AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE
VOLUME 11 | ISSUE 1 | JUNE, 2016 | 118-123
e ISSN-0976-8947
DOI: 10.15740/HAS/AJES/11.1/118-123
Visit us : *www.researchjournal.co.in*
A CASE STUDY

Hazardous electronic waste: Growing concern for health and environment

SANJAY KESHAORAO KATAIT

Article Chronicle :
***Received* :**
09.02.2016;
***Accepted* :**
29.05.2016

ABSTRACT : The waste from electronic products include toxic substances such as cadmium and lead in the circuit boards; lead oxide and cadmium in monitor cathode ray tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls in older capacitors and transformers and brominates flame retardants on printed circuit boards, plastic casings, cables and PVC cable insulation that releases highly toxic dioxins and furans when burned to retrieve copper from the wires. Many of these substances are toxic and carcinogenic. The materials are complex and have been found to be difficult to recycle in an environmentally sustainable manner even in developed countries. This research paper focuses on how electronic waste is dangerous for human health and environment and causing number of problems.

HOW TO CITE THIS ARTICLE : Katait, Sanjay Keshaorao (2016). Hazardous electronic waste: Growing concern for health and environment. *Asian J. Environ. Sci.,* **11**(1): 118-123, **DOI: 10.15740/HAS/AJES/11.1/118-123.**

Key Words :
Energy,
Environment,
Health, Recycle

Author for correspondence :
SANJAY KESHAORAO KATAIT
Department of Commerce, Shri Shivaji College of Arts and Commerce, AMRAVATI (M.S.) INDIA
Email : skk2810@rediffmail.com

It is estimated that 50 to 80 per cent of e-waste collected in developed nations is exported to developing countries such as China, India and Pakistan due to cheap labour and lenient environmental regulations (StEP, 2009). These developing nations lack the health and safety infrastructure to process and dispose of materials safely and consequently workers handle toxic metals without proper equipment. While there are operators in China who are licensed to process e-waste, the market is dominated by small-scale entities that are not authorized, nor properly equipped to treat e-scrap. Common techniques for processing e-waste in developing nations include manual dismantling of hazardous materials and open-air burning, which generates significant accounts of dioxins and furans if performed without proper emission control systems. Cyanide leaching is also a prevalent technique for processing e-waste in developing countries, posing a significant concern to worker well-being if the spent leaching solution is not properly disposed.

Problem to be investigated :

In recent decades, the use of electronic and electrical devices has increased significantly, leading to rapidly rising amounts of electronic waste. Currently, around 20-50 million tonnes of electronic waste are generated worldwide. The rate increases by as much as 3-5 per cent each year, making e-waste one of the fastest-growing hazardous waste streams on a global level. The factors behind this development are the rapid obsolescence and replacement of electronic products caused by technological innovation and aggressive marketing (UNEP, 2005). Moreover, demand for electronic products is also fuelled by unsaturated markets, mainly

in non-industrialized countries, and by low prices for many electrical goods. These aspects will contribute considerably to the dimension of e-waste quantities in the future.

E-waste is a highly complex waste stream, as it contains both very scarce and valuable as well as highly toxic components. Mobile phones, for instance, consist of up to 1000 different components, many of which contain toxic elements such as lead, cadmium or brominated flame retardants. When burned, these elements release toxic emissions. Many detrimental health effects are connected to the recycling and disposal of e-waste when performed without the necessary safety precautions. For instance, lead affects the nervous and blood system. Its effects on children are particularly negative, damaging their brain development. In addition, land filled seriously affects the environment, causing contamination problems such as the pollution of

