

Battery recyclers need investment support

The battery recycling sector needs a 'leap of faith' to overcome surging demand and mounting challenges. Will much-needed funds become available to build up the processing capacity?

Being a battery recycler is no easy task, reckons Charles Stuyck, global battery recycling manager at Umicore. 'We are being squeezed at all sides, whether you're talking about new legislation, trade challenges, economic drivers or poor design choices,' he says. 'It's a tough sector.'

The volume of products using lithium-ion (Li-ion) batteries, notably electric vehicles (EVs), is ever-increasing. 'But, ladies and gentlemen, it's time to get real,' Stuck told around 600 delegates at the annual ICBR gathering in Basel in mid-September. 'We have to get rid of the red tape of logistics, for one. It's sad this is always a current



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issue, no matter when and where in the world I am.'

LEAP OF FAITH

Stuyck likens a battery to a small chemical factory. 'Delivering battery-grade materials from spent batteries is no small feat,' with – as ever in recycling - scale being a major factor. 'There are a lot of relatively small players. 100 000 tonnes per year operations are still quite rare.' He thinks large-scale operations are unlikely to take off in the immediate future.

'Let's talk about the big elephant in the room, the investment climate. A large chunk of uncertainty comes from new and constantly changing rules. They impact the business

model that will win in the future.' He says it remains to be seen what politicians will agree on. 'Will they call for a recycling certificate? A strict chain of custody? More modern technology? A combination of all of the above? There are a lot of question marks. The fact is, if you want to do something meaningful, you'll probably need half a billion dollars in capital investment. Who is ready to take such a leap of faith right now?'

HYBRID PROCESS

Umicore's battery recycling plant in Hoboken, Belgium, has an annual capacity of 7 000 tonnes of Li-ion batteries and battery production scrap, the equivalent of 35 000 EV batteries. The site, which opened in 2011, uses a

hybrid pyro-hydro recycling method. It is a winning formula, Stuyck argues. 'We can take cells, scrap, highly varied infeed, you name it. It all goes into the same melting pot. There's no need for ten shredding lines to get the desired output. Our recycled black mass yields back alloys with a very high quality, pretty much rivalling that of virgin materials. Our results outperform that of traditional pyrological and hydrological methods.' Umicore proved commercial-scale battery recycling using its method in 2016. It has since developed a refined 2.0 process. 'We are ready to take this a step further and partner with whoever wants to do this together,' Stuyck says. 'In my experience, a pyro-hydro processing method is a very efficient for treating end-of-life batteries.'

Stuyck describes it as a localised solution, one that doesn't take as much effort as traditional methods. 'I hope that hearing about the benefits will help correct the misconception people have about this type of process. The battery expert believes solid state batteries are 'just around the corner'. Based on the latest data, he is confident Umicore will also be able to treat them.

MONEY TALKS

The calls for more opportunities for funding were echoed by Claude Chanson, general manager of Recharge. He observes that the EU Battery Regulation is 'growing up and doing well'. Following optimistic figures, his organisation believes that high electrification rates and the ramp-up of EU cell production to some 900 GWh in 2030 will drive the EU recycling market up to around 6 million tonnes of end-of-life batteries in 2040. 'I am glad the European Commission is investing up to EUR 3 billion in the battery supply chain this year,' Chanson says. 'Having said that, I do hope they will set up a dedicated Battery Recycling Fund. I doubt just a few billion will be enough to transform the entire industry in the near future.' The financial backing he is referring to is part of the EU's Innovation Fund, which will be active for at least three

LIME JOINS THE 'GREEN RUSH'

Electric scooters and e-bikes are commonly seen flitting through urban areas in big cities. Major player Lime is looking to boost its sustainability credentials.

Lime has struck a partnership with VoltR, a deep tech company specialising in the eco-design of lithium batteries. Together, the companies aim to extend the lives of Lime's electric bike and e-scooter batteries through battery cell reuse, supporting a circular economy and more sustainable urban mobility.

Recycling is certainly essential, though it occurs far too early in a battery's life cycle, according to Sedgewick Schlieszler, end-of-life products manager at Lime. 'I've spent the last five or so years taking stock of our growing fleet, looking into the best recycling options, and how best to repair our rental vehicles.'

That's been quite an assignment, considering Lime is active in 200 cities across 30 countries worldwide. Paris and London are both popular e-mobility hubs. 'We were getting mounting reports of vandalism and theft. The bikes became popular on the black market.'

Ultimately, Lime changed the design of the vehicles to make it next to impossible to manipulate or remove the battery. This was achieved by putting plastic between the cells and opting for a stronger casing. It also upgraded its track-and-trace network which can even locate e-bikes thrown in a river.

'It worked - the crime ring collapsed. The only downside is that it's now more difficult for recyclers to take out the battery once the vehicle is scrapped. These things are always a balancing act.'

