

Recycling and reusing of lead from lead acid battery: A case study on Machkhali bazar in Bera upzila of Pabna district

AFSANA SULTANA AND ZAMIL AHAMED

Under graduate student, Department of Urban and Regional Planning, Pabna University of Science & Technology(PUST) Pabna, afsana.pust@gmail.com

Under graduate student, Department of Mechanical Engineering, Bangladesh Army University of Science & Technology(BAUST), Saidpur Cantonment, ahamedzamil.1155@gamil.com

ABSTRACT

Lead-acid batteries are a common item in our daily lives. The application of lead-acid batteries is increasing day by day. The demand of lead-acid batteries has rapidly increased owing to their low cost and high availability. Lead acid battery is the most popular battery all over the world because of its recyclability, flexibility and casting efficiency. Once the lead of the battery is timed out, we have no option but to dump it because it has no use for us anymore, but the battery remains reusable which can be used for recycling. The recycling of this type of battery holds both economic and environmental benefits. In addition to this there can be considerable environmental impact during mining processes such as emission from smelting of sulfide ore, copper, nickel, and cobalt and this can be eliminated if recycling can be introduced. Battery contains toxic elements which has adverse impacts on environment and mankind. To decrease the negative impact the batteries can be recycled and reused instead of dumping. Battery reusing and recycling has combined effect on environment in Bangladesh either positive or negative. The study was undertaken considering root level recycling and reusing of battery. The most prominent battery recycling and reusing areas of Machkhali bazar in bera upzila of Pabna District were selected for this study. A survey involving approximately 20 batteries lead recycling shops were identified and 5 shops were surveyed.

Keyword: Lead-acid battery, lead, recycling, Reuse, toxic element, combined effect.

Introduction:

Use of lead acid battery in Bangladesh has increased day by day. As result, manufacturing of lead acid battery is increasing. Most of the lead used by these industries comes from recycling of lead acid battery. People use battery for various purpose like motor vehicle, IPS, electronic devices etc in our daily activities. Once a time, if the battery is expired by using, there have on options to use again but to dump it in the garbage.

Now, we have an options of recycling of lead that is again used in battery. Most of the lead consumed is derived from recycled and reused materials. The material that we obtain from the expired batteries is removed and recycled which reduces our raw material cost that are bring from aboard. The recovery of lead from damaged battery has the advantage that it is easier and far less energy dependent than the production

of primary lead from ores. The recovery of lead decreases the lead dispersion in the environment and preserves the mineral reserves for the future.

Important characteristics of lead-acid battery include: an ability to work effectively in a wide temperature range; a powerful recover ability; low cost; low maintenance or maintenance free; a safety seal; powerful recover ability; a long life cycle in the usage stage; a low self-discharge rate. Bangladesh have become a significant mode of transportation in the past decade. Because of the development of electric van, automobiles, motorcycles the demand for lead used in lead acid batteries has been increasing rapidly with their advantages of low price, high-unit voltage, stable performance, and a wide operating temperature range, lead-acid batteries are used in rural telecommunication networks, electric power, solar and wind power energy storage systems and other areas.

Lead acid battery is generally consist of both sulphuric acid and large amount of lead which is not only erosive but also a good carrier for lead and lead particles. Lead is very high toxic metal which have adverse effects on environmental, human body and so on. This toxic substances are infiltrate into the soil, groundwater and surface water through landfill and also releases toxins into the air when they are recycling openly and creates contamination. Workers have risk of exposure lead and lead toxicity who are in industry for recycling of lead acid battery.

The main theme of this paper is to find out the actual present situation of reusing and recycling of lead from lead acid battery and enhancing the public awareness. To investigate the present condition a structured root level of survey is performed in five battery recycling shop in machkhli bera upozila of Pabna district. The survey procedure is decorated with proper planning described in Methodology section.

Objective:

Objectives of this study shows-

- i) Two recycling process were found which are named Direct and Indirect recycling process in this study.
- ii) Direct recycling process is not performed dangerous exposure to environment and health risks.
- iii) To find out the actual scenario of reusing and recycling of lead acid battery and creating the public awareness.

