



## **LEAD RECYCLING AFRICA PROJECT**

### **USED LEAD ACID BATTERY (ULAB) RECYCLING IN TANZANIA**

#### **SURVEY REPORT**

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## **List of Abbreviations**

AGENDA	AGENDA for Environment and Responsible Development
CSO	Civil Society Organization
NEMC	National Environment Management Council
OSHA	Occupational Safety and Health Authority
SDGs	Sustainable Development Goals
TBS	Tanzania Bureau of Standards
ULAB	Used Lead Acid Battery
WHO	World Health Organization

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Lastly we appreciate our project partners in Ethiopia, Cameroon and Kenya for sharing experience from their own countries.

## **1. Background**

The Lead Recycling Africa Project was initiated in late 2014 after various scientists and environmental groups in Germany and several African countries had collected a substantial body of evidence that unsound lead-acid battery recycling causes severe pollution and has a serious impact on health in many metropolitan areas in Africa.

Although lead-acid battery recycling has long been practiced all over the world, rapid urbanization, a growing vehicle fleet and an unbroken demand for lead has spurred the rapid growth of domestic lead recycling industries in many African countries including Tanzania. While, formerly, batteries were often recycled in small backyard workshops, such businesses are increasingly replaced by smelters of industrial scale. On the one hand, this development can be seen as a window of opportunity for the introduction of effective pollution control measures. On the other hand, the concentration of potentially harmful practices may even increase the severe health risks for the people working and living in or around such facilities.

Unfortunately, there is as yet no comprehensive picture of the Tanzanian and largely African lead recycling industry and its impacts on human health and the environment. Furthermore, in most African countries, the general level of awareness amongst industry, decision-makers, intergovernmental agencies and the wider public is still insufficient to drive forward the implementation of effective minimum standards or ensure the respect of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

In order to expand the knowledge base on lead recycling industries in Africa, Oeko-Institut /Germany with partners in Cameroon, Ethiopia, Kenya and Tanzania launched the “Lead Recycling Africa Project” to conduct detailed investigations of the local management and recycling practices applied for waste lead-acid batteries.

The objective of the project was to identify, monitor and mitigate potentially polluting practices in the lead recycling industries of the three African countries. It aimed at stimulating public debates about health and safety and pollution control standards at the local, national and international levels for improved knowledge base on the lead acid battery recycling practices.

Project activities involved fact-finding studies on lead recycling industries in the three countries; dissemination of knowledge on standards and effective mitigation measures; and dialogue with decision-makers in African countries and at international level aiming at the reduction of health and environmental risks associated with substandard lead recycling.

## **1.1 Partners**

Implementing partners in the four countries are AGENDA for Environment and Responsible Development (AGENDA) in Tanzania, Pesticide Action Nexus Association (PAN-Ethiopia); Research and Education Centre for Development (CREPD) in Cameroon and Center for Justice Governance and Environmental Action (CJGEA) in Kenya with technical and financial support from Oeko-Institut e.V. (Germany).

## **1.2 Why lead recycling is an issue of concern?**

Lead is considered as one of the most toxic heavy metals that causes harm to several organ systems in the body. In the bloodstream, for example, it can damage red blood cells and limit their ability to carry oxygen to the organs and tissues that need it, thus causing anemia. Most lead end up in the bone, where it causes even more problems. Lead can interfere with the production of blood cells and the absorption of calcium that bones need to grow healthy and strong. Calcium is essential for strong bones and teeth, muscle contraction, and nerve and blood vessel function. Increased lead level leads to headaches, appetite loss, impaired hearing, may also lead to slow growth and a damaged nervous system damages the brain and neurological system, lower intelligence quotient (IQ) levels and causes hyperactive and violent behavior in children; damages kidneys, liver, reproductive and blood forming systems. Very high levels can cause coma and/or death. During pregnancy, especially in the last trimester, lead can cross the placenta and affects the unborn child. Female workers exposed to high levels of lead have higher risk of miscarriages and still births.<sup>1,2,3,4,5,6</sup>

Lead can be found in the air, the soil, the water, and even inside our homes. People can become exposed to lead through occupational and environmental sources. This mainly results from: inhalation of lead particles generated by burning materials containing lead, e.g. during smelting, informal recycling, stripping leaded paint and using leaded gasoline; and ingestion of lead-contaminated dust, water (from leaded pipes), food (from lead-glazed or lead-soldered containers). The use of some traditional cosmetics and medicines can also result in lead exposure.<sup>5</sup>

Lead and lead compounds have been used in a wide variety of products found in and around our homes, including paint, ceramics, pipes and plumbing materials, solders, gasoline, batteries, ammunition, and cosmetics. Lead can also be emitted into the environment from industrial sources and contaminated sites, such as former lead smelters. When lead is released to the air from industrial sources or vehicles, it may travel long distances before settling to the ground, where it usually sticks to soil particles. Lead may move from soil into ground water depending on the type of lead compound and the characteristics of the soil.

