

## LITHIUM-ION BATTERY RECYCLING

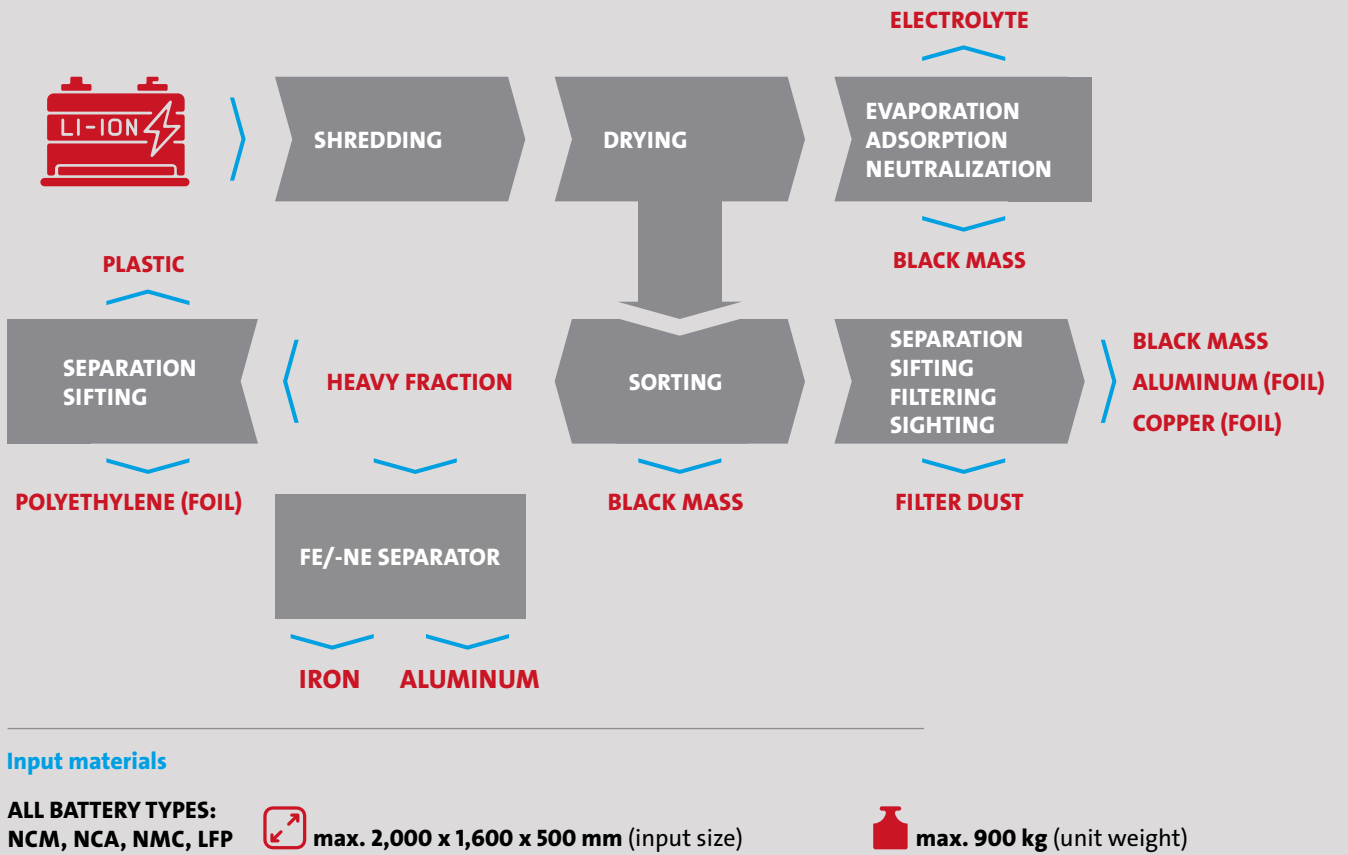


**INNOVATIVE TECHNOLOGY**  
FOR A SUSTAINABLE CIRCULAR ECONOMY

# FROM SCRAP TO RAW MATERIAL



# MAXIMUM RAW MATERIAL YIELD



## Efficient recycling of lithium-ion batteries

Electromobility is revolutionizing the way we get around. However, as the number of electric vehicles increases, so does the challenge of recycling their batteries in an environmentally friendly way at the end of their service life. Conventional recycling methods often reach their limits here, as lithium-ion batteries from electric cars are large, heavy and contain valuable raw materials. Our innovative recycling plant offers a sustainable and economical solution for safely and efficiently processing batteries with dimensions of up to 2,000 mm in length and a unit weight of up to 900 kg.

### Resource-saving process - ecological and economical

Lithium, cobalt, manganese and copper are essential raw materials for modern energy storage systems. However, their extraction is associated with considerable environmental and social challenges. An efficient recycling process helps to recover valuable materials and conserve natural resources. Our technology makes it possible to process used batteries completely mechanically - by

shredding, classifying, sorting and targeted evaporation of the volatile electrolyte components and subsequent re-liquefaction. The result: a safe, economical and sustainable solution for the recycling of valuable raw materials.

### State-of-the-art technology for maximum efficiency

Our multi-stage recycling process ensures optimum recovery of the raw materials contained in the batteries. The individual work steps - from safe discharge and mechanical shredding to precise separation and recondensation - have been specifically designed to maximize efficiency and environmental protection in equal measure.

**Safe discharge:** First, the residual energy remaining in the battery is reduced in a controlled manner to avoid potential risks such as short circuits or thermal reactions.

**Mechanical shredding:** The batteries are shredded in a specially designed process to ensure optimum material separation.

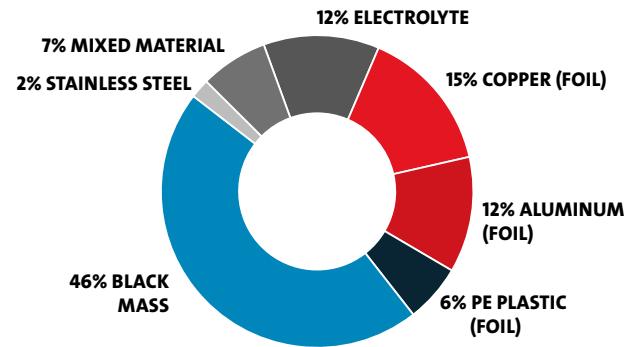
**Drying & recondensation:** The volatile electrolyte components are vaporized and then recondensed.

**Precise separation process:** Sifting, screening and classifying processes are used to cleanly separate the individual materials such as aluminum, plastics and copper.

**Recovery of the "black mass":** This contains the valuable coating materials of the electrodes, including lithium, cobalt and manganese.

With our state-of-the-art recycling technology, we are setting new standards in the sustainable recycling of lithium-ion batteries. **Efficient, safe and forward-looking - for an environmentally friendly circular economy.**

### Discharge fractions after processing:





**PROCESS DESCRIPTION**  
RECYCLING FOR  
LI-ION BATTERIES

**RETHINKING SUSTAINABILITY**  
EFFICIENT. SAFE.  
FORWARD-LOOKING.



**Step 1 & 2**  
**Unloading  
and disassembly**

- Loading the modules and packs onto lifting work tables for ergonomic pre-assembly
- Checking the batteries by specialists for residual voltage and, if necessary, discharging them to 0volts (maximizing fire safety)
- Disassembly of cables, plugs and solid parts
- Transfer of the prepared batteries via the feed roller conveyor to the fully automated recycling process

**Step 3**  
**Pre-shredding  
and separation**

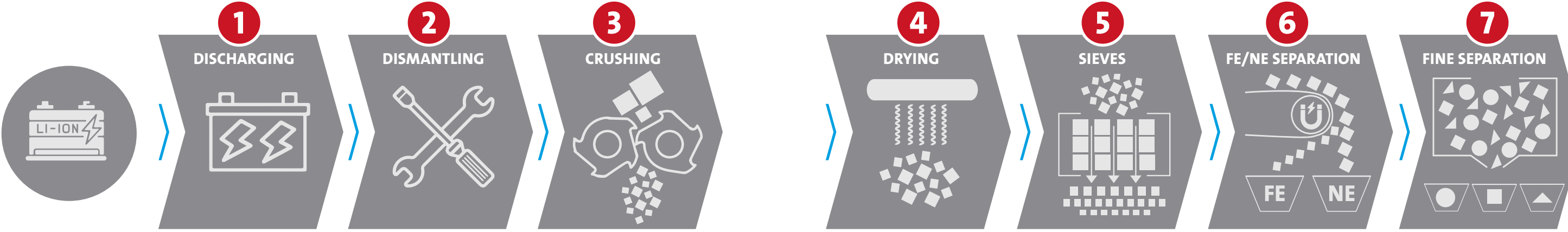
- Batteries and accumulators are fed into the inert system via an airlock
- Inerting is carried out by nitrogen system operation from an oxygen content of < 3% in the entire inerting system (monitored by oxygen sensors)
- The first stage of shredding takes place via a twin-shaft shredder with a final piece size of 50 x 100-150 mm
- The material is then conveyed for secondary shredding and shredded to a determinable particle size

**Step 4 , 5 & 6**  
**Drying, sifting  
and metal separation**

- Drying takes place in discontinuous vacuum operation
- An agitator in the vacuum dryer prevents the material from caking
- The dried shredded material is fed into an air separator, which separates light and heavy material
- The light material, mainly consisting of plastic, aluminum/copper foils and black mass, finds its place in the buffer container after being finely shredded again
- The heavy material is discharged separately to separate ferrous metals and non-ferrous metals from mixed materials, such as internal wiring and coarse plastics

**Step 7**  
**Fine processing  
and separation**

- For further processing, the material is fed from the buffer container to a sifting machine
- The screened fine fraction consists of black mass and is filled into BIG BAGS
- The coarser fraction, consisting of mixed plastic/aluminum/copper foils, gets finely in a rounding mill
- In a last sifting machine combined with air separation unit the plastic films, the rounded aluminium/copper foils, and the remining black mass get separated
- An additional air separation unit allows the separation of rounded aluminium and copper foils



**Discharge fractions:**

<b>LARGE PARTS</b>	<b>ELECTROLYTE</b>	<b>BLACK MASS</b>	<b>STEEL NON-FERROUS MATERIAL MIXED MATERIAL</b>	<b>SMALL PARTS</b>
CABLES ELECTRONICS STEEL ALUMINUM		NICKEL MANGANESE COBALT LITHIUM GRAPHITE		ALUMINUM AND COPPER FOILS (SPHERICAL) PLASTIC FOIL (INSULATOR) BLACK MASS



## VARIOUS MACHINES AND SYSTEM CONCEPTS FOR BATTERY RECYCLING

## TURNING OLD INTO VALUE – THE SMART SOLUTION FOR MORE ADDED VALUE



### Efficient battery recycling at the highest level

With the rapid development of lithium-ion batteries, the demand for rare metals such as cobalt, manganese, nickel and lithium is also increasing enormously. As these resources are limited, recycling from returned batteries is becoming increasingly important.

Thanks to our extensive range of machines, which includes various shredding technologies such as single and twin-shaft machines, hammer mills and special solutions, we offer tailor-made system concepts for different requirements. From simple solutions in dry or wet processes for battery processing to large-scale complete systems for complete material separation, we supply the right technology.

Our machines and systems are designed for throughput rates of 50 kg to 5 tons per hour and enable efficient and sustainable recovery of valuable raw materials.

#### Technical features of ERDWICH lithium-ion battery shredders:

##### ■ Delivery & unloading

Modules and complete packs are delivered on conveyor lines without prior disassembly. A specialist checks the residual voltage and, if necessary, discharges them to 0volts for maximum fire safety.

##### ■ Pre-shredding & separation

In a nitrogen-inert environment, the battery packs are first shredded to 50 x 100-150 mm using a twin-shaft shredder and then further processed to a definable piece size.

##### ■ Drying & sifting

An air classifier separates light and heavy materials. Magnetic and eddy current separators separate ferrous and non-ferrous metals, while aluminum and copper foils with black mass adhesion as well as foil material are prepared for further processing.

##### ■ Final separation & processing

Multi-stage sifting separates black mass, metals and plastics with maximum purity for recycling.

#### Safety & sustainability

High-performance filter systems ensure dust-tight processing and avoid health risks for workers.

To avoid the risk of fires and explosions, the system works with controlled nitrogen inertization. ERDWICH was able to draw on its many years of experience in e-waste and hazardous waste recycling. By precisely controlling the nitrogen supply, the oxygen content is kept constantly below 3% to prevent thermal runaway (exothermic reactions).

However, ERDWICH also offers wet processing systems in which the material is bound in a liquid, usually water, during the shredding process. This prevents the risk of fire and explosion and minimizes the release of dust. The optimum processing technology is always selected on a project-specific and application-oriented basis in order to achieve the best results for the respective recycling process.

#### Unique selling points & future prospects

The high process reliability and efficiency of the system are particularly appreciated. With this solution, ERDWICH is setting new standards in the industry and positioning itself as a technology leader in the field of safe and sustainable battery recycling. The increasing demand for recycling solutions for lithium-ion batteries shows: This is a market with enormous future potential – and ERDWICH is ideally prepared for it.

#### The advantages at a glance:

- Processing of complete battery packs without prior dismantling up to 900 kg unit weight
- Flexible adaptation to different battery sizes
- High purity of the separated fractions for optimum recycling
- Modular system enables future adaptations to new requirements in battery technology



**Further areas of application:**

- E-scrap- cooling appliances
- substitute fuels
- cardboard
- hazardous waste
- Aluminum processing
- and much more.

**Core competencies:**

- Hammer mills
- Shredding machines
- Plant construction service

**Innovation is our standard!**

As a highly specialized engineering and production company with over 30 years of experience, ERDWICH offers exceptional services in recycling and shredder technology. Shredding machines, special solutions, complete recycling plants and worldwide service are our core competencies, to which our team is enthusiastically committed every day.

Owner-managed, with personal, intensive support, short response times and comprehensive service, we provide you with first-class quality made in Bavaria. Get to know us.

**A warm welcome to you!**



**Take your chance and test your material without obligation at the ERDWICH test center.**

**We look forward to hearing from you.**

**ERDWICH ZERKLEINERUNGS-SYSTEME GMBH**

Gewerbestraße 6  
D-86859 Igling

Tel.: +49 (0)8191 - 96 52 - 0  
Fax: +49 (0)8191 - 96 52 - 16  
E-Mail: [info@erdwich.de](mailto:info@erdwich.de)

**[www.erdwich.com](http://www.erdwich.com)**