

# Study of E-Waste and Its Effect on Health and Environment

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## ABSTRACT

In this present paper, electronic waste encompassing a range of obsolete electronic devices such as computers, telecommunication devices, home appliances, recording devices, and automobile components is ever-growing resulting in the deterioration of environmental quality. Countries like India suffer not only due to the generation of their electronic wastes but also from the dumping of such wastes from developed countries. Consumers find it convenient to buy a new computer rather than to upgrade the old one due to the changing configuration and technology. The components of electronic wastes result in toxicity and carcinogenicity. Some of them include lead, mercury, cadmium, tin, copper, silicon, beryllium, aluminum, and Polychlorinated Biphenyls.

**Keywords :** Electronic Waste, Toxicity, Human Health and Environment

## I. Introduction

Electronic waste, otherwise known as e-waste or e-scrap can be defined as loosely discarded, surplus, obsolete, or broken electrical or electronic devices. Disposal of e-waste including obsolete electronic equipment like computers, monitors, printers, televisions, and cell phones is considered to be a growing problem as they contain hazardous substances. They tend to be highly toxic to humans, plants, and animals and have been known to contaminate water, and air, and not only that, they cause serious health and pollution problems. They cannot be discarded through the trash but rather must be disposed of like household hazardous waste or at a special e-waste recycling center.

Rapid changes in technology, changes in media, and falling prices have resulted in an alarming rate of electronic waste (Prashant, 2008). About 50 million tons of e-waste is produced each year and the USA discards 30 million computers each year while Europe discards 100 million phones each year. The US Environmental Protection Agency estimates that only 15-20% of e-waste is recycled, and the rest of these electronics go directly into landfills and incinerators. According to a UNEP report in, "Recycling - from E-Waste to Resources" the amount of e-waste being produced, including mobile phones and computers, could rise by 500 percent over the next decade in countries like India. The United States is the world leader in producing electronic waste about 3 million tons each year. China already produces about 2.3 million

tons (2010 estimate) domestically, second only to the United States. Despite having banned e-waste imports, China remains a major e-waste dumping ground for developed countries. In addition, developing countries like India and parts of Africa have become toxic dump-yards of e-waste.

### Components

Substances found in large quantities in e-waste include epoxy resins, fiberglass, PCBs, PVC (Poly Vinyl Chlorides), thermosetting plastics, lead, tin, copper, silicon, beryllium, carbon, iron, and aluminum. Cadmium, mercury, and thallium are

found in small amounts. There are numerous elements found in trace amounts and they include americium, antimony, arsenic, barium, bismuth, boron, cobalt, europium, gallium, germanium, gold, indium, lithium, manganese, nickel, niobium, palladium, platinum, rhodium, ruthenium, selenium, silver, tantalum, terbium, thorium, titanium, vanadium, and yttrium. Out of these substances, some may have hazardous and harmful effects on society and some may not. Some electrical and electronic equipment may contain various fractions of valuable materials.

Table 1 : Various toxicants of e-waste with their sources and health effects

Toxicants	Sources	Health effects
Lead	Solder in printed circuit boards, glass panels, and gaskets in computer monitors	Damage to central and peripheral nervous systems, blood and kidney. Affects brain development in children.
Cadmium	Chip resistors and semiconductors	Irreversible damage to human health. Accumulates in kidney and liver. Causes damage to nerves. Teratogenicity.
Mercury	Relays and switches, printed circuit boards	Chronic damage to the brain. Respiratory and skin disorders in fishes due to bioaccumulation.
Hexavalent chromium	Corrosion protection of untreated and galvanized steel plates, decorator, or harder-for steel housings	Causes Asthmatic bronchitis and DNA damage.
Plastics	Cabling and computer housing	Burning produces dioxin which causes Reproductive and developmental problems; Damage to the immune system and regulatory hormones.
Brominated flame retardants	Plastic housing of electronic equipment and circuit boards.	Disrupt the functions of hormones.
Barium	Front panel of CRTs	Muscle weakness and damage to heart, liver and spleen.
Beryllium	Motherboard	Causes lung cancer. Inhalation of fumes and dust causes chronic beryllium disease or berylliosis. Skin diseases such as warts.

