

## E-Waste is Biodegradable or Not

Eva Srivastava\*

Devpriya Tomar\*\*

E waste or we tend to say Electronic waste is the growing concern of the planet nowadays. The problem of e-waste has become an immediate and long term concern as its unregulated accumulation and recycling can lead to major environmental problems endangering human health, if not treated properly. In India E-waste containing toxic material that can have adverse impact to human health and environment, if not treated properly. In India e-waste generation rate is 15% increase. Maximum amount of e-waste is recycled and recovered by self-employed sector using basic methods such as open burning and acid stripping method. Electronic equipments, especially computers, are often discarded by the households and small businesses not because they are broken but simply because new technology has rendered them obsolete and undesirable. The both methods are harmful to the human and environmental. Many legislation and regulation available in global national level, but no legislation is governed in the informal sector. In this paper we have researched how E- waste could relate to be a voluntary Biodegradable waste.

**Key words:** E-Waste management, biodegradable waste, electronic equipment's, legislation

### INTRODUCTION

E-waste is alternative names given for electronics those have exhausted their productive life. Any thing that runs on electricity/battery or has wire and completed

its life is e-waste [1]. There are various examples of electronic waste as discarded computers, office electronic equipment, devices running on chips, electronics, mobile phones, television, tablets, kitchen appliances and any digital gadget-wastes are considered hazardous to health, as certain components of some electronic products contain materials that spread toxic substances, depending on their condition and density. Electronic waste, e-waste, e-scrap, or Waste Electrical and Electronic Equipment (W.E.E.E) [2][3] describes discarded electrical or electronic devices. As environment is so dynamic in nature due to continuous technological up gradation at such a high rate, many electronic devices become "trash" after a few years of use. In fact, whole categories of old electronic items contribute to e-waste such as VCRs being replaced by DVD players, and DVD players were being replaced by Blu-ray players [4]. Revolution through digitalization followed by the advances in information technology during the past few years has radically changed people's lifestyle. Statistics

show that Indian city of Bangalore produces some 20,000 tons of e-waste per year, according to a report by ASSOCHAM, the Association of Chamber of Commerce and Industry of India [5]. Among all the metro cities in India, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata and Ahmedabad in E- waste generation scenario. At present, India and China have become the giant global dumpsters for e-waste because of low processing costs and unorganized operating conditions. Although this development has helped the mankind, mismanagement or unorganized waste management system has led to new problems of contamination and pollution. The high quality of technical quotient acquired during the last century has posed a new challenge in the management of wastes. For instance, personal computers (PCs) contain bound components, which are highly toxic, such as chlorinated and brominated substances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives. The e- waste problem is solved by starting with educating and changing the habits of the people which results in sharing of knowledge and creating awareness. Mostly people are aware about recycling newspapers, bottles, and cans. Almost anything electronic in nature can be recycled by little efforts. So there is a need to have a proper management while disposing or recycling e-wastes. The paper highlights these issues and poses some concrete. From the survey of companies in Delhi Ncr the following data has been collected that talks about the e-waste category. The data table T.1 below is collected through questionnaires circulated in different companies of Delhi Ncr.

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**Table T.1 Categorization of E-Waste**

<b>EQUIPMENT CATEGORY</b>	<b>%Composition (by weight)</b>
Computer Equipment	72
Telecommunication Equipment	16
Entertainment Equipment	8
Electrical Equipment	4

## **RESEARCH METHODS**

The study was performed on the basis of present E-waste scenario and its problematic site identification along with recommended outline to make out probable solution. The sample area (Delhi NCR region) was selected as an emerging city corporation and Here, structural development following upward trends of IT based companies are being set up. This qualitative and quantitative research was carried out using structural questionnaire survey method. It was consisted of four parts like as part one was contained demographic information, part two was contained E-waste generation approach along with source and quantification, part three was contained E-waste management approach along with the perceptual attitude, part four was contained information on environmental and human health impacts in the aspects of exposure time, place and types of shop. But also certain areas of the nation have been included in the study to know more about e-generation situation in India. Also more of market study, collecting secondary data already available in newspapers, journals, magazines and internet acted as the source of information and important methods for completing this research work.

