"Turning waste into a resource through innovative technologies, processes and services" (7th Framework Programme)

CoLaBATS

ISSUE 01

March 2014

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Project Launch:

The CoLaBATS project was launched in October 2013, and incorporates 10 collaborative industry and academic partners. It is proposed that over the next 36 months, these partners will develop new industrial processes with the capacity 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 has the potential to reduce:

-Landfill -critical metal consumption -environmental impacts

The proposed processes will employ task specific ionic liquids (TSILs) to target Li ions and Ni metal hydride (NiMH), with enhancements made using ultrasonics to provide the most efficient metal recovery. Positive attributes of TSILs are:

- low cost
- non-toxic
- environmentally benign
- reusable (with minimal or no processing)

The use of TSILs and deep eutectic solvents (DES) allows for reactions at much lower temperatures because of the reagents 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 breaking of the battery electrode structures.

Over the initial 6 months, CoLaBATS has begun developing and characterising DES for selective extraction and separations and improving the efficacy of the solvents, to acquire materials ready for industrial scaling.

CoLaBATS Consortium Members

aprofitament assessoramen ambiental, s.l.

CEDRAT TECHNOLOGIES Innovation in Mechatronics

Solvionic

CHALMERS

TU WIEN

University of Leicester

C-Tech INNOVATION

tecnalia Inspiring Business

Env- Aqua Solutions

Editorial:

Welcome to the first CoLaBATS newsletter

The CoLaBATS project will actuate new industrial processes for the recycling of the critical metals cobalt and lanthanide, as well as key economic metals, nickel and lithium, from waste batteries.

This project aims to:

- significantly improve recycling efficiencies
- improve metal purity recovery
- reduce landfill waste
- reduce critical metal consumption
- replace current processes with a more sustainable hydrometal-lurgical process
- increase potential applicability to the SME community

The newsletter introduces the project launch & a consortium focus, highlighting individual CoLaBATS members and their companies.

For more information on this newsletter & related CoLaBATS project activities please go to:

www.CoLaBATS.eu

The European Batteries Directive & its impact on waste battery collection & recycling

Michael Green – Managing Director of G&P Batteries, Chairman of European Batteries Recycling Assoc. (EBRA)

Directive 2006/66EC of the European Parliament on batteries and accumulators and waste batteries and accumulators entered into force on 6 September 2006 and had to be transposed into the laws of all European Member States by 2009.

It is a piece of Producer Responsibility legislation, which means that any costs associated with meeting the requirements have to be met by the producers of the batteries. The environmental benefits are designed to be achieved through the application of a number of rules, and 2 key targets:

- Certain substances (e.g. Mercury, Cadmium) are banned or restricted to certain limits
- Targets are set for the volume of waste batteries to be collected, which must then be recycled
- Targets are set for the quality of the recycling processes used

And there we must leave the simple ideals of the directive behind, and delve into the many complexities that leave many on the edges of the battery industry (as well as those in it) feeling bemused by just how complicated a relatively small piece of legislation can be.

As we consider how the legislation works, it is worth bearing in mind 3 important, unwritten truths:-

1. The Directive was introduced to control the use of, and reduce pollution by, heavy metals. Discussions about the directive started well before 1996, and at that time the main worries were
    - Mercury
    - Cadmium
    - Lead

2. The Directive was never conceived as being about Carbon. Issues about carbon emissions came to the fore well after the directive's aims were formed.

3. The Directive's thrust is all about metal recovery. Newer battery types that contain little or no metal were not considered in the development of the Directive's targets.

We must also bear in mind that the European Directive set the basic rules and targets, and then left it up to each member state to transpose into local legislation how each member state was to meet the rules and achieve the targets. And of course, each member state has its own slightly different way of doing this, so that whilst we may have Europe-wide targets for collection and recycling standards, we have 28 different ways of doing this, and other related legislation can also have an impact on how collections are made. So a method of making collections that works well in one country may not work in another.

G&P Batteries was formed in 1979 as a lead battery recycler. Since then the company has developed into a leading organisation on battery waste, with Michael having attracted international recognition in the field.*

G&P has a global reputation and have been highlighted for their best practice methods in a recent Australian battery global; review.**

Where do the batteries you recieve come from?

All over the UK, from public collection sites, muicipal drop-off locations, & workplaces including the military.

**Resource Magazine, Jan 28, 2014, Masters of Waste.*

***MS2, 2013 report: Business & public policy case for battery stewardship – handheld battery. Sustainability, Victoria, AU.*

For example:

1. Waste batteries are routinely sent through the post in some European countries, whereas it is illegal to send waste batteries through the post in the UK.
2. Collection vehicles can carry up to 10 tonnes of mixed portable batteries without the need for ADR (hazardous material carriage) rules being complied with in most of Europe, but the limit is only 400 kg in the UK, above which all relevant ADR rules must be met. (this difference is caused by a different interpretation of dangerous goods rules in the UK to that in most of the rest of Europe).

