting because it allows for simultaneous fibrillation of special binders and homogenization of raw materials. The shorter residence time in the extruder as well as the flexibility in applying thermal energy to the product or removing it from the product by controlling the temperature of individual barrel elements are but a few more advantages of this technology.

The binders used in the dry process require special temperature control throughout every stage, from conveying and feeding to mixing and handling the coating mass. It is essential to maintain specific

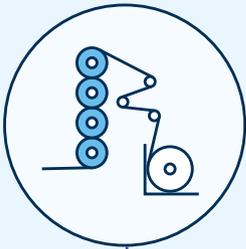
temperature windows during these processes. To address this need, Coperion provides specially designed equipment that ensures both the handling and feeding of the binder into the mixer occur at defined temperatures.

The unique new Coperion K-Tron roller feeder RF400 has been specifically developed for the dry coating process. It operates between the mixing stage and the calender, ensuring the homogeneous mass is distributed continuously and evenly within the calender gap, maintaining consistent thickness of material across the entire width of up to 400 mm. The RF400 is ideal for laboratory or pilot lines.

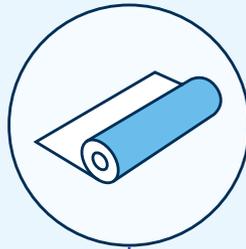


## Your advantages at a glance

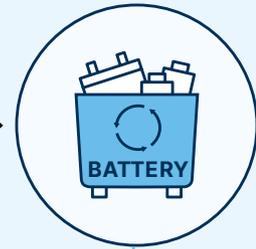
- Cost-effective process by eliminating the energy-intensive drying step and reducing space requirements
- More sustainable production by eliminating chemical solvents
- Improved capital and operational expenditures



**Calendering**



**Separator Film  
Production**



**Recycling**

### Unique new technology for precise active coating material delivery

The Loss-in-Weight Roller Feeder RF400 is a precise gravimetric device designed for continuous feeding of dry electrode coating powder blends directly into the calender gap. Featuring high-accuracy Smart Force Transducer (SFT) weighing technology and a unique dual roller system housed within a compact enclosure, this feeder ensures gentle and consistent material handling.



# Coperion feeding solutions

## Tailored to your needs



### Mining & Refining

Coperion delivers comprehensive process expertise and reliable feeding solutions, even for challenging and hazardous materials. We offer a wide range of feeding solutions tailored to a variety of process steps and material requirements. Our volumetric and gravimetric feeders are distinguished by their exceptional accuracy, excellent accessibility and easy-to-clean designs.

### Feeding solutions for solid ingredients

Our high-accuracy loss-in-weight feeders are ideal for precise, safe and reliable feeding of even the most difficult flowing ingredients used in electrode compound manufacturing.



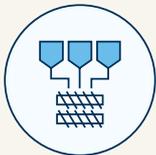
### Active Material Production



→ Coperion MechaTron® Feeder



→ Coperion K-Tron high-accuracy loss-in-weight feeders



### Mixing of Battery Masses



### Recycling



### Your advantages at a glance

- High recipe precision: Achieve continuous feeding accuracy thanks to the latest weighing and control technologies, ensuring optimal end product quality and material efficiency
- Flexibility: easily adapt to different materials by changing the screw profile
- Safe handling: OEB3 and OEB4 level solutions available for safe process material handling
- Easy maintenance: quick disassembly for efficient cleaning and maintenance
- Robust design: built to withstand harsh environments

### Feeding solutions for liquid ingredients

Coperion liquid feeders provide for the safe addition of fluids such as binders and solvents. Their modular design includes a diverse range of pumps and tanks that can be combined to create an optimal solution. Selecting the right pump for the fluid being metered is crucial, particularly when dealing with unique viscosities or dispersions. The feed pump is chosen based on the material to be fed and the required feed rate. Coperion liquid loss-in-weight feeders meet the same high standards for accuracy, containment, and cleaning options as our solid material feeders.

# The right technology for optimizing the entire process

## Intelligent weighing technology

Our advanced vibrating wire technology provides high-accuracy weighing, even in challenging plant environments. The dynamic filter algorithm continuously identifies and removes disruptive mass components from weight measurements.

## Electronic pressure compensation

An efficient yet simple electronic solution for reliable, continuous pressure compensation in the feed hopper or at the feeder outlet.

