

Duesenfeld - Ecofriendly Recycling of Lithium-Ion Batteries

Best Practices in Safety in Battery Recycling

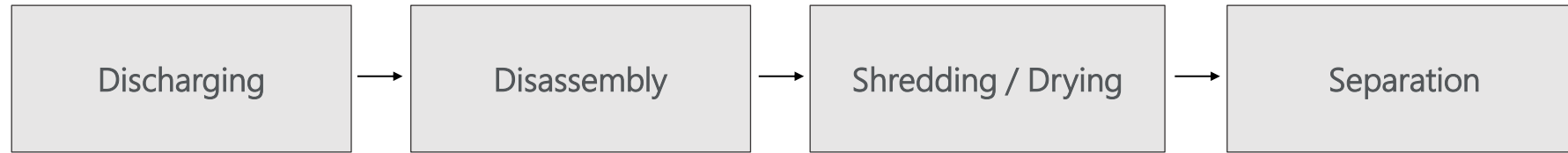
E-WASTE WORLD – Battery Recycling Expo | Frankfurt, June 18th, 2026



Company Introduction

Activity	R&D company focused on ecofriendly Recycling of Lithium-Ion Batteries. Established in 2016 application-related research and implementation on an industrial scale, specialist recycling company for Lithium-Ion Batteries
Business Model	Development of CO2 and cost-efficient recycling technologies, licensing of technologies and Know-How.
R&D Focus	Deep discharge, mechanical pre-treatment, direct recycling, direct re-use, chemical recycling (black mass processing and refining). R&D drivers: low CO2 footprint, safety, continuous improvement of recycling and recovery rates, development of recycling processes for new cell chemistries, reduce OPEX. Total R&D background: >15 years, R&D from laboratory to industrial scale – continuous development and implementation on an industrial scale.
Recycling:	Production in 3-shift operation with a capacity level up to 3,000 tons / year.

Risk Management



Compliance with all standard fire protection measures and safety regulations in accordance with legal requirements.

Safety – Hazard reduction

1. Electrical
2. Fire
3. Toxic gases
4. Dust

Electrical hazards

- Discharge as first step of the process
- Controlled deep electrical discharge (patent)
- Safe series connection: Low current – high voltage
- No cooling of the batteries necessary
- Automated short circuiting at 0 Volt
- Preventing reverse polarity
- Second switch for removing the discharged Battery during the discharging process leads to continuous safe process



Illustrative example of a short-circuit error on a battery pack (Source: Duesenfeld GmbH)

Electrical hazards

- Storage procedure (separation charged/discharge and labelling – discharged batteries short-circuited)
- Training Employees
- PPEs



Fire risk

- Major risk, together with electrical hazard, is often underestimated
- Poor SoH of the battery
- SoC upon arrival at recycling facility
- Recycling involves shredding with potential release of energy or temperature increase
- Fire involves thermal runaway
- Not many effective extinguishing methods