**Hazardous substances**

Americium is the radioactive source in smoke alarms and it is said to be carcinogenic. Mercury is found in fluorescent tubes, tilt switches, and flat-screen monitors. It causes health problems like sensory impairment, dermatitis, memory loss, and muscle weakness (Table 1). In animals, it may cause death, reduced fertility, and slow growth and development. Sulfur which is found in lead acid batteries may have adverse effects on humans like liver, kidney, and heart damage and eye and throat irritation. Its environmental effects include the creation of sulphuric acid when released into the atmosphere. Cadmium is found in light-sensitive resistors, corrosion-resistant alloys, and nickel-cadmium batteries. These nickel cadmium rechargeable batteries contain between 6 and 18% cadmium. If not properly recycled, it may leach into the soil, harming microorganisms and disrupting the soil ecosystem. The inhalation of cadmium can cause severe damage to the lungs and may also cause kidney damage.

**Non-hazardous substances**

Tin is generally a non-hazardous substance that is used in solders and coatings on component leads. Copper is commonly used in copper wire and printed circuit board tracks. Aluminum is used almost in all electronic goods using more than a few watts of power. Iron is used in steel chassis, cases, and fixings. The other non-hazardous substances present in electronic wastes include germanium, silicon, nickel (nickel-cadmium batteries), lithium (lithium-ion batteries), zinc, and gold.

**Impacts of E-waste**

The disposal of e-waste has become an alarming problem faced by many regions across the globe. Landfilled computer wastes produce contaminated leachates which eventually pollute groundwater. Acids and sludge obtained from melting computer chips, if disposed of on the ground cause acidification of soil. Incineration of e-waste

produces toxic fumes and gases which pollute the surrounding air. Uncontrolled fires arise at landfills and this has become a frequent occurrence in many countries. When exposed to fire, metals and other chemical substances, such as the extremely toxic dioxins and furans (TCDD tetrachloro dibenzodioxin, PCDDs-polychlorinated dibenzodioxins, PBDDs-polybrominated dibenzodioxin and PCDFs polychlorinated dibenzofurans) from halogenated flame retardant products and PCB containing condensers can be emitted. The most dangerous form of burning e-waste is the open-air burning of plastics to recover copper and other metals. The toxic fall-out from open-air burning affects the local environment and broader global air currents, depositing highly toxic byproducts in many places throughout the world.

Electronic wastes can cause widespread environmental damage due to the use of toxic materials in the manufacture of electronic goods (Mehra, 2004). If the CRT (Cathode Ray Tube) is crushed and burned, it emits toxic fumes into the air (Ramachandra and Saira, 2004). Most electronic products contain several rechargeable battery types and almost all of them contain toxic substances that can contaminate the environment when burned in incinerators or disposed of in landfills. The cadmium from one mobile phone battery is enough to pollute 600 m<sup>3</sup> of water (Trick, 2002). The quantity of cadmium in landfill sites is significantly increasing and a considerable amount of toxic contamination is caused by the long-term effect of cadmium leaking into the surrounding soil (Envocare, 2001). Due to the highly flammable nature of plastics, the printed wiring board and housings of electronic products contain brominated flame retardants, several of which are causing damage to human health and the environment.

## II. Conclusion

The growth of e-waste has significant social and economic impacts. The increase in the purchase of electrical and electronic appliances, consumption rates and higher obsolescence rate leads to increased generation of e-waste. There has to be an increasing trend in the reduction in the use of hazardous substances. The toxic substances have to be replaced with safe substitutes. Environmentally technologies for e-waste treatment and management can be adopted.

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