Study Area:

Bera is an Upazila of Pabna District in the Division of Rajshahi, Bangladesh. The most prominent battery recycling and reusing areas of Machkhali (raksha bazar) in bera upazila of Pabna District were selected for this study. The areas were selected in order to get an illustrative picture of the lead acid battery reusing and recycling activities in the study area. A survey involving approximately 30 batteries lead recycling shops were identified and some shops were surveyed. The survey was done in two steps. One was based on the reconnaissance survey of the area and others was talked with the shopkeeper's.

Methodology:

In this study, both primary and secondary data has been used. The study is mostly depended on reconnaissance survey and primary data and information. It would also help to identify the system of recycling and also determine the impact of it. Secondary data collection includes necessary data collection, detailed information about the collection and ready to sell again etc. This information is collected from reconnaissance survey and the owner of these shops. After collecting data from primary and secondary sources, need to the analysis of data prepared a report and submitted to supervisor for necessary correction.

Survey observation and discussion:

Recycling Procedure of lead acid battery in the study area:

The study has found a working procedure of recycling the lead acid battery. Figure-1 showing the process below:

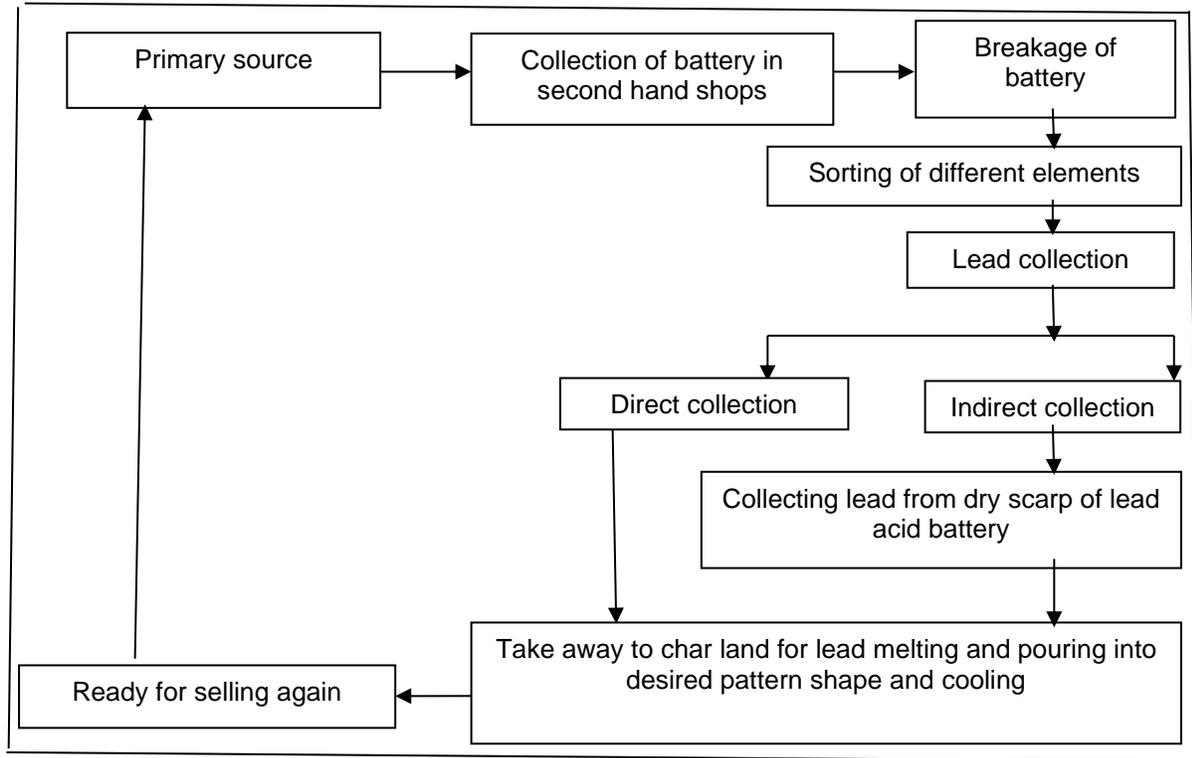


Figure-1: Recycling Procedure

Collection of battery:

