

## E-waste – environmental pollutant and alternative source of metal recovery

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### **Abstract:**

The present review deals with the study of different types of E waste, composition, importance and hazardous effect on ecosystem and living organisms. Globally increase amount of E waste due to technological advances and day to day up gradation of electronic and electrical gadgets. E waste has generation large volume as compared to its decomposition, recycling or reuse, hence government and common people have aware to its economic value. In electrical and electronic waste, the basic unit is printed circuit boards contains various metals and precious metals. The E- waste directly dumped or landfill methods along with solid waste causes environmental hazardous and lost valuable metals, therefore it is need to recover, recycle, reuse and emphasis on to find out ecofriendly strategies for treatment of end life of electrical and electronic waste.

**Key words:** E waste, decomposition, landfill.

### **Introduction:**

E waste or Electronical and electrical equipment waste (WEEE) is states to discarded Electronical and electrical equipment which has no longer used by consumers and end of its economic life span (Arda isildar et al 2018). Waste electric and electronic equipment (WEEE), or electronic waste (e-waste), are the rapidly increase waste stream, so government and common people aware to its hazardous effect. Currently, the main options for the treatment of electronic waste are involved in reuse, remanufacturing, and recycling, as well as incineration & landfilling. (Cui & Zhang, 2008). Generation of large volume of waste WEEE is challenging for its recycling and appropriate treatments, due to continuous increase demand of consumers for new electronic and electrical devices and decrease the economic life span or short end life of electronic devices. (arda Isildar,2017). WEEE generation nearly, 1.3 billion tons of wastes are generated yearly across the world, which will be expected to increase to 4.3 billion tons per annum by the year 2025.(Abdelbasir & Dina, 2018); Debnath, Chowdhury, & Ghosh, 2018). Electronic waste contains of different types of material including 50% of which constitutes of iron and steel followed by 21% plastics, 13% non-ferrous metals and 16% other constituents like rubber, concrete and ceramics. The E waste is consider as toxic waste, when it contain lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium and flame retardants are present beyond permissible. (Pant, Joshi, Upreti, & Kotnala, 2012). Electronic products contain hazardous and toxic material treated with either landfill or incineration create an environmental problem. Many electronic devices consist of batteries, which contain nickel, cadmium and other heavy metals. These toxic metals can mixed with water, air and soil as well it effect the people who engaged for recycling of E waste, Hence it is need to improve e waste management technology in India..(Mundada, Kumar, & Shekdar, 2016).

Currently different techniques available for recycling and recovery of metals from E waste like pyro metallurgy, hydrometallurgy, bioleaching, but each methods has its own limitation and advance, therefore need to find out ecofriendly methods .

The present review mainly focus on two aspect of E waste, hazardous effect of it constituents and recycling of waste through recovery of metals from it, act as the secondary source of metal.

### Composition of Electronic waste

The E waste categories in to different types include big and small household appliances, information technology and telecom equipment, consumer equipment, lightning devices, electrical and electronic non industrial tools, toys, relaxation sports instruments, medical and non-infected devices, monitors and control units, and automatic dispensers. According to different classes of e-waste according to European Union classification. Table 1 show the classification of E waste.(Nithya, Sivasankari, Thirunavukkarasu, & Silver, 2020). The structural composition of e waste depends on type and the model of electronic devices, its manufacture and age of waste .Table 2 contain the characteristic material fraction of E waste component.(Abdelbasir & Dina, 2018).

The basic component of electronic and electrical devices is printed circuit boards (PCBs) which regulate function of equipment, consist of various metals and precious metals, PCBs are also known as printed circuit wire boards (PCWs), the PCBs which assemble of electronic component is consider as printed circuit assembly (PCA).(Pejman et al 2014).The PCBs contain valuable materials. PCBs are consist of metals polymers and ceramics. Printed circuit boards are composed of polymers, ceramics and metals. About 28–30% of the content is metal, with 10–20% copper, 1–5% lead, 1–3% nickel, and 0.3–0.4% precious metals like silver, platinum and gold and other elements (Ga, In, Ti, Si, Ge, As, Sb, Se and Te) may be found in chips, with An, Pb and Cd in solder joints, and Ga, Si, Se and Ge in semiconductors, and tantalum in capacitors. Extraction of metal from PCBs act as secondary source or act as artificial ore, which prevent loss of metal and environmental pollution also support the conservation of natural resources of metals. (Vossenber, Rene, Hullebusch, & Lens, 2015;Karwowska et al., 2014; Xiang et al., 2010)(Xiang et al., 2010) . Most of electronic waste has short life span e.g. mobile phone and computer which contain precious metals and hazardous metals. A mobile phone contains different metals, including N, O, F, S, B, C, H, K, Co, In, Zn, Al, Pb, Ag, Au, Ti, Pd, Cu, Ni, Fe, Mn, Sn and Sb, that may be hazardous are precious metals. phone PCBS contains more than 40 elements .(Arshadi & Mousavi, 2015).

