

Fresh angle to battery recycling efficiency

The two main topics at last month's International Congress for Battery Recycling (ICBR) were the EU's new battery regulations as well as recycling solutions for spent lithium batteries. Along with experts from related fields, Recycling International took its seat at the three-day gathering.

This year's International Congress for Battery Recycling (ICBR) in the German city of Düsseldorf virtually coincided with the implementation of the EU's revised waste framework directive for batteries, which came into force on September 26. A record attendance of nearly 150 battery professionals - drawn from the manufacturing, collection and recycling sectors - heard a range of views on the legislation from a succession of expert speakers. They were also informed about latest technological developments in this area.

Swiss congress organiser ICM prepared a varied programme for the event at Düsseldorf's InterContinental Hotel although the spotlight fell principally on the revised EU regulations and challenges relating to spent lithium-ion



batteries. At present, around 1 billion hybrid cars on the roads of the USA and Europe are using advanced batteries for which the recycling options are far from established.

Directive implementation

At the point of implementation, only seven EU countries - Austria, Estonia, Latvia, Malta, The Netherlands, Slovenia and Spain - were in a position to transpose the new battery directive into national legislation. A further 10 member states are expecting to achieve this status six months from the moment of implementation whereas the other dozen countries will be somewhat later in coming into line with the directive's requirements through domestic regulation.

In his keynote speech, Vice Chairman of the Environmental Committee of the European Parliament Hans Blokland outlined the background to the directive and explained its consequences for the battery recycling chain. A new means of calculating collection rates - to be implemented for the first time in 2011 - is to be based on average annual sales for the last three years, excluding export sales.

Mr Blokland, who expects this new directive to result in noticeably higher levels of collection, observed: 'For 2012, we want our members to achieve a 25% collection rate, and for 2016 a 45% rate; but there is a possibility for transitional arrangements in the case of specific national circumstances.'

The EU adopted Batteries Directive 91/157/EEC in March 1991. This introduced restrictions on the use of mercury in most batteries and encouraged collection and recycling. However, the objectives of the directive have not been achieved as most portable batteries are still being sent to landfill. According to the European Commission, around 45.5% of all batteries sold in the EU - equating to over 70 000 tonnes - went to landfill or were incinerated in 2002.

In response, the EU introduced - and adopted - a new battery directive in 2006 that repealed the 1991 regulation. This new directive applies to all batteries and accumulators, but has different implications for both. Marketing of batteries that contain less polluting substances is encouraged - in particular, those comprising substitutes for mercury, cadmium and lead. In



Member of the European Parliament Hans Blokland delivers his keynote speech.



addition, the directive provides guidelines for manufacturers and for the operation of national battery collection and recycling schemes, in particular with respect to the financing of such schemes by producers.

Mr Blokland concluded: 'I believe this directive will support the environment; because there are no mercury and cadmium batteries entering the waste stream, there will be no disposal of industrial and automotive batteries and less disposal of portable batteries, resulting in increased recycling and recovery of batteries.'

No obligation to buy

The new battery directive specifies collection requirements that include the option for the consumer to return portable batteries to local collection points free of charge without being obliged to buy a new battery. Furthermore, distributors are asked to take back spent portable batteries when supplying new batteries unless existing schemes are proved to be as effective. Producers of industrial batteries, or third parties (commercial or non-commercial collection schemes) acting on their behalf, are obliged to

take back industrial batteries from end users. And finally, producers of automotive batteries, or third parties, are required to set up collection schemes for waste automotive batteries not collected through collection schemes set up under the EU End-of-Life Vehicles Directive.

As well as these recycling demands, the regulation contains various data and labelling requirements applicable to batteries. These include the use of a crossed wheelee bin symbol on the battery or, if too small, on the packaging; and chemical symbols for mercury, cadmium and lead indicating the heavy metal content of batteries containing more than a specified amount of these elements.

Addition of the capacity of portable and automotive batteries will be required from September 26 next year. And national legislation must harmonise with the EU directive by March 26 2009.

