



# Air Emissions Control Solutions for Lithium Mining, Battery Manufacturing and Recycling

The Future is Electric...

**VEHICLES, STORAGE  
AND GRID BALANCING**



## LITHIUM BATTERY SUPPLY CHAIN

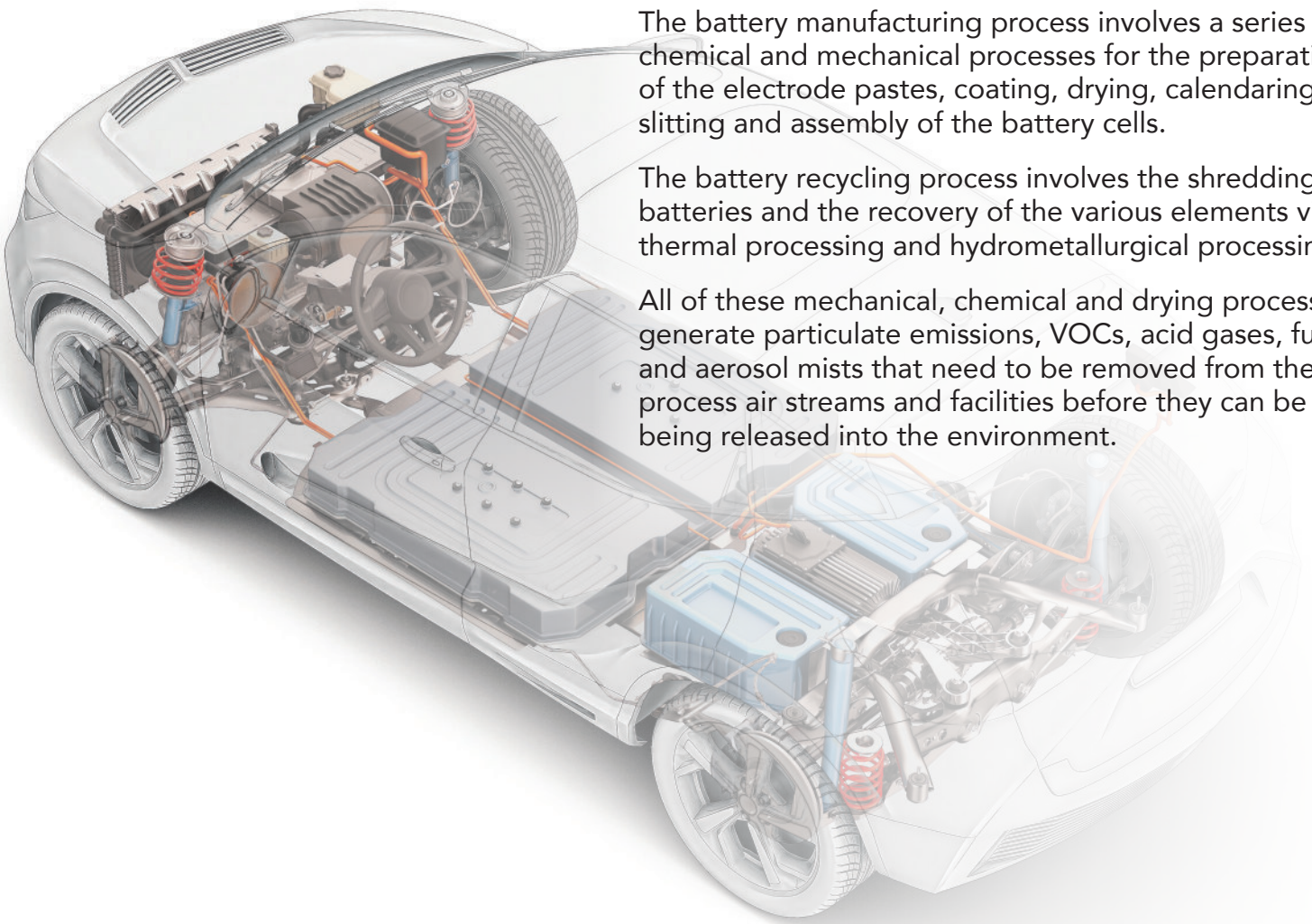
The lithium battery supply chain begins with the mining and processing of various metals and salts, and then transitions to the manufacturing of the battery cell. The final step of the process ends with the recycling.