Table.1 Classification of different types of E waste (Nithya et al., 2020)

Class of E waste	Name of the equipment
Heat exchange equipment	Fridges, Freezers, Air conditioners, Other cooling equipment Professional cooling equipment Cooled dispensers
Screens and monitors	Cathode ray tube, monitors Flat display panel monitors Cathode ray tube, televisions flat display panel televisions Laptops and tablets
Lamps	Compact florescent lamps Straight tube florescent lamps Special lamps Light emitting diode lamps
Large equipment	Central heating, Photovoltaic panels, Professional heating and ventilation, Dish washers, Kitchen equipment Washing machines, Dryers, Household heating and Ventilation, Professional IT equipment, Leisure equipment Professional medical, equipment, Professional monitoring

	and Control, equipment, Non-cooled dispensers, Professional tools
Small equipment	Microwaves, Small household equipment, Equipment for food Preparation, Equipment for hot, water preparation, Vacuum cleaners, Personal care, Small electronics, Audio and video, Musical instruments, Video and projectors, Speakers, Cameras, Lighting equipment, Household luminaires, Professional luminaires, Household tools, Household medical Equipment, Household monitoring, and control equipment, Toys
Small information technology (IT)	Small IT equipment, Desktop computers, Printers Telecommunication, equipment, Mobile phones Game consoles

Table.2 **Characteristic material fraction** (Abdelbasir & Dina, 2018)

Component of E waste								
Fraction	Metals	Screen	Plastics	Metal plastic mixture	Pollutants	Cables	PCBs	other
<b>Percentage</b>	60.20 %	12%	15.3%	5%	3%	2%	1.7%	1.4%

### Harmful effect of E waste.

E waste contain varies metals, material which are toxic to environmental and human when they are not handle properly. Hazardous effect of various metals present in electronic waste on human are summarized in Table 2.(Dissanayake & Consortium, 2014; Pant et al., 2012) (Ari, 2016; Kiddee, Pradhan, Mandal, Biswas, & Sarkar, 2020)

**Table 2 Metals and its harmful effect on humans**

Metals	Effect
Lead (Pb)	Damages occur on nervous system, blood, reproductive system in adults. Headaches, nausea, ulcer in stomach, skin damage
Cadmium(Cd)	It effect on neurodevelopment of the fetus and young children as well effect the respiratory system, kidney, bone problems and carcinogen.
Mercury(Hg)	Effect brain, central nervous system, causes of tremor, depression, and behavioral disturbances.
Chromium(Cr)	Defect in neurodevelopment, multiple organ failure, carcinogen and lead to oxidative stress.
Arsenic(As)	Its effect on respiration, cardiovascular system, risk of bladder cancer, liver and renal problems and reproductive health effects.
Nickel(Ni)	Skin allergy and carcinogen
Selenium(Se)	Neurological damages, hair loss, fatigue, irritability.
Lithium(Li)	Its effect on digestive system disorder and neurological system.
Americium(Am)	Effect on chromosomes
Zink (Zn)	Cytotoxicity, ischemia and trauma

### Conclusion:

In this study, point out the metals present in waste electronic and electric equipment. This waste continuously rapidly increase in large volume, when these waste discarded inadequate methods causes the human health and environmental problems, moreover loss of valuable metals. The

printed circuit board is basic component of electronic and electrical equipment, which regulate the function of equipment. The PCBs of mobile phone, computer, and television etc. has consist of metals and precious metals. This study reveals that waste PCBs are the valuable scraps for recovery of metals, hence waste electronic and electrical equipment is an important source of raw material and act as alternative source of metal recovery, it benefit for minimum use of natural resources and reduce environmental pollution. Current waste electronic and electrical equipment recycling methods are inadequate, each methods has its own limitation. This is the interesting area for scientific community as well as scrap business for recovery of metals for economic development. It's helps to conservation of natural resources and reduce the environmental pollution. It is need to find out ecofriendly methods to recovery of metals from printed circuit boards.

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