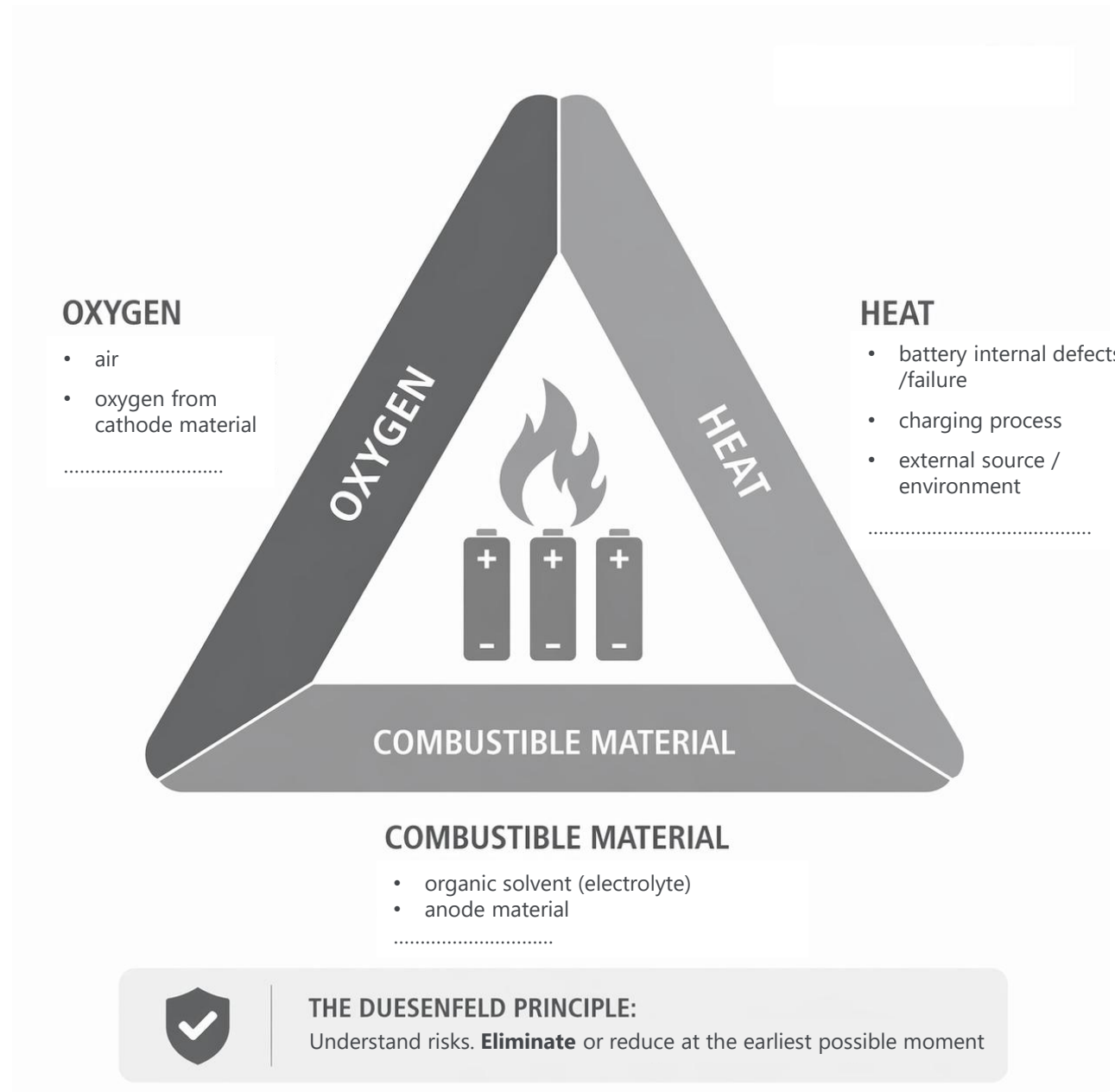


Avoiding Fire

Safe recycling: reduce the specific risk at the earliest possible moment

Avoiding fire

- Deep discharge of the battery material
- Nitrogen inertization of the process
- Safe solvent removal at low temperature
- Low-boiling solvent components are almost completely removed
- Output material is inactive and has no explosive properties
- Storage and handling concept



Avoiding Fire

The storage and handling concept:

- Material classification and separation (green / yellow / red – charged/discharged)
- Discharged material stored short-circuited
- Internal transport system (reduce variability of packaging types, improve manipulation, reduce risks for operators)
- Camera surveillance

