

# COBAT: collection and recycling spent lead/acid batteries in Italy

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## Abstract

The European Economic Community (EEC) introduced a very clear Directive (157/91) aimed at solving the problem of collecting and recycling scrap accumulators and lead/acid batteries. This waste has a potentially harmful effect on the environment if the recycling process is not carried out correctly at all stages. COBAT is a Consortium created in 1990 in order to meet the requirements of the Italian law 475/88 which preceded the above-mentioned EEC Directive. This Consortium has a broad basis comprising all sectors involved in the battery cycle life (battery producers, battery fitters, collectors and recyclers). So far the organization, using the following approach has had very positive results since its inception three years ago. The public sector, representatives from the Environmental Ministry and the Ministry of Industry are responsible for supplying guidelines and the overall supervision, whereas the private sector is in charge of the organization and the enforcement of the law. This paper explains in detail the structure and tasks of COBAT, and will proceed on to explain how COBAT is organized and how the collection network and recycling plants work. The economical aspects will be examined in detail, and emphasis will be put on how little the public will have to pay in order to safeguard the environment, and the harmful effect of a competitively run regime to the ecosystem.

*Keywords:* Recycling; Italy; Lead/acid batteries

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## 1. Introduction

Since the forties, as the lead consumption has grown, the Italian industry has increased its capacity for the collection and recycling of scrap lead (scrap and lead acid batteries).

This profit-making oriented business was affected by fluctuations in the price of the raw lead material, the production of secondary lead was therefore commenced.

The critical element in this scheme was that the collection rate depended on the quotation on the London Metal Exchange (LME) and therefore on the price of the raw material. A significant drop in the collection rate occurred when the lead price remained low for a long time. This meant that the collection of spent lead/acid batteries ceased to be profit-making in those areas with a low population density, and where long distances were entailed.

A further weak point in this collecting system of lead/acid batteries, run on purely economic criteria, was that, without a central control there was a higher risk of leakage of the sulfuric acid from the disposed batteries into the environment.

This Consortium, established by the law 475/88, has radically modified the situation concerning the collection and recycling of lead/acid batteries. In the past decades, this profit-making oriented industry had operated without taking into account the harmful effects on the environment. Nowa-

days, the concern for the environment is foremost, but at the same time the interest and the autonomy of all the sectors involved in the battery cycle life are fully respected and the system still ensures competitiveness on both the national and European market.

In conclusion, Italy had recognized the need to improve the collection and recycling of spent lead/acid batteries prior to the EEC Directive 157/91.

The EEC Directive, art. 7 states: 'All state members are allowed to introduce measures in order to encourage recycling. Such measures, however, can only be taken after having consulted the people concerned, the criteria used must be economically and ecologically acceptable, and commercial speculation must be avoided.'

## 2. Structures of COBAT

### 2.1. Tasks and aims

COBAT is a Consortium, established by the Italian law 475 in 1988, created to organize an efficient network for the collection of spent lead/acid batteries and scrap lead, and their recycling.

The by-law, approved in 1990 by a decree issued by the Environmental Ministry and the Ministry of Industry, authorized COBAT to start operating at the end of 1991.

COBAT is a non-profit-making organization, operating all over Italy:

- (i) it organizes the collection and storage of spent lead/acid batteries and scrap lead;
- (ii) the above-mentioned products are given to national and foreign industries for recycling;
- (iii) when the waste cannot be recycled or it is not profit-making to do so, COBAT ensures that it is eliminated in compliance with stringent environmental standards;
- (iv) it promotes R&D into improved recycling and disposal of lead systems.

The Consortium is authorized to carry out any operations of which the aims are laid down by the law. The following operations are carried out by the Consortium.

- (i) stipulation of contacts with both private and public companies, responsible for collecting spent lead/acid batteries and scrap lead;
- (ii) stipulation of agreements with local authorities and companies in order to achieve the aims of the by-law;
- (iii) coordination of the authorized collectors in geographic, distinct areas;
- (iv) promotion of publicity campaigns to encourage the collection and recycling of spent batteries.

## 2.2. Organization

The Consortium comprises all the sectors involved in the battery cycle life: (i) battery producers and importers; (ii) association of lead/acid battery fitters and sellers; (iii) association of spent lead/acid battery and scrap lead collectors, and (iv) recycling plant industries of spent lead/acid batteries and scrap lead.