They collect the battery from the secondary shops or to the battery dealers. The battery dealers get the lead acid battery from local customers like house, office, hotel or restaurant mainly IPS battery and from drivers (private car, CNG, truck, easy bike, motor cycle, bus and pick-up etc.) who have willingness to sell their battery; comes into the battery shops and sells battery to the shopkeeper's. When a piece of lead battery is damped, damaged and becomes non rechargeable or not damaged badly enough to require; the owner can sell it to the secondhand battery shop or to the battery dealers in low price. They get batteries namely Rahim Afroz Battery Ltd., Hamko, Volvo, Aftab Automobiles Ltd., Eastern Batteries Ltd., Haque Brothers (Carbide) Ltd., Platinum Power Trading, Tyre & Battery Bazar, Rolex Battery Co., Urmi Tyre & Battery Centre etc. Usually price of old lead battery is fixed for per kilogram.

Sorting process:

After collection the battery from different places of the country at first they stored in their own shops, After that they sort the batteries various types like small size batteries or big size automobile bus, car batteries for obtaining mainly lead and separate other constituents of lead acid battery. They sort these battery for doing other battery recycling procedure and their daily income.

Breakage of battery:

The batteries are manually broken up to separate out the acid and component parts. Then worker break the batteries with some instruments like sharp knives, hacksaw and so on. The owner of that battery recycling shop give salary depending on the size of batteries what they broken in the day. Workers get salary average range is 400-1000 taka per day according to number of per ton broken batteries .The salary of broken small size batteries is more than broken the big size batteries.

Lead collection:

The study has found two recycling processes which are named Direct and Indirect recycling process. Both in direct and indirect processes two steps has similarity which are collection and breakage of battery. Almost all parts of a lead-acid battery can be recycled in the manufacture of other plastic goods, including new battery casings. In many smaller recycling facilities in low- and middle-income countries, the plastic battery cases are often not recycled and may be dumped or burned.

- **Direct collection**

The direct collection process is done in non-sustainable manner produces lead oxide and dioxide and some other harmful gases has bad impacts on environment and human health. Workers collect lead directly from the damaged battery by separating all constraints of the broken batteris. They seperate the battery acid, lead and plastics. After that, the collected lead bring for melting.

- **Indirect collection**

The indirect collection processes is done by collecting lead from dry scarp of lead acid batteries. It's a harmful process. Many women worker has done these in their yard openly. The scarp are dried in the sun put on polythene or dry cloths. Then they strike in the dry scarp with stick to separate the lead. The collected lead then taking for melting. Sometimes, they collect little lead by washing the batteries plastics. Then the wet lead dry on the sun and taking to melting.

Take away to Char for squeezing/ melting:

After collecting lead from unused broken lead acid battery worker taken the dry lead to the char of Jamuna river for melting. They have no developed plant to melting lead without any pollution. They didn't melt lead local place because of its harmful effects and black toxic smoke. Because they have the idea about that the lead burning black toxic smoke and .the smoke is not good and that's creates contamination of the local area. So, they take to the char land for protecting the local area from the toxic smoke for lead acid.

Giving desired lead plate pattern:

After melting the lead, the molten lead are poured into desired lead plate shape pattern. A few slugs are float on the surface of hot molten lead when it is poured then the slugs are removed by using specific object. Then waiting at a definite time unless the molten lead are cool. After the cooling the plate shape pattern replica are removed and the final product (lead plate) are obtained.

Supply:

The final shape product (lead plate) are again return to the battery recycling shop for selling to different battery dealers or industries so that they use the lead again to generate new lead acid batteries.

