# Lithium Process

# Non-Technical Summary

The installation operated by LiBatt Recycling (LBR) is a hazardous waste installation, primarily involved in the treatment and processing of Lithium batteries and a secondary operation for the storage and transfer of waste oil.

Lithium batteries are a ubiquitous form of waste, classed as hazardous due to the Lithium compound content of the battery, which is highly reactive with Oxygen and/or water, and the electrolyte in the battery which in some cases contains Hydrofluoric compounds.

Lithium batteries are typically found in the following applications:

* Automotive (Car, van, lorry engine ignition)
* Uninterruptible power supply systems from alarm and lighting power back-ups to telephone and IT systems power back-up
* Motive power in electric forklifts, trains, and golf carts etc….
* Portable power in leisure activities (boating and caravans, for example)
* Hand-held devices including power tools

Due to the dynamics of Industry services, as well as the mechanisms by which Lithium batteries are managed in the waste (end-of-life) supply chain, some commercial contracts and waste management requirements involve a contractual requirement to remove Lithium batteries. This, along with other types of battery chemistry (such as Nickel Cadmium batteries also used in power back-up systems) need to be removed and are often associated with waste electrical and electronic equipment (WEEE).

Whilst these non-Lithium batteries or equipment are not to be processed at the installation they are intended to be stored, handled, and repackaged for other end recyclers to subsequently complete their recycling.

It makes environmental and commercial sense for waste types of similar nature or of an associated nature to be handled at one facility for economic movement of final components and/or whole articles to other downstream recycling specialists thus keeping environmental and commercial costs to the public as low as possible.

It is therefore the intention for the installation to deploy its resources for the treatment and recycling of waste Lithium batteries, but also to accommodate the repackaging and consolidation of other batteries and waste electrical and electronic equipment in relatively low quantities.

For the main activity at the installation, Lithium batteries will be accepted and inspected to ensure there is no contamination or other problems associated with the waste and it will be stored within the site boundary in designated storage or holding areas in closed containers or the warehouse, so it is kept in a controlled and secure environment.

Lithium Batteries will be either:

1. Sorted by category for Waste battery regulations reporting requirements, and repackaged for onward shipment to a final recycler in the UK; or
2. Be processed by LiBatt

During processing, the batteries may have a charge state assessment and, if necessary, any charge removed to render the battery safer.

Where possible, the complete battery will be fed into the system via a conveyor belt and broken in a bespoke, inert atmosphere hammer mill. The broken batteries will then pass-through subsequent separation and drying systems, screens and standard processing equipment which will generate clean metallics, electrolytes, plastics and a ‘Black Mass’ which contains the transition metal species.

Other Batteries

Other non-Lithium batteries, shall be separated from Lithium batteries before shipping, or collected separately from Lithium batteries and sorted by category and chemistry. They are then repackaged and sent to final recycling facilities in accordance with local and national regulations, and reporting of such activity shall be made to the Environment Agency for compliance with the Waste Battery & Accumulator Regulations (2009)

Unintentional Waste

Any unintentional waste electrical and electronic equipment (WEEE) shall be separated into a dedicated storage area and forwarded to an Approved authorised treatment facility for final recovery of WEEE components, and to have evidence of WEEE recycling issued in compliance with the relevant regulations in the UK.

Record Keeping

The records for all waste inputs and outputs are retained at the installation and reported to the Regulator at quarterly periods.

A register of all waste inputs and outputs, and their recovery or disposal destination shall also be maintained as a summary of the activities and waste throughput, with perpetual stock records also being maintained as a result of day-to-day activities.

All our activities shall be carried out in a large warehouse building and subject to stringent controls and adherence to both National legislation, local policies and procedures.

**Process Overview**

The primary activity to be undertaken at the Wolverhampton site is the treatment of batteries containing Lithium compounds, although other battery chemistries may be accepted including batteries containing Lead. The site has been upgraded to incorporate all the requirements of the Environment Agency (UK) for the intention of safe operation and best available techniques.

The site is designed to house a discharging facility, an inert atmosphere breaking phase for the battery recycling process and the separation equipment to produce the broken fractions of the breaking process. This means that the final products are Metal fractions (Iron, Copper, Aluminium), Plastic/Paper, Electrolyte and Black Mass (a mixture of Activated Carbon, Transition metal oxides and traces of lithium-based compounds).

**Preparatory Stage** (Receipt, Sampling, and Inspection)

Documented procedures have been submitted with this application. This document will provide a brief overview of this process.

Materials will be received to site in accordance with the **Pre-Acceptance Procedure**. The waste will then be weighed, sorted, and inspected in accordance with the **Waste Acceptance Procedure** which includes arrival, inspection, sampling, rejections, quarantine and maintaining records etc.

**Treatment Summary**

Any batteries which have been transported as ‘Unsafe’ will be identified, discharged and made safe. The safe batteries will then be fed into the inert gas breaker system via a conveyor belt and broken in a specially designed hammer mill. This is the critical phase of the process. The inert atmosphere present in the breaker removes the possibility of high-level thermal runaway or explosion. The breaker is designed to withstand explosive forces as a precautionary measure.

Oxygen detection during this phase of the process ensures that the inert atmosphere is maintained and in the event of any failure, the feed material will be ejected into a bespoke fire suppression system to avoid inadvertent fire or explosion.

The broken batteries will then pass through an inert atmosphere dryer and then subsequent separation systems:

This onward process includes screens, magnetic separation to remove Iron and other ferrous materials, eddy-current separation to remove the non-ferrous materials and finally air/gravity separation to remove the plastic and the paper.

The resultant products will consist of Black Mass, Copper foil, Aluminium foil, ferrous materials, electrolyte (small quantities), plastics and paper.

It is the Black Mass and the electrolytes which are the main products, however the metallic fraction will generate income on its own merit.

**Operational Advantages**

The breaking phase of the operation utilises well established process machinery, but the process is strictly controlled in terms of both Oxygen levels and temperature. This allows normally volatile Lithium Batteries to be crushed and made safe by the removal of the volatile electrolytes in an inert atmosphere.

The generation of clean ferrous and non-ferrous (Copper and Aluminium) products allows efficient recycling to take place at the end-user, since the amount of transition metal oxide (Co,Ni,Mn) contamination is kept to a low level.

The process therefore can recycle approximately 99% of any Lithium Battery. The only materials which are difficult to recycle are the electrolytes which account for approximately 1% of the battery weight and these currently have to be processed off-site.

**Outputs**

The out puts from this Lithium process are as follows:

Black Mass – Cobalt, Nickel and Manganese Oxides in a powder form suspended in a a bulk Carbon powder

Copper Foil

Aluminium Foil

Paper and Plastic

Electrolyte

Ferrous Metals

**Secondary Operation – Oil Storage and Transfer**

As part of the original site operations, waste oil was delivered, treated and stored by Slicker Recycling Limited.

On transfer of the permit, the storage of a small amount of oil was agreed to be maintained, but all treatment of waste oil will cease. This requires the management and operatives at LiBatt to have a working knowledge of the oil transfer system and the ultimate control for the operation lies with LiBatt.

Only authorised, tested and approved vehicles will be allowed on site for the purposes of delivery and collection of the oil.