ELSEVIER Journal of Power Sources 57 (1995) 71–73
JOURNAL OF POWER SOURCES

Nickel–cadmium battery recycling evolution in Europe

J. David
Société Nouvelle d'Affinage des Métaux, 38297 St. Quentin-Fallavier Cedex, France

Abstract

After a brief introduction on the structure of SNAM (Société Nouvelle d'Affinage des Métaux), the role of the nickel–cadmium batteries in the consumer electronic market is illustrated. Finally, the procedures and the cost for collecting and recycling nickel–cadmium battery waste are discussed.

Keywords: Recycling; Nickel; Cadmium; Batteries

1. Structure of SNAM

SNAM (Société Nouvelle d'Affinage des Métaux) is founded in 1977 in Lyon; in 1981 a new factory in Saint-Quentin-Fallavier (suburbs of Lyon) has been started, and in 1985 the capacity increased at 800 tons per year; in 1988 new factory in Viviez (France) has been built.

SNAM treats nickel–cadmium (Ni–Cd) battery waste by thermic processes. SNAM disposes, therefore, of a furnace of 1 ton/24 h capacity which enables to separate cadmium from other residues by distillation in a controlled atmosphere. Besides this furnace (14 furnaces are working in the two factories), SNAM has at its disposal: (i) automatic dismantling of industrial batteries; (ii) automatic breaking of the plastic case around power packs; (iii) pyrolysis of organic substances contained in sealed cells; (iv) cadmium refining in 99.99% quality, and (v) automatic tapping in sticks.

The efficiency of these air- and water-treatment processes enables SNAM to respect the very strict rules of effluents enforced by our treatment authorizations.

2. What is the future for nickel–cadmium batteries?

Nickel–cadmium batteries are classified into two categories:

(i) industrial (or open) batteries are sold for two purposes: traction and stationary, and

(ii) sealed batteries, mostly cylindrical shaped, are mainly assembled into plastic power packs for mobile communication, camcorders, power tools, emergency lighting, etc.

Up to five years ago, sealed Ni–Cd cells had no real competitive counterparts. In some areas such as emergency lighting or mobile communication, they had to compete with lead/acid batteries manufactures at the same price level. In other areas, such as printed circuits, they had to compete with non-rechargeable lithium cells, the life time of which was longer than the printed circuit itself.

Within the last five years, Ni–Cd cells had to face competition from two new battery developments:

(i) the nickel–metalhydride (Ni–MH)-type providing some use advantages, is more expensive than the Ni–Cd battery, and

(ii) lithium rechargeable, and mostly lithium-ion batteries, which have an energy capacity particularly efficient and voltage values up to 3.6 V. The voltage of Ni–Cd cells is, as well known, limited to 1.2 V. Unfortunately, processing cost of lithium batteries is today much higher than of Ni–Cd cells.

Professionals and mainly manufacturers of these kinds of batteries are forecasting that there will be a particular market for each type of batteries.

As far as cadmium would not be banned by the authorities for its usage in batteries, Ni–Cd batteries will probably keep the non-expensive market segment.

The forecast that the 'cordless' appliances increase slope for the next seven or eight years will be around 10% per year means that the market will double.

High performance lithium-ion cells will be established as the market leader as processing costs will strongly be reduced by increasing production capacity.

Ni–MH, as far as recycleability of its components would be proved, should keep, in the middle range quality appliances, its market share (mobile communication).

In terms of volume, the Ni–Cd battery market share will probably remain at 80% of the 1994 level.

0378-7753/95/$09.50
SSDI 0378-7753(95)02244-9

3. Collecting and recycling: what is happening by now in Europe

Unfortunately, one would say 'too little'. Within European Union countries, the European Directive 91/175 has not been completely translated in the local regulations yet. What can be said is that, when no public or more specifically environmental pressure from some specific groups (ecological) appears, things are moving slowly.

Three examples will be discussed here:

(i) *The Netherlands.* Today, in this country, 30 to 40% of almost all types of primary and secondary batteries market volume is collected. The question is whether this kind of collection is fulfilling te European Directive requirement. First, by collecting batteries containing less than 0.025% cadmium or mercury and less than 0.04% lead, the Dutch authorities are exceeding the European requirement. Second, the unsorted mixture is presently sent to Texas, USA, for processing. Up to the end of 1994, the municipalities were financing the stockpiles and processing costs. From the beginning of 1995, batteries producers and importers should have taken over the task and support all these costs.

(ii) *Switzerland.* All types of batteries are presently collected. Battery distributors and producers within the frame of the BEZO, a semi-public organization, are collecting the money necessary for collection and recycling of spent batteries. This money is provided by slightly increasing battery retailing prices.