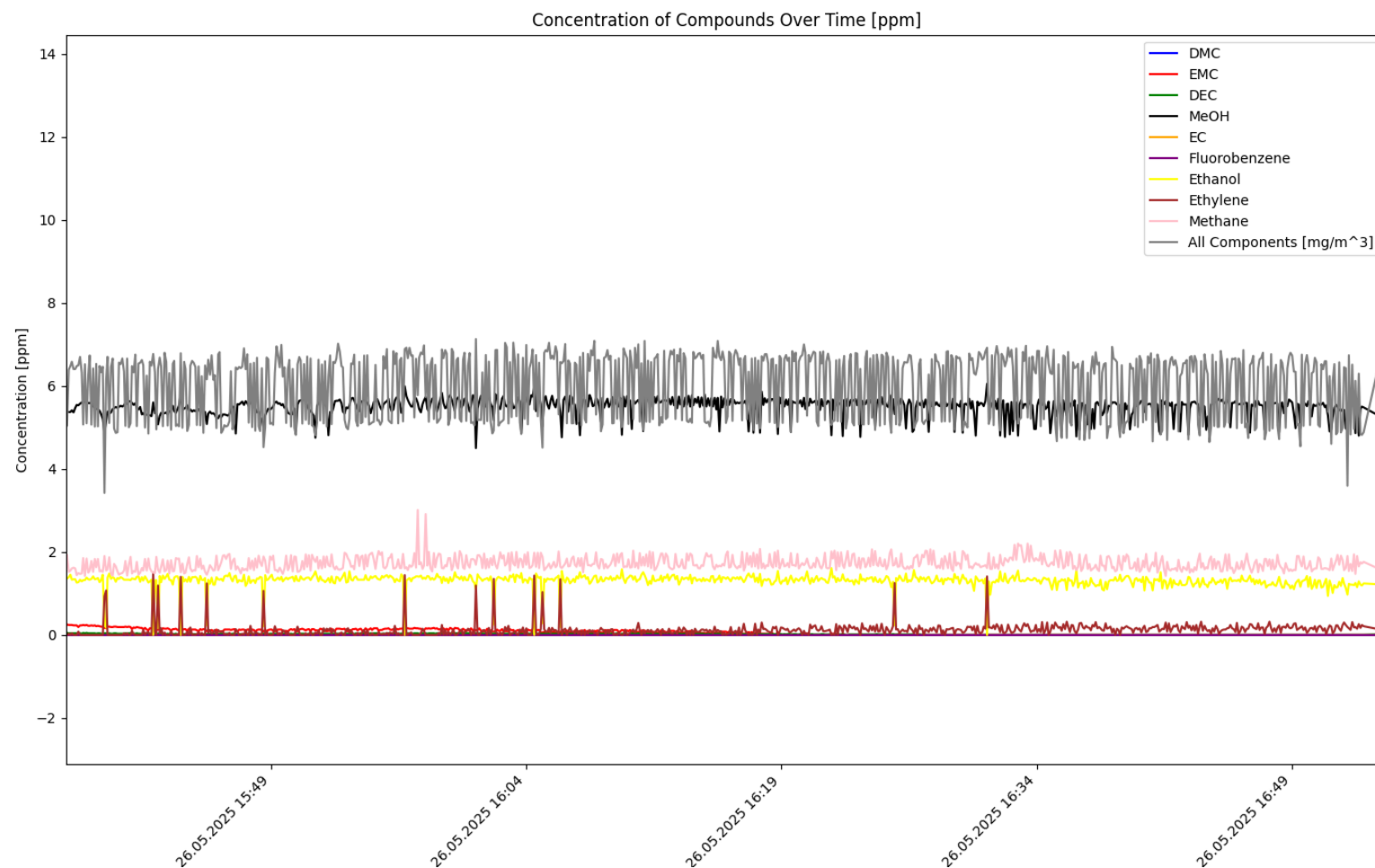


Avoiding toxic gases

Duesenfelds patented low-temperature process allows the shredded battery to be dried without the release of toxic gases.

Avoiding formation of toxic gases:

- Temperature monitoring in the shredding phase
- Drying Temperature below decomposition of LiPF₆



Avoiding toxic gases

- Avoiding emissions:
 - Gas-tight system (NO uncontrolled emissions)
 - Active carbon filter to capture non-condensed VOC

Average VOC values in the exhaust gas by activated carbon in ppm.

Measurement on 26.05.2025:

6.03 mg/m³

limit value of 20 mg/m³.

DMC	0,0
EMC	0,0
DEC	0,0
EC	0,0
Methanol	5,5
Ethanol	1,3
Methan	1,7
Ethan	0,9
Ethylen	0,1
HF	0,0

Dust reduction (Separation)

- Mechanical separation line : dust tight (negative pressure)
- Emission monitoring: leakage detection, repair/optimization
- Angle grinder use, blowing devices and compressed air are prohibited
- Regular floor cleaning
- Monitoring of employees: annual medical check-up (blood test)
- PPE for dusty work (not required for regular operation)
- Training employees



Emergency procedures

The respective risk must be reduced as much as possible at the earliest possible stage in the process. Safety and fire prevention are top priorities. At the same time, fire safety concepts and their procedures must be practiced regularly.

- Training of internal teams and firefighter local team
- Appropriate fire extinguishing methods, e.g. water basin
- Direct connection with firefighter local team
- SEVESO regulation may apply



Burning recycling facilities do not promote the acceptance of electric mobility and must be prevented. Our goal is to make safety predictable, repeatable, and scalable—to provide safe recycling technology for the coming increase in production volumes.

Committed to prevention, prepared for response!

Duesenfeld

Licensing Ecofriendly Recycling of
Lithium-Ion Batteries

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