He is sure the booming e-mobility market represents a future gold rush. 'I guess we can call it the green rush,' he jokes. 'New entrants have to realise it's a challenging market facing lots of ambiguity and legal headaches. There are hardly any rules because when recycling and repair rules were being written this industry didn't even exist. A lot rests on taking the initiative.'

years. It will benefit the most sustainable battery manufacturers in Europe. The investment is part of an overall cleantech fund totalling EUR 40 billion, of which EUR 6.5 billion (spread across 15 different projects) has already been spent.

Chanson laments that only three countries, Germany, Italy and France have received 83% of the financial aid to date. He is also concerned that access to funding takes too long and varies widely across member states. 'Some countries have to wait in line for over three years. Shouldn't access to funding for innovation be a lot easier?' He goes on: 'Europe will not win the battery race by overwhelming its companies with complex templates and questions that require input from whole teams of experts. This is the case for many of the grants today.'

MINING A SCRAP MOUNTAIN

Chanson further argues that the demand for batteries in Europe in the next ten years could be met through scrap. Thanks to a clear technological pathway and established supply

chains, recycling costs are expected to scale down by up to 50% for recycling hubs operating at 40 000 tonnes with smaller nearby facilities handling some 10 000 tonnes. What doesn't help is that some recyclers are refusing to process complicated chemistries in an attempt to meet the quota of materials to be successfully recycled.

'Most large-scale recycling projects are still only announcements,' adds Chanson. 'Further support measures to make them come to life are absolutely key.'

By 2040, around 80% of battery metals will be sourced from scrap in Europe and North America, new market data from Benchmark Mineral Intelligence indicates. 'This because we anticipate gigafactories will have ramped up their capacity and streamlined operations by then,' says senior analyst Beatrice Browning.

Europe is building up its hydrometallurgical capacity in an effort to catch up on Asia, which is now selling black mass at good prices. 'I'm confident the required capacity will come online in the next five or so years,' she adds.

'Scrap usage will likely skyrocket by the mid 2030s.'

Meanwhile, Japan is said to be investing almost EUR 2.3 billion in subsidies to boost its domestic battery production. Hubs will focus on salvaging production scrap.

WHAT IT SAYS ON THE TIN?

Recyclers are working hard to reduce contaminants from their dedicated waste stream. 'There is a lot of plastic in the e-scrap and battery streams these days,' notes Keith Harrington, global sales manager at Linev Systems in the UK. 'This makes sorting harder than it has to be. Also, not a lot of battery material is magnetic. So magnetic sorting is not the way to go and optical sorting is too superficial.'

While visiting a client in Italy to demonstrate an X-ray sorter, Harrington was initially greeted with some resistance. 'The recycler pulled out a battery he thought was wrongly sorted. He showed me the label and made a fuss. I offered to have it analysed at the lab: it turned out to be an alkaline battery all along. The label was wrong.'

Harrington shakes his head in amusement. 'It happens more often than you'd think. I've encountered fake nickel-cadmium batteries and all sorts. Some labels are so old or damaged you can hardly read them. Either way, a battery is not always what it says on the tin.'

According to Harrington, X-ray sorting is the way to go and the BatterieRay six-channel automatic sorting line is Linev's answer. It can recognise up to 12 cells per second and realises a purity of 99%. The system processes around 0.5 tonnes per hour, providing a detailed report of exactly what materials and how much are in the batch. 'We can identify batteries down to the granular level, any chemistry, no problem,' Harrington says. The artificial intelligence-driven solution was designed specifically to tackle small batteries. Large EV packs cannot yet be identified. 'We want to target those pesky vape batteries. It would go a long way to cleaning our streets.'

WHAT SHADE OF GREEN?

'I often hear people talk about green batteries. But what does that mean? There are many different shades of green,' says Timm Lux, associate director at the Boston Consulting Group (BCG). He was tasked with helping to deliver the first large-scale electronics recycling plant for Aurubis in the USA a few years ago. Meanwhile, the BCG is helping car manufacturers source an optimal combination of primary and secondary materials for their vehicles. As it stands, an EV has a higher carbon footprint than a vehicle with an internal combustion engine (ICE). While steel is the main contributor in the production process of an ICE car, with 37% of emissions, traction batteries represent 34%. The steel content of EVs is lower at just over 15%.

Lux wants the automotive industry to use more sustainable batteries. 'The EU will mandate a battery passport by 2027. This will likely impact what kind of materials are used to power the car.'

He believes it will offer a unique opportunity for producers to ask for a 'green premium' for low carbon footprint materials. 'Additional margins may be added on top of production costs, further increasing the final price of green products.'

The trust of the end-consumer is vital. 'You can earn quite a bit of money if you charge a green premium to the right customer. This works in the steel industry. Green steel costs more and people understand why.'

