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ELECTRONIC WASTE – HEALTH AND ENVIRONMENTAL IMPACT AND RE-CYCLING PRACTICES

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ABSTRACT

Electronic waste (e-waste) management has attracted increasing attention in recent years from government, business, non-governmental organizations, and consumers. Indeed, consumer electronics devices (CEDs) contain many toxic materials that can have detrimental impact on public health and the environment, if improperly disposed. Most importantly disposal of e-waste causes loss of these valuable, non-renewable resources as electronics products contain wide range of valuable materials, many of them becoming scarce in the nature. Depletion of raw material sources together with increasing need for materials in manufacturing of new products together mean that collection and recycling of obsolete products becomes more and more important. Electronics waste recycling processes may also pose a risk to environment if electronic products are not treated in a proper manner at their end of life stage. Substances of concern may lead to the environment or cause health and safety risk at the treatment phase. This review article provides a concise overview of environmental and health hazards, current disposal and recycling operations.

INTRODUCTION

Electronic waste

Electronic waste has raised concerns because many components in these products are toxic and do not biodegrade easily if at all. Based on these concerns, many European countries banned e-Waste from landfills in the 1990s. Alarming levels of dioxin compounds, linked to cancer, developmental defects, and other health problems; in samples of breast milk, placenta, and hair, these compounds are linked to improper disposal of electronic products. Furthermore, surveys have indicated that much exported US e-Waste is disposed of unsafely in developing countries, leaving an environmental and health problem in these regions. Impacts from those countries, especially Asia, have already been reported. Meanwhile, recycling and disposal of e-Waste are also grown in the regions beyond Asia, particularly in certain African countries. Today's paradigm is one of disposable electronics, and as a result we now stand at the forefront of a growing environmental catastrophe. There are only two formal recyclers in the south of India (at Chennai and Bangalore) and one in western India. Currently, there are no formal recyclers operating in the north or the east. Over 1 million poor people in India are involved in the manual recycling operations. Most of the people working in this recycling sector are the urban poor with very low literacy levels and hence very little awareness regarding the hazards of e-waste toxins. There are a sizeable number of women and children who are engaged in these activities and they are more vulnerable to the hazards of this waste [1-4].

Health and environmental impact of e-waste

Electronic products are a complex mixture of several hundred tiny components, many of which contain deadly chemicals. These chemicals are a strain on human health and the environment. Most of the components in electronic devices contain lead, cadmium, mercury, PVCs, brominated flame retardants (BFRs), chromium, beryllium etc., Televisions, video and computer monitors use cathode ray tubes (CRTs), which have significant amounts of lead. Long term exposure to these substances can damage the nervous system, kidney and bones and the reproductive and endocrine systems; and some of them are carcinogenic. These e-wastes will have long lasting effects on the environment, when improperly disposed (incinerated / land filled instead of recycling) with domestic waste, without any controls, can contaminate the soil, water and air [3].

EEEs are made of a multitude of components, some containing toxic substances that have an adverse impact on human health and the environment if not handled properly. Often, these hazards arise due to the improper recycling and disposal processes used. It can have serious repercussions for those in proximity to places where e-waste is recycled or burnt. Waste from the white and brown goods is less toxic as compared with grey goods [8-14]. A computer contains highly toxic chemicals like lead, mercury, cadmium, etc., and its effect on health is tabulated below [30-34].

Recycling practice

When it comes to e-Waste, recycling faces a number of challenges, including dealing with hazardous materials such as CRT glass and finding markets for flame-retardant plastics. Furthermore, no technology currently exists for recycling certain EEE in an environmentally friendly manner. In 2005, more than 2 million tons of e-Waste was generated in the US alone (US EPA), but only 17 to 18 per cent of that was collected for recycling. The rest, more than 80 percent, was disposed of, largely in local landfills. The hazardous materials in e-Waste can leach out of the landfills into groundwater and streams, and if the plastic components are burned, dioxins are emitted into the air. Moreover, it is estimated that 50–80 percent of the e-Waste collected for recycling in the US is actually exported to developing countries, even though it is illegal in most of those countries to accept this toxic waste stream. Much of this illegally traded waste is going to the informal recycling sectors in many Asian and West African countries, where it is dismantled or disposed of using very primitive and toxic technologies. In India, most of the recycling happens in the informal sector where poor people tear apart the different components with their bare hands and without wearing any safety gear. In many such yards people are using cable waste as fuel to cook food. In fact, people are being exposed to toxins 24 hours a day as they live, cook and sleep in the same place where waste being recycled. Though E-waste is being recycled in all metros in India, Delhi is where the illegal and dangerous practices of recycling are adopted. (About 35,000 people are involved) India has become the dumping ground of all kinds of waste from the developed countries. A report from MAIT indicates that 50,000 tonnes are being imported every year [6-12].

Chemical leaching of metals from E waste

Chemical leaching involves leaching either by using acid or ligand supported complexation. Chemical leaching techniques. Chemical leaching can also be performed by involving complexometry, where ligands get complexed with metals. Chemical leaching of metals from the E-waste can also be done by utilizing various inorganic-acids like; sulfuric acid (H_2SO_4), hydrochloric acid (HCl), and solution of H_2SO_4 and HNO_3,, Sodium hypochlorite (along with acid or alkali) can also be used for the recovery of precious metals like gold. Lee et al. (2009) used organic solvents for the extraction of heavy metals like Fe, Cu, Al, Ni, Au and Ag. Yang et al. (2011) studied chemical leaching of Cu present in waste PCB (Printed Circuit Boards) with respect to its particle size, by utilizing treated shredded Cu particles of waste PCB with sulfuric acid and hydrogen-peroxide.

Biological-leaching of E-waste

Sometimes, bleaching is a cost effective method in comparison to chemical leaching. Mainly acidophilic group of bacteria plays an important role in bioleaching of heavy metals from the wastes for instance Acidithiobacillus ferrooxidans, Acidithiobacillus thiooxidans, Leptospirillum ferrooxidans, and Sulfolobus sp. Microorganisms are active in the formation and decomposition of various inorganic as well as organic matter on the earth's crust. Bioleaching is based on the natural ability of microbes to transform solid metallic compounds to its solubility and extractable form. Autotrophic bacteria (e.g. Thiobacilli sp.), heterotrophic bacteria (e.g. Pseudomonas sp., Bacillus sp.) and heterotrophic fungi (e.g. Aspergillus sp., Penicillium sp.) are the three major groups of microbes involved in bioleaching of metals Chemolithotrophs of iron- and sulfur-oxidizing nature [13-17].

Conclusion

Recycling is the key to reduce the e-Waste. Recycling has environmental benefits at every stage in the life cycle of a computer product—from the raw material from which it is made to its final method of disposal. Aside from reducing greenhouse gas emissions, which contribute to global warming, recycling also reduces air and water pollution associated with making new products from raw materials. By utilizing used, unwanted, or obsolete materials as industrial feedstock or for new materials or products, we can do our part to make recycling work. Hybrid methodology has the potential to overcome the problems associated with chemical and biological extraction techniques for the metals present in E waste.

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