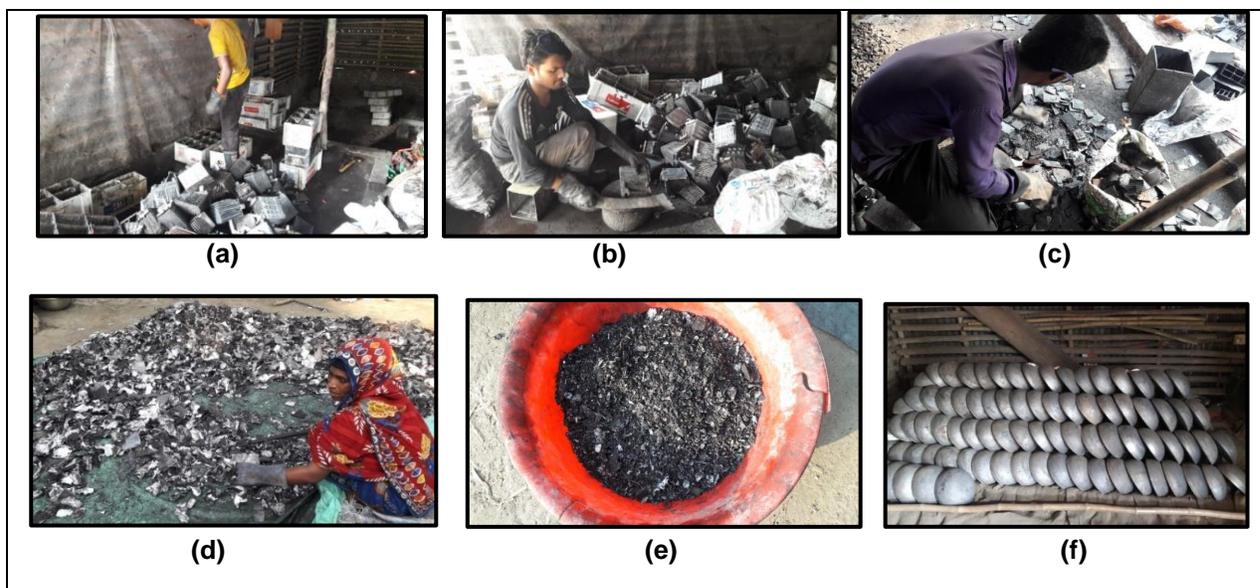


Figure-2: (a) Sorting process, (b) Breaking the batteries, (c) Collecting lead directly, (d) Collecting lead indirectly, (e) Collected leads, (f) Final product (lead plate) of unused lead acid battery and ready for selling.

Data Analysis:

Table-1: some information's of the shops

Shop name	Weekly Collection (ton)	Weekly lead plate sell(ton)	Types of automobile battery collecting maximum		Number of worker	Salary for worker who break battery	
			Large size battery	Small size battery		Large size battery(tk)	Small size battery(tk)
Mohona Battery Workshop	10-15	5-7	90%	10%	5	200-400	500-1000
Rohim Battery Workshop	10-20	5-10	95%	5%	7	450-500	500-950
Vai-Vai Enterprise	25-30	10-15	80%	20%	10	350-450	500-1000
Robiul Batteries	13-15	6-7	75%	25%	4	300-400	400-900
Nannu Enterprise	9-13	4.5-6	50%	50%	6	350-450	500-800
Hasan Battery Workshop	10-16	5-8	60%	40%	7	400-450	500-900
Azad Enterprise	20-25	9-12	70%	30%	8	350-450	500-1000

(1000kg = 1ton)

Table-2: some information's of the shops

Shop name	Number of male worker	Number of female worker	Worker dependency ratio on this shop	Age ratio of the worker		Worker education scenario	
				15-25(years)	25-40(years)	Educated	Uneducated
Mohona Battery Workshop	3	2	90%	2	3	–	5
Rohim Battery Workshop	6	1	100%	4	2	3	3
Vai-Vai Enterprise	7	3	100%	6	4	3	7
Robiul Batteries	4	–	95%	1	3	2	2
Nannu Enterprise	5	1	100%	3	2	6	–
Hasan Battery Workshop	5	2	100%	4	3	1	6
Azad Enterprise	8	–	100%	6	2	3	5

