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Short communication

How to implement efficient local lead–acid battery recycling

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Abstract

For successful recycling, at least 95% of the spent batteries in the country or region concerned must be processed. Key factors in effective recycling are the availability of at least 2,000,000 spent batteries a year which come from the vicinity of the plant, a favourable regulatory structure, efficient collection, a competitive and environmentally friendly recycling technology, adequate lead-refining know-how and, last but not least, the necessary financial backing. In the last 5 years, Campine, a long-established Belgian metallurgical company, has been able to combine these key factors and become a successful recycler covering the Netherlands and the north of Belgium. Laws and regulations have been enacted governing disposal, storage, shipping and recycling batteries. Campine obtains spent batteries via four different channels and offers a simple, competitive and environmentally sound method of recycling, using a shaft furnace and post combustion. © 1999 Elsevier Science S.A. All rights reserved.

Keywords: Recycling; Lead–acid batteries; Battery collection

1. Introduction

The keys to successful and effective lead–acid recycling are:

1. The availability of at least 2,000,000 spent batteries a year in the vicinity of the plant. This means a LOCAL or TARGET market.
2. A favourable regulatory structure
3. An efficient collection system
4. A competitive and environmentally friendly recycling technology and adequate lead refining skills
5. Financial backing.

2. Local or target market

Lead–acid battery recycling is essentially the necessary link between the local spent battery market and the battery producers, supplying new batteries in this market.

The high cost of collecting, storing and shipping the spent batteries on one hand and the legal barriers, such as cross-border regulations, local regulations minimising shipping distances, on the other, are the reasons why it is necessary to recycle as close as possible to the source, i.e., the local spent-battery market.

Economically it has been proved that a competitive recycling unit needs a minimum capacity of ±20,000 mT of Pb. Smaller units cannot cater for the environmentally necessary investment or afford the required skills.

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This means that a local market is defined as a country and/or a region where every year at least 30,000 mT of spent batteries become available (or at least 2 to 2.5 million spent batteries). For smaller countries, this quantity is too high, so the local target market must include more than one country.

As in the recycling business, competition takes place more in the raw materials market and less in the lead market itself, the geographical location of the recycling plant is highly important: population, number of cars, distances, are all factors to be taken into account.

3. Regulatory structure

It is necessary for local laws and regulations to stimulate a maximum level of recycling, i.e.:

- to ban the dumping of batteries and their components in landfill sites;
- to limit the storage of spent batteries in both time and quantity
- to grant approval only to those collectors and recyclers which comply with the stringent rules relating to environmental and human safety.

Each local authority must have the aim of keeping lead out of the environment and create a structure in which more than 97% of spent batteries will be recycled.

4. An efficient collection system

A successful collecting system produces a collection rate of above 95%. Collection points (garages, spare parts retail outlets, shredders, dismantling companies for vehicles at the end of their life cycle) must be well monitored to prevent the batteries and/or battery acid from disappearing.

The collection and shipping, as well as the administration related to these items, are best done by professional, officially approved companies which have invested in a suitable logistic infrastructure, using standard acid-resistant plastic boxes, acid-proof trucks, safe warehouses, etc.

These collection networks have to be remunerated in a fair way for the service they offer and the investment they make. In general, they earn the difference between the price they have to pay to the collector for the spent batteries and the price they receive from the recycler.

This does not always work very well, as the spent-battery prices do not always follow the LME lead prices. When LME prices are very low, as was the case in 1994, the lowest price paid to the collecting points is 0, but the recyclers were not able to pay a fair price to the collectors.

Some countries, such as Scandinavia and Italy, have implemented a compensation system. However, in most Western European countries, price-setting of spent batteries is governed by supply and demand, with the problem being that prices of recycled lead are still linked to LME prices, which are dominated by financial speculation, usually completely disconnected from the physical lead market. Most of the time, recyclers are left to pay the bill in unfavourable times.

The best situation would be that battery producers be made liable for their products and could buy secondary lead at a fair almost fixed price, independent of the LME. But this is still a dream.