One of the significant practices where lead is used is in the manufacture of lead acid batteries. At the end of its life, the lead acid battery is classified as a hazardous waste under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and should be handled accordingly in order to prevent damage to human health or/and to the environment. The Basel Convention has developed training manual for the recycling of lead acid batteries.<sup>3</sup> However, in practice these guidelines are often not respected, resulting in proliferation of substandard lead acid battery recycling businesses in developing countries, with consequence to environmental pollution.

## **2. Methodology**

Various methodologies were utilized in coming up with this report. Literature review was followed by preparation of survey tools with leading questions to the identified stakeholder groups. Discussion was then held with NEMC on the Tanzania situation and the project activities. AGENDA with support of NEMC visited the recycling facilities and conducted interviews with the management and workers separately and gathered the required information. Local governments and communities around the recycling facilities were also visited and discussions held with them on their general perception of the industry.

In addition, AGENDA surveyed battery collectors, markets and garages involved in maintenance of vehicles and battery collection or re-use for lighting. Awareness sessions were conducted with those involved in the recycling chain, communities and some media houses. At the international level, the partners created a website [www.econet.international](http://www.econet.international). The website has been used to publish reports and information about the lead-acid battery recycling situation in Africa. The partners also launched a newsletter informing about developments within the project and around lead-acid battery recycling, used existing regional and global CSOs e-mail listserves and information sharing during relevant regional and global meetings.

### **3. Market places and garages**

#### ***3.1 Markets***

Used batteries are used in almost all markets around the City of Dar es Salaam for lighting in the evening/ night hours, used as a source of energy for radios, televisions and others small electronic and electric devices. From August to November 2015, the research team visited the following market places to identify activities related to used battery recycling:

##### **3.1.1 Gerezani market at Kariakoo**

Gerezani market is located within the main business and market area in of Kariakoo, Dar es Salaam. Gerezani market has about 150 traders and 3 scrap dealers among other recyclers. Dealers in scrap metal buy used lead acid car batteries from scrap collectors. According to the information provided by two traders, the buying price of the batteries is around 500 Tanzanian shillings (TZS 500, about US\$ 0.25) per kg. The dealers sell the batteries to Steelcom Limited, in Dar es Salaam. Information about Steelcom is provided below.

##### **3.1.2 Ubungo and Mbezi markets**

These two markets are located in Kinondoni Municipality in Dar es Salaam. The number of petty traders in the markets varies from day to day but may be around 100 per market. Some traders use shared generators to power their trade kiosks or areas and pay 1000TZS per trading evening. Where no generators available, used batteries are alternative source of energy, normally for lighting and for the radio at business areas and at homes. They buy the used batteries for this purpose at 15,000TZS. They normally charge batteries after two days and pay at a cost of TZS1,000. Some of them informed the survey team that when a battery reaches a point where it can't be re-charged any more they throw them away, they do not know if there are places/individuals who can buy them. They also indicated that they know the battery consist of acid but not lead. Some think the fluid inside the battery is water.

#### ***3.2 Garages***

The Dar es Salaam City has three Municipalities namely Kinondoni, Ilala and Temeke. Fourteen garages were visited in these municipalities. The main activities undertaken in these garages are servicing and maintaining of vehicles, including battery charging. Some vehicle owners leave the batteries approaching their end of

use time at the garages after replacing with new batteries. The garage owners sell the batteries to scrap metal collectors according to the size of the scrap batteries, ranging at from 6,000TZS to 10,000TZS per unit or 800TZS per kilogram. In some garages they only pour off the acid but do not open up the batteries to remove the materials inside it. Normally, the acid is poured off on bare soil. In some garages, the acid is poured in plastic containers and sold to people who use it for washing tiles and sinks. Others pour the acid on the ground. Only a few are aware that the acid in the battery can burn or harm their bodies. Most of them do not use protective gears when handling batteries.

