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Impact of Basel convention on secondary-lead industry in economies in transition

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Abstract

Substantial trade in scrap and waste is not merely an exercise in waste management, but more importantly an element in efficient materials utilization, that has significant impact on the economy. In fact, it is an environmentally desirable and friendly activity and economically worthwhile pursuing for developing countries. Secondary recycling of materials and re-integrating them into the economy is crucial in reducing the overall demand for virgin materials for the developing economies. Scrap, ash and residues generated indigenously need to be recycled. Otherwise their disposal/dispersal will undoubtedly pose greater hazard in the future. Further, recycling of scraps and residues avoids degradation of the environment. Environmental control and monitoring in lead operations will require assiduous implementation to ensure that transportation, handling and processing are managed with greater care and the entire operation is environmental friendly. © 1997 Published by Elsevier Science S.A.

Keywords: Lead; Lead/acid battery; Recycling/primary; Recycling/secondary; Environmental control

1. Introduction

Lead is a versatile and strategic metal with many vital applications such as batteries, cable sheathing, pipes, pigments, alloys, etc. The single largest consumption of lead (70%) is in lead/acid batteries. The prime application of such batteries is in the automobile sector for starting, lighting and ignition (SLI) of automobiles. Simple and proven workhorse technology with continuous all-round improvements has enabled the lead/acid battery to defend its established position effectively.

Lead demand is primarily met by two routes, namely, primary and secondary. Phenomenal growth in secondary-lead production has taken place over the years for reasons such as: (i) an ever-increasing demand for lead and the scarcity of natural ore resources; (ii) regular and ready availability of lead recycleables as secondary-raw material, and (iii) easy, proven and economic viability of the recycling process.

Secondary lead has a vital role, particularly in developing countries that are undergoing rapid industrialization. There has been an upward trend in secondary-lead production in developing economies such as India, South Korea and Indonesia during the past two decades. The share of secondary lead in the total production of lead in these countries lies between 30 and 100%, while the consumption of secondary lead is between 16 and 40% of the total.

The major secondary-raw material for recycling is spent automotive (SLI) batteries; these batteries account for nearly 60% of the lead consumption. More than 80% of the lead going into a lead/acid battery will be available for re-use by processing.

Recently, the vehicle population has been growing at a rapid rate in the developing countries of Asia following a period of rapid economic growth. This trend will continue for the remainder of the decade. Thus, number of persons per vehicle is steadily falling in these countries.

The above developments clearly indicate not only that the demand for lead is expected to increase substantially in the future in Asian economies in transition, but also more battery scrap will be available for recycling from the booming automobile population. Accordingly, recycling of battery scrap is of utmost importance in developing economies, not only to meet the growing internal lead demand but also to ensure that spent batteries are not thrown away and thus pose environmental problems. The

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Basel ban on the movement of hazardous wastes for recycling operations will affect adversely both industrial growth and the economy of these countries.

The first and foremost problem that the recycling industry in developing countries faces is the lack of a clear-cut definition of 'hazardous wastes'. The Basel Convention does not distinguish between: (i) wastes that are hazardous in nature and whose movement should therefore be prohibited, and (ii) wastes that are non-hazardous and recycleable, and whose import/export should be allowed.

At present, the battery scrap generated internally in many of the developing countries is not adequate for economic and environmental-friendly recycling operations. There is therefore a dependence on imported recycleables from developed countries. In the absence of availability of scrap from the developed countries, as a result of the Basel ban and due to the scarcity of natural ore resources, developing countries will have to resort to the import of lead concentrates to meet the internal demand for lead. This may prove to be expensive and prevent the establishment of primary production facilities with attendant long gestation times. A sharp hike in lead prices may even eventuate and, thereby, hamper the industrial growth of developing countries. Scrap, ash and residues that are generated indigenously need to be recycled. Otherwise, their disposal/dispersal will undoubtedly pose greater hazards in future.

In fact, substantial trade in scrap and waste is not merely an exercise in waste management but, more importantly, is an element in efficient materials utilization that has a significant impact on the economy. Secondary recycling of materials and re-integrating them into the economy is crucial and important in reducing the overall demand for virgin materials in the developing economies. Nevertheless, given the toxic nature of lead, the environmental control and monitoring in recycling operations require assiduous implementation to ensure that transportation, handling and processing are managed with great care and the entire operation is environment-friendly.