## Flow aids

Depending on the feeder configuration and bulk material involved we offer a variety of solutions to keep the bulk material flowing. From flexible-walled hoppers to the vibrating ActiFlow bulk solids activator, our flow aid solutions effectively prevent bridging of poorly flowing and cohesive materials in feeder hoppers.

Shown here, ActiFlow is mounted on the exterior of the stainless steel hopper, with no product-contact parts, and emits gentle vibrations onto the hopper wall. It gently activates the bulk material inside with the optimal amplitude and frequency.



# Coperion test centers: optimizing your processes safely

Our state-of-the-art facilities offer extensive opportunities to test various process steps in battery manufacturing. These facilities serve as the ideal platform for evaluating changes or innovations to your products or recipes. Our experts support you in designing processes and technologies to achieve maximum product quality, safety and efficiency.

Our test centers are equipped to conduct tests with all common battery raw materials, and our experienced staff possess extensive expertise in simulation and scale-up.

## Test capabilities for battery manufacturing

### The following process steps can be tested in our test centers:

- Continuous extrusion of battery masses
- Pneumatic conveying and bulk material handling
- Feeding
- Pulverizing, classifying and thermal processing

### Your advantages at a glance

- ↗ Contained and controlled test environments for safely handling hazardous materials, and ensuring effective testing
- ↗ Assistance in answering critical process questions and identifying the optimal configuration of feeding and conveying equipment for your specific needs
- ↗ Comprehensive testing capabilities for the continuous extrusion of battery masses using both wet and dry processes
- ↗ A wide variety of equipment and systems available to meet diverse requirements

