SECONDARY LEAD PRODUCTION IN MALAYSIA

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Introduction

In the absence of a lead producers' association in Malaysia and the continued presence of illegal operators whose activities are confined to remelting of cable scrap and/or smelting of battery scrap using a shaft furnace, this paper relies heavily on the information obtained from Metal Reclamation Industries Sdn. Bhd. (MRI) — the only modern integrated lead smelter in the country. As a result, the data on secondary lead production in Malaysia discussed here is only semi-quantitative and of a general nature.

History

Secondary lead production commenced in Malaysia in the late 1950s. The operations were unlicensed and used simple shaft furnaces with complete disregard to pollution. The Malaysian Government had difficulties in detecting and apprehending these operators because of their mobility and the intermittent nature of the operations which were carried out in rural areas. Such activities still exist today, but on a much smaller scale. Metallic lead recovered by this method was of unknown quality and was only suitable for general plumbing purposes as no further refining was carried out.

In the early 1960s, foreign companies began to set up battery manufacturing industries in Malaysia and there was a need for known and certified lead; initially, this lead was imported from overseas. The demand resulted in the smelting of battery scrap using reverberatory furnaces in the mid 1960s. This method of lead recovery was adopted for only a few years, probably due to difficult working conditions and poor metal prices in the early 1970s.

The use of rotary furnaces to smelt battery scrap was introduced into Malaysia in the early 1970s. This is now the only method employed. Advances in the industry are not confined to smelting technology alone. Traditional procedures for the preparation of battery scrap using a large labour force were replaced by mechanical devices in 1985.

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Secondary lead smelting

The history of secondary lead smelting in Malaysia saw the technological advance from primitive shaft furnaces to rotary furnaces. The process route differs from one technology to another. A discussion of the merits and shortcomings of different types of technology and process routes is outside the scope of this paper. However, a typical modern process route is shown in Fig. 1.

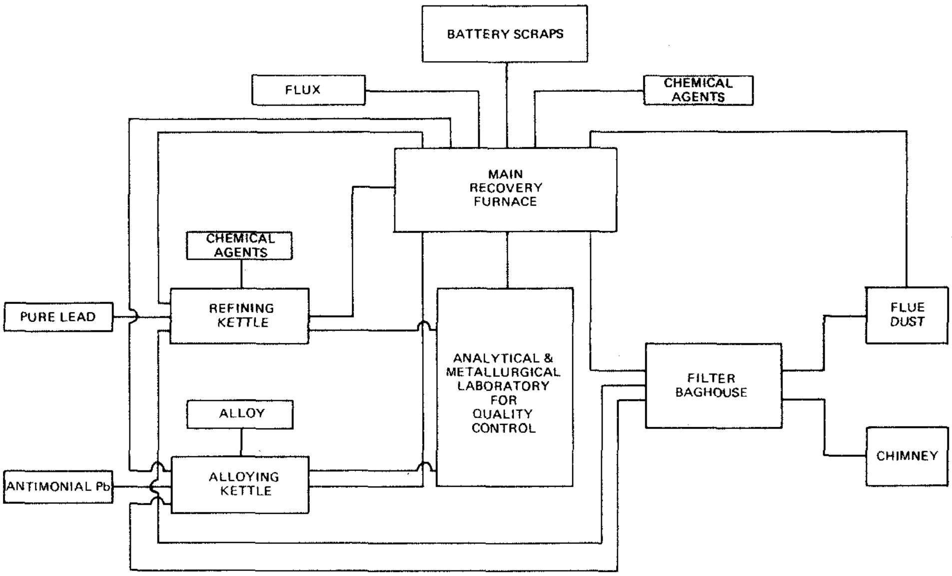

Fig. 1. Flow chart for typical secondary lead production.

Local and imported battery scrap, together with reducing agents and fluxes, are smelted in a rotary furnace. Lead bullion and slag are produced. Exhaust gas from the furnace is ducted away to a baghouse for cleaning. Samples of the bullion are sent to the analytical laboratory for testing and quality control. The bullion is treated in a kettle with the addition of chemical agents to produce pure lead, or cleansed and alloyed to customers' specifications. Fugitive gases from the kettle are collected and filtered in the baghouse. Before pure or antimonial lead is cast into ingots, numerous tests and quality control procedures are carried out to ensure conformity to standards and specifications.

