CoLaBATS

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Cobalt and Lanthanide Recovery from Batteries

The CoLaBATS project was launched in October 2013, and incorporates 10 collaborative industry and academic partners. Over its 36 month duration, the partners will develop new industrial processes with the capabilities to retrieve **cobalt, lanthanides, nickel** and **lithium** from spent waste rechargeable batteries.

The CoLaBATS project will have a positive impact on recycling efficiencies and the purity of recovered metals in comparison to current routes. Compared to hydro/pyro-metallurgical processing, the primary method being developed will have the potential to reduce landfill, critical metal consumption, and environmental impacts.

Proposed processes will employ task specific ionic liquids (TSILs) to target key metals in Li ion and Ni metal hydride (NiMH) batteries, with enhancements made using ultrasonics. Positive attributes of TSILs are: low cost, reduced environmental impact, low toxicity, and reusability (minimal processing).

The use of TSILs as deep eutectic solvents (DES) allows for reactions at much lower temperatures because of their lower melting points. They are therefore much cheaper to operate, and their utility has already been demonstrated in electroplating processes. The process will be further optimised with the addition of ultrasonics, which can be used to promote breakdown of the battery electrode structures to provide efficient metal recovery.

Over the first 12 months, the CoLaBATS consortium has been developing and characterising DES for selective metal extraction and separation, and improving the efficacy of solvents, in order to prepare them for industrial scale-up.

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 603482.

Project Objectives:

The aim is to develop new industrial processes for the recycling of waste batteries. The focus is to create new hydrometallurgical recovery capability suitable for industrial application (and therefore also having regard to the fate of the other components including battery casing materials).

These metals, or their salts, will be recovered in high purity and at greater than 95% yield.

Specific objectives are to:

- Recover nickel, cerium, lanthanum and other rare earth metals from nickel metal hydride batteries.
- Identify the economic, environmental and societal benefits of the new process technology and the potential for innovation in the metal manufacturing and recovery sectors.
- Recover cobalt from lithium ion batteries.
- Create intellectual property in the use of ionic liquids, deep eutectic solvents, electrochemistry and ultrasonic technology in the recovery of metals from batteries.
- Create new industrial applications and employment opportunities.
- Contribute to the development of improved standards in the battery recycling sector.

EU Raw Materials Initiative

The Raw Materials Initiative (RMI) was adopted in 2008, and represents 41 metals and minerals considered to be of importance to future markets, and of limited supply.