### 2.2.1. Regulations

Members are only allowed to carry out activities related to COBAT for this company and not for any other business concern.

Members must conform to all decisions taken by COBAT.

Although most of the members belong to the private sector, representatives from governmental departments and auditors are involved in the Consortium's governing body thereby giving the Consortium a social role.

In conclusion, the public and private sector work side by side in COBAT to safeguard the environment. The public sector provides guidelines and supervision whereas the private sector administers and enforces the law using clear, economic and efficient methods.

It is impressive to see that, as a result of this initiative, thousands of people with conflicting ideas are working together to safeguard the environment.

### 2.3. Collection network

As mentioned in the introduction, the collecting and recycling industry of all metallic lead has steadily evolved, since the forties in Italy.

This activity had grown as a profit-making-oriented enterprise aimed at collecting the batteries at minimum costs. In the early times, several components of the lead/acid batteries were not recycled. Sulfuric acid was disposed of, and, sometimes, ebonite was burnt without the necessary precautions. Finally, the network was only able to work if it was profitable to collect batteries, and they should be near to the recycling plants, and in sufficient quantities.

The purpose of COBAT is to upgrade and to extend the existing collection network in order to make the safeguarding of the environment efficient. Upgrading the network means ensuring that all stages in the collection, transport, and storage of the spent batteries are in compliance with high environmental standards. Extending the network means collecting from those areas which were for various reasons, the network did not exist.

The primary network consists of enterprises who are authorized to collect, free of charge, the batteries in assigned areas.

This network which should fulfill the users needs is backed up by a secondary network, responsible for collecting batteries in the industrial waste sector on a commercial basis.

COBAT has arranged an operative programme involving all the public and private companies, responsible for the collection of solid urban and hazardous industrial waste. These companies are responsible for the efficient collection network, because they help the individual citizen to respect the environment by indicating how to dispose of the batteries in the correct way. Therefore, it was necessary to set up a programme with the local authorities and operators working in the field of urban waste collection.

Nowadays, 77 authorized companies guarantee the collection of spent batteries throughout Italy. These companies were selected by a Commission to evaluate the tenders to confer a three-year contract for the collection throughout Italy. After having attentively examined the company's technical, economic and organizational requirements, a contract is signed and the company is assigned a specific area where the company is obliged to collect all spent batteries from the entire area, including those owned by garages, individual citizens and places that are difficult to reach.

Sanctions will be issued if the material should not meet the requirements. If the material taken to the recycling plants contains more foreign elements and pollutants than established then the goods are not reimbursed. The quantity of the sulfuric acid is established.

An efficient reliable collection network, run by companies which are highly qualified technically and in administrative matters is essential in order to reach the objectives set by the Consortium. For this reason COBAT organizes training courses.

A computer system is needed to monitor the whole network by collecting all the information on the quantity, the place, the type of battery, its destination, and any sanctions issued.

This network collect and transport spent lead/acid batteries, and is also in charge of collecting huge stationary batteries from the telephone exchange (TELECOM) and from ENEL Electric Co. power stations. These so-called 'big users' have signed conventions with COBAT to have the batteries collected.

#### 2.4. Recycling

Recycling lead from spent batteries means that energy and money is saved.

The annual national lead demand is about 240 000 metric ton. In Italy only about 200 000 metric ton is produced, and 80 000 metric ton come from recycled lead. 30% of the national lead consumption comes from recycled lead batteries. This means that less lead is imported.

Another advantage of recycling lead is that to produce secondary lead less energy (1/3) is needed.

The Consortium disposes of five recycling plants in Italy: four in the northern and one in the centre southern part (Fig. 1).

All the plants use physicochemical processes to separate the components parts and neutralize the liquids. A thermal process is used for the smelting and refining.

Two of these plants are capable of reducing considerably the sulfur content in the lead during the smelting phase by using a chemical process, thus reducing the air pollution.

The plants, in compliance with environmental regulations, utilize the most advanced technology. They have an overall recycling capacity of spent lead/acid batteries of about 225 000 metric ton per annum. This capacity exceeds by far the estimated quantity of scrap available on the market in case one of the recycling plants should break down.