Table 1: Composition of pollutant electronic waste

Sr. No.	Pollutant	Occurrence	Danger / disease
1.	Lead	Batteries, solar system, transistors, stabilizers, lasers, LEDs, thermoelectric elements, circuit Boards, TV screen	Affects the kidneys, reproductive system, mental development, and fumes causing respiratory problems.
2.	Plastic	Circuit boards, cabinets and cables,	Brominated flames contain Dioxins harm reproductive and immune systems. Water pollutant.
3.	Chromium	Used to protect metal housings and plates in a computer from corrosion.	Inhaling chromium can damage liver, kidneys and cause bronchial maladies including asthmatic bronchitis and lung cancer and DNA Damages.
4.	Beryllium	Electron tubes, filler for plastic switch board and rubber, lubricant additives	It is carcinogenic and causes lung diseases. Causes damages to heart liver and spleen.
5.	Cadmium	Batteries, pigments, solder, alloys, circuit boards, computer batteries, monitor cathode ray tubes	Causes severe pain in the joints and spine. It affects the kidneys, softens bones and neural damages. Cadmium is released into the environment as powder while crushing and milling of plastics, CRTs and circuit boards. Cadmium may be released with dust, entering surface water and groundwater.
6.	Acid	Circuit boards	Sulphuric and hydrochloric acids are used to separate metals from circuit boards. Fumes contain chlorine and sulphur dioxide, which cause respiratory problems. They are corrosive to the eye and skin.
7.	Arsenic	Semiconductors, diodes, microwaves, LEDs (Light-emitting diodes), solar cells	Causes lungs cancer.
8.	Brominated flame-proofing agent	Casing, circuit boards (plastic), cables and PVC cables	Causes the problem of inhaling.
9.	Cobalt	Insulators	Problems to eyes and skin
10.	Copper	Conducted in cables, copper ribbons, coils, circuitry, pigments	Excessive use causes harm to immune system, stomach pain
11.	Liquid crystal	Displays	Nausea irritant
12.	Lithium	Mobile telephones, photographic equipment, video equipment (batteries)	Damage nervous cells and system
13.	Nickel	Alloys, batteries, relays, semiconductors, pigments	Nausea , irritant and sensation of vomiting
14.	PCBs (polychlorinated biphenyls)	Transformers, capacitors, softening agents for paint, glue, plastic	Causes respiratory problems
15.	Selenium	Photoelectric cells, pigments, photocopiers, fax machines	Damage eyes and eyesight
16.	Silver	Capacitors, switches (contacts), batteries, resistors	Causes burning sensation in body
17	Zinc	Steel, brass, alloys, disposable and rechargeable batteries, luminous substances	Respiratory and lungs disorder.

groundwater through the leakage of toxins (Puckett *et al.*, 2002).

Significance of the study:

Public concern for human health and environmental issues has gradually but steadily increased over the past three decades since the inception of Earth Day appealing to preserve nature and biodiversity. Linking to electronic waste, over 100 per cent of Americans reported that they were in support of environmental protection and human health, and avoids purchasing products that are potentially harmful to the environment. Indian perspectives regarding electronic waste are also heading towards the same direction but more awareness and stricter action from government is being needed towards violation of environment. Therefore, the study undertaken is significant from the overall perspective. This research project may be helpful in providing informational benefits to consumers and users of technology. The public will be better informed of the meaning of electronic waste and the impact of obsolete devices upon the environment and public health. Consumers will realize the importance of proper recycling efforts versus the illegal disposal of electronic goods. This study has the potential as a vehicle for change. Data provided could result in more stringent governmental policies on exporting and recycling of electronic waste. A further benefit could drive consumers to question and push Indian Government for stricter environmental policy formation and helps in controlling and monitoring of shipment of exporting hazardous waste (United Nations Basel Convention).

Objectives of research :

- To know thoroughly impact of electronic waste on human health and environment.
- To study methods, application and management tools for minimizing, recycling of electronic waste globally and locally for overall sustainable development.
- To suggest some remedial measures to minimize electronic waste.

The informal recyclers are not serious about the guidelines issued by CPCB (Central Pollution Control Board) and using hazardous methods of e-waste disposal like open burning for the recovery of targeted metals like copper, aluminum, iron and steel from equipment peripherals and acid leaching for the recovery of copper and precious metals from PCB (Printed Circuit Boards), mother boards and leave all hazardous metals like Pb, Hg, Cd etc at the treating sites in open causing an explosion of pollutants in the environment.

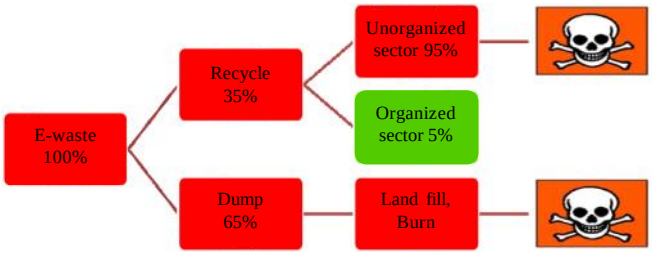

Fig. 1 : Reasons for urgent recycling of electronic waste

However, CPCB has registered 23 recyclers for treating e-waste by environmentally sound methods also, the CPCB has encouraged informal recyclers to be part of formal recycling which can be carried out with compliance under single umbrella of guidelines issued in 2008 [MoEF, Guidelines, 2008]. Presently, there is no separate law for e-waste (Management and Handling) for restricting the informal recycling in the country. However a rule for e-waste management and handling is in force since 1st May 2012 to restrict the environment unfriendly methods. Apart from above reasons following factors also contribute in proper recycling and urgent recycling process.