The electrode materials production process typically involves a series of extraction and powder processing steps (thermal, hydrometallurgical and mechanical processes) to produce electrode materials.

The battery manufacturing process involves a series of chemical and mechanical processes for the preparation of the electrode pastes, coating, drying, calendaring, slitting and assembly of the battery cells.

The battery recycling process involves the shredding of batteries and the recovery of the various elements via thermal processing and hydrometallurgical processing.

All of these mechanical, chemical and drying processes generate particulate emissions, VOCs, acid gases, fumes and aerosol mists that need to be removed from the process air streams and facilities before they can be being released into the environment.





# LITHIUM MINING, PROCESSING & EV BATTERY MANUFACTURING

## AIR EMISSIONS CONTROL SOLUTIONS

**Lithium Mining & Processing:** CECO’s contaminant control solutions include bin vents, dust collectors and bag houses that are widely used during the storage and handling of lime and soda ash, drying of product, lithium carbonate milling, packaging and air classification. Our scrubbers can be used for treating fumes and gases during the production of anhydrous lithium hydroxide.

**Lithium Battery Manufacturing:** Our dust collectors and baghouses can be used in the upstream steps such as anode and cathode powder preparation, slurry mixing, during the slitting, and anode and cathode notching steps. Our Regenerative Thermal Oxidizers (RTO) and Activated Carbon Systems can be used to treat VOC emissions and HAP from steps such as cathode drying, electrolyte filling and sealing, and cell degassing. Our scrubbers can also be used to treat acid gases (such as HCl) during cell discharge.

LITHIUM EXTRACTION PROCESS STEPS	POTENTIAL EMISSIONS	CECO SOLUTIONS
Pond Liming – Lime silo loading and discharge	PM, Fumes / Gases	Bin Vents, Dust Collectors and Scrubbers
Soda Ash Loading and Handling	PM	Baghouse
Mix Tank Lime Silo	PM	Dust Collectors
Rotary Dryer	PM	Baghouse
Lithium Carbonate Milling, Packaging and Air Classification	PM	Baghouse
Anhydrous Lithium Hydroxide (blending, compacting, granulating, screening, anhydrous drying)	Fumes / Gases	Wet Gas Scrubber

BATTERY MANUFACTURING PROCESS STEPS	POTENTIAL EMISSIONS	CECO SOLUTIONS
Anode & Cathode Preparation	PM, HAP	Dust Collectors and Bag Houses
Cathode Coating & Drying	VOC	NMP Solvent Recovery System, Scrubbers
Slitting, Cathode and Anode Notching	PM	Dust Collectors
Cathode Oven	VOC, HAP	Activated Carbon Towers or Regenerative Thermal Oxidizer (RTO)
Electrolyte Filling & Sealing	VOC, HAP	Activated Carbon Towers or RTO
Cell Degassing	VOC	Activated Carbon Towers or RTO
Cell Discharge	VOC, HCl	Scrubbers