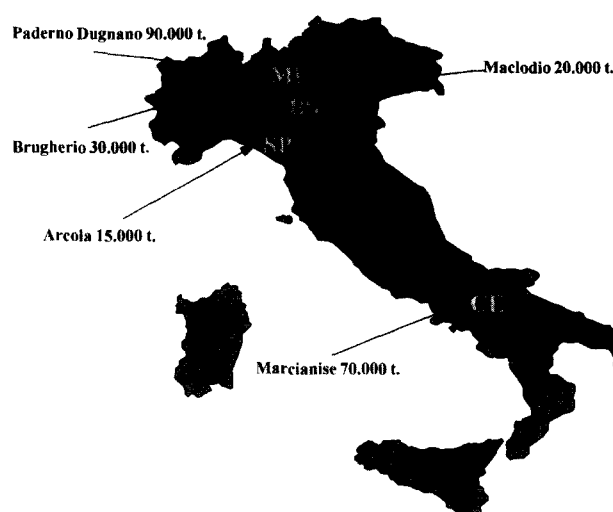


Fig. 1. Geographic locations of recycling plants in Italy. Capacity installed, total 225 000 metric ton.

Toxic waste, especially the slag produced during the smelting phase, is produced during the recycling process and this is due to the lead content. COBAT ensures that this slag is eliminated by authorized collectors in the correct way by either disposing of it on authorized rubbish tips or using it for other means in compliance with stringent environmental guidelines.

COBAT promotes research in order to find the best solutions regarding the ecological and economical aspects of the recycling problem.

#### 2.5. Development of the collection and recycling system

According to the latest data, still subject to change connected to economical factors, each year 170 000 metric ton of new batteries are put on the market in Italy falling into the following categories: (i) 135 000 metric ton starter batteries; (ii) 35 000 metric ton motive power and stationary batteries, and (iii) not including faulty batteries.

Starter batteries are most likely to be disposed of because of their limited size and weight.

As 25 000 metric ton of industrial batteries (motive power and stationary) are recycled each year, to estimate how efficient the network is, calculations are made on an estimated yield of 160 000 metric ton.

Before COBAT was set up, only 100 000 metric ton (equal to 70% of the yield) were collected. The developing trend has been positive since Cobat's inception there is a marked increase in recycled products respecting the same seasonal trend (Fig. 2). In 1993, 150 000 metric ton of batteries were collected and recycled resulting in a 30% increase compared with 1991.

Fig. 3 shows a consolidation of these rates, representing 94% of the estimated yield. However, in 1994 there was a slight decrease due to the economic recession that hit the country. This result is even more evident if a comparison is made with the lead quotation on the London Metal Exchange.

Fig. 4 shows the correlation between the lead metal quotation in 1992–1993 and the collection rate and recycling of spent batteries that tended to rise, whereas the opposite happened in 1994. This fact shows that only a Consortium financed by levies on new batteries and backed by public interest in this respect can survive and keep up the collection rate and should not be affected by an economic recession.

As the lead metal quotation is very often inclined to fall, small private collectors of lead/acid batteries find it not-profit-making to keep up the same collection rate and, therefore, a considerable quantity of lead contained in the batteries is not collected.

However, we must not be over-enthusiastic about the success obtained so far. COBAT is quite aware that a lot of work has still to be done to increase the collection rate in those 'Do-it-yourself' sectors (car, nautical and agriculture) where a high rate of disposal is observed.

In the coming years, COBAT will be engaged in finding a solution to this problem by promoting educational campaigns