2. Lead

Lead is said to have been first used in the Middle East and southern Europe over eight thousand years ago. Lead is a versatile and strategic metal with many vital applications. Today, its uses include batteries, cable sheathing, pipes, pigments, alloys, etc. The worldwide consumption of lead by different sectors during the 1980s and 1990s is shown in Fig. 1 [1].

3. Lead/acid batteries

Lead/acid batteries account for the major consumption of lead, i.e., as much as 70%. Lead consumption in batteries has registered continuous growth (Fig. 1). The most important and the largest volume application of lead/acid batteries is in the automobile sector for starting, lighting and ignition (SLI). Presently, there is no substitute for lead/acid for this application. All the proposed alternatives have suffered from many disadvantages, such as scarcity of raw materials, higher cost, or very complicated design and manufacturing technologies. Meanwhile, continuous development and innovations in lead/acid technology have been taking place to improve battery efficiency and performance, and to reduce size, cost and weight. Simple and proven workhorse technology with continuous all-round improvements has undoubtedly enabled lead/acid to be invulnerable. This pre-eminence is expected to continue into the foreseeable future.

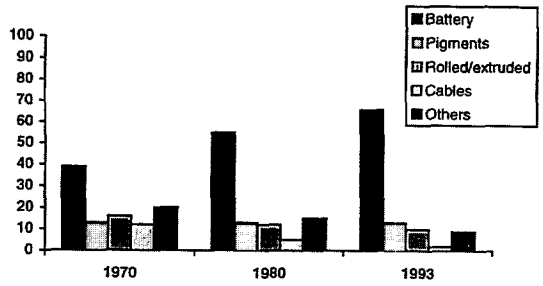

Fig. 1. Historical development of uses of refined lead (%) [1].

4. Importance of secondary lead

The major raw material for lead/acid batteries is lead which is readily available, cheap and recycleable. World lead demand is met by primary and secondary productions. Among the base metals, lead is the most recycled metal, i.e., more than 50% of world demand is met by secondary lead. In fact, the production of secondary lead surpassed that of primary lead in 1989, see Fig. 2 [2].

The phenomenal growth in the production of secondary lead can be attributed to several factors:

1. Indestructible nature of lead.
2. Scarcity of natural ore resources.
3. Thrust for sustainable development.
4. Ever-increasing demand for lead.

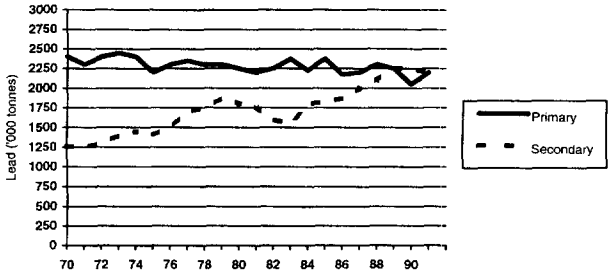

Fig. 2. Primary and secondary world lead production [2].

5. Regular and ready availability of lead recycleables as secondary-raw material; some Asian developing countries (e.g., Malaysia, Taiwan) do not have natural resources of lead and, therefore, secondary production accounts for their entire tonnage of refined-lead output; India has only a very limited natural resource of lead; in many other developing countries, there is a more even balance between the primary and the secondary sectors.
6. Easy, proven and mature recycling process.
7. Chemical and other properties remain unaltered even after repeated recycling.
8. Favourable economics of secondary-lead processing; production of secondary lead from battery scrap costs one-third the production of primary lead; the process cost will depend, however, on the process technology and the environmental control equipment that is required.
9. Ever-increasing awareness of the toxicity of lead with consequent environmental problems.
10. Recycling of lead scrap helps to reduce the environmental pollution load, etc.

Secondary lead has a vital role in meeting the demand for lead both in the developed and developing countries. It has even a more critical role in most of the developing countries and more so in the economies in transition. Rapid industrialization has pushed up significantly the consumption of lead. This is closely related to the rapid development in the automotive sector.

5. Battery scrap: raw material for secondary lead

The dominance of batteries as the main end-use for lead is growing (Fig. 1). Batteries contain a high proportion of lead, i.e., on average, 50% of the weight of an automobile battery (8 to 10 kg) is comprised of lead.

