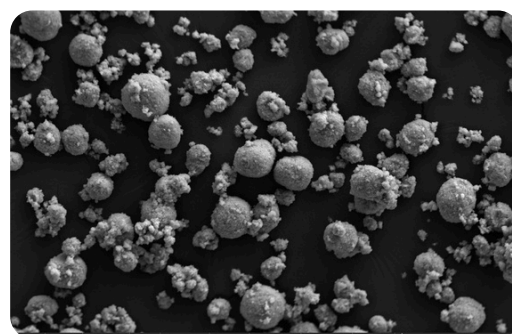


Direct recycling: putting electrode materials straight back to use

Conventional recycling breaks cathode and anode materials all the way down to raw metal salts, then rebuilds new electrode material from scratch.

REVITALISE's direct recycling process skips most of that work.

Through re-lithiation, or re-sodiation for sodium-ion chemistries, lithium or sodium lost during the battery's working life is replaced directly in the recovered electrode material, restoring it to equivalent performance to material made from virgin, primary metal salts.



Relithiated Cathodic black mass

RESULTS IN PRACTICE

- Lower carbon footprint than full pyrometallurgical or hydrometallurgical recycling
- Equivalent performance to cells made from virgin, primary materials
- A genuinely circular process that closes the loop on electrode materials

**95%
capacity
retention**

(after 100 cycles - same as new cells)

PAIN POINTS ADDRESSED

- High energy cost and CO₂ emissions of existing recycling routes
- High CAPEX of building new plant for full metal recovery when it isn't needed
- Doubts over whether directly recycled material can match virgin-material performance

**Li & Na
batteries**

TECHNOLOGY IN DETAIL

How it works

Regeneration of cathode chemistry and morphology. For cathode active material (CAM) the process involves mixing with an alkali-metal source (Li or Na), to relithiate or resodiate it, using low-energy processes to restore the Na or Li content back to where it started. Some morphology damage to the cathode material particles (such as cracks) can be fixed through these processes. Excess Li/Na is then removed to achieve a final material suitable subsequent use.

What goes in

High purity, single chemistry – but adaptable. Feedstocks need to be single electrode type (anode/cathode), single chemistry, and have minimal impurities such as copper and aluminium – so in mixed waste streams, effective sorting is essential. Beyond that, a range of electrode chemistries can be refurbished through direct recycling, including cathodes based on NMC, LFP, NFPP, Prussian White analogues, and anodes based on graphite or hard carbon.

What comes out

Performance matching. Cathode materials regenerated through our direct recycling processes have been shown to have similar performance to pristine materials.

What sets it apart

Low cost, low energy, low waste. Although hydrometallurgy is more tolerant of impurities, it can have high running costs and waste disposal issues. For suitable fractions of black mass, direct recycling offers a low cost, low energy, low waste method to recapture cathode materials.

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