Public health factor :

Discarded electronics contain a variety of toxic metals, including lead, cadmium, mercury, chromium, and polyvinyl chlorides, and thus, the disposal of electronics poses a significant environmental and health risk when not properly handled. Although e-waste represents less than 2 per cent of landfill mass, it contains 70 per cent of the hazardous waste in heavy metals (Fig. 2).

Fig. 2 : Public health factor

Environmental/resource factor :

In addition to recovering precious metals, recycling electronics also reduces the environmental impact associated with primary production of electronic products. The primary production of precious and special metals, including energy intensive stages such as mining and smelting, has a significant impact on carbon dioxide emissions. Reuse and recovery of electronics reduces the environmental impact of these products, as well as the impact from primary production of metals and fractions found in electronics.

Fig. 3 : Environmental/resource factor

Data security factor :

Privacy protection concerns have also fueled the processing of electronic waste. Confidential and personal data must be destroyed properly in order to ensure the safety of organizations and individuals information.

Economic factor :

Electronic devices contain up to 60 different elements, many of which are valuable, such as precious and special metals, and some of which are hazardous. Precious metals are rare, naturally occurring metallic elements which traditionally have a higher melting point, and are more ductile than other metals. They have a high economic value, as demonstrated by the two most well-known precious metals; gold and silver. Special metals include nickel, nickel base alloys, cobalt base alloys, titanium and titanium base alloys. Electronic equipment is a primary consumer of precious and special metals and therefore, it is imperative that a circular flow is established in order to recover these metals and valuable elements. Investments are being made to treat e-scrap and reclaim the valuable metals, especially as raw materials become more scarce and expensive (Table 2).

Circuit boards contain the highest value of precious metals in a computer, as well as most of the heavy metals (United States Geological Survey (USGS), 2001). The components of a personal computer have the highest economic value, due to gold plated connectors, components, pins and transistors.

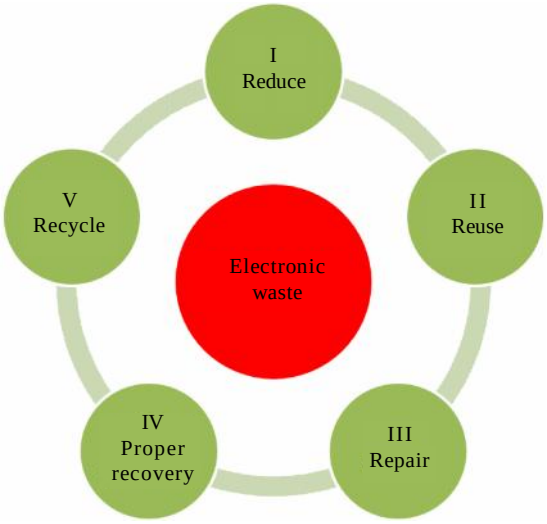

Fig. 4 : 5 - R which minimizes electronic waste

Table 2 : Economic factor

Sr. No	Electronic equipment	Copper	Silver (ppm)	Gold (ppm)	Palladium (ppm)
1.	Television (TV)	10%	280	20	10
2.	Computer	20%	1000	250	110
3.	Mobile phone	13%	3500	340	130
4.	Portable audio scrap	21%	150	10	4
5.	DVD player	5%	115	15	4

Source: Department of information technology

Conclusion :

Electronic waste accumulation in the country if not disposed-off properly may become a serious challenge for the human health and environment in the coming future. From the Government side the enforcement of the laws needs to be stricter than ever with an intention to reduce this problem as soon as early before it becomes a threatening hazard for the country. This emphasize the immediate efforts on the part of Government ,corporate, environmentalists to manage the Electronic waste through implementing a proactive and protective protocol for the agencies working in E waste reuse, recycle and disposal properly. Need is also felt to educate the general public about this critical issue which can become a major threat for the health of the public and the environment if not handle with care and consciousness.