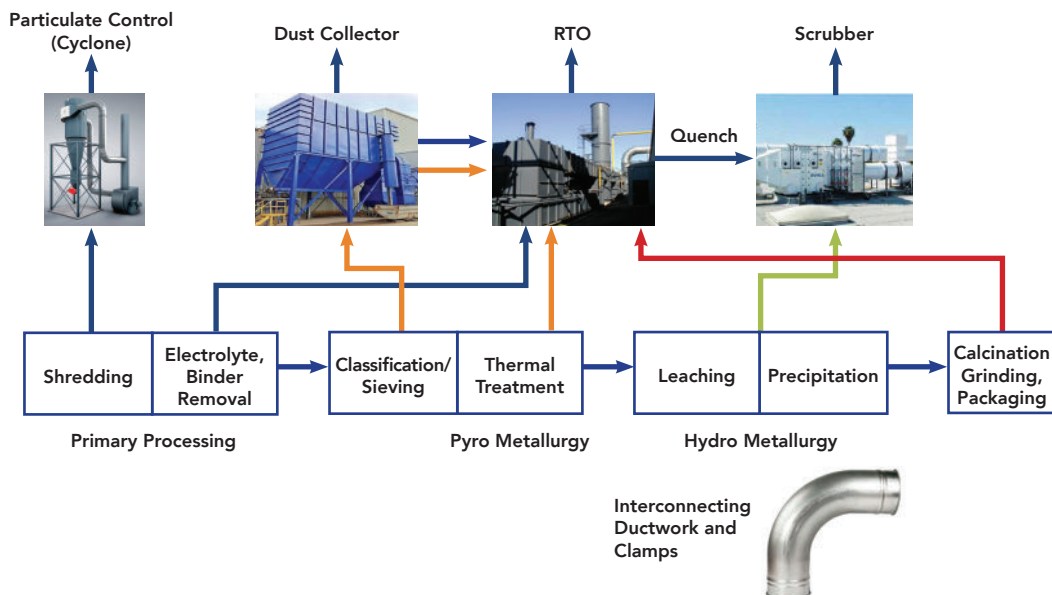
# EV BATTERY RECYCLING

## AIR EMISSIONS CONTROL SOLUTIONS

Our dust collection systems improve environmental safety and air quality in the shredding, sieving and graphite recovery processes where dust and fumes are generated. Our cyclones also enable the collection and recovery of materials. In addition, we provide thermal oxidizers and scrubbers to treat the exhaust stream from thermal processing steps that results in the decomposition of binders, electrolytes, and other organics, to treating vapors from hydrometallurgical process steps used for the recovery of metals and cathode precursor materials.

BATTERY RECYCLING PROCESS STEPS	POTENTIAL EMISSIONS	TYPICAL CECO SOLUTIONS
Dry / Wet Shredding, Screening	PM, HAP, VOC	Cyclones, Dust Collectors, RTO, Scrubber
Metal Recovery via Leaching & Extraction, Hydro-metallurgical	PM, Acid Gases, Mists, Fumes	Dust Collectors and Scrubbers
Packaging of Salts	PM	Dust Collectors
Material Storage	PM	Bin Vents
Calcination, Grinding & Packaging	PM, VOCs	RTO and Dust Collectors

## EMISSIONS CONTROL SOLUTIONS FOR LITHIUM BATTERY RECYCLING





# PARTICULATE MATTER EMISSIONS CONTROL PRODUCTS AND APPLICATIONS



Dust Collectors and Baghouses

## PARTICULATE MATTER CONTROL

Flex-Kleen's small Bin Vents and Dust Collectors (BV and PV model series) feature rugged welded housings that are equipped with automatic pulse-jet cleaning.

## TYPICAL SPECS

Air volumes: 50 to 5,000 cfm.

Individual unit sizes: 17 to 2592 square feet of media.

Construction: MS, 304 SS, 316 SS, custom.

Pressures: 20" w.g. (for pleated filters); 17' w.g. (for bag and cage filters); higher pressure designs available.



Cartridge Dust Collectors

Flex-Kleen's baghouses offer a wide variety of sizes, material of construction and filter media to fit your specific application needs. Flat wall baghouses are used when you have large airflows that require a large amount of filter area, generally at lower pressures (less than 35" w.g.).

Flex-Kleen's cartridge collectors utilize a horizontal cartridge that allows for easy inspection and removal of cartridge filters. Cartridge collectors can be the most cost effective solution available for certain applications requiring a small footprint.

Fisher-Klosterman cyclones remove relatively large particles from the air and help recover highly valuable product from process gas streams. We offer various levels of efficiency and capacities to meet your specific collection needs.



