

A REVIEW OF ELECTRONIC WASTE MANAGEMENT

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ABSTRACT

Electronic waste or e-waste deals with discarded electrical or electronic devices. The utilized electronics which are destined for refurbishment, reuse, resale. E- waste management is the process of treating e –waste offers solution for recycling. With rapid increase in development of electronic industries the old generating devices are put in the e-waste category. In today's era the fastest growing global production of electrical and electronic devices has resulted in generation of large amount of waste electric and electronic equipment. E-waste can be reduced by 3Rs approach which includes reduce, reuse and recycle. Considering e-waste to be such a critical issue in recent times the present study was undertaken. E-waste is also having impacts on the environment and human health, if not properly managed. There is an urgent need for its proper disposal.

Key words: E-waste management, impact on environment and human health, 3Rs approach

INTRODUCTION

Nowadays the fastest growing waste streams in the world are generation of E-waste .As population of the world has increased the consumption of electronic equipments in business and domestic sectors have led to the generation of large quantities of E-waste. Even the developing and under developing countries are struggling with e-waste. India is one of the fastest growing economies in the world. This is due to rapid technological advancements, demand from the IT sector and also high consumption of electronic and electrical equipment's. Since last few years the electronics industry has brought a revolution because of its massive use in our day-to-day life. After utilizing of these electronic products, they are discarded or reused which then falls under the category of Electronic Waste (E-waste). Managing E-waste is more complex and challenging nowadays as compared to other traditional waste. Unlike other waste, Electronic waste includes discarded computers, office electronic equipment, entertainment device, television sets, refrigerators, mobile phones, laptops, tablets etc. Tanvi Pradhan(2013) studied E-waste generation and management in India . Utilization of reconfigurable recycling systems for improved material recovery from e-waste was reported by Barwod etal(2015).Sinha etal.(2015) conducted a study on waste electrical and electronic equipment the EU and India sharing best practices. A review paper on E-waste technology was carried out by Vijayvargiya and Sahu (2016).Management of electrical and electronic waste a comparative evaluation of China and India was reported by Awasthi & Li (2017). E-waste management a study on legal framework and institutional preparedness in Bangladesh was carried out by Rahman (2017). A short-review was carried out by Awasthi etal. (2018) on Environmental pollution and human body burden from improper recycling of e-waste in China. Fu et.al. (2018) studied E-waste recycling in China: A challenging field. Garg and Adhana(2019) conducted a study on E-waste management in India with reference to current scenario. Halim and Suharyanti (2019) explained study on E-waste current research and future perspective on developing countries. Ecological risk assessment of arsenic, cadmium, copper, and

lead contamination in soil in e-waste separating household area, Buriram province, Thailand was made by Amphalop et al.(2020). Gollakota et al. (2020) explained inconsistencies of e-waste management in developing nations- facts and plausible solutions. Islam et al. (2020) made a review on advances in sustainable approaches to recover metals from e-waste. Leclerc, & Badami (2020) studied extended producer responsibility for E-waste management policy drivers and challenges. Recycling Potential of E-Waste for Jammu City was reported by Rabani and Thakur(2020). Abalansa et al.(2021) studied Electronic Waste, an Environmental Problem Exported to Developing Countries: The GOOD, the BAD and the UGLY .Adam et al.(2021) explained from inequitable to sustainable e-waste processing for reduction of impact on human health and the environment. E-waste management for environmental sustainability an exploratory study was conducted by Mor et al.(2021). E-waste: an emerging threat to one health was reported by Kumar and Gupta (2021). Shahabuddin et al.(2022) carried out a review of the recent development, challenges and opportunities of electronic waste (e-waste).