Battery Classification

The Directive initially classifies batteries into 3 groups, broadly by application. These categories are-

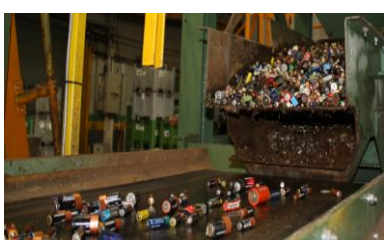
- Automotive: defined as “a battery used for automotive starter, lighting or ignition power”;
- Industrial: defined as “any battery or battery pack which is
  - designed exclusively for industrial or professional uses;
  - used as a source of power for propulsion in an electric vehicle;
  - unsealed but is not an automotive battery;
  - or sealed but is not a portable battery;”
- Portable: defined as “any battery or battery pack which
  - is sealed,
  - can be hand-carried by an average natural person without difficulty, and
  - is neither an automotive battery nor an industrial battery;”

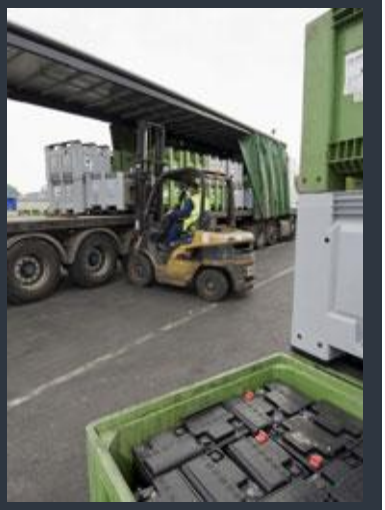
These definitions still cause confusion and problems 5 years after the legislation was introduced.

Collection Targets

For Automotive and Industrial Batteries there are no collection targets, but an assumed 100% collection rate is achieved through a ban on landfill or incineration for batteries in these categories.

For portable batteries, the directive set 2 targets for portable battery collection for member states – 25% of what was put on the market in 2012, rising to 45% in 2016. Once collected, all portable batteries must be sent through a recycling process, and cannot by landfilled or incinerated.





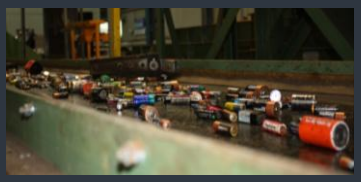
What types of batteries are processed?

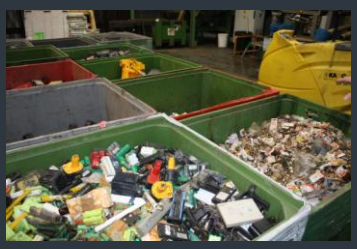
All types of batteries & chemistries including used commercial batteries, lead batteries, automotive batteries and others used for specific individual applications.

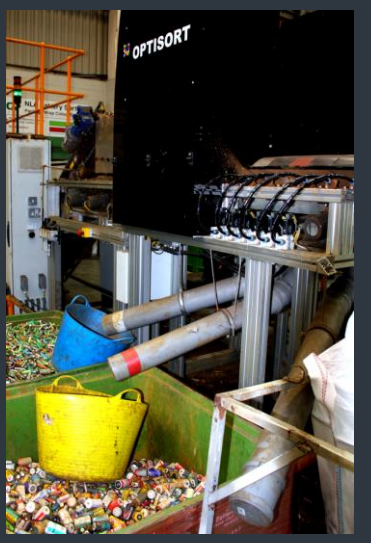
How are the batteries sorted?

Consignments of batteries are highly variable & initial sorting is conducted by hand. Further sorting is conducted on small secondary batteries (AA, AAA, D cell etc) using an optical sorter – Optisort (the first in Europe).

Photos provided by G&P Batteries







Recycling Targets

The directive sets targets for the quality of recycling - requiring all processes recycling batteries to recover a certain amount of useful material. These targets are set by chemistry group, with particular emphasis on Nickel cadmium and lead acid batteries. Defining what is constitutes recycling in this context has also proved to be extremely problematic.

The targets are:

- Nickel Cadmium batteries: 75% recycling efficiency must be achieved
- Lead Acid batteries: 65% recycling efficiency must be achieved
- For all other batteries: : 50% recycling efficiency must be achieved

These targets must be met in the calendar year 2014, for which all recyclers must provide a report of their recycling efficiency to their competent authority by March 2015 for the previous year.