## **BIODEGRADABLE WASTE**

Biodegradable waste is essentially a kind of waste which is easily soluble in the environment or we may say which could be easily broken into chemical forms and is dissolved back into the environment. Biodegradable materials (garden waste, kitchen waste and waste paper/card, wood) is harmful when not properly disposed off and leads to pollution risk and greenhouse gas emissions associated landfill disposal of waste. Biodegradable waste does not cause any harm instead it is used again and again in different forms in the environment and hence we can say that it is waste which is reused. The Fig1 explains it better. From the Diagram it gets clear that those wastes which easily dissolve in the environment leaving no harmful impact on the ecology leading to their reuse and new energy creation we can say that it is one of the property of Biodegradable waste.

### ***E-Waste as Voluntary Biodegradable Waste***

The Fig. 2 shows that how e-waste can be properly disposed off in the environment. If the e-waste is properly disposed and reused in the most efficient manner that most of the energy is not wasted but is utilized again and again in the vicious circle then surely it could be concluded that Biodegradable waste can include e-waste but voluntarily. The table T.2 shows recovery of e-waste is done and the leftover items are being disposed off properly in an environmental friendly method. This is the most important aspect which shows retention of energy by reusing and converting the e-waste into a new form to make it reusable.



**Table T.2**

OUTPUT	SELLING PRICE	PURCHASER
Cathode Ray tube (CRT)	2-4/per kg	Display electronic Manufacturers e.g.- Television
Metal parts	18-24/per kg	Metal Scrap dealer
Aluminum parts	76-87/per kg	Aluminum Trader
Plastic Parts	7-10/ per kg	Plastic manufacturer or recycler

**Case I**

Infosys OZONE initiative[7] which an initiative by infosys being healthy, safe and equipped with environmental system. The company has taken effective e-waste management under its scheme EMS(envirnomental management system). This system not only helps in driving the company environmental friendly but at the same time covers the legal issues as well related to waste management. The company has a focused approach to the e waste management policies and practices and is continuously striving for better results. The best Practices followed by Infosys for E- waste management include-

- Waste separation at source
- Plastic waste is sold to bona fide recyclers
- Paper waste is recycled externally by approved recyclers, and reused as note pads
- Hazardous waste such as DG oil, batteries, etc., are given only to PCB-approved agencies
- Certain e- components are given to get repaired and fixed to be used again
- Scrap is sold to authorized scrap dealers
- Suppliers are engaged in discussions to eliminate the use of non-bio-degradable packing material such as thermal. The company pushes their suppliers to use more environment-friendly packing material.
- Use of Degradable plastics and electronics.

**Case II**

Wipro is highly environmental conscious and therefore it is continuously striving to attain its goal of environmental friendly work processes- waste management is one of the crucial issues being put by the IT giant Wipro. In one of the clash with Greenpeace association Wipro said "The issue being highlighted by Greenpeace is about the disposal of scrapped computer by the owners and users of computer and electronic goods. This is a larger issue and involves all the users and owners of computers,

the entire installed base of computers and all the vendors/manufacturers in India" [8].This stand of Wipro is possible only because of their stiff policies on disposal of e-waste here they have a proper segment and a department to handle all the technicality related to e- waste and try to maximize their reuse to the fullest. Wipro also started offering e- waste disposal services to its customers from 2006 onwards.

**Case III**

Tata Consultancy Services one of the largest IT based company in India is strictly following environmental friendly methods, to keep the environment safe and clean. TCS has adopted the policy (OHSMS) Occupational Health and Safety Management System. TCS, a leading Indian IT company is committed towards 100% environment friendly disposal of e-waste which gives its E-waste only to the E-waste recyclers / handlers which are certified by the Ministry of Environment & Forest/ country specific regulator bodies [9]. TCS has also extended the life cycle of computers / hardware from 3 years to 5 years and procures computers / hardware only from USEPA / similar Energy star labeled vendors [9]. TCS is also committed to follow the WEEE Directives for E-waste handling [9]. Needless to say, TCS follows all the rules and regulations. TCS' waste management practices are centered on reduction in generation, segregation at source, and reuse and recycle wherever possible. Reduction at source is the most important lever, and we are pursuing this by raising awareness and motivating action towards sustainable waste management. While municipal solid waste is the predominant type of waste generated, TCS also generates electronic and electrical waste (e-waste), and a relatively smaller proportion of hazardous waste such as lead-acid batteries and waste lube oil.