CATEGORIES OF E-WASTE

The electrical and electronic equipments can be broadly categorized into following categories:

- Large household appliances includes refrigerators/freezers, washing machines, dishwashers etc.
- Small household appliances which include toasters, coffee makers, irons, hairdryers, vacuum cleaners, watches, grinders
- Information Technology (IT) and Telecommunications equipment namely personal computers, televisions, telephones, mobile phones, laptops, printers, scanners, photocopiers etc.
- Lighting equipment such as fluorescent lamps, sodium lamp, AC, coolers etc.
- Electronic or Electrical tools i.e. handheld drills, saws, sewing machine etc.
- Toys, leisure and sports equipment i.e. Video games, electric trains etc.
- Monitoring and control instruments i.e. smoke detector, heating regulators, thermostat etc.
- Automatic dispensers.
- Medical devices like radiotherapy equipment, cardiology, dialysis, CT scan machine, MRI etc.
- IT and Telecom equipments like computers, laptops, tablets and the systems used in the BPO call centres
- Large household appliances like washing machines, microwave ovens ,refrigerators, television etc
- Small household appliances like PC's, mobile phones, MP3 players, I-Pods, Tablets etc
- Consumer and lighting equipments like bulbs, CFL, fluorescent tube lights.

Causes of E-Waste

The main causes of Electronic Waste are:

- Advancement in Technology.
- Changes in style fashion and status.
- End of their helpful life.
- Not taking precautions while handling them.

Composition of E-Waste

Composition of E-waste includes materials like:

- Valuable metals like gold, platinum, silver and palladium.
- Useful metals like copper, aluminium iron etc.

- Hazardous substances like radioactive isotopes and mercury.
- Toxic substances like PCB's and Dioxins.
- Plastic like High Impact Polystyrene (HIPS), Acrylonitrile Butadiene Styrene (ABS), Polycarbonate (PC), Polyphenylene oxide (PPO) etc.
- Glass material like Cathode Ray Tube glass made up of SiO₂, CaO and Na.
For instance, a mobile phone contains more than 40 elements, base metals such as Copper (Cu) and Tin (Sn), special metals such as Lithium (Li), Cobalt (Co), Indium (In) and Antimony (Sb) and precious metals such as Silver (Ag), Gold (Au), and Palladium (Pd).

HAZARDS ASSOCIATED WITH E-WASTE

It has seen that WEEE should not be combined with unsorted municipal waste for landfills because they may contain thousand different substances out of which many are toxic including lead, mercury, arsenic, cadmium, selenium and hexavalent chromium. Some of the toxic effects of the heavy metals are discussed below.

Lead (Pb) is one of the major and typical heavy metal pollutants of e-waste, particularly enriched in circuit boards, cathode-ray tubes, solder, and batteries. Average Lead in computers- 1.72 kgs , can be up to 2-3 kg of each CRT , in solder. , Lead sulphate stabilizer in PVC sheathing for cables and wires, 0.3% by weight of lead in mobile phones (Average weight- 125gms)

Mercury- Mercury can be found in fluorescent tubes, switches in thermostats, older computers, batteries and more. When electronic waste containing mercury is sent to landfill sites or is burned in incinerators or opens burning, mercury is released into the environment. 13.6tons of mercury are released as emissions during e-waste recycling every year.

Arsenic- Arsenic can be found in circuit boards, semiconductors, LCD displays, computer chips and more and when these items are send to landfills, arsenic can leach into the soil and the groundwater. When Arsenic is burned either in incinerator or in informal recycling centres it can enter the atmosphere. Workers close to recycling plants in informal recycling areas can also be exposed to arsenic

Cadmium – Batteries 81% of the total cadmium consumption in batteries – SMD chip resistors, infrared detectors and semiconductors. Cadmium is used in rechargeable computer batteries, contacts and switches. Burning or dismantling of cadmium products such as batteries, PCBs, CRT glass, toners, plastics and infrared detectors can lead to cadmium dust or ash in the air. Some 36,000tons of cadmium are emitted during e-waste processing yearly. Cadmium from recycled electronic batteries can be recycled into new batteries.

Chromium- Chromium can be found in data tape, floppy discs, and is used for coating and plating in many electronics to prevent rut. 198,000tons of chromium are produced as emissions in electronics, Chromium (III) and Chromium (VI) are used in chrome plating and Chromium (VI) is used as coating to prevent corrosion.

The dumping of e-waste in open grounds can release harmful toxins causing serious health issues to the e-waste collectors and toxic pollution to the environment. These toxins can also affect the soil; thereby affect the lives of humans and animals. These toxic chemicals can also penetrate into ground water and cause serious water pollution issues. These toxins can cause defects in the kidney, liver, heart and skin and bone damage. They are also known to have serious effects on the nervous and reproductive systems of the human body. The burning of computer boards and cells can produce very harmful toxins which can lead to cancerous disease. Poisonous materials harm the ecosystem, including plants, trees and animals.