Common methodology

In an excellent presentation, Jean Pol Wiaux of Recharge - a Brussels-based association covering producers and the recycling chain - brought

the new directive into a wider perspective by noting that recyclers were affected not only by this new regulation but also by the WEEE, RoHS and ADR directives.

According to him, these feature the adoption of a common methodology for calculating annual sales for producers - which will offer more insight for authorities and collectors. 'And batteries and accumulators legally placed on the market before September 26 2008 can be sold after this date, without the new requirements,' Mr Wiaux pointed out.

He explained the most prominent differences in the legislation as it applied to portable and industrial/automotive batteries. Registration is required for both product groups but reporting of the quantities placed on the market is not required for the latter. Industrial and automotive batteries must not be consigned to landfill, he added.

According to Mr Wiaux, there are also some unresolved issues. He called for a general exemption for button cells for technical reasons, urging instead the use of marking on the packaging where appropriate. Secondly, he recommended the marking of power packs, instead of the individual cells inside the pack. 'Double labelling of electronic appliances, when batteries are embedded in equipment and not removable by the end user, must be avoided,' he said

Recycling efficiency

Along with the European Battery Recycling Association (EBRA) and the European Portable Battery Association (EPBA), Recharge has established a definition for the 'recycling efficiency' of batteries. This is seen as a response to the directive's requirement for detailed rules to be created



The congress in Düsseldorf attracted 147 battery professionals from all over the world.



Farouk Tedjar, founder and CEO of Recupyl Sas.

Jean Pol Wiaux of Recharge gave a clear outline of the new battery directive.



From left: Sandra Leuthold, German Federal Environment Agency, and Ruska Kelevska of the European Union.



The not-so-young-anymore guys of this swinging jazz band played some real American-style music.

before 2010 for calculating recycling efficiency. According to the findings of a working group, the recycling efficiency of spent batteries in a given recycling process is the total weight of the qualified recycled materials outflow divided by the total weight of dry spent batteries entering the recycling process calculated on the basis of an average composition range. Alain Vassart of EBRA commented: 'So it has nothing to do with the recycling rate, which has to do with the quantity of used batteries - but it is measured by weight of material recovered from used batteries during recycling.'

Using this definition, the working group proposes the following minimum achievements for battery and accumulator recycling processes: 65% for lead-acid; 75% for nickel-cadmium;

and 50% for other discarded batteries and accumulators. The group will continue to develop the guidance document which will be designed to offer greater insight into the different types of process and different classifications of output.

Registration

The new directive also sets some minimum rules for producers such as registration and organisational/financial producer responsibility, as well as the possibility of exempting small producers from financial responsibility under certain conditions. 'A producer is the person in a member state who places batteries/accumulators, including those incorporated into appliances/vehicles, on the market for the first time within the territory of that member state on a professional basis,' said Ruska Kelevska, Administrator at the European Commission's Environmental Directorate.

Each producer needs to be registered by their national authorities 'although the battery directive does not foresee what the same procedural requirements for registration should be - this has to be decided under the comitology procedure,' explained Hans Craen of the EPBA.

Worldwide interest

The new EU regulations have clearly attracted interest from around the world, including the USA. 'Europe is too large a market to shy away from, so everybody has adjusted accordingly,' says Dan Squiller, CEO of San Diego-based rechargeable battery maker PowerGenix in an article from Cleantech Media. 'Also, I think there's a general belief that what's happening in Europe is going to expand to other geographies.' Countries including Brazil and Argentina have already drafted legislation similar to that of the EU, according to George Kerchner, Executive Director of the Portable Rechargeable Battery Association, a non-profit trade group. 'A lot of countries considering these restrictions don't have the infrastructure the EU does to oversee and enforce the collection and recycling programme so they're watching to see how the EU does it,' said Mr Kerchner.

