Lead Recycling in India
A Need More than A Challenge

- Metalworld Research Team

Recycling of lead for recovery of secondary metal poses a greater challenge before Indian business houses because of strict implementation of environmental norms in the last few years. The government has made stringent norms to protect environment from release of obnoxious gas from lead recycling units. The process has made many small smelters with low installed capacity and even lower utilisation to shut down their shops or install machinery needed for environment protection. Not only installation of machinery added to the cost of secondary lead production but also falling metal prices in global markets worsened life of metal producers in India.

Lead is very easy to recycle. It can be re-melted any number of times, and provided enough processes to remove impurities are performed, the final product (termed secondary lead) is indistinguishable from primary lead produced from ore. The amount of lead recycled as a proportion of total production is already fairly high worldwide. Over 50% of lead consumed is derived from recycled or re-used material; the figure is higher in Western Europe (60%) and the USA (70%). Secondary production rates compare favourably with other metals. The long lifetimes associated with some applications of lead coupled with steadily increasing production mean that secondary production as a proportion of total production is not a good indicator of the actual recycling rate for lead (defined as lead recycled as a proportion of end-of-life material). Recycling rates of lead and other metals are estimated to be much higher than for other materials such as paper, plastics and glass.

Source of Secondary Lead

Used lead acid battery is one of the largest sources of secondary lead production globally including India. Lead is easily melted down for reuse and therefore lead batteries are rarely discarded as waste. Recycling lead by melting down used batteries (also known as secondary smelting) is a profitable business throughout the world. Unfortunately, recycling lead from used batteries is known to result in high lead exposures that can cause severe health effects and contaminate the environment unless adequate equipment is used and procedures to minimize emissions are followed.

In many developing countries individuals working on the side of the road or in "backyard smelters" carry out lead battery recycling. Because of the primitive nature of these operations and their enormous number (estimated to be in the tens of thousands) the control of lead poisoning from the contamination of homes and the environment is a major challenge. Children's exposure to contaminated dust and soil from the recycling of used lead batteries also poses a greater threat for prospering to the secondary lead industry. Large-scale recycling facilities are also known to be significant sources of lead exposure in many parts of the world. There are dozens of examples of informal and even large lead battery recycling plants that have been the source of lead poisoning among workers and local residents.

Secondary Metal : A Major Source of Lead Supply

According to the 12th Five Year Plan of the government of India, secondary source meets through three-fourth of lead demand in India. Since, the primary lead producer Hindustan Zinc Ltd. produces insufficient quantity of metal to meet rising demand; secondary source is the only option left to bridge the supply deficit.

Lead batteries industry in India is currently estimated at Rs 40,000 crore with 60% automotive and 40% industrial. Over thousand of players continued recycling activity in India through recovery of lead from telecom, uninterrupted power supply (UPS), inverters, renewable energy and other related industries. India has two major primary lead producers namely Hindustan Zinc Ltd (HZL) and Indian Lead Limited (ILL) with an accumulative annual production capacity of 200,000 tonnes.

LEAD : OPPORTUNITIES IN PRIMARY AND SECONDARY (TONNES)		
FINANCIAL YEAR	PRIMARY LEAD CAPACITY	SECONDARY LEAD DEMAND
2012-13	185,000	450,000
2013-14	185,000	490,000
2014-15	185,000	515,000
2015-16	185,000	535,000
2016-17	185,000	565,000

Source : 12th Five Year Plan

India's largest lead refinery was setup by Vedanta Group-managed by Hindustan Zinc Ltd inside the premises of HZL's Chanderia Lead Zinc smelter with the help of Australia based Ausmelt technology. Lead production from unorganised sectors (backyard smelters) is also significant. The demand of lead, which cannot be met by primary production, can be compensated to some extent by secondary production. The chief source of old scrap is lead-acid batteries and other sources include cable coverings, pipe, sheet, and other lead-bearing metals. Over 70% of the world's total output of lead is consumed in the manufacture of lead-acid storage batteries. At the end of their life, such batteries are readily collected and become the major feed to the secondary lead industries. Almost all the secondary plants use the pyro-metallurgical smelting process.

Battery scrap from automobile sector accounts for 80% of old scrap recycled as secondary lead raw material. A standard lead acid battery for starting, lighting, and ignition of vehicles has the following average composition by weight: Lead metal: 34% Electrolyte (free sulphuric acid): 11-12% Lead oxide paste: 39% Others (ebonite, PVC, paper etc) 8 -10% Polypropylene: 5 - 6% prior to smelting, batteries are usually broken up and sorted into their constituent products. Fractions of cleaned plastic (such as polypropylene) case are recycled into battery cases or other products. The dilute sulfuric acid is either neutralized for disposal or recycled to the local acid market. One of the three main smelting processes (blast furnaces, rotary furnaces, or reverberatory furnaces) is then used to reduce the lead fractions and produce lead bullion. Newer secondary recovery plants use lead paste desulfurization to reduce sulfur dioxide emissions and generation of waste sludge during smelting (Fig-1). Battery paste containing lead sulfate and lead oxide is desulfurized with soda ash, yielding market-grade sodium sulfate as a byproduct. The desulfurized paste is processed in a reverberatory furnace, and the lead carbonate product may then be treated M a short rotary furnace.