The average lead content in batteries has decreased with time because of technology changes. In the USA, for example, lead usage per battery had declined from 12.5 kg in the mid-1970s to 7.5 kg by the mid-1980s. Conversely, during the past few years, the weight of lead in some batteries has also significantly increased. This reverse trend is due to the increased energy demand from such batteries. The amount of lead available for recycling is influenced by the life span of batteries. The latter depends on climatic conditions and energy-demand requirements (e.g., air conditioning, heaters), for example, the average battery life for passenger vehicles is estimated to be four years in the USA, three years in Japan, and three years in India. Similarly, life span has been found to vary from one region to another. The Yuasa Battery Company has estimated an average battery life of 19, 21, 29 and 45 months in South Korea, India, Brazil and Japan, respectively. By contrast, the Battery Council International estimates a period of 49 months in the Asia–Pacific region. According to international lead–zinc scrap traders and various independent technology surveys, technology and design are also available to enable batteries last for five years or more. Even so, it is possible to estimate the lead availability from secondary processing of battery scrap.

Table 1
Recovery rates of secondary lead in some developed countries [2]

Country	1986	1988	1989	1990	1991
France	80		90		
Germany	83				95
Japan	93	92	94	92	
UK	84				93
USA		91	95	98	

Very little lead-bearing feed for recycling is from industrial scrap. Post-consumer product scrap constitutes more than 80% of the scrap supply for recycling, e.g., batteries, cable sheathing, radiation and sound attenuation materials, sheeting, etc. Batteries are the single largest contributors to lead scrap, accounting for as much as 90%. More than 80% of the lead going into lead/acid batteries will be available for re-use by processing.

Recycling rates are usually applicable for batteries as they have a predictable life. Battery recycling rates are determined by comparing the amount of lead recycled from batteries with the quantity available for recycling in a given year. The rates are high in many countries, sometimes exceeding 90%, see Table 1 [2].

6. Vehicle population and lead demand/availability in developing countries

Considering that spent automotive batteries contribute to the raw material input for secondary lead, motor-vehicle population/production will significantly determine lead demand/availability in a country.

During the 1970s and 1980s, there was a fast growth in the vehicle population in the newly industrializing or developing countries of Asia (Fig. 3). The rate of vehicle growth throughout the world until 1983 was 3 to 4%. The rate of growth in the Asian countries in transition was found to be more, i.e., between 6 and 18%.

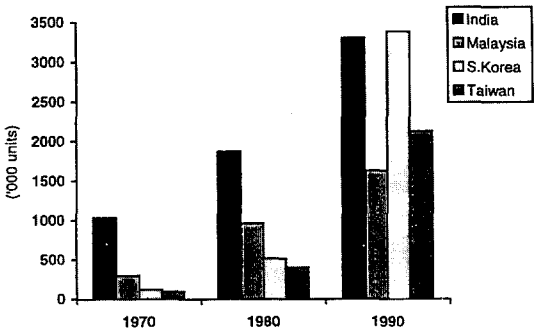

Fig. 3. Trend in vehicle-population growth: 1970–1090 (×000 units) [3].

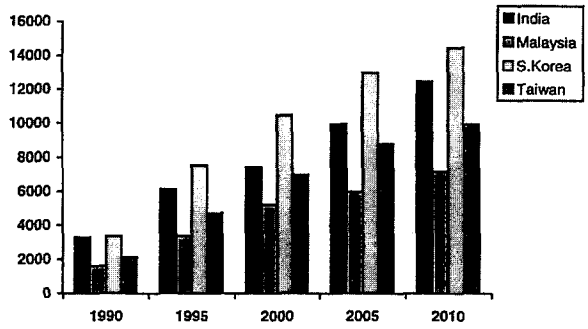

Fig. 4. Vehicle-population forecast: 1995–2010 (×000 units) [3].

Over the last few years, the number of persons per vehicle has fallen in the newly industrializing countries of East Asia. This has been due to a period of rapid economic growth and the emergence of domestic production and assembly facilities that tended to enhance local availability.

The rapid expansion of vehicle population in Asia is expected to continue, see Fig. 4. A car for each three to four persons in South Korea and Malaysia by 2010 is a distinct possibility. In India the large growth in the number of inhabitants and more rapid economic expansion than in the past will also prompt an accelerating growth in the number of vehicles, well into the next century. These trends imply that not only the demand for lead for original equipment and replacement batteries will increase substantially in future in Asian economies in transition, but also more battery scrap lead will be available for recycling from the enlarged automobile population.