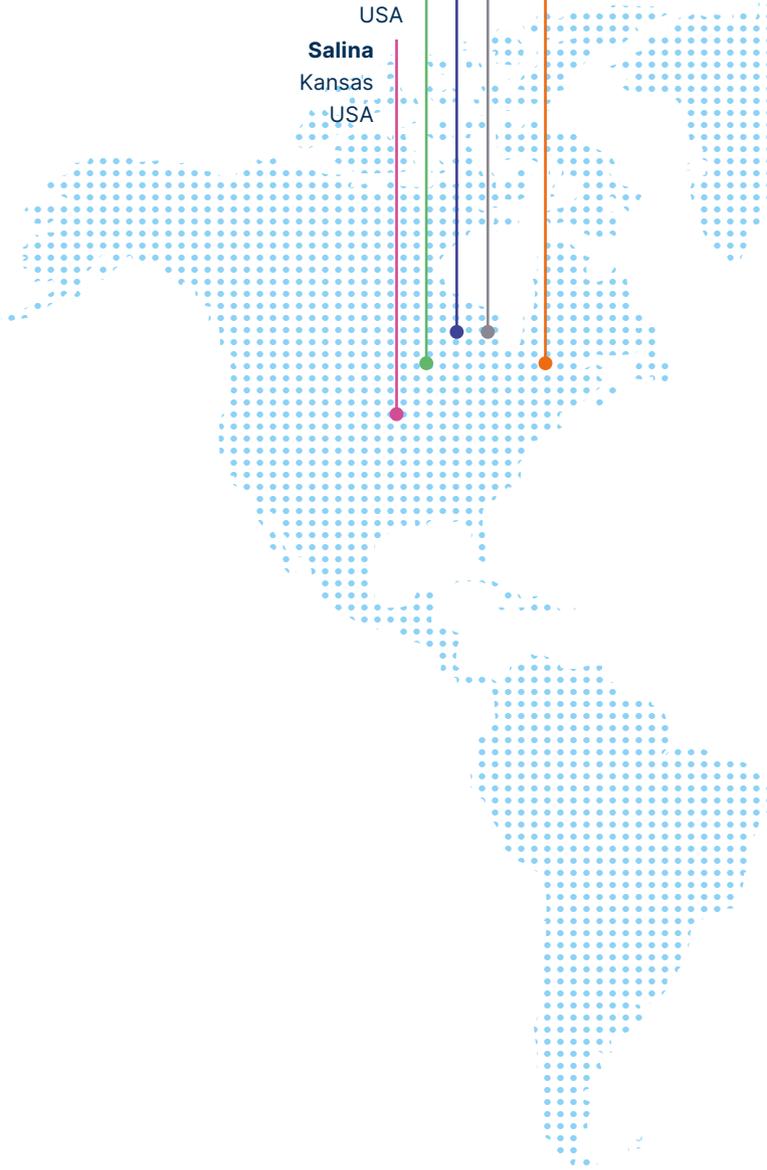
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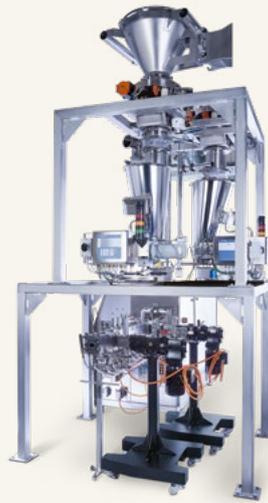
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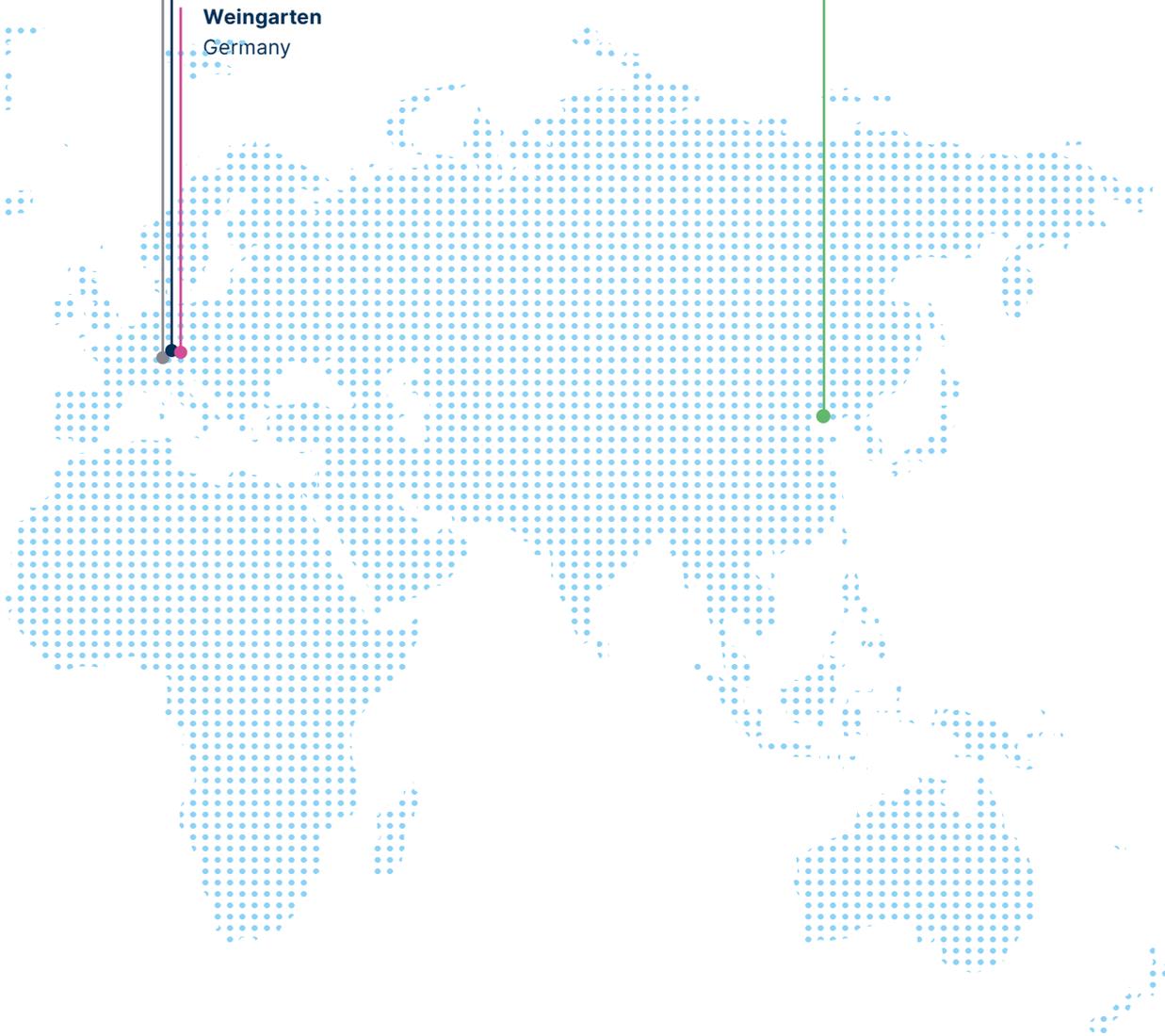


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