Cyclones

## TYPICAL BATTERY MARKET APPLICATIONS

**Lithium Extraction** - Storage bin venting, loading and handling of bulk solids (lime and soda ash), drying, milling, screening and packaging operations. **Battery Manufacturing** - Anode and cathode preparation, slitting, cathode and anode notching. **Battery Recycling** - Primary shredding, packaging of salts, material storage, calcination, grinding and packaging.



# VOC, HAP, ACID GAS EMISSIONS CONTROL PRODUCTS AND APPLICATIONS

## VOCs

### ADWEST: REGENERATIVE THERMAL OXIDIZERS (RTOs)

- Reliable, Simple Dual Chamber RTO Oxidizers from 1,000 to 80,000 CFM
- Can handle low to high VOC concentrations
- Up to 99% VOC DRE (Destruction Removal Efficiency)
- NO<sub>x</sub> free operation with flameless Natural Gas Injection (NGI)
- Lower RETOX RTO gas usage with 95-97% primary heat recovery and NGI

### HEE-Duall: ACTIVATED CARBON SYSTEMS

- Skid-mounted systems up to 2,500 CFM
- Suitable for Low VOC concentration air streams
- Custom designed single and dual bed systems
- Low pressure drop
- Space saving minimal footprint
- FRP, PVC, and PP Construction

## ACID GASES AND MIST CONTROL

### HEXMASTER DRY SCRUBBER

- Lowest pressure drop CMP system for energy and maintenance savings. Fastest payback in the industry
- Low water requirement during washdown
- Three stage unit can be upgraded to a wet scrubber

Typical contaminants removed: Chromic Acid, Sulfuric Acid, Nickel, Cyanide, Phosphoric acid, Alkaline

### PACKED WET SCRUBBER

Horizontal: Cross flow, low profile, easy access  
Vertical: Counter current flow, minimal footprint.

## TYPICAL LITHIUM BATTERY MARKET APPLICATIONS:

**Battery Manufacturing** - Treating VOCs during cathode drying, electrolyte filling, cell degassing and acid gases during cell discharge.

**Battery Recycling** - Treating VOCs and acid gases from shredding, hydrometallurgical processing, and calcination steps.



Regenerative Thermal Oxidizer



Dual Bed Carbon Systems



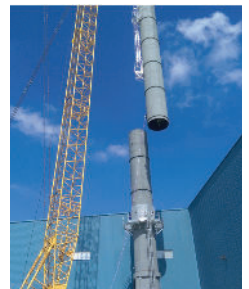
HexMaster Dry Scrubber



# END TO END SUPPLIER OF TURNKEY AIR QUALITY IMPROVEMENT SOLUTIONS

## DESIGN, INSTALLATION AND AFTERMARKET SUPPORT

- Design: Design of various items per applicable industry standards; regulatory code reviews; CAD, P & ID drawings.
- Installation & Commissioning:
  - Complete field installation and service, which includes on-site installation of fabricated components, including electrical and mechanical services.
  - Installation of: ductwork, regenerative thermal oxidizers (RTOs), cyclone dust collectors, scrubbers, bag houses, mist control and filtration systems.
- Aftermarket Support – preventive maintenance & inspection, spares and service support.



## TURNKEY SOLUTIONS

We can provide turnkey ducting and air emissions control solutions that are customized to meet specific site requirements. The benefits of working with a single vendor include streamlined and simple purchase, installation and service process including:

- A single purchase order with a single set of terms and conditions.
- Design and engineering with performance guarantees and manufacturer's warranty from a single vendor.
- Dedicated project management, installation and aftermarket spares and service support.



# CECO ENVIRONMENTAL

**CECO ENVIRONMENTAL** is a leading environmentally focused, diversified industrial company whose solutions protect people, the environment, and industrial equipment across the globe, serving a broad landscape of industrial air, industrial water and energy transition markets. It is listed in NASDAQ (ticker symbol: CECO).



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