Based on the forecast for battery demand and scrap battery availability [3], an estimate is made to determine the demand for lead and its availability from battery scrap in some of the developing economies. In this analysis, it is assumed that each automobile battery contains an average of 10 kg of lead, and lead availability is calculated assuming 80% of lead recovery from battery scrap. The results are presented in Fig. 5.

It is evident that there will be a substantial increase in demand for lead in the years to come. Further, the gap between the lead demand/availability is widening. If scrap lead is not recycled, this gap will further widen with a consequent effect on the industrial growth of the developing countries. There is no economic option for these countries except to supplementing the raw material input by imports for their secondary operations. Recycling of lead scrap has therefore become inescapable for developing countries to sustain the on-going industrial growth. The upward trend (Fig. 6) in secondary-lead production in India, Malaysia and South Korea to meet the lead demand has been made possible by imported raw material inputs for secondary-lead production. In these countries, the share of secondary lead in the total production is 30 to 100% and in consumption 16 to 40%.

At present, the battery scrap generated in the Asian developing economies in transition is insufficient to meet this lead demand. Therefore, countries depend strongly on recycleables imported from developed countries.

Lead is a toxic metal and poses health problems and, therefore, assiduous environmental controls should be implemented in handling and processing the metal. Today,

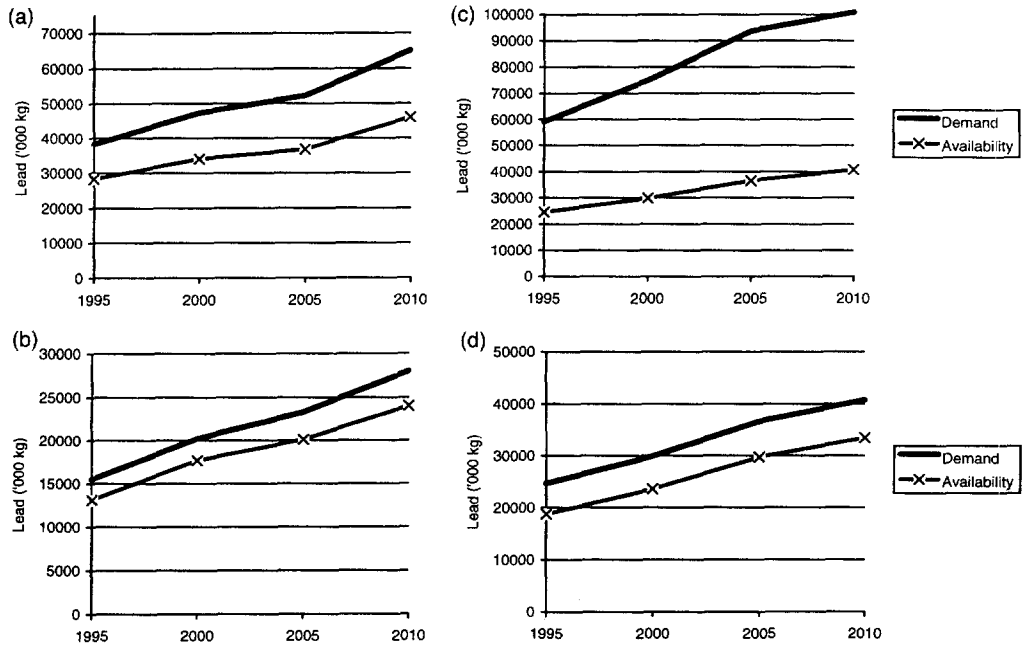

Fig. 5. (a) Lead demand and availability in India: 1995–2010 [3]. (b) Lead demand and availability in Malaysia: 1995–2010 [3]. (c) Lead demand and availability in South Korea: 1995–2010 [3]. (d) Lead demand and availability in Taiwan: 1995–2010 [3].