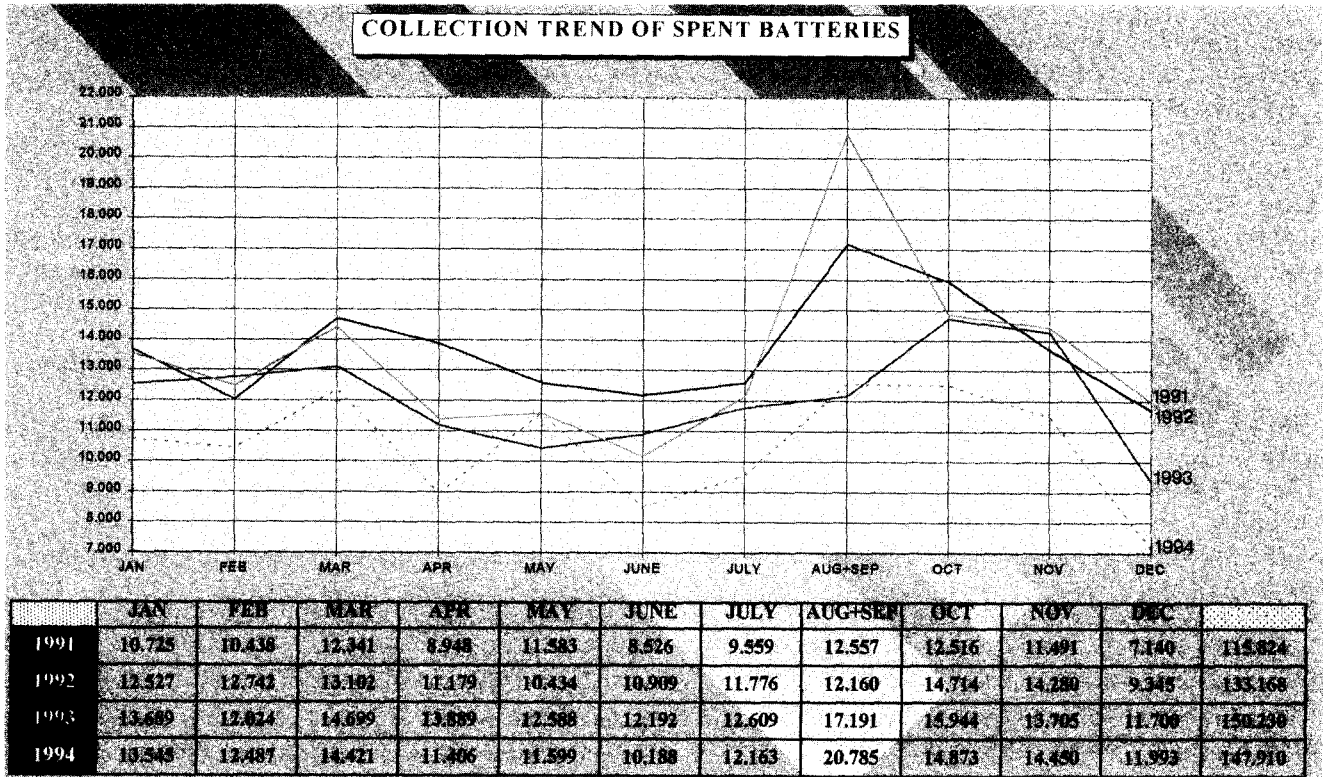


Fig. 2. Collection trend of spent batteries.

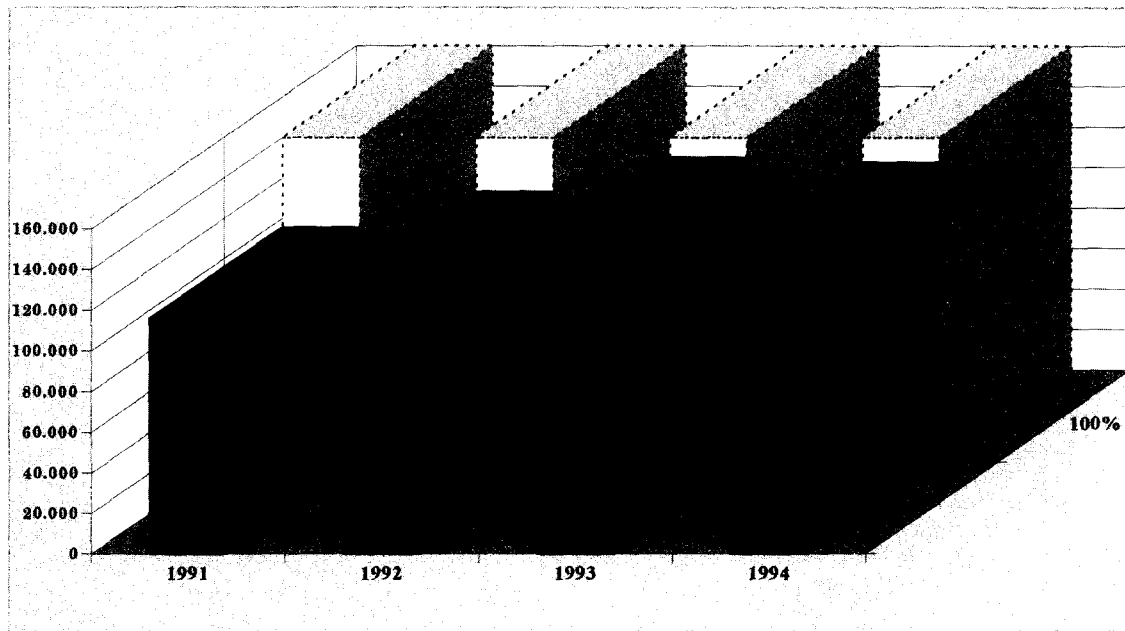


Fig. 3. Development of the rate of collection vs. estimated rate.

to make the public aware of this problem and many initiatives taken by COBAT to solve this problem are already underway.