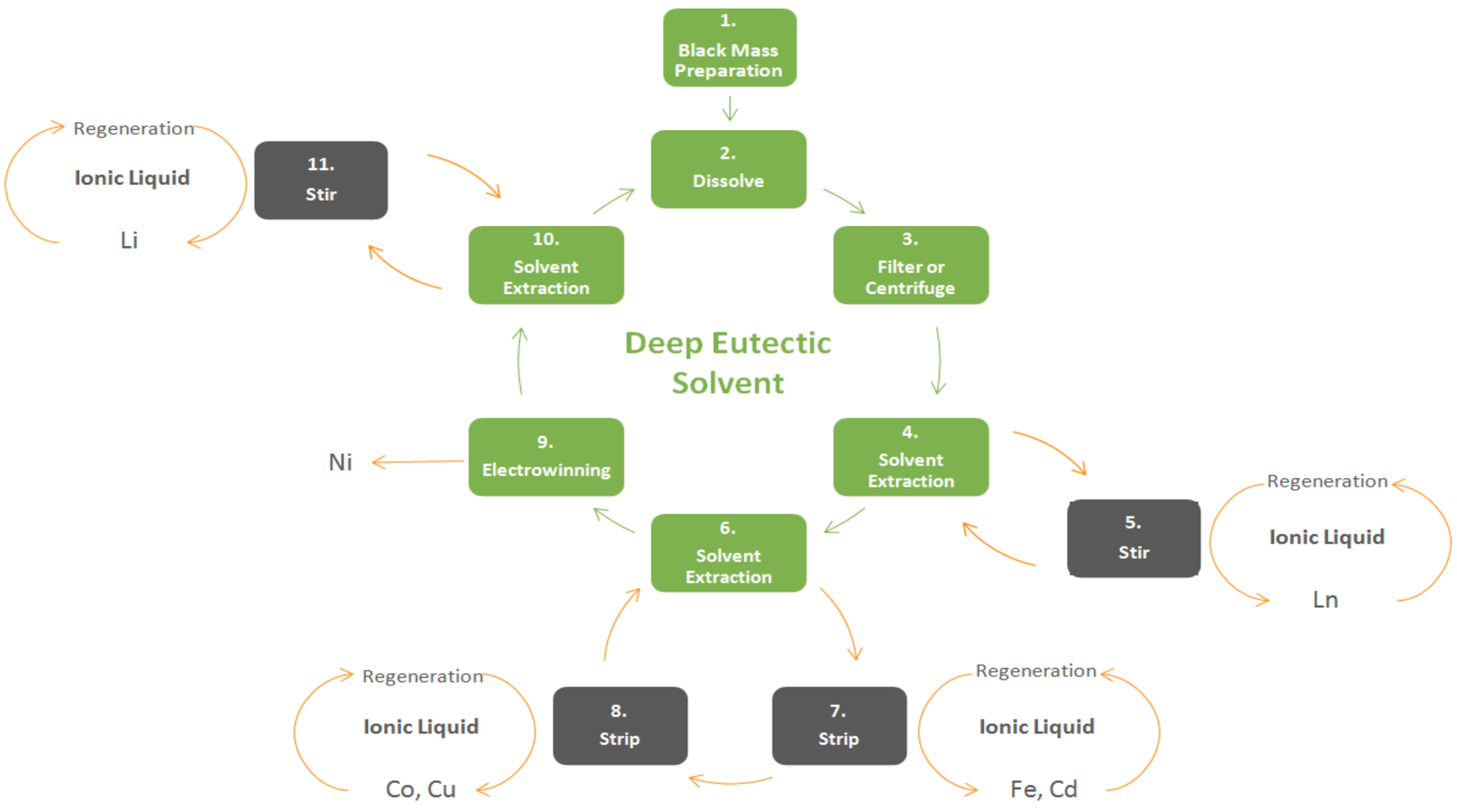
The project aims at recovering lanthanides ('critical' rare earths), cobalt ('critical'), lithium, and nickel. However, secondary batteries are known to also contain graphite ('critical'), magnesium ('critical'), aluminium, zinc, iron, and copper, which are all included in the RMI.

EC Batteries & Accumulators Directive

This directive requires all end-of-life batteries to be recycled. At least 50% of a battery must be recovered, and this excludes the casing.

The objective of the directive is to minimise the environmental impact of batteries, by improving collection schemes, regulating waste pathways, and reducing the amount of metals reaching landfills.

Proposed Metal Recovery Process



CoLaBATS Expected Results

The expected scientific outputs are:

- New deep eutectic solvents (DES) optimised for maximum solubility of target metals.
- New task-specific ionic liquids (TSIL) optimised for selective separation of metals from metal complexes.
  These solvents will form the basis of the new hydrometallurgical processes.
- Detailed experimental characterisation of solvent interactions with elements of interest including Co, Li, Ni, Ce, La, including measurement of selectivity and extraction efficiency.
- Novel processes for the direct extraction of Co and Li from battery waste TSIL.
- Solvent selection will include assessment of recyclability, physical properties, environmental impacts etc.
- The processes will have excellent selectivity and produce high grade outputs, avoiding the need for further processing. All solvents will be used in closed loop.
- Hydrometallurgical prosesses that are simpler, environmentally benign and economically attractive compared to existing pyrometallurgical processes. They should have low capital and operating costs and be suitable for operation by SMEs.

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