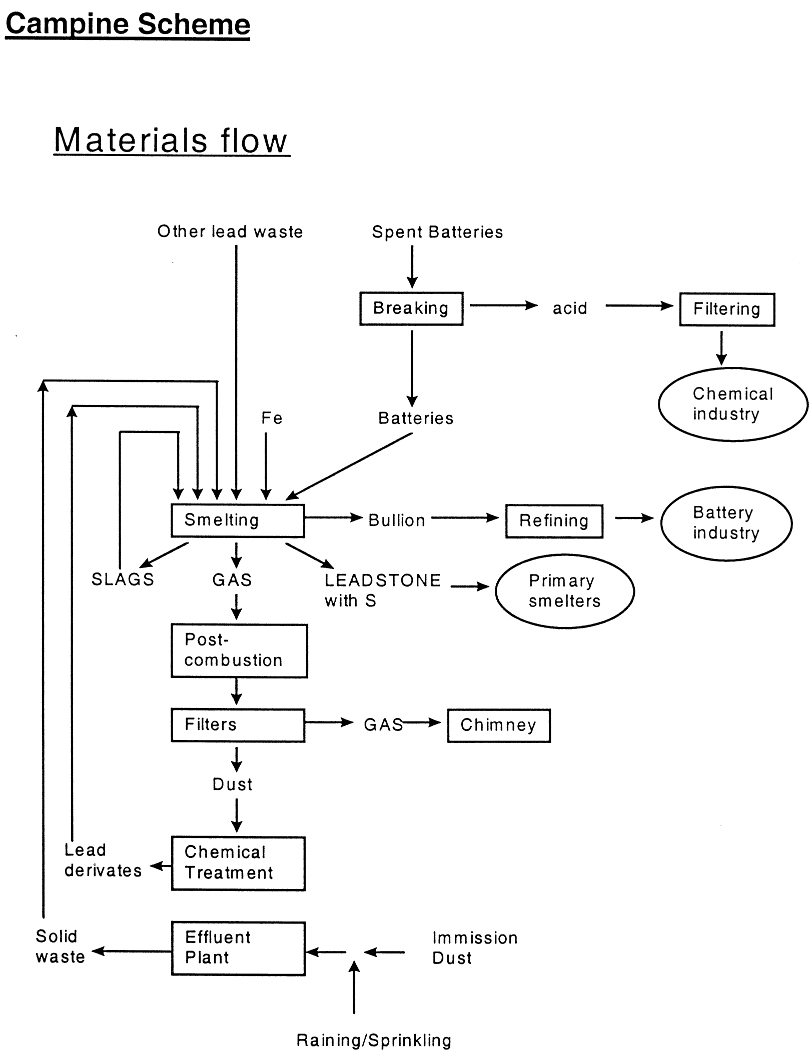
5. Technology

The technology used must be cost-effective which implies high yields, low energy consumption, low maintenance and manpower costs.

Smelting has to be environmentally friendly, which means having a minimum level of emission and immission, no landfilling of by-products and slag, using them instead for other applications. It must be one of the B(est) A(vailable) T(echnologies).

If lead-refining skills are not available, it is better to act as a 100% toll converter, supplying bullion to a larger smelter with spare refining capacity.

6. Campine scheme



Typically this technology and methodology produces 5000 mT/year sulphuric acid (15%), 25,000 mT lead bullion (98%), 1200 mT slags (1%) and 3000 mT matte (10%) to be shipped to primary smelters. Overall Pb yield is typically 98.8% at the plant level and 99.8% after reworking the matte.

Air emission is typically SO_2: 250 mg/nm^3, dust 1 mg/nm^3 and NO_x, CH_x and dioxins far below permit levels.

7. Financing

A recycling plant for 20–25,000 mT of bullion costs between 15 and 20 Mio DEM, while a refining plant of the same capacity would cost between 4 and 6 Mio DEM.

To have a sufficient return on investment on such a substantial investment, a refining plant would have to operate at full capacity for at least 11 months/year (24 h/day, 7 days/week). This is the main reason why the supply of raw materials has to be guaranteed. This can only be the case if a sufficient market exists, if there is an appropriate regulatory structure, an efficient collection system and if BAT and cost-effective technology is used.