Many county councils (or collectors of urban waste), in agreement with COBAT, have signed contracts to place collecting bins in designated locations and the same is being done for the nautical sector where bins will be placed in harbours where pleasure boats and sailing boats tie up.

### 2.6. Economic structure

The Consortium has two incomes to finance its activities:

- (i) from levies on battery sales, as the battery purchased the levy is already included in the price, and paid directly to the Consortium by producers and importers.
- (ii) from sales of scrap batteries to the recycling plants.

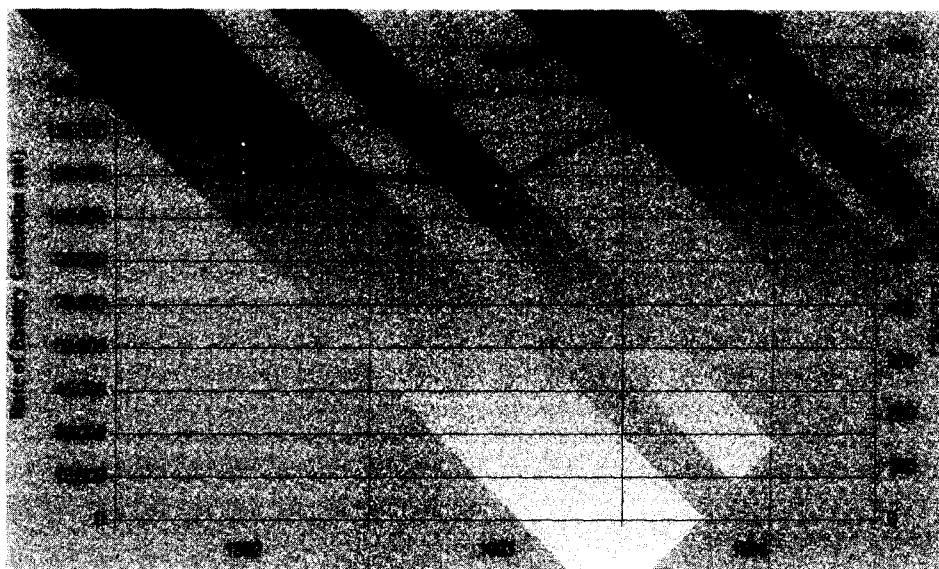


Fig. 4. Comparison between the trend on the London Metal Exchange and the rate of collection.

The levy, fixed by the Environmental Ministry and the Ministry of Industry, is in effect the 'economic instrument' which allowed a profit-making-oriented business to be transformed into a public service.

Due to this levy, the collection network and the recycling of spent lead/acid batteries is always guaranteed, independent of the lead quotations on the market.

The added cost incurred to eliminate toxic waste in compliance with the stringent national and European regulations means that, when there is a fall of the lead quotation on the London Metal Exchange, it ceases to be profit-making for the small operators, collectors and recyclers, to stay in business.

The proceeds from the sales of scrap batteries to recycling plants, subject to the variations of the price of lead on the London Metal Exchange, is determined by the cost of transformation and the expense incurred to eliminate toxic waste such as slag, mix ebonite polyvinyl chloride during the production process, as well as neutralizing the sulfuric acid.

The collection costs are paid according to the geographic area assigned and the distances to be covered.

In order to upgrade and boost the collection network, the collectors are guaranteed a fixed price which depends on the lead quotations on London Metal Exchange.

It is easy to understand from the above considerations that the price the public has to pay depends on how much the recycling plants pay for the scrap batteries. The consumer has to pay the difference between the cost of a qualified and systematic collection network and the proceeds from the sales of scrap batteries to recycling plants. In other words, the public pays a small sum of money in order to have a guaranteed collection and recycling service.