IMPACT OF E –WASTE ON THE ENVIRONMENT

E-waste as is toxic, is not biodegradable and readily accumulates in the environment, soil and water contamination, air pollution and has impact on all the living things. E –waste in open-air burning and acid baths being used to recover valuable materials from electronic components release toxic materials leaching into the environment. Poor E-waste management contributes to climate change and directly affects many ecosystem and species.

METHODS OF TREATMENT AND DISPOSAL OF E-WASTE

Nowadays E-waste is challenging because the discarded electronic products comprise of various proportions of glass plastic and metal. The recycling process of e-waste differs with respect to the material and technology employed

Land Filling

This is the most common method of electronic waste disposal. The land filling process includes the following steps: Excavation of trenches, burying e-waste in pits, covering such pits by layers of earth. The e-waste is built on flat land and the pits are pressed into the soil by putting the e-waste in it.

Incineration

A controlled combustion process wherein e-waste is burned in an incinerator unit around 900 degrees to 10,000 degrees Celsius. Incineration helps in converting hazardous substances into lesser hazardous compounds/substances. Due to this the quantity of e-waste is reduced considerably and the toxicity of the organic substance present in it is reduced significantly

Metal recovery by acid

Different types of parts like ferrous and non-ferrous metal and printed circuit boards are separated by electronic waste. Different types of metals like lead, copper, aluminium, silver, gold, platinum, etc. are used for the recovery of metals by using concentrates. Residue plastic waste is recycled for reuse.

Reuse

Old electronic devices are repaired and made for reuse. Such as computers, mobiles, laptops, inkjet cartage, inverter, television / LCD, UPS, printers, etc. can be properly reused and reused. So, by implementing above mention ways you can easily dispose of, recycle & reused your e-waste efficiently which not only helps you to reuse but also helps to keep the environment clean & safe.

Reduce

Donate or Sell Working Electronics. Consume Less. Use Your Old Mobile Phone for Music or GPS. Recycle via a Retailer. Donating or selling working electronics helps to reduce e-waste.

Recycling

A process of dismantling as in the discarding of numerous parts of electronic waste containing hazardous substances such as Printed circuit boards, plastics, discarding of CRT, segregation of non-ferrous, mobile phones, hard drives, fax machines, wires and memory chips can be recycled. Devices such as electronic waste, monitors, picture tubes, laptops, keyboards, telephones, hard drives, CD drives, fax machines, printers, CPUs, modem cables etc. can be recycled. In this process, various metals and plastics are sabotaged separately and preserved for reuse.

Conclusion: The study concludes that e-waste is hazardous to human health and the environment and needs proper treatment to achieve environmental sustainability. Remember, every time you buy an electronic device, it is your responsibility to dispose or recycle your old one properly. Each department that produces hazardous waste needs to plan training programs under the coordination

of the e-waste management committee formed at a higher level. Certain principles should be laid down for dumping e-waste. Using recycled material will also help reduce greenhouse gas emissions when new products known as “virgin material” are manufactured or processed. Electronic devices refurbished, reused and donated to a worthy cause can also be kept out of landfills. Just like garbage collection, there should be separate e-waste collect drive or resale of old products which will help users in reducing e-waste within the country and reduce its harsh effects consistently. However one must take responsibility and understand the use of these products and the harmful effects of recklessly dumping e-waste. Improper e-waste disposal can be harmful to both the environment and humankind. So, understanding the issues and solutions to the growing E-waste are vital.

REFERENCES

Adam, B., Goen, T., Scheepers, P. T. J., Adliene, D., Batinic, B., Budnik, L. T. & Wau, W. W. (2021). From inequitable to sustainable e-waste processing for reduction of impact on human health and the environment.