## **4. Collection, dismantling and smelting of batteries**

### ***4.1 Collection and supply of batteries - Steelcom Limited***

Steelcom Limited is located at Keko Mwanga in Dar es Salaam, in vicinity to Kariakoo – which is biggest business place in Tanzania. As noted on Section 2 above, the company buys scrap metal including empty aluminium cans and used batteries from individuals, groups and other companies (agents). Normally the agents receive scrap batteries from all regions of Tanzania and sometimes receive from other countries like Democratic Republic of the Congo (DRC), Uganda and Zambia where truck drivers bring scrap batteries for sale. The estimated average used batteries they receive per day is 10 tons. The company sells the batteries and other metals to recycling companies. Its customers for scrap batteries are Gaia Eco Solutions Ltd and OK Plast Ltd only. It sells other materials to other companies (not identified during the survey). The company normally sells used batteries at TZS 800 (about US\$ 0.4) per kilogram

One of the management staff explained that only five employees are working at the battery transfer area (usually transfer is from the car of the seller to the truck of Steelcom). The workers are trained on the handling of scrap batteries during the transfer period, and they are insisted to wear protective gears. The workers reported to be unaware of environmental and health effects associated with their operation. Wastewater contaminated with acid is disposed of in the municipal drainage which leads to the ocean without any treatment. In addition, two workers who were interviewed complained about acid smell and heavy lifting during the operations. They were wearing the protective gears (glove, coverall and boots).

## **4.2 Dismantling and smelting of used batteries**

### **4.2.1 OK Plast Ltd facility**



#### **Dismantling**

OK Plast Limited is located in Vingunguti Industrial Area, off the Dar es Salaam City Centre. The company started battery recycling activity in 2010. Most of batteries dealt with are vehicle batteries, bought from Steelcom Limited, normally at USD 900 for every 1 ton, estimated average of scrap batteries handled per month is approximately 280-300 tons.

After receiving the batteries, the facility drains off all the acid ready for other recycling processes. The acid is collected in a reservoir. The next process is manual battery breaking which is done by a few workers who use primitive tools such as axes, and others. Workers who were dismantling the batteries complained that sometimes remaining acid in the battery spilled on them while breaking the batteries.

After breaking, lead bearing materials are removed from the casings, and plastic casings cleaned and shredded into pieces by shredding machine. Then the pieces from the breaking process are placed in a tank, where they are sorted according to their weights/ densities as some of them sink, some float (hard rubber and plastic) and liquids go into solution (battery acid). From here, the materials are separated and treated individually. The plastics are cleaned, shredded and used to produce mats and others polypropylene materials which are sold in markets within the country. The acid is neutralized after which it is disposed off.



**Photograph 1. Place where dismantling is done at OK Plast**



**Photograph 2. Plastic casings washed ready for crushing – OK Plast**



**Photograph 3. Crushing/shredding machine at OK Plast**



**Photograph 4. Pieces of shredded plastic casings at OK Plast**



**Photograph 5. Separation of pieces shredded materials**

### **Smelting**

After collecting lead bearing materials from dismantling section, they are taken to rotary furnace for smelting. In the furnace, metallic lead is melted and lead-oxide is reduced to elementary lead. Some impurities are removed with the slag. Melted lead is casted into ingots.

### **Health and environment**

During the survey, the facility had 30 workers, with only one woman and 29 men. The management informed the team that there is a high rate of staff turnover. They normally train their staff before engaging them in work. They also provide work and protective materials like gloves, shoes, masks and glass. During the visit, there was no dismantling or smelting taking place. Two workers from the dismantling and two from the smelting sections interviewed complained that they are mostly exposed to fumes, chocking smell, dust, accidents from the processes including acid pouring on them during dismantling. They also have long working hours, with only short break of 30 minutes during lunch time. Although the workers have limited awareness of environmental effects of lead, they associated some health effects they are experiencing with their work. The environmental condition in the smelting section is dominated by dust. They mentioned headache, coughing, chest pain and abdominal pain which they experience on the working days - exposure to fumes during smelting process. The workers are provided with protective gears like overcoats, masks, gloves, shoes and goggles.

Regulatory authorities conduct occasional inspections and audit of the facility for safety of the workers and the environment. These are the National Environment Management Council (NEMC), Occupational Safety and Health Authority (OSHA), Municipal Council and Ministry of Labour and Employment. In addition, after almost every six months OSHA does general medical check-ups and check workers blood for lead levels annually.

The facility used to dispose of un-recycled materials into Pugu Kinyamwezi dumpsite. They stopped that type of disposal about two years back (2013), but keep the waste in containers awaiting for the technical advice from the NEMC on how to dispose the waste including the sludge.

### **Marketing of their products**

OK Plast sells semi processed ingots from the smelting section to Gaia Eco-Solutions Ltd. Gaia processes them further to meet the standard for export. Initially OK Plast used to export lead ingots to Kenya, India and China. Mats produced from plastic materials are sold within Tanzania.

#### **4.2.2 Gaia Eco Solutions (Tanzania) Limited**

##### **Dismantling**

Gaia Eco Solutions (Tanzania) Limited is located at Vingunguti Industrial Area, off the Dar es Salaam City Centre. Major activities of the facility are buying, dismantling and smelting used lead acid batteries. The facility started its operations in 2005. They only receive the used batteries from Steelcom Limited. In average, they receive around 300 tons per month and they recycle approximately 15 to 20 tons a day. The management informed the survey team that sometimes they are forced to stop operation for short supply or unavailability of used batteries due to illegally export done by some agents/dealers.

The used batteries are cut by machine then workers take lead bearing materials from plastic casings ready for smelting. Plastic casings are sent to cleaning pond whereby the plastic materials are thoroughly washed by using sodium hydroxide solution in order to neutralize the acid and remove lead traces and followed by rinsing with fresh water and later placed on drying bed. After drying plastic materials are sent to plastic waste storage area ready for disposal.



**Photograph 6. Scrap lead batteries ready for cut machine at Gaia**



**Photograph 7.** Lead bearing materials after being separated from plastic casings at Gaia



**Photograph 8.** Lead bearing materials ready for burning into the furnace - GAIA

## **Smelting**

The lead containing materials are fed into the smelting furnace, the rotary furnace, the temperature of which is  $1100^{\circ}\text{C}$  to  $1200^{\circ}\text{C}$  that help to remove oxygen and sulphur elements from lead oxide and sulphate in the lead bearing material. The temperature of the burner equipment and air supply are carefully monitored and controlled. When smelting is complete two different liquid layers are present in the furnace, the one in the bottom is metallic lead and the one in the top is the slag. Liquid lead will be discharged first through a small opening at the discharge port at periphery of the furnace into lead bullion before refinery to customers' specifications. The by-products are further treated and neutralized before disposal.

## **Health and Environment**

The management informed the survey team that the workers got trainings initially from experts from India and from OSHA which normally conducts training and inspection in every 3 months. The team observed warning signs placed on all important factory areas and where operations are carried out. The factory provides necessary protective gears including overalls, gloves, goggles, respirators, and boots. The workers are also provided with meals including half a litre of milk daily. The foods are saved in the canteen which is about 200m from the factory. They have installed dust and other emission control unit (see Photographs 9 & 10). The floor in the operation area is unpaved and kept wet to control dust. Workers who do not follow the required safety measures are given warning letters.

The management was thankful to the Government Regulatory Authorities - NEMC, OSHA, Tanzania Bureau of Standards (TBS) and the Municipal Council whose guidance and advice made the facility very successful including maintaining product and environment quality.

Workers interviewed were aware of health and environmental effects caused by battery recycling process through trainings given by the employer. One worker informed the team that due to hot weather of Dar es Salaam and the heat in the factory, they face difficulties in wearing respirators for long time. They mentioned regulatory authorities which have audited and monitored their health and environment as OSHA, NEMC and Ilala Municipal Council. However, there were no watergate dividing the facility in inside (poisonous) and outside (clean) areas.



**Photograph 9. Emission control**



**Photograph 10. Emission control 2**



**Photograph 11. Washing water pond**



**Photograph 12.** Some warning signs

### Marketing of their products

Gaia Eco Solutions has a laboratory equipped with quality control spectrometer to ensure they meet customer needs. Plastic parts are sold to local companies producing plastic ware. Lead ingots are exported to Spain, Dubai, Saudi Arabia, India and Italy.



**Photograph 13** Finished ingots before packing

#### **4.2.3 Gama Metal**

Gama Metal buys used batteries and scrap metal from individuals and from different small companies; on average it was at TZS 1,150 to 1,300 (about US\$ 0.6). After receiving the used batteries, they cut them and take lead containing material which is packed and exported without any processing. Operations are done manually. One of the management team members informed the study team that the average used batteries received per month is 10 tons.

The company sends its workers for training e.g. to OSHA. Regulatory authorities which have audited the working environment are NEMC, OSHA and the Ilala Municipal Council. The facility was not operating during the study as it was serving temporary closure order for environmental improvement served to it by NEMC. Following this closure, there were no workers for interview.