Lux points out that lithium-iron-phosphate batteries have CO₂ footprint roughly 50% lower than nickel-manganese cobalt batteries. Factoring recycling into the mix could further reduce emissions by up to 31%, he believes.

'Using only the most sustainable materials is not always an option due to the scarcity of some materials. Ensuring access to these materials is therefore crucial.'

‘BLACK SAND’

‘Urban mining is critical now more than ever, that’s crystal clear,’ says Robert Kang, ceo of Blue Whale Materials in the US. ‘However, a circular system is much easier to talk about than to realise’. Kang founded the company in Bartlesville, Oklahoma, nine years ago to help turn the tide. It uses proprietary technology to produce ‘a very dry product’ that his team refers to not as black mass but ‘black sand’. Up to 98% of high-quality cobalt and nickel is recovered from lithium-ion batteries. ‘Our output is optimised to serve hydrometallurgy refining,’ Kang observes.

Blue Whale Materials has been dedicated to R&D for years and is currently building its first US pilot plant. It will start operations in 2025 with capacity around 25 000 tonnes a year. A 93 000m² battery material testing facility and warehouse will also follow next year.

‘Our big plans are the result of major multi-billion grants from federal government in the last 12 months,’ Kang states. ‘We are very thankful for this backing, which will no doubt accelerate recycling best practices.’ Recent support includes being selected for funding of US\$ 55 (EUR 52 million) by the US Department of Energy.

The recycler also benefits from BWM’s EUR 103.5 million expansion initiative that will allow it to process at least 50 000 tonnes of battery feedstock annually at the existing site in Bartlesville. This partnership will provide the carmaker with enough critical minerals to power more than 100 000 electric vehicles per year. The expanded operations will convert 3.5 times more end-of-life batteries and production scrap into black mass than currently.

‘MAD SCRAMBLE’

Kang hopes his firm’s new facilities will alleviate the lack of domestic refining. ‘US players are scrambling like mad to find the missing link in the value stream. To be frank, I fear that even if more batteries are recycled there will still not be enough volume to reintroduce them into US produc-

tion. Battery recycling is like a kind of speed dating. It’s so hard to find the right partners and schemes that are economically viable in the US.’

It helps that Blue Whale Materials can transport batteries – even damaged ones – across the country without interstate paperwork. The ceo explains his team learned from shipping spent batteries to Samsung in South Korea. ‘We’ve faced transboundary issues and other logistical nightmares. I’m glad to say we’ve gained more expertise and we’re now replicating best practice in the US.’

One theme that keeps coming back is the regulatory status of black mass. Even though it has commercial value, it is classified as waste. Some states even see it as hazardous waste.

‘How does this make sense? Bear in mind that by simply neutralising the electrolyte, black mass falls under the regular solid waste classification.’

In that scenario, it’s possible to import the material into the US without special import permits that take over six months to acquire. ‘This is a huge factor in building more capacity in battery processing in the US,’ Kang points out. The lack of industry specification for black mass is another concern. He supports calls for the quality of the material to be highlighted. ‘Quality matters. Not all black mass is the same,’ Kang argues.

He also expects new rules on potential material toxicity, such as per- and poly-fluoroalkyl substances (PFAS), to be introduced soon. He points out that recyclers do not need hazardous waste permits as long as they are processing black mass within 24-72 hours.

Looking ahead, Kang observes it’s an ‘really intense time of serious negotiations that will have big implications on all of our futures’. In his view, reaching the next level of battery recycling success is not something a single nation can tackle alone. He concludes: ‘Our industry requires inter-connectedness. The stakes for the world are high.’

MILES TO GO

‘The best way to treat batteries is to extend the cycle as much as possible,’



Umicore’s site in Hoboken can treat the equivalent of 35 000 EV batteries per year.

argues Levi Thomas, business development manager at US recycler GreenTec who acknowledges greater battery processing capacity is needed. The family-owned company, based in Kansas, was launched 15 years ago and specialises in remanufacturing automotive batteries.

‘Most EV batteries that we look at are still pretty decent,’ Thomas says. ‘In the right hands, there are still many more miles in them. All the work is in-house. Our team can fix any brand from Tesla to Honda, Ford or Range Rover.’

GreenTec operates 28 sites across the US with plans for 50 by 2028. ‘More exciting news is that we are launching a new site in Vancouver next year. This follows a facility we opened in Toronto earlier this year. The next stop? Europe,’ Thomas says with a big grin. ‘We are in the process of picking a location. It’s likely to be Sweden.’

At each site, GreenTec has 12 large machines that test more than 400 batteries a day. It uses a dry recycling method to recover valuable materials that don’t qualify for second-life use. ‘I know car batteries are a risky segment, but we have never had a fire,’ Thomas adds.

The engineer is keen to take on a mentoring role with young people to teach basic dismantling and repair skills. ‘With sustainability, once people get involved with their hands, the subject matter really comes to life! It’s wonderful to see.’