Raw materials

Raw materials generally consist of battery scrap, cable sheath and factory rejects. These raw materials come from three sources:

(i) local scrap;

(ii) lead ingots produced by unlicensed operators using shaft furnaces; availability depends on intermittent operation and supplies are therefore erratic;

(iii) imported battery scrap (due to insufficient local scrap); this attracts import duties, freight, insurance, port and handling charges which ultimately increase the cost of the scrap.

At present, Malaysia needs to import approximately 33% of its raw material requirement in the form of battery scrap each year. This problem would worsen if Malaysia was to increase its production capacity.

Products

In the absence of a secondary lead producers' association, there are no official or authoritative data for secondary lead production in Malaysia. However, MRI has consented to provide its production figures for the last six years (Fig. 2) to give an idea of the size of this industry in Malaysia.

In recent years, the majority of the lead produced in Malaysia has been in the form of antimonial lead. Of late, antimony contents range from 1.5 to 4.0 wt.%. Varying amounts of additive metals (such as copper, tin, arsenic, selenium — to different customers' specifications) are sometimes deliberately included to give specific qualities to the alloys, *e.g.*, corrosion resistance, improved castability, strength, or fine grain structure.

Pure lead is the victim of high production costs and excessively long process times. Unless new refining techniques are developed or adopted, producing pure lead using battery scrap is not economically viable. A small percentage of lead produced in Malaysia is used to make solder and other finished lead products, *e.g.*, anodes, tubes, etc.

Quality control

Quality control, being an integral part of the manufacturing process, calls for significant investment in modern testing and analytical equipment. To this end, MRI has acquired a state-of-the-art, fully computerised spectrometer dedicated to the analysis of lead, tin, and their alloys to monitor manufacturing processes "on-line". Lead produced by MRI has been accepted both nationally and internationally because of the high standard of quality control adopted. MRI's products not only meet the customer's specifications but also international standards (such as the British and American ASTM standards) for certain alloys when required. The MRI approach to quality control gives a good insight into the state of practice in this area in Malaysia.

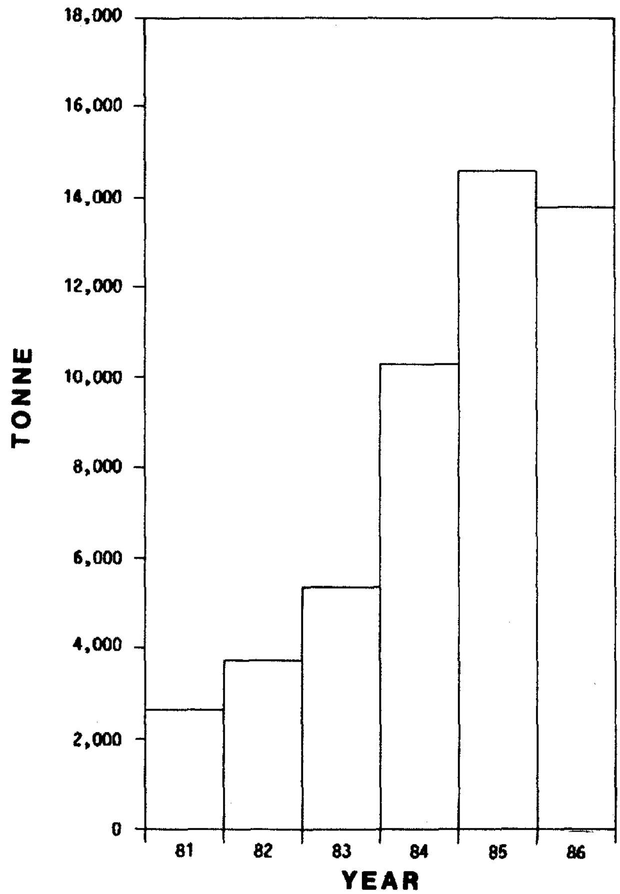

Fig. 2. Lead production at Metal Reclamation (Industries) Sdn. Bhd.