Some key points for what cannot be included in the recycling efficiency calculation are:-

- Outer casing of a battery packs is excluded
- Water is excluded
- Emissions to atmosphere is excluded
- Oxygen from atmosphere is exdcluded
- Energy recovery (from plastics and others) is excluded
- Battery materials in slags for landfilling are excluded

It is the recycling efficiency which is causing most difficulty as there are several battery chemistries (e.g. primary lithium, automotive lithium ion), where today there are no commercially available recycling processes that can meet the recycling efficiency target.

Further, in time we may expect that the European Commission will review and potentially increase both the collection and the recycling efficiency targets, to further improve the environmental performance of this industry. How feasible and costly this may be to producers, and thus ultimately to the consumer, remains to be seen.

Michael Green **www.g-pbatt.co.uk**

Aprofitament i assesorament ambiental S.L. is a SME created by Cristobal Hernandez in 2005. The company started in Les Franqueses del Vallès with the recycling of all kind of batteries as the main market. The thing that made **A3** different was that **A3** started collecting batteries and other hazardous waste from garages; such as oil filters, antifreeze and hydrocarbon mixtures. During those days, **A3** only gathered batteries, and would then send them off to recycling companies. Then **A3** began with the business of metallic scrap on a small scale (stainless steel, normal scrap, etc.).

In 2011 **A3** changed its workplace to the present location in Granollers. This move opened the doors to increase and diversify the business in three main markets:

1. The company has now progressed to handling different types of scrap and can work with a large range of volumes (ferric scrap, aluminum, copper, lead, different types of steel).
2. Additionally the company has begun with the business of more valuable metals such as tungsten carbide, nickel, etc.
3. And most recently, **A3** has started with the collection enterprise of oils including hydraulic oils from automobiles and the automotive industry, and the business of replacement parts for vehicles, for example starter motor, alternator, steering control, etc.

The Granollers **A3** site is home to the **Precious Group Metal (PGM) Division** that has 2 main areas of market interest:

1. The recovery of gold, silver, platinum and palladium from waste with a PGM content, such as jewelry wastes, electroplating baths, radiographs, silver cutlery, ashes, etc. Just a few months ago **A3** started with the business of electronic scrap such as motherboards, electronics, telecommunication PCB, CPU's, RAM memories, etc. The CPU, RAM memories, telecommunication PCB, & high PGM material content are recovered in our **PGM Division**.
2. Automotive catalytic convertors purchased from scrap yards. **A3** has one of the biggest databases with approximately 5000 catalytic convertors containing Pt, Pd and Rh. This makes purchasing more accurate, and the catalytic convertors are treated in our plant where they are transformed into dust and sent to metal recovery plants

A3 is open to handling all kinds of problems related with waste treatment, to find an adequate solution for our clients with the resources that we have. We have specialized in finding solutions to recover valuable materials from waste, for example from the copper wires with lower quality we can triturate them and separate the different materials (copper, aluminum and plastics), and we find feasible solutions to recover precious metals from all kind of materials.

We are interested in the valorization of materials that other companies normally don't work with, and we are focused on the investigation of recovery methods for materials that have either a low or high price and that come from waste to revalorize the material, as we have shown for the PGM area and other areas of non PGM metals and materials without leaving behind the market of the batteries.

http://www.residuos.info/

News from the Batteries Directive:

The EC website on the Batteries directive (2013/56/EU) provides links to the directive & recent amendments. Most recently developments are for cordless power tools (CPT) comprising of portable batteries & accumulators containing cadmium & their exemption from the directive. Legislation has been proposed to remove CPT exemptions from the directive and aim for industry phase out by 2016. A current impact assessment for this proposed legislation is available on the website, & concludes that a delayed withdrawal (by 2016) would be optimal for industry, the consumer market and the environment.

Defining & labelling the capacity of batteries was a requirement of the Batteries Directive (2006/66/EC), to be achieved by 2009. Whilst a definition for secondary batteries is complete, no implementable strategy has been identifiable for primary batteries.

By 2016 member states are required to be collecting 45% of spent batteries & accumulators at no charge to the end-user (including CPT). Additionally, 50% by average weight material recovery from recycling must be achieved (this percentage is higher for Pb-acid and NiCd; 65% and 75% respectively).

http://ec.europa.eu/environment/waste/batteries/

TECNALIA RESEARCH & INNOVATION

(www.tecnalia.com)

A private, independent, nonprofit research organisation resulting from the merger (1st January 2011) of eight research centers: Cidemco, European Software Institute, European Virtual Engineering, Fatronik, Inasmet, Labein, Leia and Robotiker. Legally a Foundation, Tecnalia is the leading private and independent research and technology organisation in Spain and one of the largest in Europe, employing 1,419 people (164 PhDs) and income of €110 Million in 2012.