Reserves and Deposits

It is estimated that India's identified zinc-lead resources as on April 1, 2011 are 671 million tonnes. India on the world zinc Reserve Base scale was at 7th position at the beginning of 11th Five Year Plan. The country has now moved to a respectable 4th position mainly on account of significant exploration success reported by HZL. Looking at the present scale of operations, zinc and lead resource position will become critical after some 10 years. Therefore, there is a strong need to focus on exploration activities in the country to find new economic resources for sustaining the present and planned expansions in zinc metal production, or to contemplate any increase in the primary lead metal production. Indian government alone has proposed to spend an amount of US$ 1.25 billion for mineral exploration and related activities (other than coal & lignite) through its agencies / departments in next five years.

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Global Experience

Apart from Mexico, the U.S. exported smaller quantities of used lead batteries to 47 other countries (including approximately 27 developing countries) many with weaker environmental standards and insufficient enforcement capacity. In addition, the U.S. is apparently allowing these exports to countries outside the OECD without obtaining consent from the receiving countries in violation of the Basel Convention. Our analysis shows that more lead is being exported from the U.S. in used batteries to Mexico, than in all the e-waste leaving the US. In tracking used lead battery exports from the U.S., we noted that exports to Mexico have been growing exponentially following the lowering of the lead emission standards in the U.S. under the Clean Air Act in 2008. The U.S. Customs data shows that the increase in used lead batteries exported to Mexico was twice as large in the four years starting in 2008 (209,204,651 kg) than in the previous four-year period (94,774,929 Kg) before the change in U.S. EPA regulatory standards.

Even lead battery recycling plants in the U.S. are sources of significant emissions which have resulted in the contamination of hundreds of sites around the country. In the U.S. lead battery recycling facilities are now subject to the strictest national emission standards of any country. However, there is still significant variability in their reported lead emissions, ranging from 11 to 27,000 pounds (5 to 12,250 kg) annually. Emissions from these plants to surface waters range up to 540 pounds (245 kg). Our evaluation of this self-reported emissions data is that these differences are not due to plant capacity but are likely due to differences in pollution technologies and in state and local permitting requirements.

An Exide Technologies battery recycling plant in Vernon, California was shut down by State regulators in 2015 due to its excessive lead and arsenic emissions which were shown to be contaminating thousands of homes and exposing residents to these dangerous neurotoxins. At one point in the last decade it was releasing more than 3,400 pounds (1,540 kg) of lead air emissions annually, although levels dropped significantly in its last few years of operation. Although the Exide facility outside Los Angeles was closed, there are still lead battery recycling facilities operating in the U.S. that are releasing thousands of pounds of lead into the air annually that is contributing to

soil and dust contamination.

Battery Collection and Benefits of Recycling

National collection systems are needed to direct used lead batteries to environmentally sound recycling facilities. To be effective, the collection a system must provide financial incentives such as purchase discount or a deposit system. If designed correctly, such a program can gradually bring the informal sector to operate as collectors (and not recyclers) and contribute to its success. Laws establishing specific responsibilities on battery producers and mandatory fees (discount or deposits) are necessary to improve product stewardship. China, India and some other countries already have general laws requiring lead battery manufacturers to take back used batteries for recycling. However, these are largely ineffective because they don't provide financial incentives and do not impose penalties for noncompliance. For example, the Indian Battery Management and Handling Rules, require lead battery manufacturers to collect a minimum of 90% of the batteries sold through dealers. The law established an extensive reporting system to track the supply chain. In order to evaluate compliance with this law, OK International obtained individual company reports filed with the government. The data indicates that very few companies are complying with this law and even large battery producers are falling short of the mandatory provisions in this standard.

Recycling lead used in batteries improves the utilization of the metal, reduces greenhouse gas emissions, and saves energy. However, informal sector recycling carried out by dismantling batteries and melting down the material in open vessels or crude furnaces can easily result in 50 percent of the lead to be lost to the environment. The recovered lead from most of these processes is of very poor quality and unusable for making new high quality lead batteries without additional refinement.

Improving recycling practices will provide significant energy savings and result in less greenhouse gas emissions. Recovering lead from used batteries is much less energy intensive than producing primary lead from ore using approximately 39% less energy than that needed to produce lead from mining and resulting in a 39% decrease in greenhouse gas emissions.