Pollution controls

The secondary lead production industry has been classified by the Malaysian Government as a heavy, toxic, and highly polluting industry. The Government passed laws (Environmental Quality Act 1974 and Environmental Quality (Clean Air) Regulations 1978) requiring all industries to conform strictly to the Act. Table 1 gives the maximum emission of lead and other metals, or their compounds, permitted by the said Act and Regulations.

Compliance with the Act requires the installation of filter plants (that can cost millions of ringgits) to filter airborne dust particles generated at various stages of production. As a guide, the financial, maintenance and operating costs for filtering dust, water treatment and waste disposal, generated in a secondary lead smelter, is about M$180 per ton of lead produced.

The lead smelting industry in Malaysia also has to comply with the Factories and Machinery Act 1967 and the Factories and Machinery (Lead)

TABLE 1

Extract from Environmental Quality (Clean Air) Regulations 1978

Substance	Hg	Cd	Pb	Sb	As	Zn	Cu
Standard A	0.02	0.025	0.040	0.040	0.040	0.15	0.15
Standard B	0.01	0.015	0.025	0.025	0.025	0.10	0.10
Standard C	0.01	0.015	0.025	0.025	0.025	0.10	0.10

Concentration in g Nm^{-3} (before admixture). Every existing facility shall comply with standard A within 2 years and with standard B within 3 years from 1 October, 1978. Every new facility shall comply with standard C.

TABLE 2

Extract from Factories and Machinery (Lead) Regulations 1984

1.	A maximum airborne concentration of lead of 75 μg Nm^{-3} of air, averaged over an 8 h period.
2.	Permissible Exposure Limit (PEL) of 150 μg Nm^{-3} of air, averaged over an 8 h period.
3.	Maximum blood lead level of 80 μg per 100 g of whole blood.

Other requirements in the Act include exposure monitoring, medical surveillance, record keeping, laundry, etc.

Regulations 1984. The stipulations of this Act and regulations are shown in Table 2.

In 1979, the Environmental Quality (Sewage and Industrial Effluents) Regulations were gazetted. The third schedule, which outlines the parameter limits of effluent in catchment areas and down-stream areas, is given in Table 3. Finally, there is another regulation: The Environmental Quality (Schedule Wastes) Regulation, which will be gazetted in the near future.

All these Acts and Regulations, with their good intentions and purposes, are an expensive exercise that will inevitably increase the cost of production.

Future

If Malaysia aspires to become a major secondary lead producer in the Asian region, the industry must:

(i) import raw materials in the form of scrap batteries;

(ii) develop or acquire newer technology, as and when it becomes available;

(iii) be able to cope with the various changing regulations on pollution control;

(iv) have technical skills and efficient quality controls to meet the challenges posed by battery manufacturers in their quest for new alloys in the production of low maintenance and maintenance-free batteries.

TABLE 3

Effluent parameter limits for standards A and B

Parameter	Unit	Standard A	Standard B
Temperature	°C	40	40
pH value	—	6.0 - 9.0	5.5 - 9.0
BOD at 20 °C	mg l^{-1}	20	50
COD	mg l^{-1}	50	100
Suspended solids	mg l^{-1}	50	100
Mercury	mg l^{-1}	0.005	0.05
Cadmium	mg l^{-1}	0.01	0.02
Chromium, hexavalent	mg l^{-1}	0.05	0.05
Arsenic	mg l^{-1}	0.05	0.10
Cyanide	mg l^{-1}	0.05	0.10
Lead	mg l^{-1}	0.10	0.50
Chromium, trivalent	mg l^{-1}	0.20	1.0
Copper	mg l^{-1}	0.20	1.0
Manganese	mg l^{-1}	0.20	1.0
Nickel	mg l^{-1}	0.20	1.0
Tin	mg l^{-1}	0.20	1.0
Zinc	mg l^{-1}	1.0	1.0
Boron	mg l^{-1}	1.0	4.0
Iron (Fe)	mg l^{-1}	1.0	5.0
Phenol	mg l^{-1}	0.001	1.0
Free chlorine	mg l^{-1}	1.0	2.0
Sulphide	mg l^{-1}	0.50	0.50
Oil & grease	mg l^{-1}	n.d.	10.0

Standard A = catchment or upstream areas. Standard B = downstream areas. Note: The point, or points, of discharge of effluent shall be determined by the Director General.
n.d. = not detectable.