We may confirm that all the objectives established by the law have been reached in the period 1992–1994, see Table 1. A slight increase in the rate of collection during the lead market slump was registered. The average collection price (IL 159/kg) resulted in being consistent, even though it was

Table 1  
Lead recycling in Italy, 1992–1994

	1992	1993	1994	Total	Unit price (IL/kg)
London Metal Exchange (IL/kg)	663	639	881		
Batteries metric ton collected	133168	150230	147910	431308	
<i>(a) Costs (IL/million)</i>					
Batteries collected	20987	23841	23812	68640	159
Slag lead	86	358	509	953	2
General expenses, Communication, R&D	5068	3549	2763	11380	26
Total	26141	27748	27084	80973	187
<i>(b) Production (IL/million)</i>					
Batteries sales	7696	5250	10655	23601	55
Operative deficit	– 18445	– 22498	– 16429	– 57372	– 132
Levy	17306	17314	24058	58678	135
Management balance and deficit	– 1139	– 5184	7629	1306	3

independent of any commercialization criteria. The average sales price IL 55/kg for each unit was adequate to guarantee that all the collected spent batteries were recycled. In 1993 more spent batteries were recycled than the previous year. Recycling was performed in compliance with the environmental and safety regulations. Although, the lead metal quotation on the London Metal Exchange, in that period, did not allow for a profit to be made in an activity orientated towards the protection of the environment. The levy on the sales of new batteries was set at a low price, even if, in 1994 in order to create an economic equilibrium, the levy was reviewed to a slightly higher rate. The average value per unit is IL 136/kg equal to about IL 1900 each. This rate adds about 1.5% to the original cost of a new battery. Therefore, the cost the user has to pay to recycle the spent battery is just over IL 600 per year (IL 1900 over a period of three years).

Because of the positive metal quotations and in particular lead on the London Metal Exchange, the financial year was closed with a slight operating surplus, therefore, the Consortium's governing body decided to lower the levy by 15% in 1995.

If the current positive market trend should continue, the ecosystem would cost less to be protected and the public would also have to pay less.

### 2.7. Communication

COBAT promotes publicity campaigns to ensure the public awareness of the need for collecting and recycling of spent lead/acid batteries. In 1992, during its first operative year, it launched a publicity campaign, in the form of leaflets to inform the public of its existence and aims. The same thing was done in 1993, but to a lesser degree.

From two years of experience in this field we have learned that in order to reach successfully our objectives, e.g. upgrading and maximizing the collection network, it is necessary to create an efficient communication system. A programme, consisting of three elements, to become operative in 1995, was drawn up to solve this problem:

(i) One aim is to consolidate the institutional and public administration contacts to introduce some new legislative adjustments which are even more related to upgrading the Consortium's activities. The Consortium is also planning to establish contacts with district departments, provinces, councils and local authorities to find ways of providing an efficient

collection network for the public and upgrading the existing one.

(ii) The Consortium intends to enhance communication among members, especially battery fitters, car electricians and collectors so that the problem of correctly recycling and eliminating toxic waste, in compliance with the national and European regulations, will be solved in collaboration.

(iii) Part of the programme is dedicated to the area of 'Do-it-yourself' (nautical, agriculture and urban sectors). COBAT plans to conduct an educational programme for those people responsible for producing most damage to the environment by the disposal of spent batteries in the environment, and by making them aware of these harmful effects.

The following instruments of communication will be used:

(i) periodical review will be published for members of the Consortium and for the public administration and the press;

(ii) simple and clearly written leaflets, addressing to those involved in the battery cycle life and waste producers, will be printed to bring to their attention to the problems caused by incorrect disposal of spent batteries into the environment;

(iii) educational campaigns will be conducted, addressing to those involved in the recycling process (local authorities, nautical operators, industry and agriculture);

(iv) information on the Consortium's programmes, aims, as well as the organization related to each specific area, will be supplied to local television stations.

The Consortium is aware that it will take time before all the objectives will be fulfilled, but it will do its utmost to adjust the programme and aims according to the development of the scheme. In short, what is meant by communication is that information will be given on what has been done to provide an efficient service for the public.

### 3. Conclusions

Development is compatible with the environment only if all, involved in the collection and recycling scheme, collaborate.

The Italian solution to the problem of recycling of spent lead/acid batteries has been successful because it has united the sectors involved in the battery cycle life.

These often opponent sectors are coordinated by one single law body, COBAT. These operators are obliged to accept the Consortium's strategies and guarantee the public a clear-cut management, and extending the collection network in order to safeguard the environment.