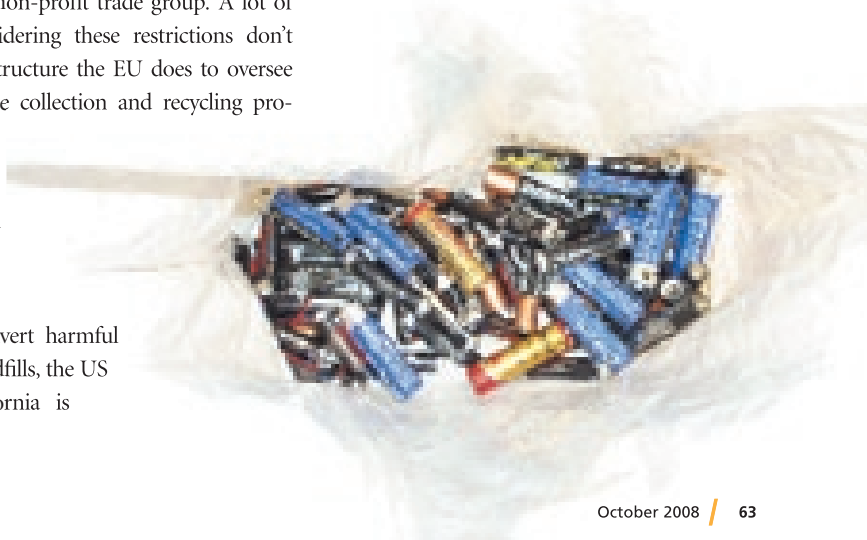
In a bid to divert harmful waste from landfills, the US state of California is

looking at legislation that would echo the EU's ban on certain elements in electronic devices and on electronics with batteries that cannot be replaced. This year, a regulation known as AB 218 got stuck at the Senate Appropriations Committee stage but other legislation currently in the pipeline could impose similar restrictions. 'We're looking at the EU and how they're dealing with electronics,' said Andrew Zingale, a legislative staffer for Assemblywoman Lori Saldana who wrote the AB 218 regulation with input from electronics manufacturers and environmental groups. 'The manufacturers' feedback was they want consistency in the market instead of one set of rules in Europe, and one set in California, and another elsewhere in America.'

Lithium-ion battery success

Each year, lithium batteries are produced in their billions and find their way into massively popular devices. As a result, the volume of these batteries appearing in the waste stream is on the increase. 'Lithium-ion batteries have an energy content which largely exceeds that of other conventional batteries,' Professor Bruno Scrosati of the University of Rome told delegates in Düsseldorf.

Prof. Scrosati, who was Chairman of this year's IBRC, gave an overview of the status of lithium batteries, which generally consist of a graphite anode, an electrolyte (a salt in an organic solvent mixture) and a cathode. Lithium-ion batteries have proved to be successful in small electronic appliances but there are still many challenges ahead when it comes to larger technology such as vehicles. Prof. Scrosati observed: 'Currently, common lithium batteries fall short of satisfying needs for high energy for application in more demanding markets, such as hybrid vehicles.' Improvements in energy density and especially



Battery recycling in 2007

The European Battery Recycling Association (EBRA) - which is the umbrella for more than 90% of EU battery recycling activity - celebrated its tenth anniversary on October 15. And at a presentation in Brussels, EBRA's President Bertrand Schutz announced the 2007 battery recycling results from the organisation's 19 members.

A total of around 31 000 tonnes of portable batteries were recycled last year - a figure similar to that for 2006 - whereas recycling of industrial nickel-cadmium batteries surged 44.4% to 4404 tonnes.

As in 2006, plants in France and Germany were responsible for recycling a significant proportion of these batteries, the former handling 10 800 tonnes and the latter 8900 tonnes last year. The quantity recycled in France climbed 7.7% when not including industrial nickel-cadmium batteries whereas the total for Germany showed a slight decrease.