Effects of Lead Acid:

Positive effects:

Economically developed

The study area is situated besides the Jamuna river of Bangladesh. In few years ago this areas living situation, life styles was not good. The people who living in this area are just like a slum area and the area is under developed and they are fully dependent on boat, catching and selling fish and their daily income was also coming only this selected professions. They had no enough education system and not better school, college also there. But at present many people including male and female are works in recycling shop, they change their life standard day by day, they improve their life style and also many of them send to their children the school. The new school college also established day by day and people also started new business and many students also work their leisure hours in this battery recycling shop and they also contribute on their family. This battery recycling shop is one of the main source of the area which make it economically developed otherwise the area will faced with a dangerous crisis.

Employment

The study area have about 20-30 shops which are worked for recycling unused, expired battery. For the establishment of this manually recycling shop there were creating new job opportunity permanently and part time and its ratio is increasing daily. In each recycling shop, there were 7-8 male person and female person

also working permanently and many others also works on their own residence. Thus the unemployment rate of the study area is decreased.

Working facility for women

In the battery recycling shop the working facility of women and women contribution also increasing. Because of the maximum women those are working this shop is nearest living, their residence is not so far from the shop and working safety, and other facilities ensured by the owner of the shop. Many women also work in their residence whose are also connected on this battery recycling shop. That's why the involvement of women to work enhancing in a speedy way. Poverty is reduced in a significant way.

Local development:

For the increasing of lead acid battery recycling shop, the local development is significantly change and its development is in extensively way on the study area. Besides the study area also developed remarkably. New NGO, Banks, mobile network tower, educational institutions (primary school, high school and college), good communication system, new high way road, grocery shops, medical pharmacy, and community clinic are also established on the study area.

Negative effect:

Effect on health

Lead used in batteries is toxic and causes a wide range of negative effects. In the study area, workers don't have idea about the adverse health effects. Most of the time they don't use any protection. The effects of lead are widely spread and that's affect all body internal circulation systems. The effects include loss of appetite with weight loss, constipation, abdominal pain or discomfort, nausea, vomiting and a metallic taste in the mouth. Diarrhea occurs occasionally. Lead exerts toxic effects in all parts of the nervous system. Initial signs include sporadic vomiting, loss of appetite, behavioral changes with aggression, irritability and agitation, headache, clumsiness and intermittent lethargy. This may progress to persistent vomiting, ataxia, convulsions, severe cerebral edema, raised intracranial pressure, coma and death. Lead may also cause visual impairment and reduced hearing. It may be mentioned here that If one gets expose excessively to lead it can cause damage to brain and kidney, impair hearing, and can led to various other associated problems.

Environmental pollution

Table-1: Different Types of pollution occur in the study area

Soil pollution	Water pollution	Air pollution
Recycling of spent lead acid batteries and disposal of process slag potentially contaminate soil with lead. Lead creates obstacles for plant growth and natural soil process including nutrient availability and microbial activity. For this reason, tree production is hampered. Spilling and leaking of acid from the batteries directly to the soil. Leaching of acid and lead salt due to improper processing which Create adverse impact on ecosystems (plants, animals, humans).	Lead also contaminate the ground water and surface water (pond and river). They dump the wastes of lead acid batteries directly into the water. Lead acid hampered the aquatic ecosystem of the study area. For this reason, production of fishes reduced day by day. Spilling and leaking of acid to water surfaces. Direct dilution of lead salts in water or through rain water when present in soil.	At each of these stages, lead fumes and dust are released into the air, contaminating both the workplace and the wider environment. The smoke which is created for melting lead hampered the growth of plants and reduces the plant fertile rate in the study area.

