ELSEVIER

Journal of Power Sources 57 (1995) 47–49

JOURNAL OF POWER SOURCES

Battery-recycling as a part of the Swiss waste management concept

Hans-Peter Fahrni

Federal Office of Environment, Forests and Landscape BUWAL, Waste Division, 3003 Berne, Switzerland

Abstract

The efforts presently taken by the Federal Office of Environment, Forests and Landscape of Switzerland to control and reduce the environmental risk associated with battery waste, are described and evaluated in terms of efficiency and cost.

Keywords: Recycling: Spent batteries; Switzerland; Regulations

1. Introduction

The main objective of waste management in Switzerland is to reduce, to the greatest extent possible, the environmental impacts caused by waste handling and treatment, at least to a level that is not noxious. This means that the goals for air quality control, for water, nature and landscape protection and for the economical use of energy and resources must be given consideration. To achieve this objective we rely on four strategies:

(i) minimization of waste at the source, by use of non- or low-waste technologies;

(ii) reduction of hazardous substances in products and processes;

(iii) waste reduction through improved re-use and recycling, and

(iv) treatment of the unrecoverable waste in an environmentally safe manner within Switzerland.

2. The battery problem

More than fifteen years ago, high-mercury emissions in municipal waste incinerators were registered by the authorities during control measurements. It was quite clear that one of the most important sources of Hg in the flue gases were spent batteries, simply disposed of by the consumer with the municipal waste. At that time, for instance, alkaline batteries contained more than 1 wt.% Hg. It was therefore obvious that action had to be taken against these emissions. The Federal authorities' scheme was based on the following three measures:

(i) On a short-term basis, the separate collection of spent batteries led to a reduction of hazardous substances (mainly Hg and Cd) in municipal waste.

(ii) As a solution with a middle-term effect, limit values for the Hg and Cd contents of batteries were set up and introduced as part of the 'Ordinance on hazardous substances'.

(iii) The legislator called for an effective flue gas treatment in municipal waste incinerators, a measure which was achieved within a time span of three to seven years.

These three measures and combination of them proved to be important and successful.

(i) *Separate collection of spent batteries.* The separate collection of spent batteries led not only to lower Hg emissions in municipal waste incinerators, but was also an important contribution to enhancing awareness of the waste disposal issues by the consumer. People realized that every product becomes waste one day and that its disposal may be a problem for our environment.

(ii) *Hg and Cd limit values for batteries.* Switzerland was the first country to set limit values for the Hg and Cd contents of batteries. This regulation prompted the battery-producing industry to conduct intensive research and decide on high investments. Their success was impressive: today, most batteries are Hg and Cd free or contain only traces of these heavy metals; this, of course with the exception of special batteries and Ni–Cd accumulators.

The introduction of legal regulations in Switzerland concerning the Hg and Cd limit values triggered actions in other countries and even prompted the European Community to release regulations on this issue. Today, the current Hg and Cd limit values for batteries in the European Community countries are stricter than the first Swiss limit values at that

SSDI 0378-7753(95)02239-D

time. Almost every country has now enacted regulations for the Hg and Cd content of primary batteries.

(iii) *Regulations for flue-gas treatment of municipal waste incinerators.* The severe regulations for emissions from municipal waste incinerators led to the construction of wet scrubbers in the incineration plants in the early 80s. How successful this was, could not only be seen in the lower Hg emission of these waste treatment plants but also in the strong reduction of other emission as, for example, HCl or dioxins.

Although these strategies were successful, the battery issue was still not solved as a whole. Another disposal method for spent batteries had to be found.

3. The next problem

As a consequence of the separate collection of waste, large amounts of spent batteries had to be disposed of. At that time, the only option for disposal was a controlled landfill site for hazardous wastes in Kölliken, Switzerland. The bad quality of the leachate of the landfill evidenced immediately that this disposal method for batteries and other hazardous wastes was in no way environmentally safe. The mentioned landfill had to be closed and is now a contaminated site which requires continuous monitoring and remediation. Intensive thinking was started to find a solution to the environmentally safe disposal of spent batteries. In the meantime spent batteries were being exported, mainly to the former GDR and France, there again for landfilling. It was obvious that these exports were certainly not an acceptable way to dispose of spent batteries. Therefore, starting 1991, about one year before the battery-recycling plants were expected to be operative, the Federal Office of Environment, Forests and Landscape, the Swiss environmental authority, prohibited any further export of spent batteries. The export stop is now still in force.

4. The idea of battery recycling

Serious thoughts were given as from 1985 to find ways of recycling spent batteries. The goal to be reached was already laid down in the Swiss guidelines for waste management. Every form of waste treatment must result either in re-usable substances or residues with an acceptable quality for final storage. The decision was taken to search for a recycling solution.