Suggestion :

Proper e-waste disposal :

In modern day, our life and living standard, all are going to digitalized, which on one hand, is making our life much simpler but then it is creating a different kind of problem. So there is an urgent need for proper handling and disposal of e-waste with utmost sincerity. The need for e-waste disposal arises from the fact that, old and useless electronic items are not biodegradable. The most common practices adopted for disposal of e-waste are acid baths, land filling and open air burning. When electronic equipments are burned, they release abundant fumes which are dangerous for environment way beyond our imagination and estimation. Stewart and Lemieux suggested that incineration may be a viable option for electronics waste disposal, provided an appropriate particulate control device is used to control metal emission. A lot needs to be done to make disposal of e-waste a safe process.

Basic principles :

The principle of "Reduce, Reuse and Recycle" applies here. Reduce the generation of e-waste through smart procurement and good maintenance. Reuse still functioning electronic equipment by donating or selling it to someone who can still use it. Recycle those components that cannot be repaired.

Public education :

Public education and outreach may well be the most important component. That is because no matter what infrastructure is available and developed, what the laws are, and what the option are, no one will be aware of it without public education.

Fig. 5 : Suggestions

Hazardous e-waste solutions :

- Waste Management: Minimize impact
- Waste Prevention: Minimize the volume
- Reduce waste and pollution
- Reuse as many things as possible
- Recycle and compost as much waste as possible
- Chemically or biologically treat or incinerate
- Bury what is left
- Ban hazardous waste exports
- Get the poisons out
- Exercise precaution-no new poisons
- Make the producer responsible
- Require producers to take back
- Design for longevity, upgrade, repair and reuse

REFERENCES

Anonymous (2002). EU government to enforce E-waste recycling: newrules make producers pay.*Waste Age*, **33**(12) : 14

Babu, B.R., Parande, A.K. and Basha, C.A. (2007). Electrical and electronic waste: a global environmental problem. *Waste Mgmt. & Res.*, **25** (4) : 307-318.

Billinghurst, B.M. (2005). E-Waste: A comparative analysis of current and contemplated management efforts by the European Union and the United States. *Colorado J. Internat. Environ. Law & Policy*, **16**(2) : 399-428.

Cairns, C.N. (2005). E-waste and the consumer: Improving options to reduce, recycle and reuse. Proceedings of

International Symposium on Electronics and the Environment, May 16-19, New Orleans, US.

Chatterjee, S.S. (2012). *Electronic waste and India*. Department of Information Technology, Electronics Niketan, 6, C.G.O.Complex, NEW DELHI, INDIA.

Chaturvedi, A., Arora, R., Khatter, V. and Kaur, J. (2007). E-waste assessment in India-Specific focus on Delhi. MAIT-GTZ study, prepared by BIRD and GTZ, p. 66.

CPCB (Central pollution Control Board) (2008). The Hazardous Materials (Management, Handling and Transboundary Movements) Rules.

CPCB (Central Pollution Control Board) (2010). List of Units Registered with MoEF/CPCB as Recyclers/ Reprocessors having Environmentally Sound Management Facilities (e-waste Reprocessors).

E-waste (Management and Handling) rule 2012. Indian market Research Bureau (IMRB) survey of =*E-waste generation at Source*‘ in 2009.

Mohite, B.J. (2013). Issues and strategies in managing E-Waste in India. *Indian J. Res. Mgmt., Bus. & Soc. Sci.,* **1**(1) : March 2013.

Ministry of Environment and Forest, Government of India, Central Pollution Control Board, Delhi, 2011, “Implementation of E-Waste Rules 2011 Guidelines.

Mitra, Abhijeet (2013). Electronic waste management. *Indian Context Internat. J. Mgmt., IT & Engg.,* **13** : 358-366.

Saoji, A. (2012). E-waste management: An emerging environmental and health issue in India. *National J. Med. Res.,* **2**(1) : 107-110.

Singh, Ravinder Pal (2013). India: A matter of electronic waste; the Government initiatives. *J. Bus. Mgmt. & Soc. Sci. Res.,* **2**(4) : 15-20

WEBLIOGRAPHY

Ammons, J. and Sarah, B. (2003). Eliminating e-waste: recycling through reverse production. at *www.lionhrtpub.com* accessed on 7th September 2005.

Rajya Sabha Website, *http://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf*