OBSTACLES TO COMPLIANCE WITH REGULATORY OBLIGATIONS RELATING TO THE RECYCLING OF USED LEAD-ACID BATTERIES IN KENYA

BY

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Z51/75043/2014

A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Arts in Environmental Law, University of Nairobi

JUNE 2021

DECLARATION

I declare that this Thesis is my own original work and has not been presented nor is it currently under consideration for the award of a degree in any other University.

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ACKNOWLEDGEMENTS

This study would not have been possible without the cooperation and support of the various companies and individuals that either collect, transport, or recycle used lead-acid batteries. I am particularly indebted to the collection, transportation, and recycling companies and individuals that took their time to share relevant information relating to the use and disposal of used lead-acid batteries. Their insights provided valuable material for the study.

I am equally grateful to Dr. Kariuki Muigua and Dr. Robert Kibugi who gave me wide-ranging guidance throughout the study and trained me a lot about environmental law research. I would also like to thank to Dr. Collins Odote for sharing with me his insights as I made final revisions to the study.

I similarly thank my loving and supportive wife and daughter who have been a source of never-ending inspiration.

DEDICATION

I dedicate this study to everyone who sacrificed their lives and health to raise awareness about the hazards associated with the unsound recycling of used lead-acid batteries. Your sacrifice has been permanently inscribed in the process of strengthening our regulatory framework relating to the management of hazardous wastes and chemicals in an environmentally sound way.

Abstract

Despite the enactment of an elaborate framework to regulate the handling of used lead-acid batteries in Kenya, the country has witnessed numerous cases of lead poisoning and pollution stemming from the handling of these batteries leading to serious health complications, loss of lives and property and, significant degradation of the environment. This study sought to examine why handlers of used lead-acid batteries in Kenya are unable to prevent and mitigate cases of lead pollution and poisoning arising from the collection, transportation, disposal and recycling of used lead-acid battery despite the existence of a robust regulatory framework. Specifically, the study sought to identify the obstacles that hinder compliance with regulatory obligations relating to the handling of used lead-acid batteries. The study was conducted under the rationalist compliance theory which provides a basis for firms' compliance with laws and is a valuable optic for observing and comprehending behavior that drives compliance as well as reasons for those behaviors. The study was conducted using a mix of qualitative and quantitative methods. The quantitative aspects of the study were based on a survey of 5 scrap metal dealers and 22 motor vehicle owners in Viwandani ward in Makadara sub-county of Nairobi City within the Republic of Kenya. The qualitative aspect was based on in-depth interviews with key informants from the National Environment Management Authority in Kenya and with key informants from the Associated Battery Manufacturers Limited, the only licensed enterprise by the National Environment Management Authority to recycle used lead acid batteries. A content analysis of the legal framework governing the recyling of used lead-acid batteries was also conducted to identify any gaps in the framework. The data collected was edited, coded, classified and tabulated in an excel sheet in preparation for analysis. The analysis was then presented in the form of pie-charts. The results revealed that awareness of the regulatory obligations and technological constraints constitute the greatest obstacles to the compliance with regulatory obligations relating to the handling of used lead-acid batteries. Inadequate enforcement also seems to play some role in non-compliance. In addition, the regulatory framework governing the handling of used lead-acid batteries, does not extend the responsibility of manufacturers of used lead-acid batteries to collect and recycle the batteries. Further, the framework does not contain any provision that would encourage or motivate consumers of lead-acid batteries to collect and return the batteries to the manufacturer or a recycler. The national environment management authority pursuant to its

mandate under section 9(2)(m) of the Environmental Management and Coordination Act, 1999 may wish to consider developing and rolling-out a programme to sensitize handlers of used lead-acid batteries such as scrap metal dealers, owners of motor vehicles and recyclers of used lead-acid batteries about the hazards of these batteries as well as environmentally sound ways of collecting, transporting, disposing and recycling of the ULABs. Secondly, since environmental regulatory programs typically require significant capital expenditures for technologically complex pollution control equipment, the government in collaboration with industry stakeholders may wish to address deficits through various approaches including site visits, hotlines and awareness raising through print or electronic source materials. Moreover, motivational measures such as tax incentives and subsidies could be incorporated into the regulatory framework to enhance compliance. Enacting legal provisions that make it mandatory for producers to take back and recycle ULABs at the end of their useful life and that creates an incentive for consumers to return ULABs to producers for recycling would also increase levels of compliance with regulatory obligations relating to the handling of used lead-acid batteries

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CHAPTER ONE: INTRODUCTION

1.1 Introduction to the study

Lead-acid batteries contribute a significant role in our day to day life[1]. They provide storage technologies for sources of renewable energy, such as wind turbines and solar cell[2]. They are also used to power fuel, electric as well as hybrid vehicles.[3] Furthermore, lead acid batteries provide back-up power supply in case of power failure in emergency and essential supply facilities such as hospitals, water supply and other essential supply installations.[4]

These batteries are complex industrial products consisting of lead, sulphuric-acid and plastics.[5] The largest component is lead which comprises 80% of the battery with sulphuric- acid and plastic comprising 12% and 8% respectively.[6] The batteries have a recycling rate of about 99% and therefore constitute the most recycled consumer products globally.[7] They can also be recycled for an unlimited period of time with very little drop in quality.[8] Their recycling contributes to long-term sustainability by minimizing the use of non-renewable resources and lowering carbon emissions through a simple and cost-effective energy recovery procedure.[9] Indeed, recycling lead saves energy since it takes substantially less energy to recycle lead than it does to extract and

[1]Zhang, R., Wilson, H., Vincent, H., Aixin, G. & Meng, G. (2015). Source of lead pollution, its influence on public health and the countermeasures. International Journal of Health, Animal Science & Food Safety. 2. 18-31. 10.13130/2283-3927/4785.

[2] Ibid

[3] Ballantyne A.D, Hallett J.P, Riley DJ, Shah N, Payne DJ. (2018) Lead acid battery recycling for the twenty-first century. *R. Soc. open sci.* **5**: 171368. http://dx.doi.org/10.1098/rsos.171368

[4] Ibid

[5] Salomone, R., Mondello, F., Lanuzza F., & Micali, G. (2005). *An Eco-balance of a Recycling Plant for Spent Lead-Acid Batteries*. Messina, Italy. University of Messina

[6] Ibid

[7] ILA (2020). Lead recycling: Sustainability in Action, International Lead Association, London, UK available at https://www.ila-lead.org/UserFiles/File/ILA9927%20FS_Recycling_V08.pdf

[8] Ibid

[9] Ibid

process raw lead[10]. As a result, battery recycling is a resource-saving technique for both natural and commercial resources[11].

Despite their extensive sustainable use and high recycling rates, lead-acid batteries present the most significant exposure pathways of lead poisoning to the human health and pollution of the natural environment.[12] The exposure to lead has caused serious health implications because lead accumulates in the teeth and bones and can be distributed to the brain, liver and kidney.[13] Overtime, the accumulation in the body affects the growth of the nervous and brain system while also increasing the possibility of damage to the kidney and high blood pressure.[14] Pregnant women can also miscarry, give birth prematurely or deliver children with extremely low birth weight if exposed to high lead levels.[15] Consequently, the lead-acid battery recycling sector especially in low to middle income countries is now rated among the most contaminating industrial processes universally.[16]

In Kenya, several cases of lead pollution and poisoning arising from lead-acid battery recycling have been reported with the most prominent being the Owino Ouru lead poisoning case[17].

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[10] Kelektsoglou, K. (2018). Efficiency of the Air-Pollution Control System of a Lead-Acid-Battery Recycling Industry. Energies, 11, 3465; doi:10.3390/en11123465

[11] Ibid

[12] See - Odongo, O.A., Moturi, W.N. & Obonyo, M.A. (2020) Influence of task-based airborne lead exposures on blood lead levels: a case study of informal automobile repair artisans in Nakuru town, Kenya. *Environ Geochem Health* **42,** 1893–1903 (2020). https://doi.org/10.1007/s10653-019-00464-7; WHO (2019) Lead Poisoning and Health, World Health Organization, Geneva, Switzerland, available at https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health accessed on 19.8.19

[13] WHO (2019) Lead Poisoning and Health: Key facts, available at https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health

[14] Ibid

[15] Ibid. See also Odongo, A.O., Moturi, W.N. & Mbuthia, E.K. (2016). Heavy metals and parasitic geohelminths toxicity among geophagous pregnant women: a case study of Nakuru Municipality, Kenya. *Environ Geochem Health* 38, 123–131

[16] Earth, P., & Cross, G. (2016). World's worst pollution problems 2016: the toxins beneath our feet. *NY USA, Zurich Switzerland*, 1-56. See also Gottesfeld, P. et al. (2018). Soil contamination from lead battery manufacturing and recycling in seven African countries. *Environmental Research*, 609-614 and Were, F.H et al (2012). Air and Blood Lead Levels in Lead Acid Battery Recycling and Manufacturing Plants in Kenya, Journal of Occupational and Environmental Hygiene, 9:5, 340-344, DOI: 10.1080/15459624.2012.673458

[17] Government of Kenya, Report of the Senate Standing Committee on Health on the Owino Ouru Public Petition [2015] – laid on the table of the senate on 1st April 2015 - http://www.parliament.go.ke/sites/default/files/2017-

According to the Report of the Senate Standing Committee on Health on the Owino Ouru Public Petition,[18] thousands of people in Mombasa were exposed to severe health effects from toxic lead emanating from a battery recycling facility situated at Owino Ouru outside Mombasa. The Senate committee established that a secondary lead smelter had been recycling used lead-acid batteries within the densely populated neighborhood[19] and there was evidence that several workers from the smelter fell ill and died and upon forensic tests and autopsies, it emerged that these workers had died from lead poisoning.[20] Further, blood lead level tests among fifty residents of the community disclosed that a majority of them faced persistent poisoning from lead.[21] The Environment and Land Court of Kenya sitting in Mombasa has also found that the recycling company was liable for the lead pollution and poisoning of the residents of Owino Ouru village in Mombasa[22].

Similar cases of lead pollution and poisoning have been replicated in Africa. In Dakar, Senegal, between November 2007 and March 2008, 18 children died from severe poisoning of lead in a neighborhood of Dakar .[23] In Ghana, a health assessment of lead levels in the blood of 20 workers working in a lead smelter in the port city of Tema was conducted in 2010 and all of them had extremely high levels of lead in their blood with attendant risks of severe and possibly deadly health effects.[24] In Ethiopia's capital Addis Ababa, lead battery recycling businesses are usually situated in highly populous areas which has exposed huge populations to lead poisoning.

05/Wednesday_1st_April_2015_-_Afternoon.pdf. See also Kelvin Musyoka & 9 others – V – Attorney General & 7 Others [2016] Mombasa ELC Petition No. 1 of 2016 [2020] eKLR, available at http://kenyalaw.org/caselaw/cases/view/198619/

[18] ibid

[19] ibid

[20] Ibid

[21] ibid.

[22] Kelvin Musyoka & 9 others – V – Attorney General & 7 Others [2016] Mombasa ELC Petition No. 1 of 2016 [2020] eKLR, available at http://kenyalaw.org/caselaw/cases/view/198619/

[23] Haefliger, P., Mathieu-Nolf, M., Lociciro, S., Ndiaye, C., Coly, M., Diouf, A., Faye, A. L., Sow, A., Tempowski, J., Pronczuk, J., Filipe Junior, A. P., Bertollini, R., & Neira, M. (2009). Mass lead intoxication from informal used lead-acid battery recycling in dakar, senegal. *Environmental health perspectives*, *117*(10), 1535–1540. https://doi.org/10.1289/ehp.0900696

[24] Lomotey H. S. (2010). Workers' exposure to lead in metal recycling industry at Kpone Industrial Area, Tema: *A dissertation submitted to the school of public health,* University of Ghana.

Despite the adverse impacts associated with lead acid batteries, Kenya like most African countries continues to record increases in the number of motor vehicle into the country. Between 2015 and 2020, the number of vehicles on Kenyan roads increased from 2, 457, 588 to 3, 608, 110, an increase of about 68%[25]. With the increasing number of vehicles in Africa all powered by used lead acid batteries which continue to be recycled, the battery recycling industry remains a rising perilous industry throughout the continent if not well managed.[26] Moreover, as the industry for lead-acid batteries expands, the number and size of the recycling plants will increase to meet the projected needs.[27] The risks of lead poisoning will equally increase. An immediate response to address risks to surrounding communities by controlling the emissions emanating from the recycling of the batteries and the legacies of lead contamination therefore remains a priority.[28]

In response to the lead pollution and poisoning challenge arising from the recycling of these batteries, the United Nations Environment Programme and the World Health Organization have proposed the implementation of the "*environmentally sound management of used lead-acid batteries*" to minimize the risks associated with the recycling of these batteries.[29] The environmentally sound management of ULABs involves "*the overall process of collection, transport, recovery and/or disposal of used lead batteries, including the supervision of such operations in a manner that does not adversely impact human health and the environment*"[30].

[25] Kenya National Bureau of Statistics (2020). Statistical Abstract 2020 p. 208, available at https://www.knbs.or.ke/?wpdmpro=leading-economic-indicators-december-2020
[26] Omanwa M.E et al (2016) Analysis of the levels of selected heavy metals in the vicinity of a lead batteries Recycler plant in Athi-River, Kenya available at http://www.journalijar.com/uploads/896_IJAR-12101.pdf
[27] Gottesfeld, P et al (2017). Soil contamination from lead battery manufacturing and recycling in seven African countries. Journal of Environmental Research 161 (2018) 609–614
[28] Ibid
[29] Refer to the United Nations Environment Assembly Resolutions 2/7 and 3/9 available at https://environmentassembly.unenvironment.org/un-environment-assembly-and-governing-council-sessions
[30] UNEP (2015). Guidelines for the Environmentally Sound Management of Used Lead Batteries in the Mediterranean available at https://wedocs.unep.org/bitstream/handle/20.500.11822/7747/-Guidelines_for_environmentally_sound_management_of_used_lead_batteries_in_the_Mediterranean-2015guidelines_sound_management_used_lead.pdf.pdf?sequence=3&isAllowed=y

The World Health Organization and the United Nations Environment Programme propose a raft of measures as part of the environmentally sound management of ULABs[31]. The measures encompass standards for collection, transportation and recycling; standards on discharges and emissions; standards for ensuring occupational safety of workers and; regulation on the location of lead battery smelters.[32] Other measures include the incorporation of extended producer responsibility to collect ULABs to ensure that those batteries are recycled in an environmentally sound manner[33]. The standards for collection are meant to ensure appropriate and efficient collection infrastructure of the used batteries where lead and acid are not emitted or discharged into the environment before delivery to the recycling plant. To reduce the possibility of an unintended spill, handlers must ensure that spent lead-acid batteries are placed inside acid-resistant containers at the collecting location. These containers can simply be wrapped and used as the transport container. In addition, collection stations must not store large numbers of used batteries for an extended period, as this increases the risk of leaks. Furthermore, collectors should avoid selling batteries to unlicensed lead smelters, as these smelters are one of the most significant causes of lead pollution.

In terms of transportation, the standards prescribe that used batteries must be transported inside containers which should be packed appropriately in the transportation vehicle in a way that they do not move while being transported. The vehicle should then be identified with symbols showing that dangerous and corrosive items are being transported. Equipment to combat any accidental spillage or leakage should be supplied and the team transporting the batteries should be trained on how to use it; personal protection equipment should be provided to transport team and; a transport schedule and map should be provided by the transporter.

[31] World Health Organization. (2017). Recycling used lead-acid batteries: health considerations.
[32] Ibid
[33] Refer to paragraph 16 of the United Nations Environment Assembly Resolution 2/7 available at http://wedocs.unep.org/bitstream/handle/20.500.11822/11183/K1607167_UNEPEA2_RES7E.pdf?sequence=1&isAllowed=y

In terms of standards on discharges and emissions reduction, the World Health Organization and UNEP suggest that every lead smelter should have waste handling station to treat the water that leaves the recycling facility; install a dust collection and air filtration system; install a fugitive emissions control mechanism to ensure that the atmospheric releases from the industrial processes released to the air without passing through any sifting device or control apparatus are reduced or eliminated; install a system that eliminated the emission of sulfur dioxide; and ensure a reliable supply of oxygen to the furnace burners to guarantee a cleaner production process.

Most of these control measures have been incorporated into Kenya's legal framework including in Article 69(g) of the Constitution of Kenya 2010, Acts of Parliament[34], Subsidiary legislation[35], and County Legislation. The overarching objective of the framework in relation to the recycling of used lead-acid batteries is to ensure that all processes and activities that are likely to endanger the environment are eliminated[36]. To this end, the legal framework seeks to prevent the release or discharge of lead particles into the environment; mitigate the impact that may be caused in the event of such release or discharge; and secure and protect the safety, health and welfare of workers engaged in the handling of these batteries.

To prevent the release or discharge of lead into the environment, the legal framework enjoins the generators of lead waste arising from the collection, transportation, storage, disposal or recycling of used lead-acid batteries to adopt cleaner production principles[37]. The adoption of cleaner production principles involves improving the process of production, observing the product sequence from start to end and, integrating environmental concerns in the design, process, and disposal of a product[38]. Specifically, the legal framework enjoins collectors and transporters of used lead-acid batteries to segregate the batteries from other wastes[39], To obtain a license to collect

[34] The Occupational Safety and Health Act, 2007; The Environmental Management and Co-ordination Act, 1999;
[35] Environmental Management and Co-ordination (Waste Management) Regulations, 2006;
[36] Article 69 (1)(g) of the Constitution of Kenya 2010 available at www.kenyalaw.org
[37] Refer to Regulation 6 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006
[38] Ibid
[39] Refer to Regulation 5 of the Environmental Management and Co-ordination (Waste Management Regulations), 2006

and transport the batteries[40], operate a transportation vehicle with specifications approved by the National Environment Management Authority, collect the batteries from a designated area and, deliver the same to a designated site or plant[41]. The transporters should also use scheduled routes for transportation and maintain a tracking document while transporting the used lead-acid batteries[42]. Moreover, the framework prohibits recyclers from discharging lead into the environment during the recycling process and criminalizes such discharge[43]. It also enjoins operators of recycling plants to obtain a license[44] and carry out annual environmental audits[45]. It further directs operators of recycling plants to install anti-pollution equipment based on the best practicable means[46].

To mitigate the impacts of lead pollution arising from the recycling process, the framework obligates a payment to restore the environment damaged or destroyed because of the discharge of lead into the environment[47]. The framework also provides for the undertaking of clean-up operations using the best available clean-up methods[48]. In the event, a lead waste generator fails or neglects to make payment for the restoration or to undertake clean-up operations, the National Environment Management Authority may seize and in certain circumstances sell the lead waste generator's facility[49]. In addition, the lead waste generator may also be prosecuted[50].

Concerning the obligation to protect the safety, health and welfare of workers engaged in the recycling of these batteries, the framework prescribes preventive and mitigation measures that should be observed in the occupational environment to protect workers from adverse lead exposure. The measures are contained in the Occupational Safety and Health Act, 2007 read

[40] Regulation 17 of the Environmental Management and Co-ordination (Waste Management Regulations), 2006
[41] Refer to Regulation 9 of the Environmental Management and Co-ordination (Waste Management Regulations), 2006
[42] Regulation 8 of the Environmental Management and Co-ordination (Waste Management Regulations), 2006
[43] Refer to section 93(1) and (2) of the Environmental Management and Coordination Act, 1999
[44] Regulation 17 of the Environmental Management and Co-ordination (Waste Management Regulations), 2006
[45] Regulation 12 of the Environmental Management and Co-ordination (Waste Management Regulations), 2006
[46] Regulation 14 of the Environmental Management and Co-ordination (Waste Management Regulations), 2006
[47] Refer to section 93(3) of the Environmental Management and coordination Act 1999
[48] Refer to section 93(4) of the Environmental Management and coordination Act 1999
[49] Refer to section 93(5) and (6) of the Environmental Management and coordination Act 1999
[50] Refer to section 143(1)(a) of the Environmental Management and coordination Act 1999

together with the Factories and Other Places of Work (Safety and Health Committees) Rules, 2004, the Factories and Other Places of Work (Medical Examination) Rules, 2005 and the Factories and Other Places of Work (Hazardous Substances) Rules, 2007 [51]. The measures include obligations on the part of the employer to ensure the used lead-acid batteries are handled, transported and disposed safely to avoid adverse effects to human beings or the immediate environment[52]; to provide safety information[53]; to clearly label and mark the used lead-acid batteries as hazardous and provide directions for the secure management of the contents as well as what steps should be taken in the event of a leak or unintended exposure[54]; observe the occupational exposure limits related to lead and lead compounds[55]; undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries[56]; to conduct a health and safety audit of the workplace at least once in every twelve months by a health and safety advisor[57].

The framework also encompasses the common law duty based on the rule of strict liability which creates liability based on the violation of an unqualified obligation to make something harmless notwithstanding actual negligence or intent to harm.[58] This form of liability is usually applicable to either extremely hazardous activities or in cases of product liability.[59] Whereas the legal framework does not specifically refer to lead-acid batteries, it designates lead as hazardous waste[60]

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[51] Available at www.kenyalaw.org Just cite the case number (this is not a case, it is a statute)
[52] Section 83 of the Occupational Safety and Health Act, 2007 read with regulation 7 of the Factories and Other Places of Work (Hazardous Substances) Rules
[53] Section 84 of the Occupational Safety and Health Act, 2007 read with regulation 12 of the Factories and Other Places of Work (Hazardous Substances) Rules
[54] Section 85 of the Occupational Safety and Health Act, 2007
[55] Section 88 of the Occupational Safety and Health Act, 2007 read with regulation 5 of the Factories and Other Places of Work (Hazardous Substances) Rules, 2007
[56] Section 103 of the Occupational Safety and Health Act 2007 read with regulation 19 of the Factories and Other Places of Work (Hazardous Substances) Rules and the Factories and Other Places of Work (Medical Examination) Rules, 2005
[57] Section 11 of the Occupational Safety and Health Act 2007 read with regulation 13 of the Factories and Other Places of Work (Safety and Health Committees) Rules, 2004
[58] Garner, B.A (2009) Black's Law Dictionary. 9th ed. Thomson Reuters, Minneapolis, USA, p.998
[59] Ibid
[60] Refer to paragraph Y31 of the fourth schedule of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006

and therefore brings lead-acid batteries under the ambit of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006.

Despite these elaborate provisions in the legal framework, cases of lead pollution and poisoning in Kenya have persisted over the years as evidenced in the Owino Ouru case. Reasons for the continued pollution and poisoning vary but compliance theories suggest that these may be attributable to capacity constraints, inadequate awareness of the regulations governing the recycling of used lead-acid batteries, and inadequate enforcement by the regulatory authority[61]. Capacity constraints are largely driven by lack of adequate technology, inadequate financial capacity and, human skill and expertise to comply with the regulations[62].

Inadequate enforcement by the regulator also has a bearing on whether organizations will comply with regulatory obligations. The extent to which the regulatory authority actively and consistently conducts its monitoring, enforcement and sanctioning activities will impact on compliance with the regulations by the regulated entity[63]. Frequent and comprehensive inspections and, eagerness to sanction wrongdoers will significantly impact compliance with the regulations by the regulated community[64].

1.2 Statement of the research problem

Kenya has enacted an elaborate legal framework to prevent lead poisoning and pollution stemming from the collection, transportation, storage, disposal, and recycling of used lead-acid batteries. The framework prescribes preventive and mitigation measures to protect the safety, health and welfare

[61] Weaver, R.K. (2014). Compliance regimes and barriers to behavioral change. *Governance* 27 (2): 243–265.
[62] Winter, S.C., and May, P.J (2001). Motivation for compliance with environmental regulations. Journal of Policy Analysis and Management 20 (4): 675–698
[63] Weaver, R.K. (2014). Compliance regimes and barriers to behavioral change. *Governance* 27 (2): 243–265.
[64] Ibid

of workers engaged in the handling of these batteries. It also prescribes mitigation measures to reduce or minimize the impact of lead poisoning or pollution that may arise in case lead is discharged into the environment during the collection, transportation, handling, disposal, or recycling process. The framework further prescribes measures aimed at preventing the release or discharge of lead particles into the environment and to the surrounding communities during the recycling process.

Despite the enactment of the very elaborate provisions, the country has witnessed numerous cases of lead poisoning and pollution stemming from the handling of ULABs leading to serious health complications, loss of lives and property and, significant degradation of the environment . Courts have made findings of employees suffering illnesses because of lead exposure in lead-acid battery companies[65]. Employees working in lead-acid battery recycling plants have exhibited blood lead levels above occupational health thresholds[66].Livestock kept in areas around these recycling plants have died from acute lead poisoning[67]. Workers in the recycling plants have died from lead poisoning while others have been left with chronic lead poisoning[68]. Children living in communities around the recycling plants have died from lead poisoning[69] and the soil and water near these plants has been contaminated with lead.[70]

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[65] John Muthengi Muthui v Added Performance Kenya Limited, 1016 of 2013 (Employment and Labour Relations Court of Kenya October 12, 2018) available at http://kenyalaw.org/caselaw/cases/view/160374.

[66] Shiundu P. et al (2012) Air and Blood Lead Levels in Lead Acid Battery Recycling and Manufacturing Plants in Kenya; Farida H. W et al (2014). *Lead Exposure and Blood Pressure among Workers in Diverse Industrial Plants in Kenya*. Journal of Occupational and Environmental Hygiene Vol. 11 , Iss. 11,2014; SyndiGate Media Inc. (2015). Former battery firm staff 'suffer lead poisoning'. (2015, Jul 03). AllAfrica.Com Retrieved from https://search.proquest.com/docview/1693265150?accountid=28957

[67] Mbaria J.M et al (2013) Forensic case of lead poisoning from a battery manufacturing company in Nakuru, Kenya

[68] Government of Kenya, Report of the Senate Standing Committee on Health on the Owino Ouru Public Petition [2015] – laid on the table of the senate on 1st April 2015 - http://www.parliament.go.ke/sites/default/files/2017-05/Wednesday_1st_April_2015_-_Afternoon.pdf

[69] OKEYO, V. (2016, Nov 08). The slow death of baby Samuel. Daily Nation Retrieved from https://search.proquest.com/docview/1836962207?accountid=28957

[70] Ondayo, Maureene Auma, Gelas Muse Simiyu, Phillip Okoth Raburu, et al. 'Child Exposure to Lead in the Vicinities of Informal used Lead-Acid Battery Recycling Operations in Nairobi Slums, Kenya', *Journal of Health & Pollution,* vol. 6/no. 12, (2016), pp. 15-25

The poisoning and pollution cases would have been significantly less if generators of lead waste arising from the handling of used lead-acid batteries complied with their regulatory obligations relating to the collection, transportation, storage, disposal, and recycling of these batteries[71]. However, reports indicate that most of these enterprises and individuals, especially in the sub-Saharan Africa region, lack the capacity and ability to comply with safety obligation measures to prevent the release of battery-acid and lead in places of work and the environment during manufacture and recycling.[72] Inadequate enforcement of regulations governing the handling of ULABs has also been identified as a contributor to insufficient compliance by the recycling companies[73].

Literature on compliance attributes low levels of regulatory compliance to capacity constraints, insufficient awareness of the regulatory frameworks and inadequate enforcement [74]. In Africa, low levels of awareness of lead hazards, and weak capacity to enforce legislation, have been identified as key challenges that have limited the prospects of successful lead pollution and poisoning prevention efforts[75].

[71]Manhart A. et al (2016). *The deadly business – Findings from the Lead Recycling Africa project*. Oeko-Intitut e.v. Available at http://www.econet.international/index.php?id=3

[72] ibid

[73] Bornman, M. et al. (2017). Endocrine Disruptors and Health Effects in Africa: A Call for Action. *Environmental Health Perspectives*, Vol. 125, issue 8

[74] May, P.J. (2005), Regulation and Compliance Motivations: Examining Different Approaches. Public Administration Review, 65: 31-44. doi:10.1111/j.1540-6210.2005.00428.x; Zhao, X., Qi, Y. (2020).Why Do Firms Obey?: the State of Regulatory Compliance Research in China. Journal of Chinese Political Science**25,** 339–352 (2020). https://doi.org/10.1007; David P. Carter D. & Siddiki, S (2019) Participation rationales, regulatory enforcement, and compliance motivations in a voluntary program context, Regulation & Governance, 10.1111/rego.12289, **0**, 0,; Fowler, L (2019). Best practices for implementing federal environmental policies: a principal-agent perspective, Journal of Environmental Planning and Management, 10.1080/09640568.2019.1670627, (1-17).

[75] Bornman, M. et al. (2017). Endocrine Disruptors and Health Effects in Africa: A Call for Action. *Environmental Health Perspectives*, Vol. 125, issue 8.

This study therefore examined why handlers of used lead-acid batteries in Kenya are unable to prevent and mitigate cases of lead pollution arising from the transportation, collection, disposal and recovery of lead from used lead-acid battery despite the existence of a robust legal framework.

1.3 Research questions

This study sought to address the following questions.

1) What hinders handlers of used lead-acid batteries from preventing the release or discharge of lead into the environment?

2) What prevents handlers of used lead-acid batteries from addressing the safety, health and welfare of workers engaged in the handling of used lead-acid batteries?

3) Are there any gaps in the regulatory framework governing the handling of used lead-acid batteries in Kenya?

1.4 Objectives of the study

This study sought to identify the obstacles that hinder compliance with regulatory obligations relating to the handling of used lead-acid batteries in Kenya. Specifically, the study sought;

(i) To identify factors that hinder handlers of used lead-acid batteries from preventing the release or discharge of lead into the environment.

(ii) To identify factors that prevent handlers of used lead-acid batteries from addressing the safety, health and welfare of workers engaged in the handling of used lead-acid batteries.

(iii) To identify any gap(s) in the regulatory framework governing the handling of used lead-acid batteries in Kenya

1.5 Justification of the Study

The study will help existing and prospective used lead-acid battery collection, transportation, disposal and recycling enterprises put in place measures that will enable them enhance their ability to comply with their regulatory obligations relating to lead-acid battery recycling and thereby prevent lead poisoning and pollution. The outcomes of the study will also help the national environment management authority re-examine some of the approaches used to regulate the handling of used lead-acid batteries so as to increase compliance with the regulatory obligations by the generators of lead waste. In addition, the study will contribute to the body of environmental compliance literature especially in hazardous waste management generally and specifically in the environmentally sound management of used lead-acid batteries.

1.6 Theoretical Framework

The framework of the study is derived from the rationalist compliance theory. The rationalist compliance theory is one of the approaches that provides a basis for firms' compliance with laws and is a valuable optic for observing and comprehending behavior that drives compliance as well as reasons for those behaviors[76]. Proponents of this theory therefore propose various approaches that can be adopted to encourage organizations observe legislation intended to advance environmental protection[77].

Compliance in an organizational context and particularly in the field of environmental regulation can be regarded as positive acts that organizations are required to take. Being matters of behavioral motivations, the incentives for the positive acts can be viewed from logics of human behaviour[78].

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[76] Stilwell, M., Young, O and Zaelke, D (2011). *Compliance Theories. Making Law Work*. INECE, Washington D.C available at https://www.inece.org/assets/Publications/5759730b752fc_MakingLawWorkChapterTwoIntroductionComplianceTheories_Full.pdf

[77] Ibid

[78] March, J.G and Olsen, J.P (1998) *The Institutional Dynamics of International Political Orders*, 52(4) INT'L ORG, 949-54

According to the rationalist theory, human action is based on the logic of consequences which essentially suggests that actors choose sensibly among options based on their calculation of likely consequences[79].

In essence, the decision maker will compare utility of compliance by evaluating the costs and benefits of compliance against the costs and benefits of non-compliance as the basis for deciding whether to comply with a given law or regulation. Strictly applied, the rational compliance model includes the assumptions of comprehensive knowledge of alternatives, consequences, and probabilities, and employment of a unitary utility function. Proponents of this theory therefore emphasize deterrence and enforcement to shift an organization's over-emphasis on costs and benefits.[80]

From the foregoing, compliance is therefore dependent on the adequacy of the enforcement practices and, the capacity of the regulated community to comply and reasons that limit that ability. The study is therefore built on the approach that compliance with environmental regulations is dependent on an organization's capacity to comply with the set rules as well as the thoroughness of the regulatory authority's enforcement practices.

1.7 Conceptual Framework

Based on the rationalist compliance theory discussed above, the study begins on the premise that generators of lead waste arising from the recycling ULABs are unable to comply with their regulatory obligations due to capacity constraints and inadequate enforcement. The study assumes that there is an adequate and effective legal framework, though some gaps may exist, to prevent and control the pollution that may arise from the recycling of these batteries. Essentially therefore,

[79] Ibid
[80] March, J.G and Olsen, J.P (1998) *The Institutional Dynamics of International Political Orders*, 52(4) INT'L ORG, 949-54

removing the capacity constraints, enhancing regulatory awareness, and ensuring adequate and thorough enforcement by the regulatory authority will enhance compliance by generators of lead waste arising from the recycling of ULABs. In this study therefore, generators of lead waste are unable to prevent the release or discharge of lead particles into the environment and are not able to address the safety, health and welfare of workers in their establishments because they lack the capacity to adopt cleaner production techniques, are not aware of their regulatory obligations and, the level of enforcement of the regulatory obligations is inadequate. There could also be some gaps in the regulatory framework that worsen the ability to comply.

A conceptual framework is graphically presented in figure 1 below.

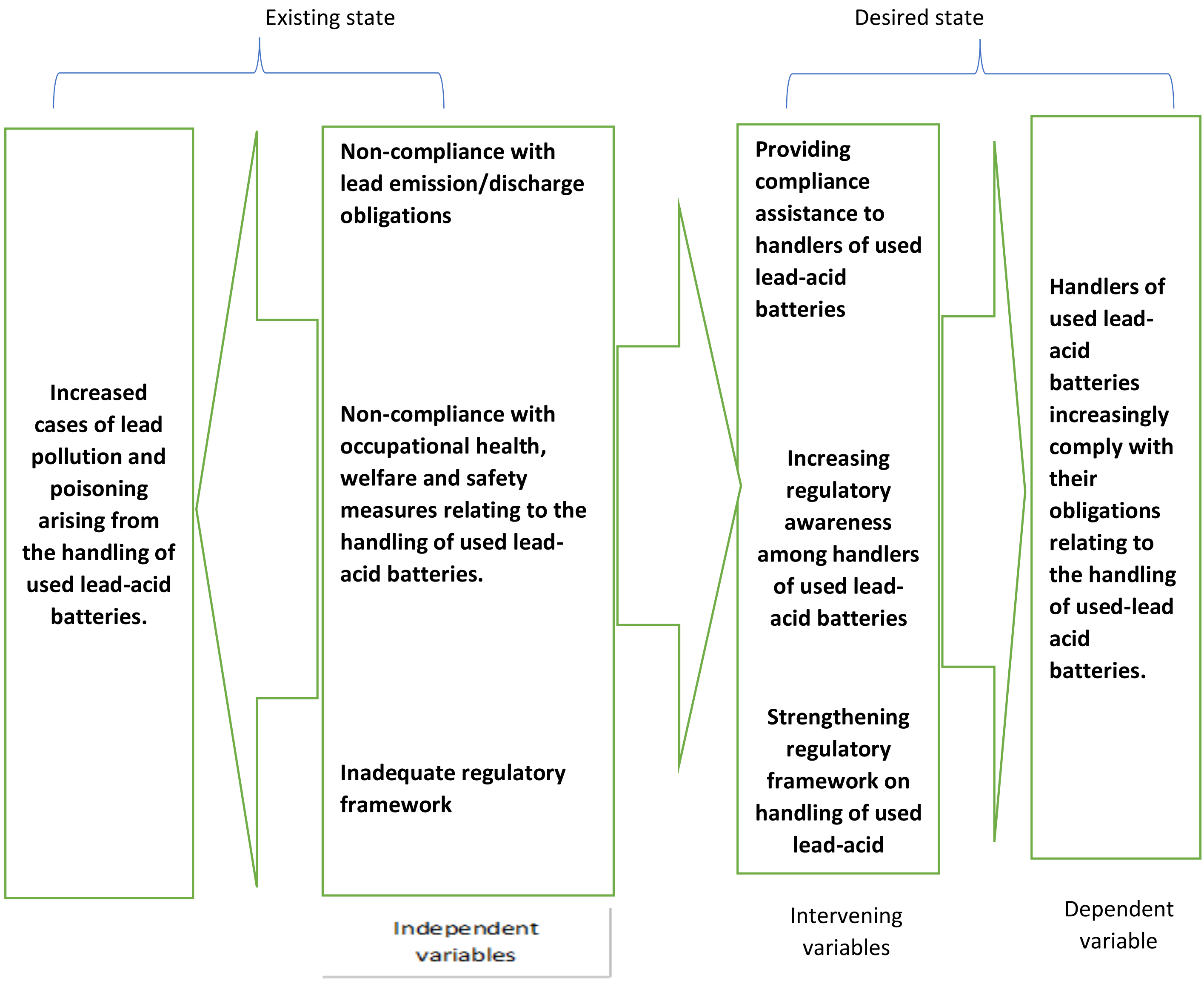

Figure 1: Conceptual Framework

Source: Author

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews relevant literature on lead discharge prevention, occupational exposure to lead as well as literature on effective used lead-acid battery legislation. The review seeks to analyze the state of knowledge on preventing hazardous lead emissions and discharge, preventing occupational exposure of employees handling used lead-acid batteries and effective legal provisions for ensuring environmentally sound recycling of used lead-acid batteries. The review is conducted with a view to identifying and ascertaining the hindrances to compliance with regulatory obligations by handlers of used lead-acid batteries.

2.2 Lead discharge or emission prevention

Effectively addressing lead poisoning and pollution requires an emphasis on prevention and stronger enforcement of existing legislation[1]. For the prevention efforts to achieve positive outcomes, laws and regulations are designed to make sure that only minimal lead is released or discharged during handling of any product containing lead. This can be accomplished by employing a variety of control or preventative strategies[2] including prescribing mandatory application of technology in handling products containing lead; awareness raising among handlers of products containing lead and effective enforcement and monitoring by the regulatory authority.

The application of technology to prevent lead emissions or discharges during the handling of used lead-acid batteries however requires significant capital expenditures for the technologically

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[1] Cohen, J., & Amon, J. (2012). Lead poisoning in China: A health and human rights crisis. *Health and Human Rights, 14*(2), 74-86.

[2] Aviso, K. B., Ngo, J. P. S., Sy, C. L., & Tan, R. R. (2019). Target-oriented robust optimization of emissions reduction measures with uncertain cost and performance. *Clean Technologies and Environmental Policy, 21*(1), 201-212

complex pollution control equipment which the regulated community especially from developing countries often lack[3]. Furthermore, in most poor countries, up to 50% of discarded lead-acid batteries are recycled in informal or sub-standard facilities, resulting in considerable lead emissions into the environment and high levels of lead exposure among the population[4]. This is because most of the informal recyclers cannot afford the required technology for environmentally sound recycling of these batteries. In addition, these developing countries continue to use outdated recycling processes resulting in large amounts of lead being discharged or emitted into the environment with serious environmental and health consequences[5]. Appropriate pollution control system using the best available technology in such industries is therefore necessary[6]. Consequently, countries have responded by enacting legislation that largely rely on control technologies to prevent lead exposures and reduce lead emissions and discharges into the environment[7]. The regulations target pollution prevention during the collection, transportation, dismantling and the actual lead recovery process[8].

The use of technology in the form of engineering controls has been touted as a very effective tool for controlling lead pollution. A series of institutional and low-cost engineering controls were implemented in a village in Vietnam where the population had been exposed to severe lead poisoning for at least a decade as a result of informal ULAB recycling, resulting in significant reductions in human and environmental lead levels[9]. Capping of lead-contaminated surface soils, cleaning of home interiors, an information campaign, and the creation of a work-clothes changing and bathing facility were among the measures taken [10]. This therefore shows that low-cost, rapid,

[3] Stoughton, M., Herb, M.J., and Sullivan, J. (2001). Toward Integrated Approaches to Compliance Assurance. The Environmental Law Reporter, 31 11266

[4] Zhao, Y. et. al. (2021). A Review on Battery Market Trends, Second-Life Reuse, and Recycling, *Sustain. Chem.* 2021, *2*(1), 167-205

[5] Kelektsoglou, K., Karali, D., Stavridis, A., & Loupa, G. (2018). Efficiency of the air-pollution control system of a lead-acid-battery recycling industry. *Energies, 11*(12)

[6] ibid

[7] Malloy, T. F. (2014). Principled prevention. Arizona State Law Journal, 46(1), 105-190

[8] Wei, M., Ma, J., & Gao, T. (2021). Analysis on pollution prevention and control of waste lead battery recycling process. *IOP Conference Series. Earth and Environmental Science, 651*(4)

[9] Ericson, B. et al. (2018). Improving human health outcomes with a low-cost intervention to reduce exposures from lead acid battery recycling: Dong Mai, Vietnam. *Environmental Research*, 181-187.

[10] Ibid

and well-coordinated interventions can significantly reduce preventable human health harm from lead exposure[11].

Whereas most handlers of used lead-acid batteries are willing to comply with regulations that seek to prevent lead discharge or emissions, they often find themselves non-compliant with environmental regulations because they lack the technological capability to take required actions[12]. Compliance assistance should therefore be provided to enable them to comply. Compliance assistance refers to the practice of developing the ability of regulated entities, in this case, those handling ULABs, to observe environmental laws[13]. The efficacy of the help in guaranteeing adherence is based on the idea that the Regulatees are keen to observe the law but are incapable because they lack the technological capacity and the requisite knowledge and understanding[14]. An environmental protection agency may therefore wish to cater for these deficits through various approaches including site visits, hotlines and awareness raising through print or electronic source materials[15].

Technological constraints may also be driven by inadequate or lack of financial resources which hinder the ability of managers to adopt environmentally responsible corporate strategies and practices to protect the environment and human health[16]. Indeed, high implementation costs have been identified as one of the barriers to the adoption of environmentally sound technology by industrial plants in emerging nations[17]. For example, compliance requirements on waste disposal and reclamation of land involve prohibitive overheads well beyond range for many

[11] ibid
[12] Ibid
[13] Stoughton, M., Herb, M.J., and Sullivan, J. (2001). Toward Integrated Approaches to Compliance Assurance. The Environmental Law Reporter, 31 11266.
[14] Ibid
[15] Ibid
[16] Ahorbo, G. (2014) *Business Drivers for Environmental Regulations Compliance in Ghana's Mining Sector*. Minneapolis, Walden University
[17] Ibid

establishments[18]. These financial limitations have constrained the acquisition of the relevant technology and resources required to comply with statutory obligations.

In Kenya, the absence of technology for separating hazardous waste from precious metals and for e-waste recycling has impeded efforts to handle hazardous wastes such as spent lead-acid batteries [19]. Consequently, toxic materials such as lead, enter the waste stream causing harmful effects on the environment and human health[20]. An assessment of the concentration of airborne and employee blood lead levels in a lead-acid battery recycling plant in Kenya, has revealed that the hazardous lead exposure was largely attributable to inadequacies in engineering controls beyond the affordable limits of the recycling establishment[21].

Adequate enforcement and monitoring of the regulated community by the regulatory authority also plays a significant role in preventing lead discharges into the environment especially where the regulated community appreciates that breaches will likely be detected, and sanctions will be applied when the said breaches are detected[22]. Certainly, Regulatees will likely comply with legal rules when they determine that the benefits of complying, including avoiding fines or other sanctions, exceed the costs of complying[23]. Regulatory practices and how they are perceived by the regulated community therefore impact on the level of compliance with the regulations and probable delinquents react to the likelihood of being detected and the harshness of penalty if discovered and sentenced[24]. Violators may therefore be deterred by increasing the punishment, augmenting monitoring actions to boost probability that the violator will be apprehended or,

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[18] Ibid

[19] Jecton, A. T., & Mwololo, W. T. (2013). Towards an e-waste management framework in Kenya. *The Journal of Policy, Regulation and Strategy for Telecommunications, Information and Media, 15*(5), 99-113.

[20] Ibid

[21] Were, F. H., Kamau, G. N., Shiundu, P. M., Wafula, G. A., & Moturi, C. M. (2012). Air and blood lead levels in lead acid battery recycling and manufacturing plants in Kenya. Journal of Occupational and Environmental Hygiene, 9(5), 340.

[22] May, P.J (2004) Compliance Motivations: Affirmative and Negative Bases, 38 Law & Soc'y Rev. 41, 68 (2004)

[23] Winter, S., & May, P. (2001). Motivation for Compliance with Environmental Regulations. *Journal of Policy Analysis and Management, 20*(4)

[24] Cohen, M.A (2000) *Empirical Research on the Deterrent Effect of Environmental Monitoring and Enforcement,* 30 ELR 10245

altering the laws to enhance the chances of conviction[25]. There must however be a credible prospect of discovering violations; rapid, definite, and apt punishment on discovery and a view among the Regulatees that detection and the possibility of punishment are present[26]. Enhancing effectiveness of the regulator through frequent inspections; thoroughness of the inspections; likelihood of sanctions; consistency in inspection practices and enforcement styles of inspectors is likely to produce greater compliance with regulatory obligations[27]. Increases in monitoring in the form of frequent inspections leads to increases in compliance and performance[28].

Further, firms will comply with or ignore environmental rules and standards depending on the enforcement institutions' deficiencies in implementing the rules and standards such as inadequate and infrequent inspections impede compliance[29]. To increase environmental compliance therefore, regulatory authorities need to improve their monitoring. Increases in the likelihood of punishment, such as those achieved through increased government monitoring increase facility-level compliance and performance[30]. Firms react to the prospect of being detected and the harshness of sentence if discovered and convicted[31]. Deterrence may therefore be enhanced by either increasing the punishment for violation, escalating monitoring actions to increase the chances that the violator will be apprehended or by varying rules to enhance the prospects of conviction[32].

Weak law enforcement, weak institutions and graft among the people charged with the responsibility of offering leadership contributes to violation of environmental regulations as has

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[25] ibid

[26] Silberman, J.D (2000) *Does Environmental Deterrence Work? Evidence and Experience Say Yes, But We Need to Understand How and Why*, 30 ELR 10523

[27] Environmental Working Group, Prime Suspects: The Law-breaking Polluters America fails to Inspect 3 (2000) available at http://www.ewg.org/pub/home/reports/primesuspects/index.html

[28] ibid

[29] Samad G et al (2015). "Environmental Regulations and Compliance in the Textile Processing Sector in Pakistan: Empirical Evidence," Working Papers id:7531, eSocialSciences

[30] Mark A. Cohen, M.A (2000), *Empirical Research on the Deterrent Effect of Environmental Monitoring and Enforcement,* 30 Envtl. L. Rep. (Envtl. L. Inst.) 10,245, 10,245 (2000)

[31] Becker, G.S (1968) *supra*

[32] Grossman, D., & Zaelke, D. (2005, April). An introduction to theories of why states and firms do (and do not) comply with law. In *Seventh International Conference on Environmental Compliance and Enforcement* (Vol. 9, p. 15).

been witnessed in the increased unregulated and unsustainable sand harvesting in Machakos area in Kenya[33]. If viewed from the context of enforcing ULAB handling regulations, weak or inadequate enforcement and institutions would contribute to non-observance of regulatory obligations meant to prevent human health and the environment from the adverse effects of unsound handling of used lead-acid batteries. Indeed, inadequate inspection of workplaces has contributed to non-compliance with Occupational Safety and Health laws at places of work despite the Occupational Safety and Health Act, 2007 providing suitable provisions for the health and safety of workers at the workplace[34].

Adequacy of enforcement measures has also been found to be a significant factor in ensuring deterrence and compliance to charcoal legislation by commercial charcoal producers and transporters in Kitui county in the Republic of Kenya[35]. Majority of these charcoal producers and transporters comply with the charcoal legislation owing to fear of sanction and detection[36] and the County government of Kitui can increase compliance by setting up a system for supervising implementation of reforestation plans, detecting fake or forged permits and tracking vehicles transporting charcoal[37].

Awareness of regulations governing handling of used lead-acid batteries as well as the hazards of these batteries can also play a significant role in preventing lead emissions or discharges during the handling process. Inadequate awareness of regulatory requirements has been identified as an impediment to the capacity of supervisors in minor and average-sized establishments to embrace environmentally responsible business approaches and practices[38]. Sufficient staff awareness of the

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[33] Gitonga, E (2017) Factors Affecting Sand Harvesting in Machakos County, Kenya available at http://erepository.uonbi.ac.ke/handle/11295/101653

[34] Ayubu, B.L (2010) The extent of compliance with occupational safety and health regulations at registered workplaces in Nairobi available at http://erepository.uonbi.ac.ke/handle/11295/95776

[35] Muthui, R. M (2018) Assessing compliance with charcoal laws and regulations in Kitui County, Kenya available at http://erepository.uonbi.ac.ke/handle/11295/104342

[36] Ibid

[37] Ibid

[38] Ahorbo, G. (2014) *Business Drivers for Environmental Regulations Compliance in Ghana's Mining Sector*. Minneapolis, Walden University

necessity and effect of complying with regulatory requirements can diminish mishaps and instances of breaching environmental rules and regulations[39]. However, in most developing countries, firms have a difficult time understanding complex regulations because their staff lack adequate understanding of the rules and regulations[40].

Existing literature suggests that firms fail to comply with regulations because they do not understand what can be done to address the problem[41]. They therefore require information and technical assistance to enable them to comply[42]. As a result, lack of awareness among employees has been cited as one of the greatest barriers to complying with environmental regulatory obligations[43]. Educating organization employees through continuous training and awareness raising activities is therefore important to prompting them to adhere to environmental rules[44].

An assessment of the knowledge of waste management regulatory obligations of waste transporters in Kenya revealed that many of the transporters do not comply with the environmental rules governing transportation of the waste.[45] A majority of the transporters used vehicles that were either not covered or partially covered, implying that they did not understand the regulatory requirements on appropriate vehicle design for the transportation of wastes while a significant number did not understand the regulatory obligations relating to labeling of the transport vehicles[46].

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[39] ibid

[40] Vendinello, L. (1998). *Reaching the Regulated Community Through Compliance Assistance Centers*. Fifth International Conference on Environmental Compliance and Enforcement, Washington, DC

[41] May, P.J (2004) Compliance Motivations: Affirmative and Negative Bases, 38 Law & Soc'y Rev. 41, 68

[42] Ibid

[43] Kehbila, A.G., Ertel, J., & Brent, A.C. (2009). *Strategic corporate environmental management within South American automotive industry: motivations, benefits, hurdles*. Corporate Social Responsibility and Environmental Management, *16,* 310-323

[44] Renwick, D.W.S., Redman, T., & Maguire, S. (2013). *Green human resource management: A review and a research agenda*. International Journal of Management Reviews*, 15, 1–14*

[45] Makuyu, G. (2011) Institutional factors affecting municipal solid waste management compliance: a case study of Waste Transporters in Nairobi City available at http://erepository.uonbi.ac.ke/handle/11295/3251

[46] Ibid

In another study that sought to evaluate the compliance by the Mater Hospital to regulatory obligations relating to medical waste management and in particular the awareness of biomedical waste management processes by hospital staff, found that the staff were inadequately trained on the correct ways of dealing with medical wastes.[47] Moreover, some of the staff handling wastes did not separate wastes but rather mixed both infectious and noninfectious waste.[48] The study established that frequent training and re-training programs should be designed and implemented at the hospital in addition to stringent application of guidelines on biomedical waste management.[49]

In yet another study that sought to evaluate the level of consciousness and usefulness of pesticides labelling among pesticide retailers found that though sellers of pesticides were aware of the significance of labelling pesticides , they did not entirely use all the obtainable material found on the labels[50]. They also disregarded valuable label information that was critical for secure handling and use of pesticides and did not have regard for the legal implications of overlooking label information[51]. The study therefore recommended training programs to raise the awareness levels among pesticide retailers[52].A research that assessed aspects affecting compliance to the Environment Impact Assessment (EIA) and the Environment Audit (EA) 2003 regulations in Kenya found that developers' awareness levels affected the compliance to their regulatory obligations[53]. The study therefore suggested that there was need to raise the awareness levels of the developers to help them comply with their said obligations[54].

[47] Othigo, E. A (2014) Evaluation of biomedical waste management: a case study of the Mater hospital in Nairobi county – Kenya available at http://erepository.uonbi.ac.ke/handle/11295/75428
[48] Ibid
[49] Ibid
[50] Katali, E.M (2013) Evaluation of the effectiveness of Agricultural Pesticide label information awareness and dissemination in Nairobi county by retailers available at http://erepository.uonbi.ac.ke/handle/11295/52356
[51] Ibid
[52] Ibid
[53] Mohamud, H.A (2012) Factors influencing compliance to Environment Impact Assessment/Environment Audit Regulation 2003 in Kenya, a case of Garissa Central Division available at http://erepository.uonbi.ac.ke/handle/11295/7214
[54] Ibid

2.3 Addressing the safety, health, and welfare of workers in the handling of used lead-acid batteries.

Exposure to lead in the workplace has long been associated with a list of health problems, disability, and death[55]. Indeed, lead poisoning has been a frequent disease among workers in lead-acid battery manufacturing and recycling industries[56]. The poisoning is even more rampant among workers in the informal lead-acid battery sectors such as scrap metal dealers who are usually exposed to lead particles emission through inhalation and ingestion[57]. Artisans in this informal sector risk high blood lead levels, which has severely affected their health[58]. To address the health and safety of workers, regulatory frameworks have responded by prescribing maximum allowable level of lead in air inhaled by workers, regular environmental monitoring and record keeping, awareness raising among employees, medical surveillance of employees and mandatory provision of personal protective equipment to workers[59].

Despite the regulatory provisions, employee illnesses attributable to lead exposure have persisted. Assessments on the influence of occupational tasks on personal airborne lead exposures and evaluations of the relation between these exposures and blood lead levels of the artisans, reveals that the artisans working on lead–acid battery repairs have very high lead exposure levels exceeding the World Health Organization's airborne lead permissible exposure limit[60]. Lead exposure assessments, medical screening, and intervention measures to minimize the risk and consequences of occupational exposures to lead among the workers should therefore be established

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[55] Matulef, M. L. (2002). On-the-job lead poisoning: Early judicial treatment of claims for recovery from exposure to workplace lead. University of Baltimore Journal of Environmental Law, 10(1), 1-48.

[56] Nouioui, M. A., Araoud, M., Milliand, M., Bessueille-Barbier, F., Amira, D., Ayouni-Derouiche, L., & Hedhili, A. (2018). Evaluation of the status and the relationship between essential and toxic elements in the hair of occupationally exposed workers. *Environmental Monitoring and Assessment, 190*(12), 1-28.

[57] Odongo, O. A., Moturi, W. N., & Obonyo, M. A. (2020). Influence of task-based airborne lead exposures on blood lead levels: A case study of informal automobile repair artisans in nakuru town, kenya. *Environmental Geochemistry and Health, 42*(7), 1893-1903.

[58] ibid

[59] ibid

[60] Odongo, O.A., Moturi, W.N. & Obonyo, M.A.(2020). Influence of task-based airborne lead exposures on blood lead levels: a case study of informal automobile repair artisans in Nakuru town, Kenya. *Environ Geochem Health* 42**,** 1893–1903 (2020).

and consistently implemented[61]. Unfortunately, lead poisoning among workers in African countries is usually difficult and expensive to assess or screen because of limited resources[62]. The association of lead poisoning to workers employed in lead-acid battery manufacturing or recycling establishments implies that policies and actions to reduce heavy metal levels must be implemented and reinforced to address the health issues affecting workers.

Available literature also reveal that most workers are exposed to the various hazards either through their nature of work or environment and therefore there is need for a systematic assessment of Occupational Health Hazards, practices and outcomes to identify how economic and production policies affect Occupational Health[63]. The cost of such impacts and the potential benefits to be gained from investment in prevention, should be enhanced by a regulatory framework that ensures that regulations are enforced and penalties are used as a deterrent for non-compliance with occupational safety measures[64]. Additional interventions to address occupational exposure to lead arising from the handling of used lead-acid batteries have been suggested including, providing pregnant women workers with special protection; instituting medical surveillance programmes for employees handling used lead-acid batteries; providing personal protective equipment; and, raising employee awareness on the hazards and safety measures for handling used lead-acid batteries.

In developing countries where most informal and primitive e-waste recycling occurs, environmental exposure to lead, is prevalent at high concentrations in pregnant women and young children[65]. Furthermore, developmental neurotoxicity is a serious concern in these regions[66]. Pregnant women and young children living close to informal used lead-acid battery recycling sites

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[61] ibid

[62] Were, F.H et al (2008). Use of human nails as bio-indicators of heavy metals environmental exposure among school age children in Kenya, *Science of the Total Environment*, Volume 393, Issues 2–3, 15 April 2008, Pages 376-384

[63] Gikonyo, E. (2008). The impact of occupational hazards on the health of metal workers in Kenya's jua kali sector: a case study of Kamukunji metal work cluster in Nairobi, University of Nairobi Library, 2019

[64] ibid

[65] Chen, A. et al. (2011). Developmental Neurotoxicants in E-Waste: An Emerging Health Concern, Environmental Health Perspectives, Vol. 119, No. 4

[66] ibid

are at risk of possible perturbations of fetus and child neurodevelopment[67]. Concrete measures for protecting pregnant employees working in ULAB recycling enterprises should therefore be developed and strictly enforced.

Monitoring blood lead levels of workers handling used lead-acid batteries is equally a useful measure for reducing lead poisoning and take-home exposures by these workers[68]. This can be achieved through medical surveillance programmes to assess exposures[69]. Workers with high blood levels manifest clinical symptoms such as frequent night time urination, excessive accumulation of fluid in tissue spaces of the body, decline in the reflex of tendons, concentration deficit, irritation, headache, depression, stomach pain, exhaustion, and reduced sex drive which might go unnoticed by health professionals unless disclosed by the employee[70]. An employer must therefore ensure frequent medical check-ups to detect and address the causes of these symptoms[71]. Such surveillance programmes have been implemented in developing countries such as Nigeria and have been found to be feasible, cost-effective and can greatly improve health outcomes among workers handling used lead-acid batteries[72].

Employers should also put in place adequate engineering controls, work safety practices, provide personal protective equipment and raise awareness about the hazards involved in handling used lead-acid batteries. Workers employed in used lead-acid batteries have exhibited elevated blood lead levels occasioned by inadequate engineering controls, work safety practices, respirator use, and personal hygiene[73]. Moreover, health and safety awareness among workers in battery recycling plants has also been inadequate in several instances because owners and operators of these plants

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[67] ibid

[68] Gottesfeld, P. (2019). Declining blood lead levels among small-scale miners participating in a safer mining pilot programme in Nigeria, *Occupational and environmental medicine*, Volume 76, Issue 11, pp. 849-853

[69] ibid

[70] Malekirad, A., Kalantari-Dehaghi, R., Mohammad, A. (2013). Clinical, Haematological, and Neurocognitive Findings in Lead-Exposed Workers of a Battery Plant in Iran

[71] ibid

[72] Gottesfeld, P. (2019). Declining blood lead levels among small-scale miners participating in a safer mining pilot programme in Nigeria, *Occupational and environmental medicine*, Volume 76, Issue 11, pp. 849-853

[73] Were, F. et al (2012) Air and Blood Lead Levels in Lead Acid Battery Recycling and Manufacturing Plants in Kenya, Journal of Occupational and Environmental Hygiene, 9:5, 340-344

have not developed adequate worker awareness measures to ensure employee safety during the recycling process[74].

2.4 An effective legal framework for ULAB recycling

Recovery of lead from used lead-acid batteries in an environmentally sound manner can only be fruitfully realized when legal rules are applied effectively and all or at least most of the regulated community have the capacity to recycle as prescribed in the legal rules[75]. An effective regulatory framework is therefore one of the key measures for ensuring used lead acid batteries are handled in a manner that does not adversely affect human health and the environment[76].

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (The Basel Convention) in its efforts to provide guidance on the environmentally sound recycling of ULABs has developed "*Technical guidelines for the environmentally sound management of waste lead-acid batteries*".[77] The guidelines provide advice to countries which intend to develop and expand their ability to manage ULABs. It adopts a broad approach and provides succinct information on various aspects of ULAB recycling and specifically in relation to the adoption of the environmentally sound management of ULABs[78]. According to the guidelines, ULABs must be carefully collected, transported, and stored even before reaching the recycling plant, to avoid adverse health effects and environmental contamination[79]. The guidelines suggest that the only way to apply an effective lead-acid battery recycling program is by

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[74] Ngaira, S.A. (2014). Organizational communication strategies on health and safety awareness in associated battery manufacturers (East African) limited company, University of Nairobi library, Nairobi, 2019

[75] UNEP (2015). Guidelines for the Environmentally Sound Management of Used Lead Batteries in the Mediterranean available at https://wedocs.unep.org/bitstream/handle/20.500.11822/7747/-Guidelines_for_environmentally_sound_management_of_used_lead_batteries_in_the_Mediterranean-2015guidelines_sound_management_used_lead.pdf.pdf?sequence=3&isAllowed=y

[76] World Economic Forum. (2020). Consequences of a Mobile Future: Creating an Environmentally Conscious Life Cycle for Lead-Acid Batteries, Global Battery Alliance, Geneva

[77] UNEP (2003) Technical guidelines for the environmentally sound management of waste lead-acid batteries, UNEP, Geneva, Switzerland

[78] Ibid

[79] Ibid

establishing a suitable and efficient infrastructure for collecting lead-acid battery.[80] The collection system must be well designed since it involves various stakeholders including battery and scrap metal dealers, lead smelters and consumers into an organized group which offers an uninterrupted supply of lead material to the recycling process[81]. Furthermore, control actions must be applied at the points of collection to avoid mishaps that can create harm to human health and the environment.[82]

ULABs should be cautiously collected to prevent harmful health and environmental effects.[83] The batteries should be stored whole at collection points and should not be drained or dismantled at the collection point[84]. Moreover, the storage area at the point of collection should be well shielded from heat, well ventilated and have an impermeable surface with proper curbing. The area should also have appropriate corrosive warning sign[85].

Regarding transportation, ULABs must be treated and transported as hazardous wastes because the acid inside the battery may leak.[86] Control measures to reduce the chances of spilling and define the actions to be taken in case of an accident should be established.[87] ULABs must be transported inside sealed containers with the containers well packed in the transport vehicle and the vehicle identified with the internationally recognized hazard symbols.[88] The team transporting the ULABs should be provided with and trained on how to use the necessary equipment to deal with any spillage or leakage challenges that may occur.[89] Moreover, drivers and the transportation

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[80] Ibid
[81] Ibid
[82] Ibid
[83] UNEP (2017) Revised factsheets on specific waste streams available at ww.basel.int/Implementation/CountryLedInitiative/EnvironmentallySoundManagement/ESMToolkit/Overview/tabid/5839/Default.aspx
[84] Ibid
[85] UNEP (2003) Technical Guidelines for the Environmentally Sound Management of Waste Lead-acid Batteries http://www.basel.int/Implementation/Publications/TechnicalGuidelines/tabid/2362/Default.aspx
[86] UNEP (2003) Technical guidelines for the environmentally sound management of waste lead-acid batteries, UNEP, Geneva, Switzerland
[87] Ibid
[88] Ibid
[89] Ibid

support team should be taught on how to deal with hazardous wastes and in emergency procedures.[90] They should also know about the dangerous material carried and how to contain the effects of a possible accident.[91] Finally, the transporter should have a route schedule and map[92].

The Basel Convention guidelines further suggests some environmental control measures for the actual recycling process. It suggests that every lead-recycling facility should undergo an environmental impact assessment before commencing business to avoid environmental pollution and ensure the protection of environmental and human health. In this sense, the environmental impact assessment offers the best opportunity to revise the project at the least possible costs and to prepare in terms of the most appropriate and best available technologies.[93] The guidelines also propose technological improvements, environmental control measures and environmental monitoring as critical components of protecting the environment and human health from the harmful impacts of ULAB recycling[94]. Some of the technological improvement measures include installing technologies to stabilize the discharge of acid electrolyte and effluents; remove smoke and dusts and eliminate sulfur dioxide. Some suggested environmental control measures on the other hand include providing workers with personal protection equipment; adopting some work health policies to decrease the health contamination risks; conducting recycling operations inside enclosed buildings; safe storage of slags; having an appropriate air filtration system; and collecting rain water since it might contain hazardous leachates[95]. The guidelines also propose the monitoring of some key targets including effluents, gases, soil and plant, air quality and medical surveillance.

Several countries, largely the more advanced economies, have incorporated these ULAB recycling practices into their legislation which has resulted in them achieving high rates of recycling with

[90] Ibid
[91] Ibid
[92] ibid
[93] Ibid
[94] Ibid
[95] Ibid

less pollution outcomes[96]. The use of hazardous compounds, the environmental performance of batteries throughout their lives, and the collection, treatment, and recycling of used batteries have all been emphasized in the laws of these more advanced countries[97]. This has resulted in the addition of collection targets, extending producers' responsibility to lessen the product's immediate environmental impact by reducing the product's harm at the end of its useful life, and enhancing recycling efficiencies[98]. Extending the producers' responsibility transfers responsibility for a product's whole life cycle from municipalities to the manufacturer of the targeted product [99]. It implies that the manufacturer is responsible for the product's physical and/or financial aspects [100]. In the case of European Union member states, the producer is required to "take back" the used vehicle battery from the end-user [101], ensure that the batteries are treated and recycled[102], provide end-users with information on take-back programs and the negative consequences of improper disposal [103]. Moreover, the producer is responsible for any net costs associated with the collecting, treatment, and recycling of batteries, as well as education campaigns [104].In addition, the Directive forbids the use of landfills or incineration to dispose of waste industrial and automotive batteries and accumulators[105].

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96 Gupt, Y. (2015). Economic instruments and the efficient recycling of batteries in Delhi and the national capital region of India. *Environment and Development Economics, 20*(2)

97 Ahuja, J., Dawson, L., & Lee, R. (2020). A circular economy for electric vehicle batteries: Driving the change. Journal of Property, Planning and Environmental Law, 12(3), 235-250.

98 ibid

99 ibid

100 ibid

101 Refer to Article 8 of Directive 2006/66/EC on of the European Parliament and of the Council of 6 September 2006 batteries and accumulators and waste batteries and accumulators available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006L0066.

102 Refer to Article 12 of Directive 2006/66/EC on of the European Parliament and of the Council of 6 September 2006 batteries and accumulators and waste batteries and accumulators available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006L0066.

103 Refer to Article 20 of Directive 2006/66/EC on of the European Parliament and of the Council of 6 September 2006 batteries and accumulators and waste batteries and accumulators available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006L0066.

104 Refer to Article 16 of Directive 2006/66/EC on of the European Parliament and of the Council of 6 September 2006 batteries and accumulators and waste batteries and accumulators available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006L0066.

105 Refer to Article 14 of Directive 2006/66/EC on of the European Parliament and of the Council of 6 September 2006 batteries and accumulators and waste batteries and accumulators available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32006L0066.

In Germany, importers and manufacturers are responsible for collecting the ULABs[106]. They are required to jointly develop "take-back systems" to arrange, fund and ensure collection and further treatment of the batteries as prescribed.[107] In Canada, a consumer is paid about US$10–20 for returning a ULAB to a retailer[108]. In the United Kingdom, legislation for collecting ULABs is based on what is referred to as reverse logistics[109]. Reverse logistics (also known as closed loop supply) "*is the process of planning, implementing, and controlling the efficient and cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal*".[110] The closed loop supply ensures products used are returned to the originator after their use so that they are properly discarded, reused, recycled, or re-manufactured[111].

In the United States, several States have enacted robust provisions to address lead pollution arising from ULAB recycling. Though these States are lagging Europe in terms of enacting battery recycling regulations and extended producer responsibility, 32 of them have laws that mandate some form of extended producer responsibility for any product[112]. Extended producer responsibility is seen as the primary vehicle to mandate and/or support product recycling efforts[113].

In developing nations and in nations with transition economies, the situation is not as encouraging. Environmentally sound management of ULABs requires the establishment of collection, transportation, treatment, storage, recovery, and disposal facilities which are often lacking in

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[106] Schultmann, F et al. (2003) Closed-loop supply chains for spent batteries, University of Karlsruhe, Germany
[107] Ibid
[108] Commission for Environmental Cooperation (2013) Hazardous trade? An examination of US-generated spent lead-acid battery exports and secondary lead recycling in Canada, Mexico, and the United States
[109] Swallow, K. (2010). Passing the acid test. *Commercial Motor, 213*(5404), 32-35. Retrieved from https://search.proquest.com/docview/813881369?accountid=28957
[110] Rogers, R. Tibben-Lembke)1999) "Going backwards: reverse logistics trends and practices" Reverse Logistics Executive Council
[111] Jayant, A. (2013) Reverse Logistics Practices In Lead Acid Battery Recycling Plant: A Case Study, Punjab, India
[112]Rahman, A. (2014). *The Optimal Reverse Logistics Network for Consumer Batteries in North America.* Cambridge: Massachusetts Institute of Technology
[113] ibid

developing countries and countries with economies in transition[114]. Further these countries are unable to sensitize citizens and provide them with incentives for ULAB collection to avoid open dumping[115]. In Brazil, for example, despite the fact that the National Policy for Solid Waste Law of 2010 mandates that manufacturers, importers, distributors, and battery dealers organize and implement reverse logistics systems upon product return after consumer use, most producers have yet to sign sector agreements to implement reverse logistics programs [116]. India, which has had a used lead-acid battery recycling legal framework[117] for more than 15 years, continues to experience informal recycling of used lead-acid batteries unabated, causing significant environmental pollution[118]. This is because there are no incentives for collectors to deliver the batteries to smelters. On a more positive note, India's regulatory framework mandates the implementation of a deposit reimbursement scheme (DRS) based on expanded producer responsibility principles (EPR)[119].To ensure environmentally sound recycling of ULABs, a suggestion has been made to integrate informal recycling by introducing an independent collection agency, strengthening the upstream deposit refund system, eliminating informal recycling, and ensuring effective compliance monitoring[120]. In China, an effective waste battery collection system is lacking, the regulatory framework does not provide for extended producer responsibility and consumers are not under any obligation to send waste batteries to a designated battery collection point[121].

[114] Ferronato, N., & Torretta, V. (2019). Waste mismanagement in developing countries: A review of global issues. *International Journal of Environmental Research and Public Health, 16*(6), 1060.
[115] ibid
[116] Simone, M. S., João, C. N., & Maisa Mendonça Silva. (2019). Forecasting model to assess the potential of secondary lead production from lead acid battery scrap. *Environmental Science and Pollution Research International, 26*(6), 5782-5793
[117] The Batteries (Management and Handling) Rules, 2001'
[118] Gupt, Y. (2015). Economic instruments and the efficient recycling of batteries in delhi and the national capital region of india. *Environment and Development Economics, 20*(2), 236-258.
[119] Gupt, Y., & Sahay, S. (2015). Managing used lead acid batteries in India: Evaluation of EPR-DRS approaches. Journal of Health and Pollution, 5(8), 52–63. Retrieved from https://www.journalhealthpollution.org/doi/pdf/10.5696/i2156-9614-5-8.52
[120] Ibid
[121]Zhao, Y., Pohl, O., Bhatt, A. I., Collis, G. E., Mahon, P. J., Rüther, T., & Hollenkamp, A. F. (2021). A review on battery market trends, second-life reuse, and recycling. *Sustainable Chemistry, 2*(1), 167.

2.4 Knowledge gap

While several studies have examined the issue of safety to human health and the environment in the handling of used lead-acid batteries, there seems to be a dearth of studies and literature in Kenya that have examined the safe handling of these batteries with a view to protecting human health and the environment. The existing literature on ULABs in Kenya has largely focused on the level of lead exposure to workers, the environment and to communities living around lead smelters. None of the available literature has looked at why handlers of used lead-acid batteries in Kenya are unable to prevent the discharge or emissions of lead while handling these batteries. In addition, none has sought to address why the handlers of these batteries are unable to protect their employees from occupational exposure to lead despite the existence of a robust occupational and health safety legislation. Moreover, a review of literature on safe handling of used lead-acid batteries in the country has not yielded any study that sought to examine the adequacy of the regulatory framework to protect human health and the environment from the adverse effects of lead exposure arising from ULAB recycling.

This study therefore sought to identify the obstacles that hinder compliance with regulatory obligations by those handling used lead-acid batteries in Kenya. It specifically sought to establish what hinders handlers of used lead-acid batteries in the country from preventing the release or discharge of lead particles into the environment. It also sought to establish what prevents handlers of used lead-acid batteries from addressing the safety, health and welfare of workers engaged in the handling of used lead-acid batteries. Finally, the study also sought to find out whether there are any gaps in the regulatory framework governing the handling of used lead-acid batteries in Kenya and which may have contributed to the unsound handling of the batteries.

CHAPTER THREE: METHODOLOGY

3.1 Analytical Framework

The study was conducted through the prism of the rationalist theory which is one of the compliance theories that underlie most regulatory policies. Compliance theories provide the basis for firms' compliance with laws and are valuable optics for observing and comprehending behavioursrelated to compliance and grounds for those behaviours[1]. Proponents of these theories propose various approaches that can be adopted to encourage organizations to observe laws intended to advance protection of the environment[2]. Based on the rationalist compliance theory, the study derived three key factors that can hinder compliance with regulatory obligations relating to the collection, transportation, disposal, and recovery of lead from used lead-acid batteries. The three included technological constraints, inadequate awareness of the regulatory obligation, and inadequate enforcement by the regulating authority.

3.2 Methods and Study Design

This study used a mix of qualitative and quantitative methods. The use of this approach has been described as convergent methodology, multimethod/multi-trait convergent validation or, what has been called triangulation[3]. Mixed methods research involves the gathering, evaluation, and combination of quantitative and qualitative data in a single or multiphase study[4]. The approach is based on viewing qualitative and quantitative methods as complementary rather than as rival

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[1] Stilwell, M., Young, O and Zaelke, D (2011). *Compliance Theories. Making Law Work*. INECE, Washington D.C available at https://www.inece.org/assets/Publications/5759730b752fc_MakingLawWorkChapterTwoIntroductionComplianceTheories_Full.pdf

[2] Ibid

[3] Jick, T. (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly, 24*(4), 602-611. doi:10.2307/2392366

[4] Hashemi, M., & Babaii, E. (2013). Mixed Methods Research: Toward New Research Designs in Applied Linguistics. *The Modern Language Journal, 97*(4), 828-852

camps[5]. Proponents of the mixed methods approach suggest that researchers ought to gather various data using various strategies, styles, and methods in such a way that the resultant mix or arrangement is likely to result in corresponding strengths and nonoverlapping weaknesses[6]. They further posit that effective use of this principle ensures the outcome or product is better than single-method studies[7]. For instance, combining qualitative interviews with experiments as a control check and perhaps as a way to discuss directly the issues under investigation and tap into participants' perspectives and meanings will reduce some probable challenges with the investigational method[8].

The quantitative aspects of the study were based on a survey of scrap metal dealers engaged in the collection and transportation of used lead-acid batteries and, owners of motor vehicles. The survey was meant to generate information about the collection, transportation, disposal behaviours that have a bearing on lead emission and discharge. The qualitative aspect was based on in-depth interviews with key informants and who are enforcement officials from the National Environment Management Authority in Kenya and with key informants from the Associated Battery Manufacturers Limited, the only licensed enterprise by the National Environment Management Authority to recycle used lead acid batteries. The qualitative data was meant to provide information to help understand the enforcement practices of the regulator and how this impacts compliance with regulatory obligations of ULAB handlers in Kenya. The qualitative data was also meant to assist generate information regarding hindrances to preventing lead discharge or emissions as well as hindrances to ensuring health and safety of workers handling used lead-acid batteries.

Qualitative research entails inductively examining real-world situations to develop rich narrative descriptions and develop case studies. It is especially beneficial when you want to fully comprehend a real-life phenomenon while also considering key contextual factors [9]. It examines

[5] Ibid
[6] Johnson, R., & Onwuegbuzie, A. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher, 33*(7), 14-26.
[7] Ibid
[8] Ibid
[9] Yin, R.K. (1994) *Case study research: design and methods*. 2nd edition. Thousand Oaks, CA: Sage.

depth rather than extent and emphasizes complete examination of a small quantity of occasions or situations and their interrelations[10]. The qualitative approach was also adopted for this study because the data needed could easily be collected from Associated Battery Manufacturers Ltd; the resources required to visit the site, collect and analyze the data was minimal and; the available time was enough to conclude the study within the prescribed study period.

Quantitative research involves the measuring quantity or amount and is applied to circumstances that can be expressed in terms of quantity[11]. The quantitative approach was chosen because it allows for the use of statistical data, it saves time and resources, and the results are methodical [12]. The use of statistical data further reduces the time and energy which the researcher would have used to describe his results and, data can be computed and performed by simple computer programmes such as excel[13]. Secondly, using scientific methods for data collection and analysis make generalizations possible. In addition, the explanation of research findings is quite reliable[14]. The quantitative approach was also chosen for its ability to remove researcher bias. Quantitative research removes researcher bias because the researcher is not in direct contact with the participants[15]. Conclusions and the objectivity of the researcher will not be compromised and even more important, respondent anonymity is guaranteed[16].

Prior to embarking on the case study, a comprehensive literature review of environmentally sound recycling of used lead-acid batteries and environmental compliance was conducted. Information from the literature review was then supplemented by information obtained from responses to the questionnaire, information derived from the researcher's observation of the activities and process of the recycling company, analysis of the latest audit reports of the company obtained from

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[10] Ibid

[11] Kothari, C.R (2004) Research Methodology. New Delhi. New Age International (P) Limited

[12] Eyisi, D. (2016) The Usefulness of Qualitative and Quantitative Approaches and Methods in Researching Problem-Solving Ability in Science Education Curriculum, Journal of Education and Practice, Vol. 7, No.15, 2016

[13] Ibid

[14] Ibid

[15] Ibid

[16] Ibid

National Environment Management Authority and, interview of key informants using an interview schedule.

3.2.1 **Study site**

The study site was the Viwandani ward of the Makadara sub-county in the Nairobi City within the Republic of Kenya. Viwandani ward consists of residential, business, and industrial sections for Nairobi residents and businesspeople. The industrial area section hosts large industries and factories that manufacture an assortment of products. According to the latest statistics by the Kenya National Bureau of Statistics conducted in 2019, Viwandani ward has a population of 44,881 and a land area of 5.7 square kilometers[17]. The ward is also home to the Associated Battery Manufacturers Limited, the leading lead-acid battery recycling and manufacturing company in Kenya and the East Africa Region, and, the only enterprise licensed by the National Environment Management Authority of Kenya to recycle used lead-acid batteries. A map of Viwandani ward is represented as figure 2 below.

[17] Government of Kenya (2020). 2019 Kenya Population and Housing Census available at https://www.knbs.or.ke

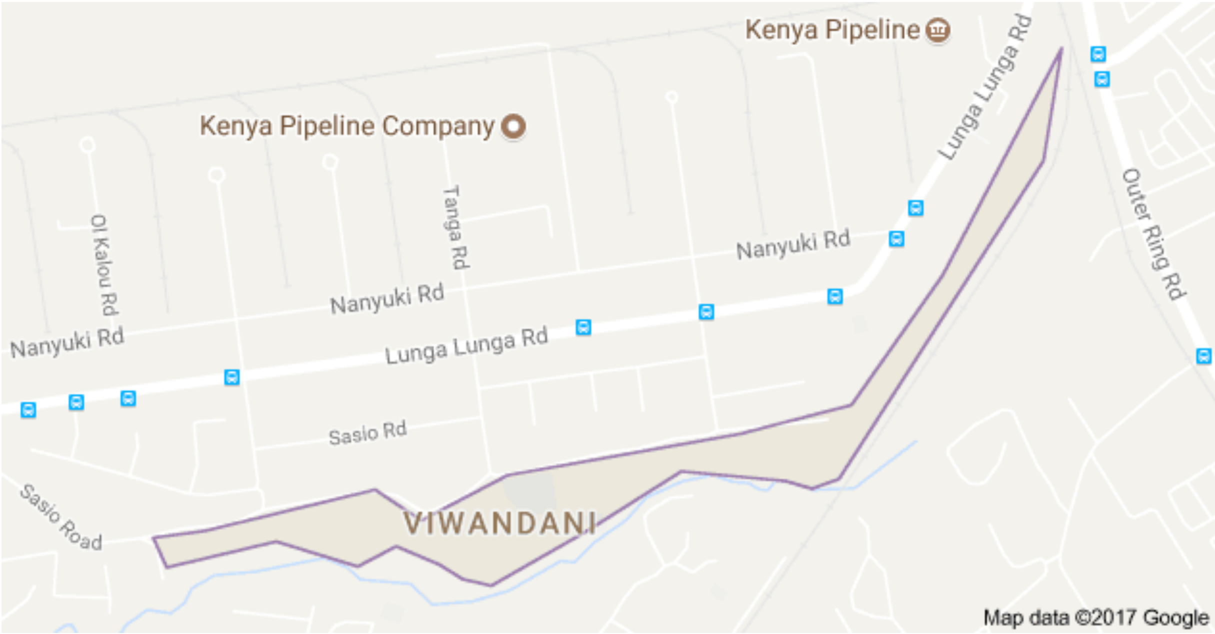

Fig. 2: Map of Viwandani Ward

Source: Google Maps

3.2.2 Target Population

The target population for this study were the handlers of used lead-acid batteries. Handlers of used lead-acid batteries include persons who dispose, collect, transport, or recycle the batteries. These comprise owners of motor vehicles who dispose of the used lead-acid batteries after their end of useful life, scrap metal dealers who collect and transport the batteries to smelters and, recyclers of the used lead-acid batteries.

According to the Kenya Business Directory, there are 42 scrap-metal dealers in Nairobi involved in either collection or transportation of used lead-acid batteries[18]. Out of the 42 scrap metal dealers

[18] See https://www.kenyaplex.com/business-directory/?categoryid=755

engaged in the collection and transportation of the batteries, eight (8) of them undertake their businesses in Viwandani ward of the Makadara sub-county in Nairobi city.

Three key informants were interviewed for the study. One of the key informants holds a senior managerial position at the Associated Battery Manufacturers. Information from the National Environment Management Authority reveals that there is only one licensed company – the Associated Battery Manufacturers, that recycles used lead-acid batteries[19]. Associated Battery Manufacturers is in industrial area, in Viwandani ward of Makadara sub-county in Nairobi County. The company was established in 1965 under the name Chloride Metals Kenya Ltd (CMK) with a furnace capacity of about 100 tons per month[20]. The name of the company was subsequently changed to Associated Battery Manufacturers Limited[21]. The company carries out its battery recycling activities in Industrial area along Kampala Road in Nairobi County within the Republic of Kenya and has a total combined work force of about 700 staff[22]. With its new 5 metre furnace commissioned in 2014, the company now has a smelting capacity of 1000 tons per month which translates to an ability to recover 12,000 metric tonnes of lead metal and to produce over 900,000 batteries per year[23]. Two other key informants from the National Environment Management Authority were also interviewed. The two work in the compliance and enforcement department of the authority.

In relation to motor vehicle owners, the study surveyed motor vehicle owners from the Mariakani Estate in the Viwandani ward. The estate was chosen for being the closest residential area to the only licensed used lead-acid battery recycling establishment in Kenya. Mariakani Estate consists of 240 housing units. Out of the 240 residents, 72 of them own motor vehicles.

[19] NEMA (2015) National Solid Waste Management Strategy
[20] https://www.abmeastafrica.com/about-us
[21] Ibid
[22] Ibid
[23] ibid

3.2.2.1 Sampling and sample size

The study used two sets of samples, guided by the research design and the study objectives. The first sample set targeted the scrap metal dealers within the study area while the second set targeted motor vehicle owners within the study area. Out of the 8 scrap metal dealers located in the study area, a sample of 5 was selected using simple random sampling. Using this method of sampling, any of the 8 scrap metal dealers had an equal chance of inclusion in the sample. Specifically, all the names of the 8 scrap metal dealers were written on small pieces of paper which were then thrown into a bag and then 5 were drawn out, one after the other, without looking at the one being drawn. The second set of samples targeted owners of motor vehicles in Mariakani Estate in the Viwandani ward in Makadara sub-county in Nairobi within the Republic of Kenya. Out of the 72 motor vehicle owners, a sample of 22 was selected using simple random sampling. Again, all the names of the 72 motor vehicle owners were written on slips of paper which were then mixed together in a bag and thereafter 22 were drawn out one after the other without looking at the one being drawn.

3.2.2 **Data collection**

Being a mixed research design, data was collected using surveys, in-depth interviews with key informants, and by way of content analysis. Based on the data needs identified in figure 3 below, the study used the mixed research design method to facilitate a well-grounded understanding of all matters relevant to the study.

Figure 3: Data Needs Matrix

Research Question	**Research Requirements**	**Method**
What hinders handlers of used lead-acid batteries from preventing the release or discharge of lead particles into the environment?	Reasons why handlers of ULABs are unable to prevent the release or discharge of lead into the environment among handlers of ULAB	• Questionnaire • Key informant interviews
What prevents handlers of used lead-acid batteries from addressing the safety, health and welfare of workers engaged in the handling of used lead-acid batteries?	Reasons why handlers of ULABs are unable to protect the health, safety and welfare of employees handling ULABs	• Questionnaire • Key informant interviews
Are there any gaps in the regulatory framework governing the handling of used lead-acid batteries in Kenya?	Key elements for an effective ULAB recycling law	Content analysis

Fig. 3: Data needs matrix

Source: Author

A questionnaire was administered to scrap metal dealers involved in the collection and transportation of used lead-acid batteries. Another questionnaire was administered to owners of motor vehicles from the target population and who dispose their ULABs at the end of its useful life. Interview schedules were used to conduct in-depth interviews with key informants from the Associated Battery Manufacturers limited and with compliance and enforcement officials from the National Environment Management Authority. A content analysis schedule was used to examine legislation at the national level and the county level to examine the efficacy of these laws to prevent lead pollution and poisoning emanating from the recycling of used lead-acid batteries. The questionnaires, interview schedules and content analysis schedule are attached as annexes 1(a) and 1(b), 2(a) and 2(b) and 3.

The questionnaires were structured in the form of standard questions and predetermined response options and consisted of questions relating to the collection, storage, transportation, disposal and practices of the respondents relating to the recovery of lead, from used lead-acid batteries. The interview schedules consisted of questions relating to the enforcement practices of the regulatory authority and, the practices of the recovery of lead from used lead-acid batteries by the recycling enterprises. The content analysis schedule was prepared by extracting key elements for an appropriate legislation, from the Basel Convention Guidelines on the Environmentally sound Management of Used Lead-acid Batteries. The key elements of the content analysis are then applied against the legislation the subject of this study to assess their adequacy to prevent lead pollution arising from the recycling of used lead-acid batteries.

Additional data was collected by observing the processes and activities at the company's recycling facility and an analysis of the company's environmental audit reports. The environmental audit reports were obtained from the audit unit of the National Environment Management Authority and they cover the periods 2015 and 2016. The objective of both audits was to establish whether the company was complying with the relevant provisions of the Environmental Management and Coordination Act, 1999 and the Environmental (Impact Assessment and Audit) Regulations 2003 and further assess compliance of the company to environmental regulations, legal compliance status, management systems and implementation of existing gaps in an operational context. The scope of the audit covered all company operational departments which included the battery production unit, assembly plant, and acid plant, administrative section, engineering section, storage area, laboratory, parking lot and waste management/collection section, dispensary among others.

3.2.4 **Data Analysis**

In preparation for analysis, the data was edited, coded, categorized, and tabulated in an excel sheet. The data was edited to detect errors and omissions by scrutinizing the completed questionnaires and/or schedules. This was done to ensure that the data was correct, that it was consistent with other information acquired, that it was uniformly input, that it was as thorough as possible, and that it was neatly organized to make coding and tabulation easier. The responses were coded by assigning numeric symbols so that they could be categorized into a small number of groups or classes which were labelled as technological constraints, inadequate awareness and, inadequate enforcement by the regulatory authority. A fourth class titled gaps in regulatory framework is also examined. The analysis was then presented in the form of pie-charts.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results derived from responses to the questionnaire administered among handlers of ULABs, responses from in-depth interviews with key informants from the only licensed ULAB recycling company as well as from the National Environment management Authority and, results from content analysis of the regulatory framework governing the handling of ULABs. Additional results were also obtained by observing the processes and activities at the company's recycling facility and, an analysis of the company's environmental audit reports.

Results emerging from responses to the questionnaires, in-depth interviews with key informants, observation of the recycling company's processes and activities, an analysis of the recycling company's environmental audit report and, the content analysis of the regulatory framework are summarized below.

4.2 Lead discharge/emission prevention

Out of the scrap metal dealers that responded to the questionnaire in relation to their involvement in the collection and transportation of ULABs, none of them holds a license to collect and transport used lead-acid batteries yet section 88 of the Environmental Management and Co-ordination Act, 1999 read together with regulation 7 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 requires transporters of hazardous waste to first obtain a license before engaging in hazardous waste transportation . Most of them (60%) explained that they do not have a license because they did not know of a regulatory requirement to obtain one. Some (40%) however confirmed that they were aware of the license requirement but suggested that they have never been asked by any authority to produce a license for collecting or transporting the used lead-acid batteries. The findings are consistent with compliance literature that have found that Inadequate awareness of regulatory requirements as well as insufficient enforcement of the regulatory requirements, constitute a significant impediment to the capacity of minor and average-sized establishments to comply with regulatory obligations[1].

Figure 4 below, illustrates why collectors and transporters of ULABs do not obtain a license for collection and transportation of the batteries.

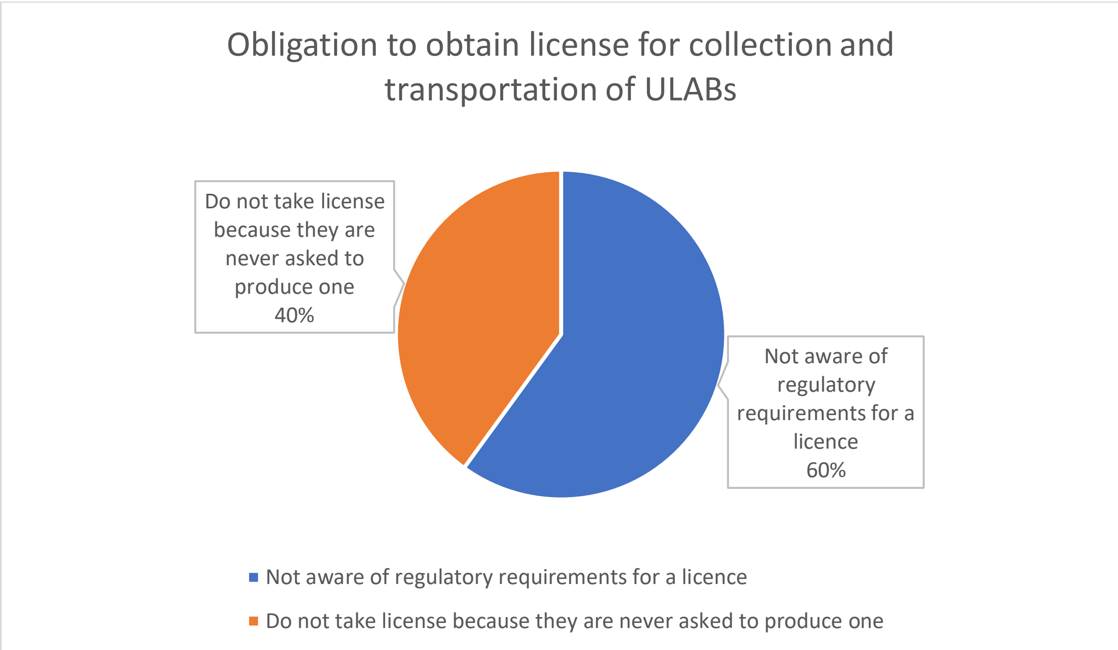

Fig. 4: Why collectors and transporters do not obtain license to transport ULABs.

Source: Author

On whether they segregate the ULABs from other wastes, all the scrap metal dealers that responded to the questionnaire stated that they do not separate the batteries from other wastes. Seventy per cent (70%) of them said they were not aware of a requirement to separate ULABs from other wastes while thirty per cent (30%) of them said no one inspects whether they segregate the batteries

[1] Ahorbo, G. (2014) *Business Drivers for Environmental Regulations Compliance in Ghana's Mining Sector*. Minneapolis, Walden University

or not and therefore they do not find a strong reason to separate the batteries. This is contrary to the provisions of regulation 5 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006. The findings are also consistent with compliance literature that have attributed low levels of regulatory compliance to insufficient awareness of the regulatory frameworks and inadequate enforcement [2].

Figure 5 below, illustrates why collectors and transporters of ULABs do not segregate ULABs from other wastes.

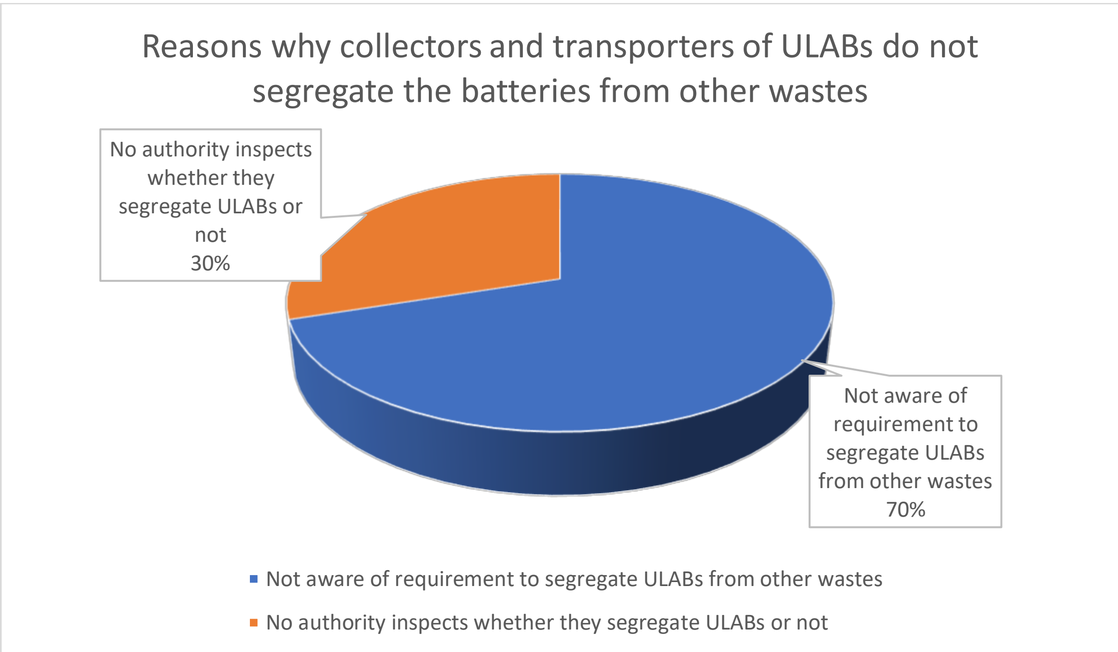

Fig. 5: Why collectors and transporters of ULABs do not segregate ULABs from other wastes.

Source: Author

[2] May, P.J. (2005), Regulation and Compliance Motivations: Examining Different Approaches. Public Administration Review, 65: 31-44. doi:10.1111/j.1540-6210.2005.00428.x; Zhao, X., Qi, Y. (2020).Why Do Firms Obey?: the State of Regulatory Compliance Research in China. Journal of Chinese Political Science**25,** 339–352 (2020). https://doi.org/10.1007; David P. Carter D. & Siddiki, S (2019) Participation rationales, regulatory enforcement, and compliance motivations in a voluntary program context, Regulation & Governance, 10.1111/rego.12289, **0**, 0,; Fowler, L (2019). Best practices for implementing federal environmental policies: a principal-agent perspective, Journal of Environmental Planning and Management, 10.1080/09640568.2019.1670627, (1-17).

Regarding the prevention of lead discharge during transportation of the batteries, none of the scrap metal dealers surveyed use vehicles with approved specifications from the national environment management authority. Moreover, they all said that they were not aware of a requirement to use vehicles with approved specifications to transport the ULABs. They further stated that they do not collect and/or deliver the ULABs from or to a designated place because they are not aware of any requirement to collect and/or deliver the ULABs from or to a designated place. In addition, the scrap metal dealers that transport ULABs do not use scheduled routes to transport ULABs and neither are they aware of a requirement to use scheduled routes to transport the batteries. They also do not maintain a tracking document while transporting the ULABs because they do not know of any obligation to maintain one. This is consistent with previous studies on waste transportation which have found that transporters do not comply with the environmental rules governing transportation of wastes with many of them using vehicles that did not meet the regulatory requirements on appropriate vehicle design for the transportation of wastes while a significant number did not understand the regulatory obligations relating to labeling of the transport vehicles[3].

In relation to motor vehicle owners, 58% of those surveyed, dispose their used lead-acid batteries together with their household waste while the rest (42%) leave them at the motor vehicle service stations where they purchase a replacement. Figure 6 below illustrates how motor vehicle owners dispose of their vehicle used lead-acid batteries.

[3] Ibid

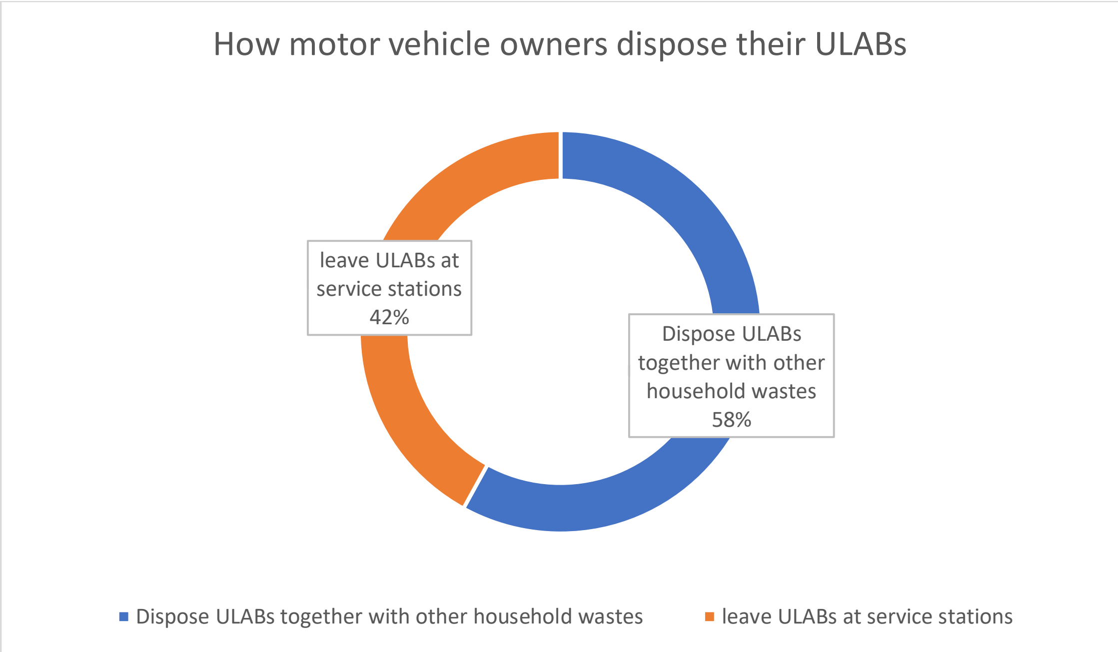

Fig. 6: How motor vehicle owners dispose their ULABs.

Source: Author

Out of the motor vehicle owners that dispose the batteries together with their household waste, none of them know of any designated ULAB collection centres or any other environmentally sound mode of disposal. However, seventy per-centum (70%) of the motor vehicle owners surveyed appreciate that used lead-acid batteries can be dangerous to human health and the environment while the rest (30%) do not know or are not sure. Unfortunately, even the ones that say ULAB can be dangerous to human health and the environment, do not know exactly how the batteries pose the said danger to human health and the environment. Figure 7 below illustrates the level of awareness among motor vehicle owners, of the hazards posed by ULABs.

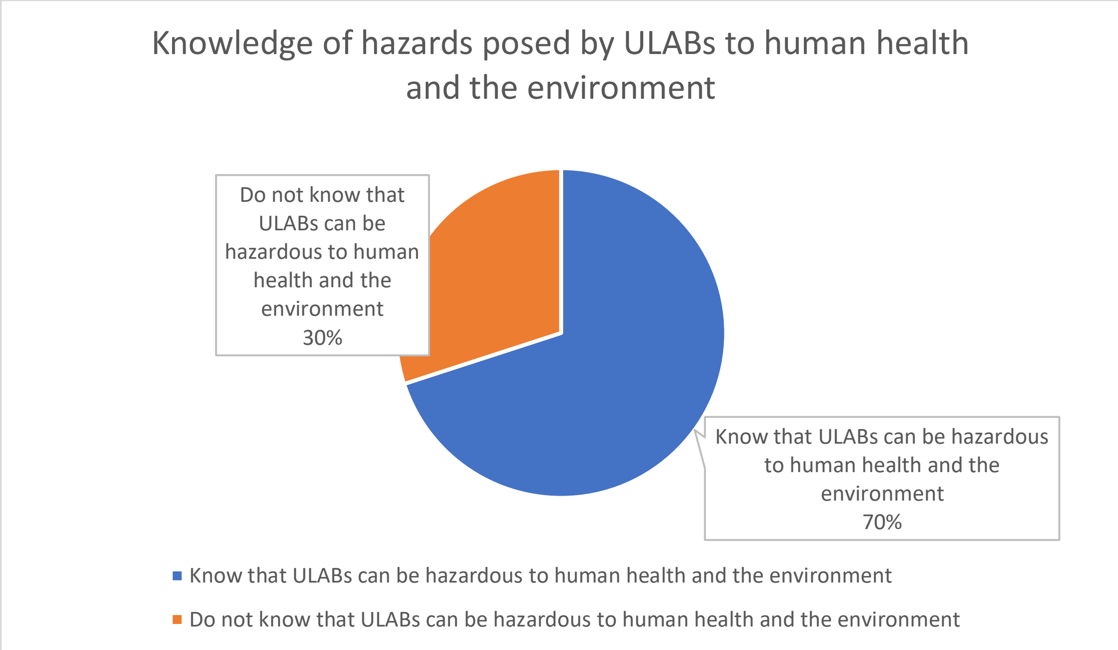

Fig. 7 Knowledge of hazards posed by ULABs to human health and the environment by motor vehicle owners.

Source: Author

The in-depth interview with the key informant from the only licensed recycling company revealed extremely insightful information. In response to the question on the kind of technology they use to recycle ULABs, he indicated that they were using "*pyrometallurgy*", "*a method of recovering metals such as lead using heat to bring about chemical and physical transformations*". He went on to explain that in this process, "*the batteries are first drained of any acid before breaking them and putting them into the recycling equipment*". The key informant however conceded that the recycling method used at the company is not based on the best available environmental technology. He explained that the latest technology for lead recovery from used lead-acid batteries now is known as "*iono-metallurgical process*". In this process, "*lead salts are dissolved in a liquid consisting of choline chloride and ethylene glycol*". "*After the dissolution, the lead is recovered through electrodeposition while the liquid can be recycled for further recycling of lead*". According to the key informant, "*the iono-metallurgical process uses less energy as compared to the commonly used pyrometallurgical process which therefore means less carbon dioxide* *emissions*". Furthermore, it also reduces exposure from lead to air emissions. However, and in response to the question on why they have not adopted this seemingly cleaner production method, the key informant stated that the "*iono-metallurgical technology is relatively costly*". Indeed, he indicated that "*costs of installing this latest technology, would cost approximately 1.5 Million US Dollars*". This is consistent with existing literature which have found that most handlers of used lead-acid batteries are willing to comply with regulations that seek to prevent lead discharge or emissions, they often find themselves non-compliant with environmental regulations because they lack the technological capability to take required actions[4].

In terms of anti-pollution technology, the key informant confirmed that "*the company had installed anti-pollution equipment based on the best practicable means to prevent the discharge of lead into the environment during the recycling of ULABs*". In this regard, the key informant stated that "*the acid electrolyte from the batteries and the effluents from the recycling process are first treated before being discharged into the environment*". "*The company has also installed bag filters, electrostatic precipitators, wet electrostatic precipitators, and wet scrubbers to filter the air and collect the dust emerging from the recycling process*". To control fugitive emissions, the key informant indicated that "*they have a ventilated tapping of the furnace bullion which easily allows the bullion to solidify*". The key informant further asserted that "*they use wet scrubbers with calcium carbonate to significantly reduce the discharge of sulfur dioxide into the environment*". He also indicated that "*they use pure oxygen to enrich the air supply to the furnace burners which then provides a much cleaner production process*".

The key informant stated that "*the company conducts annual environmental audits*" as prescribed in the legal framework. To corroborate this information, environmental audit reports from the national environment management authority were obtained. The company's environmental audit reports for 2015 and 2016 reveal that the company stores the ULABs in a well caged storage facility with metal bars for security and which is well roofed though the drainage channel in this section and floor should be renovated and connect to a neutralization tank to control any acid leakages.[5] The store is also well organized and arranged, lit and spacious with path ways well

[4] Ibid
[5] Ibid p. 10

marked and indicated. Climbing ladders towards heights are also sufficient as well as fire points[6]. Emergency doors are availed, and warning signs appropriately displayed[7]. Finally, the key informant stated that "*they take out all the requisite licenses and permits required to engage in the business of recycling used lead-acid batteries*". "*All the licenses were prominently displayed in the office of the key informant*".

The in-depth interviews with a key informant from the compliance and enforcement section of the national environment management authority reveals inadequate capacity to enforce obligations to prevent lead discharge into the environment. The key informant stated that they "*rarely inspect used lead-acid battery handling establishments for compliance with their regulatory obligations*". "*The infrequent inspections of the establishments are largely due to a shortage of inspectors*". The key informant further stated that "*the national environment management authority has distributed inspectors among the 47 counties of the Republic of Kenya according to the environmental risk potential for each county*". "*In total the country has about 200 environmental inspectors against a target of 1000*". "*Nairobi being the headquarters has about 10 inspectors*". The key informant suggested that "*the total number of inspectors is a far cry from the optimal figure required to ensure an effective inspection programme*". He compared this number to England which "*has a total of about 5000 environmental inspectors – about 2500% more*". The upshot of the shortfall in number of inspectors is that the authority is unable to effectively execute the broad functions and responsibilities prescribed under section 117 of the Environmental Management and Coordination Act.

Regarding prosecutions, the key informant conceded that "*they had not prosecuted any handlers of used lead-acid batteries for violating any provision governing the safe handling of ULABs*". The main reason has been "*a shortage of inspectors within national environment management authority*" who are the only staff mandated to institute prosecutions as provided under section 118 of the Environmental Management and Co-ordination Act, 1999.

[6] Ibid p.10
[7] Ibid p. 11

The key informant further disclosed that they "*have not conducted any programmes to enhance public awareness on the hazards of used lead-acid batteries*". He stated that "*whereas the national environment management authority is mandated to undertake, in co-operation with relevant lead agencies, programmes intended to enhance environmental education, public awareness and public participation, they have not undertaken any public awareness on the hazards of used lead-acid batteries due to budgetary constraints*".

Regarding environmental audits, the key informant confirmed that "*the handling of used lead-acid batteries through the collection, transportation, storage, disposal, and recycling constitutes activities that require environmental auditing*". "*However, due to staff shortage and budgetary constraints, the national environment management authority is not able to examine activities of ULAB handling enterprises to ascertain that their activities conform with the statements made in the environmental audit reports submitted to the authority*".

The key informant also highlighted other obstacles that impede effective enforcement and sanctioning of violations by lead acid-battery recyclers. Specifically, he mentioned "*inadequate technology, obstruction of inspectors in the course of carrying out inspections, inability of inspectors to make full use of the broad powers conferred by the Environmental Management and Coordination Act, lack of transparency by some recyclers as well as inadequate specialization among inspectors*".

He stated that "*used lead-acid battery is a unique sector which may require the use of sophisticated equipment to conduct analysis on some of the compliance measures put in place by the recyclers*". "*For example, inspectors may be required to analyze plants and soils and plants in and near the recycling facility to establish and detect the level of dust contamination*". "*The National Environment Management Authority does not have a laboratory to conduct these tests and in most cases, they must rely on an external laboratory to carry out analyses they require to undertake enforcement work*". Besides the lack of adequate equipment to conduct the relevant analyses, "*inspection of used lead-acid battery facilities requires specialized skill beyond basic skills held by a general environmental inspector*". "*Currently, none of the inspectors have undergone any special training to enable them to adequately monitor the activities of lead acid battery recycling facilities*".

Lack of transparency in the dealings by the battery recycling facilities is yet another obstacle hindering effective enforcement of violations of regulatory breaches. To support this point, the key informant referred to "*a lead-acid battery recycling Company in Nakuru County that had been closed for violating its regulatory obligations*". "*The company then purported to comply by changing its business to a timber processing enterprise but a subsequent inspection by the National Environment Management Authority revealed that the company had reverted to the lead-acid battery recycling business*".

Obstruction of inspectors is yet another problem that inspectors have had to contend with. The key informant intimated that "*there have been cases where some companies incite neighboring communities to picket on days when the inspectors are scheduled to conduct inspections*". "*In other cases, companies have craftily denied inspectors the access to crucial documents necessary for a full and effective inspection*". According to the key informant, "*the companies engage in these unlawful activities with the full knowledge that the Authority rarely invokes the prosecutorial powers for violations prescribed under section 118 on offences in relation to inspections*". Section 118 of the Environmental Management and Coordination Act confers inspectors with inter-alia, authority to prosecute subject to the directions and control of the Director of Public Prosecutions.

4.3 **Protection of safety, health, and welfare of workers handling ULABs**.

Regarding the obligation to protect the safety, health and welfare of workers handling used lead-acid batteries, the data collected from the surveys and in-depth interviews presents some concern.

Out of the scrap metal dealers surveyed, none of them provides safety information to their staff handling the used lead-acid batteries. 85% of them do not provide the safety information because they are not aware of any requirement to provide this information to their workers while the rest (15%) stated that they do not know where to obtain or how to develop the safety information material. Figure 8 below illustrates why the scrap metal dealers do not provide safety information to their staff who handle used lead-acid batteries.

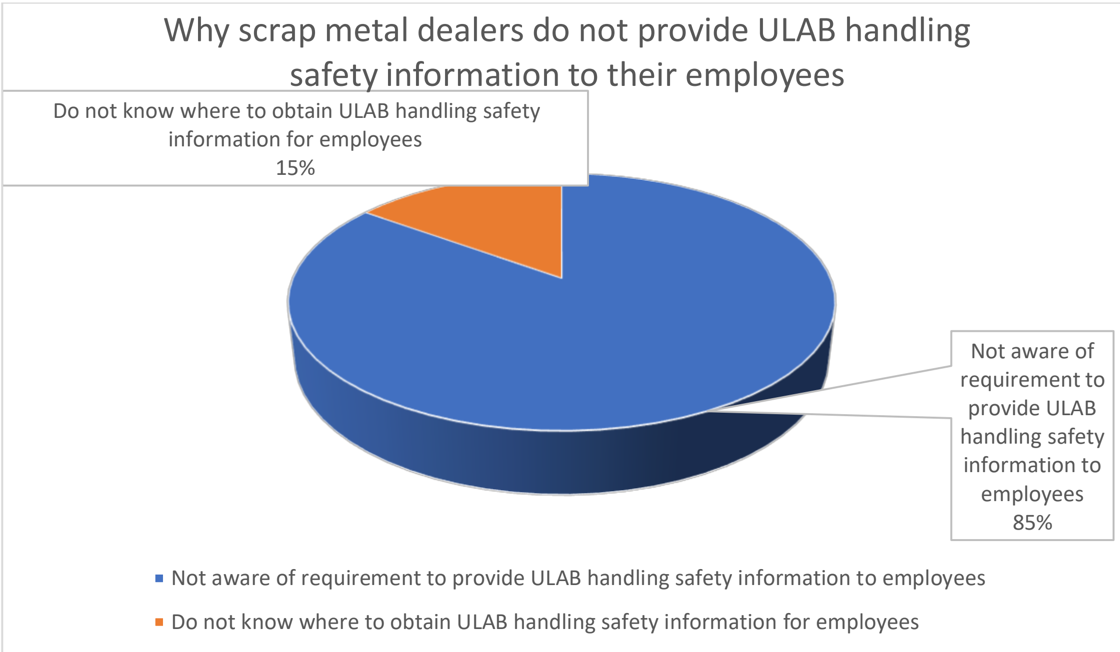

Fig. 8: Why collectors and transporters of ULABs do not provide ULAB handling safety information to their employees.

Source: Author

Furthermore, all the scrap metal dealers surveyed do not label or mark the used lead-acid batteries as hazardous because either they are not aware (60% of them) of any requirement to clearly label and mark the ULABs as hazardous or they have never been directed (40%) by any authority to label or mark the ULABs as hazardous . Figure 9 below is an illustration on why scrap metal dealers surveyed do not label or mark the used lead-acid batteries as hazardous.

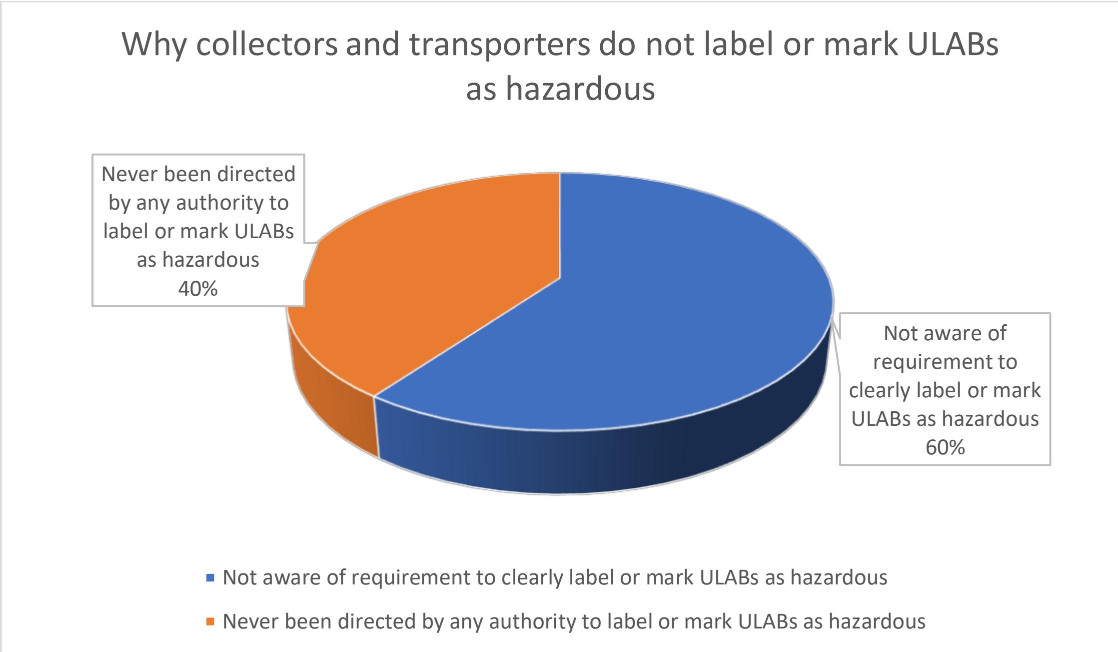

Fig. 9: Why collectors and transporters do not label or mark ULABs as hazardous.

Source: Author

Further, all the scrap metal dealers surveyed do not provide instructions for handling the battery contents safely, as well as precautions to take in the event of leakage or unintentional exposure to the ULAB contents. They gave the reason for not providing this information as either lack of awareness (80%) of any requirement to provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs or lack of knowledge of how to develop or where to obtain information to develop instructions for handling of the contents safely as well as actions that should be taken in the event of a spill or unintentional exposure to ULAB contents (20%). Figure 10 below provides an illustration on why scrap metal dealers do not provide instructions for the safe handling of the contents of ULABs.

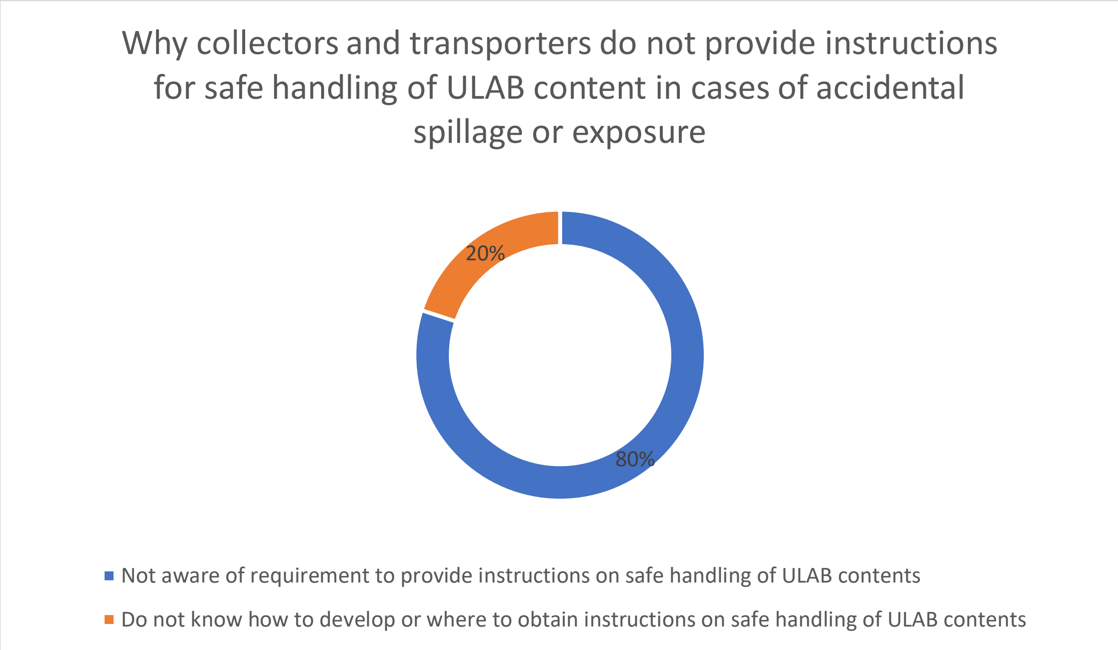

Fig. 9: Why collectors and transporters of ULABs do not provide instructions for safe handling of ULAB content in cases of accidental spillage or exposure.
Source: Author

Moreover, all the scrap metal dealers do not observe any occupational exposure limits related to lead and lead compounds. They gave the reason for not observing the occupational exposure limit as not being aware of any requirement to observe the occupational exposure limits related to lead and lead compounds.

On the question of undertaking periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries, the scrap metal dealers surveyed indicated that none of them undertakes this. This is because they are not aware of any requirement to undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries. It also emerged that none of the scrap metal dealers surveyed, conduct safety and health audits of their workplaces because they are not aware of any requirement to conduct a safety and health audit of the workplace.

On the other hand, information emerging from the in-depth interview with the key informant from the recycling company in relation to the protection of health, safety, and welfare of workers, was however encouraging. He indicated that "*workers at their recycling establishment were provided with safety information for handling the used lead-acid batteries*". Specifically, he stated that "*the whole factory has clear signage of areas handling hazardous material such as battery acid and lead*". In addition, "*the company has developed a safety manual for all workers handling used lead-acid batteries in the factory*". "*The safety manual contains information about how and where to drain the acid in the batteries, how and where to store the batteries delivered to the factory, the maximum number of batteries that can be stored at any given time, the use of personal protection equipment at all times while in the factory, restriction on eating and drinking in certain areas within the factory premises, daily hygiene measures such as showering at the end of the day and change of clothes and, handling of accidental spillages or emergencies that may occur at the factory premises*".

The key informant further disclosed that "*all the used lead-acid batteries entering their storage facility are clearly labelled and marked as hazardous and that they provide regular training for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the used lead-acid batteries*". In addition, he explained that "*the company has established occupational exposure limits related to lead and lead compounds at 15mg/m3 and that they do subject all employees handling used lead-acid batteries to periodic medical examination and surveillance*". "*They also conduct safety and health audit of the workplace every year*".

4.4 **Gaps in the regulatory framework governing ULAB handling**

Content analysis of the regulatory framework as well as in-depth interviews with enforcement officials from the national environmental management authority revealed useful information that could help address some of the weaknesses in the regulatory framework governing the handling of used lead-acid batteries in Kenya.

An analysis of the regulatory framework shows that the law prescribes a requirement for mandatory licensing for transporting, disposing, and recycling of used lead-acid batteries. There is however no requirement for a collector of ULABs or a person who stores the used lead-acid batteries to be licensed. The explanation could be that the discharge of the lead into the environment would ordinarily occur only during transportation, disposal, or recycling.

The regulatory framework clearly prescribes an obligation to adopt the best available technology in handling ULABs. Specifically, regulation 17 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 enjoins every trade or industrial undertaking to install at its premises anti-pollution technology for the treatment of waste emanating from such trade or industrial undertaking and that the Anti-pollution technology installed should be based on the best available technology not entailing excessive costs or other measures as may be prescribed by the Authority.

In addition, the regulatory framework prescribes collection, transportation, storage, and recycling standards for used lead-acid batteries. Specifically, regulation 24 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 prescribes standards for handling, storing, and transporting of hazardous waste while regulation 6 enjoins recyclers of used lead-acid batteries to adopt cleaner production principles in the recycling process.

Further, the regulatory framework makes it mandatory to undertake a Lead Recycling Plant Planning through Environmental Impact Assessments (EIA). Regulation 23 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 makes it mandatory for any person who engages in any activity likely to generate any hazardous waste such as lead waste to first obtain a valid environmental impact assessment licence issued by the national environment management authority before embarking on the activity.

Moreover, the regulatory framework prescribes obligations for ULAB handlers to develop and implement measures for pollution sources treatment and pollution prevention. It also prescribes environmental monitoring measures for ULAB handling establishments. In particular, regulation 18 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006, restrains owners or operators of a trade or industrial undertaking from discharging or disposing any waste in any state into the environment, unless the waste has been treated in a treatment facility and in a manner prescribed by the Authority in consultation with the relevant lead agency. Regulation 17 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006, on the hand enjoins owners and operators of trade or industrial undertakings to install anti-pollution technology based on the best available technology not entailing excessive costs or other measures as may be prescribed by the Authority.

In relation to employee safety, health and welfare, the regulatory framework prescribes an obligation for enterprises handling ULABs to provide health and safety information to employees, prescribes occupational lead exposure limits, prescribes lead poisoning preventive measures and, prescribes medical control measures for workers engaged in handling ULABs. Specifically, Section 84 of the Occupational Safety and Health Act, 2007 read with regulation 12 of the Factories and Other Places of Work (Hazardous Substances) Rules prescribes an obligation on the part of employers to provide safety information to employees handling hazardous substances such as lead. Section 88 of the Occupational Safety and Health Act, 2007 read with regulation 5 of the Factories and Other Places of Work (Hazardous Substances) Rules, 2007 prescribes occupational exposure limits related to lead and lead compounds. Section 103 of the Occupational Safety and Health Act 2007 read with regulation 19 of the Factories and Other Places of Work (Hazardous Substances) Rules and the Factories and Other Places of Work (Medical Examination) Rules, 2005 makes it mandatory for employers to undertake periodic medical examination and surveillance of employees engaged in the recycling of used lead-acid batteries while Section 11 of the Occupational Safety and Health Act 2007 read with regulation 13 of the Factories and Other Places of Work (Safety and Health Committees) Rules, 2004 obligates employers to cause a thorough safety and health audit of the workplace to be carried out at least once in every period of twelve months by a safety and health advisor.

However, the regulatory framework does not extend the responsibility of manufacturers of used lead-acid batteries to collect and recycle the batteries. Further, the framework does not contain any provision that would encourage or motivate consumers of lead-acid batteries to collect and return the batteries to the manufacturer or a recycler.

4.5 Conclusion

From the results of the study, awareness of the regulatory obligations and technological constraints constitute the greatest obstacles to the compliance with regulatory obligations relating to the handling of used lead-acid batteries. Inadequate enforcement also seems to play some role in non-compliance. In addition, there are a few gaps in the regulatory framework which if addressed, would enhance compliance with regulatory obligation relating to the handling of used lead-acid batteries.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study sought to identify the obstacles that hinder compliance with regulatory obligations relating to the handling of used lead-acid batteries in Kenya. Using Viwandani ward in Makadara sub-county in Nairobi City as the study area, the study examined factors that hinder handlers of used lead-acid batteries from preventing the release or discharge of lead particles into the environment. It further examined what prevents handlers of used lead-acid batteries from addressing the safety, health and welfare of workers engaged in the handling of used lead-acid batteries and it also analyzed the regulatory framework governing the handling of used lead-acid batteries to identify any gaps that could contribute to inadequate compliance with the regulatory obligations of ULAB handlers.

This chapter presents a summary of the findings and recommendations to enhance compliance with and the enforcement of regulatory obligations relating to the recycling of used lead-acid batteries.

5.2 Summary of Findings

Most handlers of used lead-acid batteries are not licensed to handle these batteries despite the fact the batteries consist of hazardous waste substances, contrary to the provisions of section 88 of the Environmental Management and Co-ordination Act, 1999 read together with regulation 7 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006. They do not obtain licenses due to lack of awareness of the requirement for a licence as well as inadequate enforcement by the regulatory authority to enforce licensing requirements.

Many of the handlers of used lead-acid batteries also do not segregate used lead-acid batteries from other wastes contrary to regulation 5 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 which requirement was promulgated pursuant to section 86(4) of the Environmental Management and Co-ordination Act, 1999. This is because of lack of awareness and inadequate enforcement by the regulatory authority of the requirement to separate ULABs from other wastes.

The study further found that transporters of used lead-acid batteries do not use vehicles with approved specifications from the national environment management authority to transport the batteries contrary to regulation 7 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006 . This is because they are not aware of the regulatory requirement to use vehicles with approved specifications. The transporters of ULABs also do not use scheduled routes to transport ULABs because they are not aware of a requirement to use scheduled routes to transport the batteries. In addition, the transporters do not maintain a tracking document while transporting the ULABs because they do not know of any obligation to maintain one. The respondents also revealed that they do not collect the ULABs from a designated place contrary to regulation 1(3) of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006. This is because they are not aware of any requirement to collect the ULABs from a designated place.

Concerning disposal of used lead-acid batteries, most motor vehicle owners dispose their used lead-acid batteries together with their household waste contrary to regulation 5 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006. They do this because they do not know of any designated ULAB collection centres or any other environmentally sound mode of disposal. However, many motor vehicle owners acknowledge that used lead-acid batteries can be dangerous to human health and the environment.

The study further found that the most common technology used to recycle used lead-acid batteries is the pyrometallurgy method which recovers metals such as lead using heat to bring about chemical and physical transformations. The best available environmental technology is the "*iono-metallurgical process*". However, the iono-metallurgical technology very expensive.

Used lead-acid battery recycling companies have the capacity to install anti-pollution equipment based on the best practicable means to prevent the discharge of lead into the environment during the recycling of ULABs. They also conduct annual environmental audits as prescribed in the legal framework and they observe the licensing and permitting requirements.

Results of the study also revealed inadequate enforcement of obligations to prevent lead discharge into the environment. The inadequate enforcement is attributable to insufficient staff, budgetary constraints, inadequate technology and equipment, inability of enforcement officials to make full use of the broad powers conferred by the Environmental Management and Coordination Act, lack of transparency by some recyclers as well as inadequate specialization among inspectors.

Regarding the obligation to protect the safety, health and welfare of workers handling used lead-acid batteries, scrap metal dealers handling used lead-acid batteries do not provide safety information to their staff in direct contravention of Section 84 of the Occupational Safety and Health Act, 2007 read with regulation 12 of the Factories and Other Places of Work (Hazardous Substances) Rules. This is because they are not aware of any requirement to provide this information to their workers and, they do not know where to obtain or how to develop the safety information material. Moreover, scrap metal dealers handling used lead-acid batteries do not label or mark the used lead-acid batteries as hazardous contrary to regulation 24 of the Environmental Management and Co-ordination (Waste Management) Regulations, 2006. This is because either they are not aware of any requirement to clearly label and mark the ULABs as hazardous and they have never been directed by any authority to label or mark the ULABs as hazardous.

Further, all the scrap metal dealers handling used lead-acid batteries do not provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs as prescribed in Section 84 of the Occupational Safety and

Health Act, 2007 read with regulation 12 of the Factories and Other Places of Work (Hazardous Substances) Rules 2007. This is because they do not know of any requirement to provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs and, they also lack of knowledge of how to develop or where to obtain information to develop instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs. The scrap metal dealers handling used lead-acid batteries do not observe any occupational exposure limits related to lead and lead compounds contrary to section 88 of the Occupational Safety and Health Act, 2007 read with regulation 5 of the Factories and Other Places of Work (Hazardous Substances) Rules, 2007 . Again, this is because they do not know of any requirement to observe the occupational exposure limits related to lead and lead compounds.

It further emerged that the scrap metal dealers handling used lead-acid batteries do not undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries in direct contravention of section 103 of the Occupational Safety and Health Act 2007 read with regulation 19 of the Factories and Other Places of Work (Hazardous Substances) Rules and the Factories and Other Places of Work (Medical Examination) Rules, 2005. This is because they do not know of any requirement to undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries. Moreover, they do not conduct safety and health audits of their workplaces as prescribed in section 11 of the Occupational Safety and Health Act 2007 read with regulation 13 of the Factories and Other Places of Work (Safety and Health Committees) Rules, 2004. This is because they are not aware of any requirement to conduct a safety and health audit of the workplace.

Companies that recycle used lead-acid batteries on the other hand, provide workers at their recycling establishment with safety information for handling the used lead-acid batteries. They issue safety manuals and train their employees on safety measures for recycling the batteries. They have also established occupational exposure limits related to lead and lead compounds and further subject all employees handling used lead-acid batteries to periodic medical examination and surveillance. They also conduct safety and health audit of the workplace every year.

Concerning the regulatory framework, it emerged that whereas Kenya's regulatory framework incorporates best practices as derived from the Basel Convention's guidelines on the environmentally sound management of used lead-acid batteries, there are a few gaps that call for some attention. First, whereas the regulatory framework clearly prescribes an obligation to adopt the best available technology in handling ULABs as well as an obligation to install anti-pollution technology based on the best available technology not entailing excessive costs or other measures as may be prescribed by the Authority, the framework does not prescribe any incentives to encourage or motivate the adoption of such technology.

The framework further does not contain any provision extending the responsibility of producers to collect and recycle the batteries which would encourage or motivate consumers, collectors and recyclers of lead-acid batteries to collect and return the batteries to the manufacturer or a recycler.

5.3 Conclusions and recommendations

From the findings of the study, awareness of the regulatory obligations constitutes the greatest obstacle to compliance with regulatory obligations by handlers of used lead-acid batteries. This is also consistent with previous studies which have shown that inadequate awareness of regulatory requirements is an impediment to the capacity of supervisors in minor and average-sized establishments to embrace environmentally responsible business approaches and practices[1]. It is also consistent with studies that have found that sufficient staff awareness of the necessity and effect of complying with regulatory requirements can diminish mishaps and instances of breaching environmental rules and regulations[2].The national environment management authority pursuant to its mandate under section 9(2)(m) of the Environmental Management and Coordination Act, 1999 may wish to consider developing and rolling-out a programme to sensitize handlers of used lead-acid batteries such as scrap metal dealers, owners of motor vehicles and recyclers of used lead-

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[1] Ahorbo, G. (2014) *Business Drivers for Environmental Regulations Compliance in Ghana's Mining Sector*. Minneapolis, Walden University

[2] ibid

acid batteries about the hazards of these batteries as well as environmentally sound ways of collecting, transporting, disposing and recycling of the ULABs.

Technological constraint is yet another significant contributor to non-compliance with regulatory obligations relating to the handling of used lead-acid batteries. This is consistent with previous studies on compliance with environmental obligations which have shown that companies do not comply with environmental regulations because they lack the technological know-how to take desired actions and they should therefore be provided with technical assistance to be able to comply with their regulatory obligations. Since environmental regulatory programs typically require significant capital expenditures for technologically complex pollution control equipment, the government in collaboration with industry stakeholders may wish to address deficits through various approaches including site visits, hotlines and awareness raising through print or electronic source materials[3]. Moreover, motivational measures to adopt the best available environmental could also be enacted to introduce tax incentives and subsidies to enhance compliance.

Inadequate enforcement also plays a role, though a minor one, towards increasing non-compliance with regulatory obligations by handlers of used lead-acid batteries. Again this affirms previous studies that have found that enforcement plays a critical role in shaping behaviours of the regulated community especially to the extent that breaches will be detected, and sanctions will be applied when breaches are detected[4]. Violations may therefore be deterred by increasing the punishment, augmenting monitoring actions to boost probability that the violator will be apprehended or, altering the laws to enhance the chances of conviction[5]. There must however be a credible prospect of discovering violations; rapid, definite, and apt punishment on discovery and a view among the Regulatees that detection and the possibility of punishment are present[6]. Enhancing effectiveness of the regulator through frequent inspections; thoroughness of the inspections; likelihood of

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[3] Ibid

[4] May, P.J (2004) Compliance Motivations: Affirmative and Negative Bases, 38 Law & Soc'y Rev. 41, 68 (2004)

[5] ibid

[6] Silberman, J.D (2000) *Does Environmental Deterrence Work? Evidence and Experience Say Yes, But We Need to Understand How and Why*, 30 ELR 10523

sanctions; consistency in inspection practices and enforcement styles of inspectors is therefore likely to produce greater compliance with regulatory obligations[7].

Some gaps in the regulatory framework could also be augmenting non-compliance with regulatory obligations by handlers of used lead-acid batteries in Kenya. Reviewing the regulatory framework to prescribe incentives to encourage or motivate the adoption of the best available technology for handling used lead-acid battery would be a significant step. Prescribing tax reprieves and subsidies for enterprises that adopt the best available environmental technologies would also go a long way towards removing obsolete and polluting technology in the ULAB recycling sector.

Enacting legal provisions that make it mandatory for producers to take back and recycle ULABs at the end of their useful life and that creates incentives for consumers to return ULABs to producers for recycling would also increase levels of compliance with regulatory obligations relating to the handling of used lead-acid batteries. This is the approach adopted in the laws of the more advanced countries which have placed a key focus on regulating the use of hazardous substances such as used lead-acid batteries[8]. Specifically, this has involved extending the responsibility of producers to reduce the immediate environmental impact of the product by mitigating the products' harm at its end of useful life and, increasing recycling efficiencies[9]. Extending the producers' responsibility passes responsibility for the whole life-cycle of a product away from municipalities and transfers it to the producer of the targeted product[10].

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[7] Environmental Working Group, Prime Suspects: The Law-breaking Polluters America fails to Inspect 3 (2000) available at http://www.ewg.org/pub/home/reports/primesuspects/index.html

[8] Ahuja, J., Dawson, L., & Lee, R. (2020). A circular economy for electric vehicle batteries: Driving the change. Journal of Property, Planning and Environmental Law, 12(3), 235-250.

[9] ibid

[10] ibid

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ANNEX 1(a)

QUESTIONNAIRE FOR SCRAP METAL DEALERS

A. Obligation to prevent release or discharge of lead into the environment during the handling of ULABs.

1. (a) Do you have a license to collect and transport ULABs?

   Yes [ ] No [ ]

   (b) If you do not have a license to collect and transport ULABs, why don't you have one? obtaining one

   [ ] We are not aware of the requirement for a license

   [ ] We have never been requested to produce a license for collecting or transporting ULABs

   [ ] Others, (please specify)

   …………………………………………………………………………………………………

2. (a) When collecting the ULABs, do you segregate the ULABs from other wastes?

   Yes [ ] No [ ]

   (b) If you do not segregate the ULABs from other wastes, what prevents you from doing so?

   [ ] We are not aware of a requirement to segregate

   [ ] We do not know how to segregate

   [ ] We have never received a directive from any authority to segregate

   [ ] Others, (please specify)

   …………………………………………………………………………………………………

3. (a) If you transport ULABs, do you use a vehicle with approved specifications from NEMA?

   Yes [ ]   No [ ]

   (b) If you do not use a vehicle with approved specifications from NEMA, what prevents you from using one?

   [ ] We are not aware of a requirement to use a vehicle with approved specifications from NEMA

   [ ] We have never received a directive from NEMA or any authority to use a vehicle with approved specifications

   [ ] We are not able to obtain a vehicle with the approved specifications

   [ ] Others, (please specify)

   ……………………………………………………………………………………….

4. (a) Do you collect and/or deliver the ULABs from and/or to a designated place?

   Yes [ ]   No [ ]

   (b) If not, what prevents you from collecting and/or delivering the ULABs from and/or to a designated place

   [ ] We are not aware of any requirement to collect and/or deliver the ULABs from and/or to a designated place

   [ ] We do not know how to develop a mechanism for collecting and/or delivering the ULABs from and/or to a designated place

   [ ] We have never been directed by NEMA or any other authority to collect and/or deliver the ULABs from and/or to a designated place

   [ ] Others, (please specify)

5. (a) Do you use scheduled routes to transport ULABs? Yes [ ] No [ ]

   (b) If not, what prevents you from using a scheduled route to transport ULABs?

   [ ] We are not aware of any requirement to use a scheduled route to transport ULABs

   [ ] We have never been directed by NEMA or any other authority to use a scheduled route to transport ULABs

   [ ] We are not able to design a scheduled route for transporting ULABs

   [ ] Others, (please specify)

   …………………………………………………………………………………………

6. (a) Do you maintain a tracking document while transporting the ULABs?

   Yes [ ] No[ ]

   (b) If not, what prevents you from maintaining a tracking document while transporting the ULABs?

   [ ] We are not aware of any requirement to maintain a tracking document while transporting the ULABs

   [ ] We have never been directed by NEMA or any other authority to maintain a tracking document while transporting the ULABs

   [ ] We are not able to design or develop a tracking document while transporting the ULABs

   [ ] Others, (please specify) ……………………………………………………….

B. Obligation to protect the safety, health, and welfare of workers handling ULABs.

7. (a) Do you provide safety information to your workers handling ULABs?

   Yes [ ] No [ ]

(b) If you do not provide safety information to your workers handling ULABs, what hinders you from doing so?

[ ] Not aware of any requirement to provide safety information

[ ] Do not know where to obtain or how to develop the safety information material

[ ] have never been directed by any authority to provide safety information

[ ] Other, (please specify) …………………………………………………………..

8. (a) Do you ensure that the ULABs are clearly labeled and marked as hazardous?

Yes [ ] No [ ]

(b) If not, why don't you clearly label and mark the ULABs as hazardous?

[ ] Not aware of any requirement to clearly label and mark the ULABs as hazardous

[ ] Do not know how to label or mark the ULABs as hazardous

[ ] Never been directed by any authority to label and mark the ULABs as hazardous

[ ] Other, (please specify) …………………………………………………………..

9. (a) Do you provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs?

Yes [ ] No[ ]

(b) If you do not provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs, what prevents you from doing so?

[ ] Not aware of any requirement to provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs

[ ] Do not know how to develop or where to obtain information to develop instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs

[ ] Never been directed by any authority to provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the contents of ULABs

[ ] Other, (please specify) …………………………………………………………..

10. (a) Do you observe the occupational exposure limits related to lead and lead compounds?

Yes [ ] No[ ]

(b) If you do not observe the occupational exposure limits related to lead and lead compounds, what prevents you from doing so?

[ ] Not aware of any requirement to observe the occupational exposure limits related to lead and lead compounds

[ ] Do not know how to develop a mechanism for observing the occupational exposure limits related to lead and lead compounds

[ ] Never been directed by any authority to observe the occupational exposure limits related to lead and lead compounds

[ ] Other, (please specify) …………………………………………………………..

11. (a) Do you undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries?

Yes [ ] No[ ]

(b) If you do not undertake periodic medical examination and surveillance of your employees handling ULABs, what prevents you from doing so?

[ ] Not aware of any requirement to undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries

[ ] Do not know how to develop a mechanism to undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries

[ ] Never been directed by any authority to undertake periodic medical examination and surveillance of employees engaged in the handling of used lead-acid batteries

[ ] Other, (please specify) …………………………………………………………..

12. (a) Do you conduct a safety and health audit of the workplace?

Yes [ ] No[ ]

(b) If yes, how frequent do you conduct the safety and health audits?

[ ] At least once every 12 months

[ ] At least once every 2 years

[ ] Others, (please specify)

(c) If you do not conduct a safety and health audit of the workplace, what prevents you from conducting the audit?

[ ] Not aware of any requirement to conduct a safety and health audit of the workplace

[ ] Do not know how to conduct a safety and health audit of the workplace

[ ] Never been directed by any authority to conduct a safety and health audit of the workplace

[ ] Other, (please specify) …………………………………………………………..

ANNEX 1(b)

QUESTIONNAIRE FOR MOTOR VEHICLE OWNERS

1. Whenever you need to replace the lead-acid battery in your motor vehicle, how do you get rid of the used one?

   [ ] I dispose it together with my household waste

   [ ] I leave it at the motor vehicle service station where I purchase a new one

   [ ] I deliver it to a designated used lead-acid battery collection centre

   [ ] Others, (please specify) ………………………………………………………………

2. If you dispose of your used lead-acid battery together with your house-hold waste, why do you do this?

   [ ] I do not know of any other way to get rid of the used battery

   [ ] I do not know of any designated used lead-acid battery collection centre

   [ ] Others, (please specify)

   ……………………………………………………………………………………………………
   …….

3. (a) Do you think used lead-acid batteries can be dangerous to human health or the environment?

   Yes [ ]

   No [ ]

   Not sure/don't know [ ]

(b) If yes, briefly explain how the ULABs can endanger human health and the environment.

…………………………………………………………………………………………………
………………………………………………..

4. How in your view, can the relevant authorities improve the way in which you dispose a ULAB so that it does not pose a danger to human health and the environment?

   [ ] By designating ULAB collection centres

   [ ] By sensitizing motor vehicle owners on the dangers of improperly disposing ULABs

   [ ] By making it mandatory for motor vehicle owners to deliver ULABs at designated collection centres

   [ ] By creating a system that pays a small fee to those that deliver ULABs to designated collection centres.

   [ ] Others, (please specify) ………………………………………………………………

Annex 2(a)

INTERVIEW SCHEDULE

KEY INFORMANT ASSOCIATED BATTERIES MANUFACTURERS LIMITED

A. Obligation to prevent release or discharge of lead into the environment during recycling of ULABs.

1. What technology do you use to recycle ULABs?

2. Is this the best available technology?

3. If this is not the best available technology, what prevents you from using the best available technology for the recycling of ULABs?

4. Have you installed anti-pollution equipment based on the best practicable means to prevent the discharge of lead into the environment during the recycling of ULABs?

5. If you have not installed the anti-pollution equipment in 4 above, what has prevented you from installing such equipment?

6. Do you conduct annual environmental audits?

7. If you do not conduct annual environmental audits, what prevents you from carrying out the same?
8. Do you have a license to engage in the recycling of ULABs?

9. If you do not have a license to engage in the recycling of ULABs, what has prevented you from taking out one?

B. Obligation to protect the health, safety and welfare of workers engaged in the recycling of ULABs.

10. Do you provide safety information to the workers engaged in the recycling of ULABs? If you do not, what prevents you from doing so?

11. Do you clearly label and mark the used lead-acid batteries as hazardous? If, not, what prevents you from doing so?

12. Do you provide instructions for the safe handling of the contents as well as measures to be taken in case of spillage or accidental exposure to the used lead-acid batteries? If not, what prevents you from providing the instruction?

13. Have you established occupational exposure limits related to lead and lead compounds? If, so, how do you the observation of the occupational exposure limits

14. Do you subject your employees engaged in the recycling of used lead-acid batteries to periodic medical examination and surveillance? If not, what prevents you from doing the same?

15. Do you conduct safety and health audit of the workplace? If so, how often do you conduct the safety and health audit? And who conducts the safety and health audit?

16. What other challenges do you face while recycling ULABs?

Annex 2(b)

INTERVIEW SCHEDULE

CHIEF ENFORCEMENT OFFICER, NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY – KENYA

INSPECTIONS

1. How often do you inspect ULAB handling establishments for compliance with their regulatory obligations?

2. What prevents you from conducting regular inspections of ULAB handling establishments to ascertain compliance with their regulatory inspections?

PROSECTIONS

3. Have you instituted any prosecution against any handlers of ULABs for violating any provision governing the safe handling of ULABs?

4. If you have instituted any prosecutions against any handlers of ULABs for violating any provision governing the safe handling of ULABs, what challenges have you faced in the prosecution process?

5. If you have not instituted any prosecutions against any handlers of ULABs for violating any provision governing the safe handling of ULABs, what has prevented you from instituting the prosecutions?

INVESTIGATIONS

6. Have you instituted any investigations against any handlers of ULABs for violating any provision governing the safe handling of ULABs?

7. If you have instituted any investigations against any handlers of ULABs for violating any provision governing the safe handling of ULABs, what challenges have you faced in the investigation process?

8. If you have not instituted any investigations against any handlers of ULABs for violating any provision governing the safe handling of ULABs, what has prevented you from instituting the investigations?

PUBLIC AWARENESS

9. Have you conducted any programmes to enhance public awareness on the hazards of ULABs?

10. If you have not conducted any programmes to enhance public awareness on the hazards of ULABs, what has prevented you from doing this?

ENVIRONMENTAL AUDITING

11. Is ULAB handling one of the activities that requires environmental auditing?

12. Have your environmental inspectors examined activities of any ULAB recycling enterprise to ascertain whether their activities conform with the statements made in the environmental audit reports?

Annex 3

Content Analysis Schedule

	Issue	Finding	Comment
1.	Whether the regulatory framework prescribes mandatory licensing for the handling of ULABs		
2	Whether the regulatory framework prescribes an obligation to adopt the best available technology in handling ULABs		
3	Whether regulatory framework prescribes an extended producer responsibility		
4	Whether regulatory framework prescribes collection, transportation, storage, and recycling standards		
5	Whether regulatory framework prescribes an obligation for enterprises handling ULABs to provide health and safety information to employees		
6	Whether regulatory framework encourages or motivates the participation of consumers in the ULAB collection process		
7	Whether regulatory framework prescribes for a Lead Recycling Plant Planning through Environmental Impact Assessments (EIA)		
8	Whether regulatory framework prescribes obligations for ULAB handlers to develop and implement Pollution Sources		

	Treatment and Pollution Prevention measures		
9	Whether regulatory framework prescribes environmental monitoring measures for ULAB handling establishments		
10	Whether regulatory framework prescribes lead exposure limits		
11	Whether regulatory framework prescribes lead poisoning preventive measures		
12	Whether regulatory framework prescribes medical control measures for workers engaged in handling ULABs		
13	Whether regulatory framework prescribes adequate enforcement measures		