

RAW MATERIAL RECOVERY WITH LITHIUM-ION RECYCLING

New process increases safety
and efficiency

TRANSFORMING
MATERIALS INTO VALUE



Batteries and accumulators are popular worldwide for renewable energy storage. But as production increases, so does the need for recycling methods. These methods should both recover the maximum amount of raw materials while ensuring the highest level of safety for people and the environment. BHS-Sonthofen has developed a novel mechanical recycling process for lithium-ion batteries: Lithium, nickel, cobalt, manganese (NMC), and the other components of the batteries can thus be recovered efficiently and in an environmentally friendly manner. Safety is of utmost importance. This is ensured by the inert process in a protective atmosphere – which also consumes considerably less energy.

Advantages

- ✓ Standardized process solution in a modular design for different throughputs and feed materials
- ✓ Highest process reliability in compliance with applicable occupational safety standards and environmental regulations
- ✓ Maximum recovery rates for black mass and highest purities for generated output fractions
- ✓ Global service

INNOVATIVE PROCESSES AND TECHNOLOGIES

The recycling process in detail.

1 & 2 | Crushing stage

The process starts with crushing the input material. This is a one or two-stage crushing process depending on the size of the input material. A pre-shredding system in the form of a rotary shear (VR) in a gas-tight design from BHS is used for processing battery modules and packs: the first stage of shredding. For shredding battery cells or production waste, the gas-tight universal shredder (NGU) is perfectly suited. This also forms the second stage when pre-shredding is required. Using the universal shredder lays the foundation for the highest black mass recovery rates during the shredding process. At the same time, minimal contamination is ensured by optimum disintegration of the material to be crushed. A homogenizer then collects the output material and ensures uniform distribution of the different materials. Large portions of the electrolyte already evaporate during shredding and in the homogenizer without the addition of drying energy, which leads to a significant reduction in energy consumption compared to other processes.

3 | Drying stage

In the second process stage, drying, the shredded material is gently dried slowly and at low temperatures in a horizontal dryer from BHS-Sonthofen. A large proportion of the remaining electrolyte evaporates in the process. This is condensed back and discharged in the downstream vacuum and condensate unit. Special cleaning cycles using the condensed electrolyte reduce the maintenance intervals of the components contained to a minimum.

Gas cleaning stage

In the gas cleaning stage, the exhaust gas streams generated during drying or evaporation are cleaned. In this process, a gas scrubbing plant with downstream activated carbon absorber breaks down remaining impurities in the gas flow before it is released into the atmosphere. All requirements for limit values within the EU are met with the BHS process.

4 & 5 | Sorting stage

Depending on customer requirements for target fractions, BHS-Sonthofen adds sorting to the process after the drying or gas cleaning stage. This separates the output material from the dryer into individual fractions using screens as well as air and magnetic separation technology. The recovered aluminum, copper, and plastics are returned to primary raw material production. For further hydrometallurgical processing, the produced black mass is optimally prepared. The main components of the separation technology, such as screens, sifter, and separating tables, are also produced by BHS. Screen sections are individually adapted or optimized according to the input material on the basis of internal BHS empirical values or specific test data. Adjustment options of the separating tables allow individual adaptation to the different feed materials and thus optimized separation of the output material into light and heavy fractions, even during ongoing plant operation.