(iii) *Germany.* It is a very impressive example of selective Ni–Cd collection.

For the last five years, ARGE BAT, a subsidiary of the ZVEI, has been organizing the collection of spent Ni–Cd batteries, through various distribution networks. Those batteries are transported to the area of Frankfurt, where they are prepared in order to be shipped for recycling. The batteries arrive in Frankfurt in cardboard boxes. There should be only Ni–Cd batteries, but up to 50% consists of other types of batteries.

It means that 600 metric ton of collected batteries represent only 300 metric ton Ni–Cd batteries. Adding selectively collected batteries from other sources, a total of about 400 metric ton per year is achieved. If we compare this number with the total quantity available in Germany (about 2000 metric ton/year in 1990), the efficiency of this selective collection is 20% only. But, at least, this proves that selective collection is feasible.

Another route for Ni–Cd batteries collection is batteries returning through the distribution network of battery equipment. Along this route, the products are sold through specialist's networks. The user, whether a private individual or professional, who has a problem with his equipment or battery, will return it to his reseller. He will not try to find the battery reference for fear of being mistaken.

Spent Ni–Cd batteries are thus automatically returned to a collection point. In addition, the risk of mixing them with other types of batteries, such as primary ones, is low.

Once spent batteries have been returned to this collection point, it is possible to group them through networks of equipment and battery manufacturers' after-sales-services and marketing departments.

This system is already operating in Europe as illustrated by the following examples:

(i) An example is Motorola, UK, from which SNAM has been receiving battery packs from the UK and also from Germany or France for almost two years. These batteries frequently come from the after-sales-service departments for each of these countries. The first loads were from 100 to 500 kg. Today, several tons are being received from the UK.

(ii) Concerning industrial batteries in Germany, the collection is accepted and promoted by producers and importers. There customers are required to return spent batteries for any new selling. So, we receive 700 to 800 tons/year from the four German industrial Ni–Cd producers. From scraps dealers, roughly 400 tons more arrive for recycling.

(iii) In Belgium, the railway company forces scraps dealers in charge of spent batteries collection to prove that those batteries are totally recycled in a fully authorized factory and the railways company pays the recycling cost.

(iv) In Italy, COBAT, the semi-public group in charge of lead/acid battery collection, is also in charge of the industrial Ni–Cd collection. Money would be collected from battery importers.

(v) In France, it is possible to dismantle Ni–Cd batteries in order to make profit by selling the nickel plates and storing the cadmium plates for unlimited periods and in unlimited quantities. Furthermore, one may wonder what becomes of the negative plates which have in some cases been piling up for more than four years.

One may stress that that SNAM, an authorized production facility of cadmium, has indeed a maximum inventory limit for the spent batteries, as well as for the final cadmium metal produced.

There is a problem when one knows that one of the three 'authorized' companies to carry out such dismantling only, went bankrupt in June 1994 with 520 tons of cadmium waste from batteries. Such 'accidents', which are beginning to

Table 1
Cost of recycling of various types of Ni–Cd batteries

Between FF 500 and 6000 per metric ton is added the costs of transport and collection of spent batteries
Sealed battery without plastic pack sold at FF 30 per unit in R6 gives overhead cost of recycling: 1%
Power pack of video camera (300 g) sold at FF 350 per unit gives overhead cost of recycling: 0.9%
Power pack of a cordless tool (500 g) sold at FF 400 per unit gives overhead cost of recycling: 1.25%
Power pack of a cellular phone (150 g) sold at FF 300 per unit gives overhead cost of recycling: 0.5%

become familiar in France, will put into difficulties not only those who entrusted (for financial reasons) their batteries to this company for dismantling.

4. Conclusions: what is collected and recycled in Europe?

First, we should bear in mind that although 15 000 tons of Ni–Cd batteries are scrapped every year in Europe (10 000 tons sealed and 5000 tons industrial units), only 1700 tons of these arrive at SNAM of which 1400 tons were industrial and 300 tons sealed units.

Assuming that SAFT NIFE receives 1000 tons from Europe in its Swedish plant, of which 800 tons are industrial and 200 tons sealed, that means that only 48% of used industrial units and 5% of sealed units are recycled (in the sense of exploiting all nickel and cadmium components).

For all these partners and for us, the recyclers, collection and recycling are the main cost-determining steps. It is known that Ni–Cd batteries recycling costs FF 500 to 6000 per ton, to which, obviously, one has to add the costs of collection, storage and transport. This means additional cost of 1% for an individual battery sold in a supermarket in France for FF 30 per item (type R6) or additional cost of 0.9% for a video power pack sold at FF 350, see Table 1.