Environmental Research, 194, 110728. <https://doi.org/10.1016/j.envres.2021.110728>

Aditya Vijayvargiya, Mr. Kapil Sahu(2016) :A Review Paper on “E-Waste” Technology, International Journal of Engineering Research & Technology (IJERT) (Volume 4 – Issue 32) DOI : 10.17577/IJERTCONV4IS32007

Amphalop, N., Suwantarat, N., Prueksasit, T., Yachusr, C., & Srithongouthai, S. (2020). Ecological risk assessment of arsenic, cadmium, copper, and lead contamination in soil in e-waste separating household area, Buriram province, Thailand. Environmental Science and Pollution Research, 27, 44396-44411. <https://doi.org/10.1007/s11356-020-10325-x>

Atul Kumar and Varun Gupta(2021) E-waste: an emerging threat to one health In book: Environmental Management of Waste Electrical and Electronic Equipment (pp.49-61) Edition: 1st Chapter: 3 Publisher: Elsevier April DOI:[10.1016/B978-0-12-822474-8.00003-9](https://doi.org/10.1016/B978-0-12-822474-8.00003-9)

Awasthi, A. K., & Li, J. (2017): Management of electrical and electronic waste: A comparative evaluation of China and India. Renewable and Sustainable Energy Reviews, 76, 434-447.

Awasthi, A.K., Wang, M., Awasthi, M. K., Wang, Z., and Li, J. (2018). Environmental pollution and human body burden from improper recycling of e-waste in China: A short-review. Environmental Pollution, 243, Part B, 1310-1316

Barwod, M., Li, J., Pringle, T., and Rahimifard, S. (2015). Utilisation of reconfigurable recycling systems for improved material recovery from e-waste. Procedia CIRP, 29, 746-751

Dr. Neha Garg and Deepak Kumar Adhana (2019) E-waste management in India: a study of current scenario.

International Journal of Management, Technology And Engineering Volume IX, Issue I,
January/2019 ISSN NO: 2249-7455 Page No: 2791-2803

Fu, J.; Zhang, H.; Zhang, A.; Jiang, G. (2018) E-waste recycling in China: A challenging field.
Environ. Sci. Technol., 52, 6727–6728.

Gollakota, A. R., Gautam, S., & Shu, C. M. (2020). Inconsistencies of e-waste management in developing nations- facts and plausible solutions.
Journal of Environmental Management, 261, 110234.

Islam, A., Ahmed, T., Awual, M. R., Rahman, A., Sultana, M., Abd Aziz, A., & Hasan, M. (2020). Advances in sustainable approaches to recover metals from e-waste- a review.
Journal of Cleaner Production, 244, 118815.

L.Halim and Y. Suharyanti (2019) E-waste: Current research and future perspective on developing countries .
International Journal of Industrial Engineering and management (IJIEEM), Vol.1., No.2

Leclerc, S. H., & Badami, M. G. (2020). Extended producer responsibility for E-waste management: Policy drivers and challenges.
Journal of Cleaner Production, 251, 119657.

Rabani, B.; Thakur, B.(2020) Recycling Potential of E-Waste for Jammu City.
Int. J. Progress. Res. Sci. Eng., 1, 29–32.

Rahman M.A. (2017) E-waste management: A study on legal framework and institutional preparedness in Bangladesh
The Cost and Management, 45, pp. 28-35

Rahul S. Mor , Kuldip Singh Sangwan, Sarbjit Singh, Atul Singh, Manjeet Kharub (2021) E-waste Management for Environmental Sustainability: an Exploratory Study.
Procedia CIRP 98 193–198

Samuel Abalansa, Badr El Mahrad , John Icely and Alice Newton(2021)
Electronic Waste, an Environmental Problem Exported to Developing Countries: The GOOD, the BAD and the UGLY
Sustainability, 13, 5302. <https://doi.org/10.3390/su13095302>

Shahabuddin, M.; Uddin, M.N.; Chowdhury, J.; Ahmed, S.; Uddin, M.; Mofijur, M.; Uddin, M. (2022) A review of the recent development, challenges, and opportunities of electronic waste (e-waste).
Int. J. Environ. Sci. Technol., 1–8. <https://doi.org/10.1007/s13762-022-04274-w>

Sinha, S., Mahesh, P., & Donders, E. (2015): Waste electrical and electronic equipment: the EU and India: sharing best practices.
Delhi: Toxic Link, 1-104.

Tanvi Pradhan(2013) E-Waste generation and management in India
Recent Research in Science and Technology 5(5): 83-87 ISSN: 2076-5061
Online: <http://recent-science.com/>