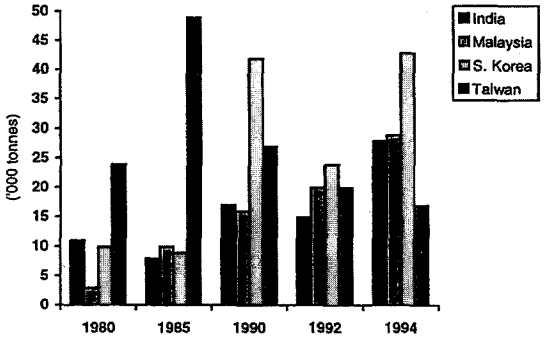

Fig. 6. Secondary lead production in some Asian countries: 1980–1994 (×000 units) [3].

the developing countries in transition are aware of the adverse health effects of lead and its degrading environmental impact and are gradually equipping themselves for clean and environmentally safe recycling operations.

7. Basel ban and its implication on recycling and trans-boundary movement of batteries

The above discussion clearly highlights the fact that scrap batteries play a vital role in meeting the domestic demand for lead in economies in transition. The Basel ban, which includes this important recycleable scrap material in the hazardous category, will adversely affect the lead industry in many developing countries.

The first and foremost problem that the recycling industry in developing countries faces is the lack of a clear-cut definition of a 'hazardous waste'. Further, the Basel Convention definition of wastes includes those meant for recycling/re-use operations as well. There is no distinction between (i) wastes that are hazardous in nature and, therefore, their movement should be prohibited, and (ii) wastes that are non-hazardous and recycleable, and their import/export should be allowed. As a result of this non-distinction, many of the important recycleables have been included under the ban purview and lead battery scrap is among them. Further, it is significant to note that the ban is inconsistent with GATT Article XI, which requires contracting parties not to employ restrictions other than taxes or duties on the importation/exportation of any product desired for the territory of another contracting party. The Basel ban will also discriminate against non-parties and non-annex VII states, unless bilateral, multilateral or regional agreements under Article 11 of the Convention are allowed to continue when the export ban becomes legally binding after ratification of the amendment by 75% of the parties. If the Article 11 provision is negated by the proposed amendment, then the export ban will clearly be discriminatory. Developing countries will be unable to continue sourcing recycleables from developed countries, even if they can ensure environmentally sound management of these materials.

The ban to restrict the movement of scrap battery between the developed and developing countries will certainly have an adverse effect on the economy and industrial growth of emerging and developing countries. As of today, the battery scrap generated internally in many of the developing countries is not substantial to sustain recycling operations and these countries are therefore strongly dependent upon imported recycleables from developed countries (Fig. 7).

First, in the absence of availability of scrap from the developed countries as a result of the ban and the scarcity of virgin ores, these countries will be forced to resort to the import of lead concentrate, as well as primary production process or virgin lead, in order to meet the internal demand for lead. Both options will be uneconomical for these countries. This may even result in a sharp hike in lead prices and, thereby hamper the industrial growth of developing countries. Further, countries such as Taiwan and Malaysia, where 100% of the lead produced is from secondary sources, will be hit hard. Secondary-lead production has been found to be a profitable trade in these countries. These countries consume only about 40% of total lead production for domestic needs and 60% is exported.

Second, if recycling operations are not sustained properly, these wastes will end up in the final disposal. In the long term, one would expect a proportional increase in waste generation matching the pace of rapid industrialization. Reduced capacities and unavailability of facilities and sites for disposal may then create a renewed interest in recycling the scrap lead resources as a waste management option.

Third, dumped recycleable lead scrap may prove to be even more environmentally hazardous. The metallic content that leaches out from the scrap material upon exposure to different hostile environments may cause ground water pollution. This again demands precautionary steps to be taken to carry out the dumping operations and the whole exercise will be even more costly.

Overall, the proposed export ban will not affect all developing countries to the same extent. Much will depend upon a combination of factors: the list of wastes that will result from the work of the technical working group, the extent of importation, and dependence on Annex VII states.

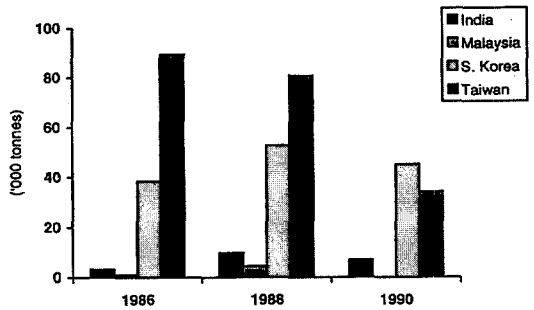

Fig. 7. Net imports of lead scrap by selected countries: 1986–1991 (×000 tons) [3].

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