**VOLUNTARY E-WASTE IN NEW FORM**

US researchers have developed a flexible, organic and biodegradable semiconductor that can help to cut the mounting pile of global electronic waste, a research published said [10]. Stanford engineer Zhenan Bao and her team created the flexible electronic device that could easily degrade just by adding a weak acid – vinegar, said the Proceedings of the National Academy of Sciences' paper [10]. The team working in the Stanford University has developed the degradable electronic circuit and a new biodegradable substrate material for mounting electrical components. Electronic components used in electronics such as computers, televisions, laptops etc. are usually made of gold. But for this device, the researchers created components from

iron. Bao noted that iron is a very environmentally friendly product and it is nontoxic to humans [10]. This substrate supports electrical components, flexing and molding to rough and smooth surfaces alike [10]. When an electronic device is no longer needed, the whole things can biodegrade into nontoxic components. In Bao group, they tried to mimic the function of human skin to think about how to develop future electronic devices. Bao, a professor of chemical engineering and materials science and engineering, said in a statement. "We have achieved the first two (flexible and self-healing), so the biodegradability was something we wanted to tackle" [10]. Previous material designed by Bao's team could bend and twist in a way that could allow it to interface with the skin or brain, but it couldn't degrade, said the Stanford release. This theory and scientific research gives the platform where in future E-waste could surely be considered as biodegradable waste and its hazardous limitations could be removed to the maximum extent. This is a beginning of a new concept which is only possible when there is a follow up approach towards proper E-waste management system.

## CONCLUSION

The Biodegradable waste holds the property of being in the environment in different forms of energy. In Biodegradable waste the energy is not wasted but is retained and continuously flowing in a cycle. The scientific law says "Energy cannot be created nor be destroyed" which means that whether a product is in its waste form the energy is not destroyed, energy is still there so to retain that energy is what is required in the E-waste management system. From Fig1 and Fig. 2 it gets clear that if one of the properties of Biodegradable waste is inherited in E-waste it can be categorized as Voluntary Biodegradable E-waste. For this to become an evident and full fact more scientific researches needs to happen. Moreover, most of E-waste is composed of Cu, Al and Fe, attached to, covered with or mixed with various types of plastics and ceramics, which are very hazardous and are not easily disposable in the environment. For that Scientists are continuously striving for innovation and new inventions to bring the waste form into a new era where E-waste could be properly disposed off and the environment is free from toxic substances. And just in time, the biodegradable circuit board arrives, can it solve the problem? While transient electronic components currently exist, putting all of these parts together into an entirely biodegradable circuit board has yet to be conquered, until now. A group of scientists at the University of Illinois Urbana-Champaign Frederick

Seitz Materials Research Laboratory set out to create a fully functional PCB that disintegrates when exposed to water [11].

## The Biodegradable System

The scientists determined to create a working circuit board system that could do the following:

- Measure variations in room temperature, and report that data back to an external recording system through a wireless signal.
- The data would need to be very accurate when compared with conventional temperature measurement systems.
- The circuit board would also need to be completely biodegradable, leaving only components and trace materials after being exposed to water.

The results were pretty amazing. This biodegradable circuit board was able to record temperature results that were so accurate that they aligned almost perfectly with temperature reports from a local weather station during a 24 hour period. And when the PCB was immersed in water for only 10 minutes, it completely disintegrated, leaving behind only the components and biodegradable materials. And the best part? The entire thing was flexible. So all this comes to a conclusion that scientists are trying to achieve E-waste as biodegradable waste through new experiments and as researchers it is important to explore more over this theory and deliver it to the world. So the theory of E-waste as voluntary biodegradable waste could be explored by more researchers in the coming time.

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