The survey team was informed that the company exports the lead containing material mainly to Napoli, Italy.

#### **4.2.4 Kamdheh Credit**

Kamdheh Credit was operating at Minazi Mirefu, Kiwalani Ward in Temeke Municipality. The facility was conducting used battery recycling, however, when the team visited the area they could not locate it or get details of their operations. It was informed that the factory was unofficially operating and was shifted to Guru. The team could not find it in Guru. The community around Minazi Mirefu area where it operated complained on the pollution including noise and smoke emission. Activities were mostly done secretly during night time and there was no name on the gate.

### **5. Down-stream markets of lead recycling in Tanzania**

The finding of the study is that lead ingots are exported to Spain, Dubai, Saudi Arabia, India and Italy. The raw lead containing materials are also exported to Italy. The team could not get the estimate of the export amount, but the quality from Gaia was 99.984 measured in their laboratory which is equipped with an Optical Emission Spectrometer for quality assurance.

## **6. Community response to health and environmental impacts**

### ***6.1 Local government officer and community based organization at Miembeni***

The team met with one of the Miembeni Local Government Committee member and Chairperson of community based organization in Miembeni area where OK Plast is located. The leaders reported people around the area (especially women) complaining of health problems including cough and chest problems, TB, skin rashes, stomachache, among others. When the factory operates, the smoke coming out normally chocks the community. It was also reported that iron sheets of the nearby houses deteriorate in a relatively short time due to rust. People have complained and have even requested compensation and relocation to other places but this has not been done. There is no any kind of compensation of the disturbances caused to the people. Have reported the problems to Ilala Municipal Council and some officers from the Council and from other government authorities have visited the area without providing feedback to the community.

### ***6.2 Women group***

The team talked to four women in the area. They complained about smoke, bad smell, people suffering from difficult breathing and tuberculosis (TB). They reported that before the battery recycling, the factory was packaging milk and there were no problems associated with the process.

Some government agencies and environmental stakeholders have visited and talked with the people but there is no any feedback provided. The community has written to the responsible authorities but no response, none of their efforts has borne fruits. They reported that they had proposed two options, either the factory be closed or the community get compensated and relocated to safe areas.

### ***6.3 Men group***

The team met with a group of seven (7) men whose main activity is community waste recycling. They reiterated what was raised by the women group. They added that the shift from milk production to battery recycling was not transparent. For them they only want to see the factory closed. Absence of transparency and lack of involvement of stakeholders in changing operation or initiating a facility was also raised by the Minazi Mirefu community in Kiwalani area, Temeke Municipality where Kamdheh Credit was operating secretly and mostly during night hours.

## **7. Conclusions and Recommendations**

From the survey, it was found that there is still a big gap of the existing laws related to environment and human health, industrial establishment and auditing, relocation and compensation issues. The entire process from collection of the batteries, transportation, dismantling, smelting and disposal of the components is not adequately done. The practice does not meet requirements of existing relevant guides and laws such as the Occupational Health and Safety Act, 2003; the Environmental Management Act, 2004 among others. The process poses a high risk of contamination to human health and the environment. The community complaining of changing or establishing an industrial facility and operation of the facilities without their involvement and compliance issues are challenges and weaknesses to be addressed without more delay if Tanzania needs to comply with international conventions and agreements it has signed and ratified.

Responsible authorities visiting the community as a way of solving the problems should work on the community concerns. It is expected that any facility before starting an operation will take adequate and necessary measures e.g. community involvement as required by the Environment Management Act, 2004. Complaints by the community indicate a gap in the implementation of national policies and laws as well as the Multilateral Agreements including the Basel Convention.

Now countries need to take measures to achieve the globally agreed sustainable development goals (SDGs). Tanzania will have difficulties in achieving the goals if the gaps outlined above are not addressed.

Furthermore, there is a need to extend the study to other regions and involve analysis of lead in the environment and do human-health monitoring to understand the extent of the problem then put appropriate plan in place with all responsible stakeholders playing their part, including review of policies and legislation and their effective enforcement. This is of paramount importance as World Health Organization (WHO) estimates that economic losses due to reduced IQ from preventable lead exposure is approx 1.2% of global GDP. WHO shows that economic loss in the African Region is international dollars (I\$) 134.7 billion or 4.03% of GDP, and childhood lead exposure contributes to approximately 600,000 new cases of children with intellectual disabilities per year.<sup>7</sup>

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