Tecnalia is very active in FP7, participating in 377 projects & coordinating 81 of them. Tecnalia has a strong market orientation aiming at achieving major impacts in economic terms, by means of innovation and technological development.

At **TECNALIA** we are organized in 7 fully interconnected Divisions. This way of working is the best example of our innovative spirit applied to an operational model, where cooperation works thanks to the transversality of teams, projects and clients collaborating with each other, combining experience, commitment and knowledge:

- **Energy and Environment:** We turn energy and environmental challenges into economic and development opportunities through the promotion of renewable energies deployment and the resources efficiency.
- **Sustainable Construction:** We work to promote the transformation and sustainability of the Construction industry through a comprehensive vision of the technology and the society which generates new opportunities for the development.
- **Innovation Strategies:** We work from the generation of an innovative idea to its transformation. We offer advice to public administration so that they can develop environments that favor sustainable competitiveness.
- **ICT - European Software Institute:** We help to taking profit of the opportunities provided by a digital and interconnected world. We work on three main axes: The new eServices in society, “smartisation” of all types of products and solutions and the competitiveness of the equipment to produce perfect software systems.
- **Industry and Transport:** We answer to the needs of sustainable mobility and efficient manufacturing in a globalized environment. Our knowledge of the transport, machine-tool, foundry and steelworks industrial sectors allows us to provide comprehensive solutions through R&D&I.
- **Health:** We are committed with the future’s greatest challenge: to improve people’s quality of life, particularly for the ageing phenomenon from different health perspectives, by developing and marketing high-impact life-transforming products and services.
- **Technological Services:** For the evaluation and diagnosis of materials, processes and products.

The Division of TECNALIA involved in **COLABATS** project is the **Energy and Environment** Division. In this Division our objective is to turn energy and environmental challenges into development opportunities. We devote our R&D to the development of technologies, products and tools for a rational and sustainable use of energy focusing on clean generation sources and future energy carriers: wind energy, solar energy, marine energy, bioenergy and bio-refinery, smart grids, energy storage, energy efficiency in buildings, materials for energy and environment, sustainable mobility and electrical vehicle, and power electronics.

We face environmental challenges of the economic manufacturing workshops and society in relation to urban and territorial sustainability developing supporting tools and specific solutions for specific problems (acoustic, air quality, landscape, urban comfort) applied to urban and infrastructures sustainable planning, design and management. We integrate the improvement of the environment and the promotion of the economy through the green economy. Our activities focused also to the urban and territorial adaptation to climate change and adverse meteorology and climatology.

Upcoming Milestones & Events:

CoLaBATS

Milestone 1 – MS1 **Month 9 (May, 2014)**

- Definition of input materials for processes (laboratory analysis report)

Interim Meeting **Month 12 (Sept, 2014)**

- Tecnalia Research & Innovation Visit - San Sebastian. Spain

Milestone 2 – MS2 **Month 15 (Dec, 2014)**

- Identification of suitable TSIL (validation of metal recyclability)

Conferences

• Automobile Recycling Congress IARC http://www.icm.ch/iarc-2014	March	2014	Belgium
• Energy Storage World Forum http://www.energystorageforum.com/	April	2014	UK
• International Meeting on Lithium Batteries (IMLB) http://www.imlb.org/	May	2014	Italy
• Battery Power http://www.batterypoweronline.com/conferences/	August	2014	USA
• Batteries http://www.batteriesevent.com/site/GB/Conference	Sept	2014	France
• Battery Recycling (ICBR) http://www.icm.ch/	Sept	2014	Germany

Useful Links:

- CoLaBATS – http://www.colabats.eu
- European Battery Recycling Association (EBRA) - http://www.ebra-recycling.org
- Energy Storage Publishing Ltd (ESPL) – http://www.bestmag.co.uk/
- European Commission and Batteries - http://ec.europa.eu/environment/waste/batteries/
- LCA of NiCd, NiMH & Li-ion in power tools - http://ec.europa.eu/environment/waste/batteries/pdf/report_12.pdf

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

Other UK & EU Funded Battery Projects:

HYDROWEE:
Innovate hydrometallurgical processes to recover metals from WEEE including lamps and batteries

www.sat-research.at/hydroWEEE/

SOMABAT:
Development of novel solid materials for high power Li polymer batteries – recyclability components.

www.somabat1.ite.es

ReCHARGE: (TSB)
Recovery & reuse of high value metal resources from portable battery waste.

Env- Aqua Solutions