Also in 2007, new recyclers began participating in EBRA - a noteworthy point, says the body, given the large number of collection organisations formed within Europe and the increasing use of batteries for technologies such as cell phones, lap-tops and other wireless equipment.

www.ebrarecycling.org

Volumes recycled (tonnes)

Battery type	2006	2007	% change
Alkaline, Zinc-carbon, Zinc-air	26 928	26 900	-0.05%
Lithium primary	317	306	-3.5%
Nickel-cadmium industrial	3050	4404	+44.4%
Nickel-cadmium portable (sealed)	2412	2689	+11.48%
Nickel-metal hydride	596	611	+2.5%
Lithium-ion	547	458	-16.3%
Button cells	70	75	+7.1%

safety are required, he added.

In the speaker's opinion, there is not yet a lithium battery which has the right chemistry for this application and most hybrid cars are running on nickel metal hydride batteries. The present configuration of lithium-ion batteries cannot be further modified to induce growth in energy density, he said.

According to Prof. Scrosati, his own laboratory had demonstrated a new battery configuration. 'We combined a Li4Ti5O12 anode with a LiFePO4 cathode with a gel membrane as an electrolyte separator to form a two-volt polymer battery,' he explained to delegates.

Advanced recycling

Congress organiser ICM had invited Dr Steven Sloop of the USA to speak about the recycling of



An Anglo-American gathering during the networking dinner. From left: Timothy Ellis from RSR Technologies, Michael Green from G & P Batteries (UK) and Steven and Julie Sloop of OnTo Technology LLC.

advanced lithium batteries. He is the founder of OnTo Technology, a research institute which has developed what is described as a simple process for recycling lithium ions.

His firm has been hired by several major US car manufacturers to pursue a fresh recycling approach. Its patented low-temperature, low-energy, totally 'green' process recovers valuable nano-materials and is also very cheap. Dr Sloop declared: 'My process recycles primary and secondary batteries for one tenth of the cost of hydro- or pyro-metallurgic processes.' It also exceeds EU standards as it recycles 80% of material by weight and can handle different battery types such as Li-ion, Li-primary, NiMH and alkaline. 'And,' he added, 'the process yields no environmental contaminant such as slag or organic solvent waste.'

French recycler Recupyl SAS has developed a patented sustainable recycling route for hybrid electrical vehicles (HEV). The Grenoble-based venture specialises in processing advanced batteries and its facility in Singapore recycles 160 tonnes of lithium-ion cells every month. The generic RECUPYL process is based on leaching of battery materials followed by purification and then recovery of valuable components such as lithium, titanium (from new emerging anode materials), vanadium, manganese and nickel.

HEV and EV batteries are totally different from their household or industrial counterparts and could be compared to some stationary batteries, according to Recupyl's CEO Professor Farouk Tedjar. He recommended a pre-treatment process for this type of battery, noting: 'At end of life of the full pack, it is generally expected that some elements could having some individual elements with important levels of charge. Then, direct handling and recycling could be problematic.'

His hydro-metallurgical treatment process extracts metal salts instead of primary metals - a factor which could offer market advantages in certain circumstances. According to Prof. Tedjar, the most economically promising material is the lithium-iron phosphate extracted by Recupyl.

Transportation issues

An EU agreement on transporting dangerous goods now incorporates a special section covering lithium batteries which can be highly flammable. This agreement is the basis for national legislation in many countries and the revised version will come into force on January 1 next year.

According to Marco Ottaviani from the Italian electronics manufacturers association ANIE, the regulation does not apply to lithium batteries which are 'packed' in products such as electronics or vehicles. The new agreement offers guidelines on how the lithium batteries must be transported by road vehicle or aircraft.

Used lithium cells and batteries with a gross mass of not more than 500 g each, collected for disposal, may be carried together with other used, non-lithium batteries or alone without being individually protected, when they are packed in 1A2 drums or 4A boxes fitted with a polyethylene bag and conforming to the packing group II performance level for solids. □



EBRA's Bertrand Schutz and Alain Vassart (right) gave an overview of their members' latest battery recycling statistics.