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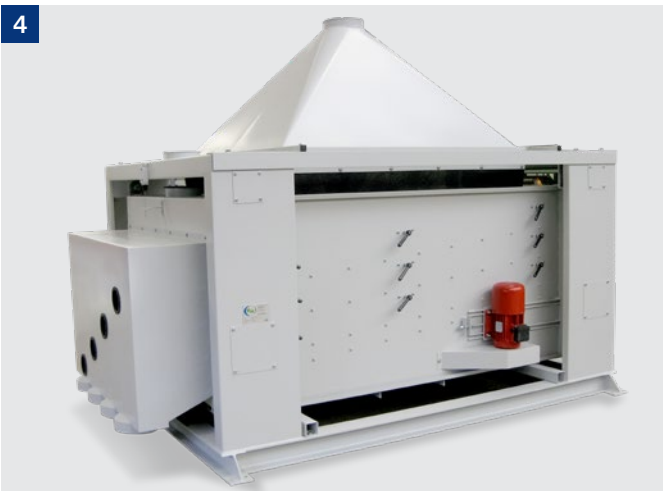
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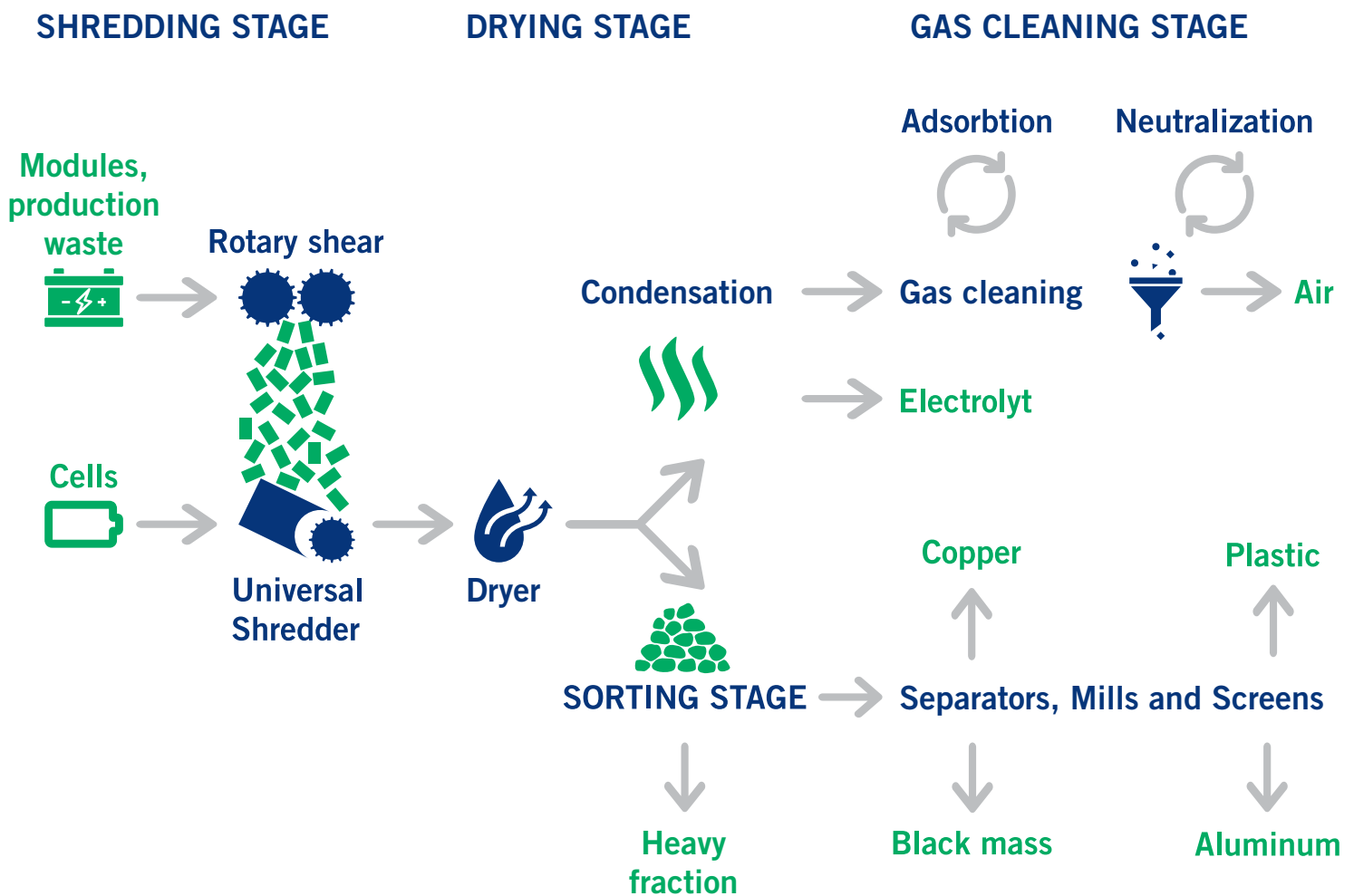
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MAXIMUM RECYCLABLE MATERIAL RECOVERY

Sustainably. Safely. Efficiently.

BHS-Sonthofen’s standard process for recycling lithium-ion battery modules, packs, cells, and production waste is based on a mechanical drying process in a protective atmosphere. The basic process consists of three main stages: crushing, drying, and subsequent gas cleaning. After drying and gas cleaning, BHS offers a sorting stage that is tailored to the various customer requirements in terms of output materials:



[Get more details](#)

[www.bhs-sonthofen.com/
battery-recycling](http://www.bhs-sonthofen.com/battery-recycling)

CORE COMPETENCIES FROM ONE SOURCE

Technical expertise and value creation for the process.

Process technology

Extensive process engineering experience in the field of recycling metalliferous composites, countless battery tests in the in-house test center, and resulting analyses and test evaluations. This is the basis for the highest process efficiency. The goal is high output quality and recovery rates with minimized operating costs.

Efficient plants with process reliability

Due to many years of plant engineering in the divisions of recycling and environment, process technology, and building materials machinery, reliable plant planning and realization is ensured, taking into account operational safety, time, and costs. Synergy effects in terms of project management experience in a wide range of industries make it possible to meet the highest customer requirements. Turnkey solutions come from a single source at BHS-Sonthofen, from tests to planning, production, procurement of plant components, expediting, acceptance tests, and installation, right through to final commissioning and trial operation on site. The development of a safe recycling process for lithium-ion batteries – using risk analyses, HAZOP studies, and ATEX know-how – is, in particular, based on the many years of experience in plant engineering and in-depth process know-how in the process technology division through cooperation with well-known EPCs as well as major customers from the chemical industry and the energy sector. In addition to reliable process development, the elaboration of a safe plant concept with regard to ATEX as well as environmental and workplace regulations was the greatest challenge. This is fully ensured by the BHS standard process.

Mechanical engineering

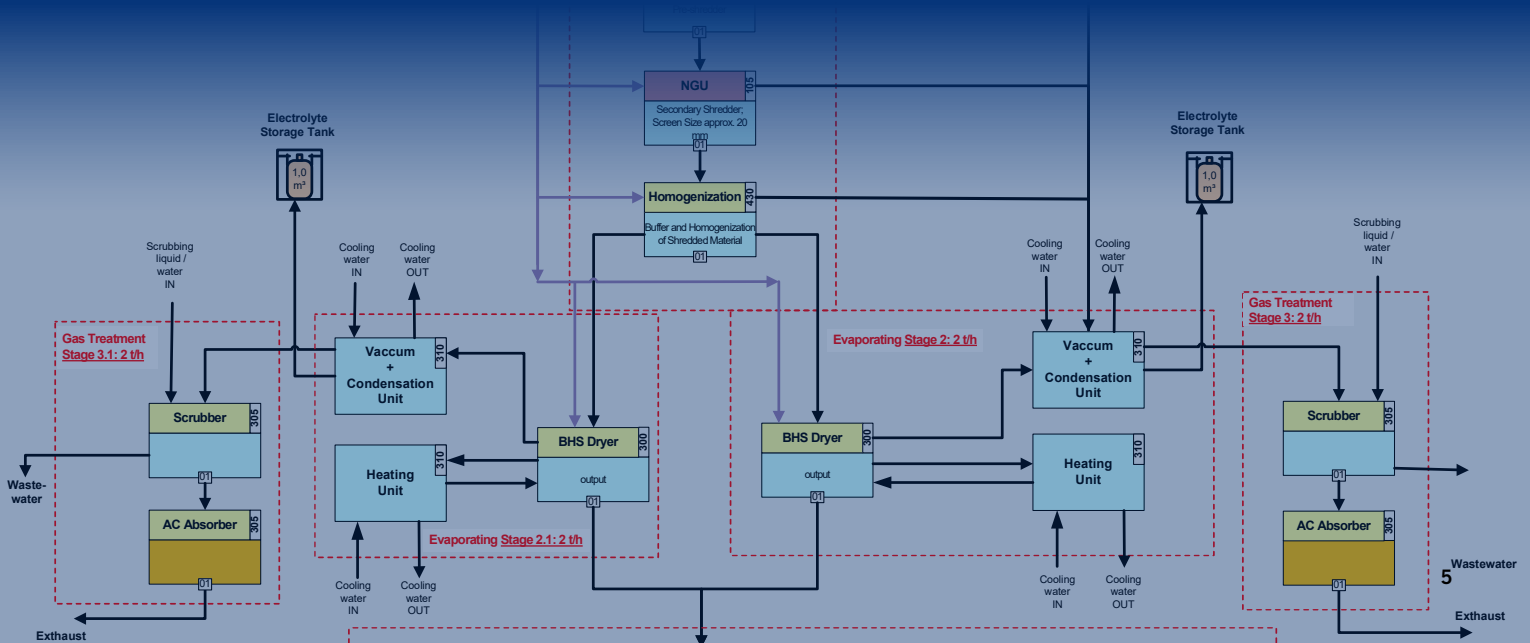
BHS-Sonthofen produces all important core technologies and plant components for the lithium-ion battery recycling process within the group of companies in order to maintain control of critical components with regard to quality and adherence to schedules.

On-site service

Even small parts can have a big impact if they break. BHS ORIGINAL PARTS meet the highest standards in terms of quality and are designed to work seamlessly with our machines and systems. Take advantage of the speedy delivery of 10,000+ wear parts available in stock and reduce your downtimes to a minimum.

Control engineering

The process control system is continuously further developed by the in-house control system division. Prefabricated recipes for various input materials, wear indicators, and traceability of input materials as well as IoT topics are thus developed within the BHS group of companies and integrated into plant control.



DEVELOPMENT AND INNOVATION

From tests in the test center to the reference plant at the customer site.

Large-scale tests to determine the design

The possibility of carrying out production-scale tests in the company's own BHS test center enables us to achieve an optimum process configuration in relation to individual customer requirements. Our two test facilities can be used to carry out both large-scale crushing tests in a protective atmosphere and sorting tests of the shredded material from which electrolyte has been removed. From production waste to battery cells to battery modules to battery packs, all common input materials in the field of lithium-ion battery recycling can be safely crushed in the inert shredding machines.


Testing possibilities at a glance

- Large-scale tests of the standard process with customer material on a production scale
- Individual tests of all process steps (crushing, drying, sorting, and gas cleaning)
- Top process reliability in an inert environment

Reference plants in operation worldwide

Through years of development and research in battery recycling, BHS-Sonthofen has commissioned a variety of lithium-ion battery recycling plants in recent years.

 [Get more details](#)

 [www.bhs-sonthofen.com/
recycling-test-center](http://www.bhs-sonthofen.com/recycling-test-center)