Two main problems arose: (i) identify the appropriate technology, and (ii) how to fund battery recycling.

Thanks to the efforts of the Federal Office of Environment, Forests and Landscape, the support of different Cantons and that of a large Swiss retail company, shareholders were found to start the investigations for a battery recycling. Different technologies were considered or specially developed. The technical problems proved to be much more complex than expected. As a consequence, the technologies used nowadays for battery recycling are quite sophisticated. Therefore, it took some years until our two plants, using different technologies, BATREC AG and RECYMET SA, started last year to work to their full capacity.

In this volume the technologies of RECYMET SA and BATREC AG are explained in detail [1,2]. As a fact Switzerland has today enough capacity for the recycling of its own batteries and even free capacity.

5. Costs of the battery recycling

But, once again, the batteries proved to be a masterpiece for generating problems:

Due to the highly developed technology required for the recycling of batteries and the rather small dimensions of both plants, the treatment costs are high. In addition, as a consequence of the export stop of spent batteries, the costs for storing about 5000 tons of spent batteries had to be covered as well.

As a matter of fact, unlike what some expected, battery recycling is not profitable — on the contrary. Therefore, a funding scheme had to be found as soon as possible.

In the absence of legal regulations it is the great merit of the involved parties, namely producers, importers and retailers, to have joined their forces and sought a solution to fund battery recycling. Already in November 1991 these parties founded on a voluntary basis the BESO, the 'self-help organisation for battery disposal'. The BESO introduced a prepaid disposal fee for the funding of battery recycling. This means that a consumer pays for recycling already when he purchases new batteries. It can only be regretted that some 'free-riders' sincerely jeopardize this voluntary system simply because of a short-term financial advantage.

6. Today's situation

In Switzerland, some 3500–3900 tons of batteries are purchased yearly. The returning rate of spent batteries today is only about 50–60% — much too low a figure. It is astonishing: such great effort has been done to collect harmless wastes as for instance glass, PET bottles, aluminium cans and manage to achieve a returning rate of up to 80% (PET 70%). Why are batteries, which, after all, are a concentrate of heavy metals and a source of raw material, disposed of in the normal municipal waste at a proportion of still 40 to 50%?

The price tag of CHF 4750 the costs of the recycling of one ton of spent batteries, cannot be the reason for such low returning rates, since the recycling costs are already included in the price of the batteries and nobody is complaining about that; also the costs for the recycling of PET bottles or aluminium cans are high: they amount to CHF 2000 and 3000 per ton, respectively. The low returning rate of batteries is due to other factors, for example, the small size of batteries which makes them very easy to throw away with the munic-

ipal wastes, or the fact that collecting points are not well indicated, etc.

Because of the too low returning rate of spent batteries, measures have to be taken to increase this figure. The annex of the 'Ordinance on hazardous substances' on batteries is therefore presently being revised. Beside a harmonization with the current European Community regulation, every retailer of batteries will be obliged to take back any kind of used batteries. In addition, it is proposed that is a certain returning rate of spent batteries, e.g. 80%, is not achieved within two years, a deposit for any kind of battery will be introduced. In order to stimulate the use of heavy metal-free accumulators, a deposit on Ni–Cd accumulators is proposed, if the technically possible replacements of such accumulators cannot be reached. With these proposals the involved parties will still have the opportunity to find their own way of increasing the returning rate without the mandatory enforcement of a battery deposit rule.

At the present time, the amount of the prepaid disposal fee would not cover the recycling costs for all batteries in order to reach the required high returning rates. Because the prepaid disposal fee is a voluntary action of the involved parties it would be difficult to increase the free without endangering the system. Therefore with the revision of the Swiss 'Environmental law', which is now being discussed in Parliament, one paragraph will provide for the legal basis to introduce a mandatory prepaid disposal fee. Voluntary solutions will still be possible, but the problem of 'free-riders' will be solved with this legal regulation.

7. Future problems and outlook

Let us have a look at the future evolution of battery recycling. We are convinced that today, and for about the next ten years, our option for a relative high-tech and therefore expensive battery recycling scheme is the solution we need. After that time span, when only so called 'green batteries' will be sold and therefore returned, it may be, that recycling is possible with a simpler technology. But there will remain the so-called 'special batteries' with very high Hg and Cd contents and the Ni–Cd accumulators. Both will need to be recycled in an environmentally safe manner with the best available technology.

References

[1] R. Burri and A. Weber, *J. Power Sources*, 57 (1995) 31–35.
[2] P. Ammann, *J. Power Sources*, 57 (1995) 41–44.