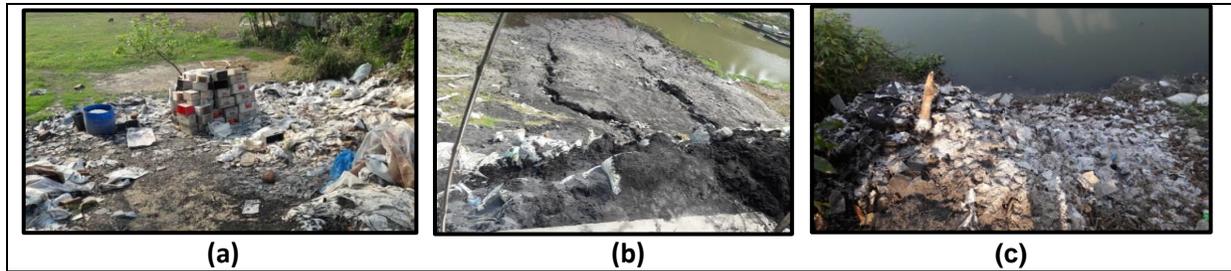


Figure-2: (a) Soil pollution, (b) Fill the river with wastes, (c) Water pollution

Dependable on this work

Dependable on this work: The maximum people on the study area are fully dependent on this recycling shop. The dependency ratio is 85-90%. In our survey we see that they are working in this shop maximum 8-10 hours in a day. Without this they are not doing in other profession because of lack of job opportunity, family conditions, educational conditions, lack of invest money and so on.

Fill the river

Some of them the wastes lead acid battery of the shops throw directly into the river, beside the switch gate of Jamuna river in the study area. Show a picture in the figure-2. For this reason, the water is contaminate and river fill up gradually.

Recommendation:

In our survey area they are working in open space in the nearest village market, their own residence area and besides their living free space. They are cut the batteries, separate the battery ingredients like plate, grids, lead raw materials etc in the open space. The people who are working on this recycling shop are not properly maintained safety as like wearing hand gloves, face protection, gum boots and other safety options. Although the safety materials are provided by the owner of the shop but very few worker wear safety items and they are also not enough cautious about working without safety materials. After the various steps such as cutting, shorting, curing and drying, plate preparation etc of lead acid battery recycling process different types of accessories are obtained. This accessories include kamina vent plugs with co-injected O ring, vent plugs double lids, VRLA valve plugs, vent plugs, hold down adaptors, pole protector, cord handle, elbow fitting etc. They cannot gather this accessories in a fixed place, they throw the elements around the nearest place. It's harmful to throw the wastes of lead acid batteries in the garbage. Needs to forbidden the pour battery acid onto the ground or into a drain in the study area. Increasing awareness so that they don't take lead acid batteries to a landfill and also don't store batteries outside, unprotected from the weather. The use of automated, enclosed processes with pollution control devices can reduce these emissions of dust and lead fumes. With adequate technology, training (working and increasing awareness) and regulatory frameworks and support battery recycling can positively contribute to the conservation of natural resources, energy savings, a reduction of toxic gases and the development of the area.

Conclusion:

Recycling process of lead from lead acid batteries is not a simple work which can be done in small enterprises in an area. Constructing, commissioning and operating a modern environmentally sound recycling plant is a very expensive. Not only does the initial capital investment, but there is an ongoing, and essential, huge cost to cover environmental and hygiene control systems. Any modern recycling plant must have a fixed and high throughput of used lead acid batteries. The popularity of recycling of lead acid battery is increasing and the catastrophic health implications of lead exposure, it is increasingly important that safe and efficient recycling exists. While recycling of lead from lead acid battery is successful, the current methods is inexpensive and potentially hazardous smelting process in the study area. To minimize safety risks and environmental contamination it is essential to follow systems where informal recycling operations operate and fewer environmental and safety regulations are in place, the health are severe, leading to

recycle lead being classified as the most polluting industrial process. Offer a method which has some manners to minimize the release of contaminants. Since secondary lead recycling from spent lead acid battery is expected for lead metal alternative resource and positively affect economic growth, the term of environmental issue due to this processing activity must be strictly concerned. Despite lead smelting route which commonly used give significant impact on the environment issue toward emission was a major drawback. Local governments should focus on an environmentally safe collection of used lead acid batteries and delivery the lead plate to an environmentally sound smelter. This is highly regulated and practiced at the state, national and international levels.

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