

E-Waste Management- An Overview

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Abstract—21st century - An era of people being obsessed with technology where everybody is in the rat race of updating oneself with the latest gadgets but grim reality is they are in oblivion of its aftermath.

E-waste is wastage generated from electronic and electrical devices. Basically it comprises engineered plastics, polymers, metals and other materials not naturally decomposable. Problem of E-Waste is exponentially increasing day by day as till today we have always been concerned about technological development regardless of the fact that this development too has a negative side.

The most depressing fact about it is that 40 to 50 million metric tons of E-waste are generated worldwide every year yet we are not considering it as a serious problem and taking any effective measures on a vast level to decompose or recycle it. This is directly and indirectly causing numerous problems to human life and environment like polluting the land, occupying the space, generating harmful rays and chemicals which are carcinogenic and neurotoxic. It's high time to work on our shortcomings & the need of the hour is 3R's i.e. REDUCE, REUSE & RECYCLE can lead to less generation and effective management of E-waste. Development should not be demoralized but we should also consider the negative aspects at early stage of development so that it doesn't result in a massive problem as we are facing today.

Keywords: e-waste, recovery, reduce, reuse, recycle, environment.

I. INTRODUCTION

Technology, gadgets, machines and automation - this is what modern era is all about. In past two decades, there has been exponential growth in the area of technology which has drastically changed our way of living. Human life now days are gadget driven and we cannot even imagine our daily routine without technology. Innovations, developments and changes are happening at a very fast pace and every day we are seeing something new in the world of technology. People are eager to switch to updated and technologically more advanced appliances as fast as it launches into market.

On the one hand this practice is improving our living standard and making lives easy but on the other hand this is giving rise to a very serious threat which has not yet been considered as serious as it actually is. That threat is of increasing E-waste in the world. The e-waste is fastest growing waste in the world and it contributes 8 to 10 percent of the total solid waste. The accumulation rate is increasing almost three times the other solid waste.

Everyday changing technology has reduced the life span of gadgets and electronic appliances as people want to be updated and use the latest technology. For this, they discard

their old devices and buy the new and updated one. This action results in increased quantity of obsolete and discarded appliances and gives rise to a new problem of managing and disposing that waste of electronic and electrical devices.

Most of the materials which are used in manufacturing electronic and electrical appliances are the materials which are not naturally decomposable and also hazardous for the environment. It binds us to think in the direction to manage, reuse, recycle or dispose the E-waste.

We all know that resources are limited on earth and if we continued the consumption at the speed at which we are doing now, it will be very difficult for the coming generations to survive. Thus it becomes very much necessary to start to plan and act for Sustainable Development in the present so that our coming generations can get enough resources for their living and a healthy environment to survive.

E-waste contains elements and materials like plastic, aluminium, iron, copper etc. out of which many are recyclable and reusable if systematic processes are applied by result of which actual waste out of discarded and obsolete materials can be minimized.

II. E-WASTE

According to European commission directive E-waste is "electrical or electronic equipment which is waste including all components, sub assemblies and consumables, which are part of the product at the time of discarding."

Organization for Economic Co-operation and development (OECD) defines E-waste as "any appliance using an electric power supply that has reached its end of life."

From the above definitions it very is clear that E-Waste is waste of and generated from discarded electronic and electrical devices. All the devices like television, refrigerators, mobile phones, tablets, computers, laptops etc. when discarded are called E-waste.

If we further analyze the components of E-waste we find that major constituents of it are PVC, mercury, lead, sulphur, cadmium, aluminium, copper, iron, silicon, gold like elements. There can be many basis of classification of E-waste e.g. on the basis of source i.e. home appliances and office appliances, on the basis of risk for environment i.e. hazardous and nonhazardous, on the basis of capability to reuse i.e. reusable and non-reusable, on the basis of capability to recycle i.e. recyclable and non-recyclable and many more.

III. E-WASTE – A PROBLEM

With the rapid advancement in the technology, the electronic products manufacturing rate is increasing and at the same rate the electronic products are becoming obsolete. This is coupled with the explosive sales in consumer electronics which means that the electronic products are being disposed or are being discarded even if they are still in working condition. One more factor guiding this waste production is the race of having the latest in ones hand. To have or possess the latest is the status symbol in present scenario. Second problem is that these electronic products are not designed for recycling and their life ends in a landfill. Even if these products are taken for recycling either the process of recycling is very costly and tedious or the recycling firms take a low road by exporting these materials to the impecunious and impoverished countries in the world, where these materials are dismantled in such a manner that air, water and land along with all ling world around is affected sorely.

IV. EFFECTS OF E-WASTE ON ENVIRONMENT AND HUMAN LIFE

E-Waste comprises of materials and elements which are not naturally decomposable hence can turn very harmful to our environment. Some of major hazardous elements found in E-waste are lead, mercury, BFRs, beryllium oxide, perfluoro octanic acid, chromium etc. which pollute environment and negatively affect human life as well.

We can divide the impact of E-waste on environment and human life in following major categories -

- 1) *Impact on land and soil* – E-Waste consume lot of space on land where it is dumped, so on this earth where we humans already are short of land to live, this is turning into a very severe problem. Further, elements like lead, cadmium, nickel, sulphur and BFRs badly affect the fertility of land. These elements leach into the soil harming microorganism and disrupt the soil eco system, thus affecting both plant and animal growths directly or indirectly. Many a times due to the accumulation of these hazardous elements plants do not grow and develop properly.
- 2) *Impacts on Air* – E-Waste contaminants are spread into the air via dust. This is a major exposure pathway for humans through inhalation and skin absorption. There is also a threat that if E-waste is exposed to fire, harmful gases will emit and will pollute the environment.
- 3) *Impacts on Water* – E-Waste can also be one of the major pollutants of groundwater. When electronic devices are not properly disposed, hazardous and toxic substances like mercury, lead, cadmium etc. can seep into soil and eventually find their way to groundwater resources. These contaminants can also enter aquatic system via

leaching from dumpsites. Similarly the disposal of acid following hydrometallurgical processes into water.

- 4) *Impacts on Human Life* – It is quite obvious that if environment in which we survive is negatively affected, human life and health will also have negative impacts. Some hazardous elements which are major part of E-Waste like Lead, Mercury, Arsenic, Perfluoroctanic acid etc. are very dangerous for humans. For example – Mercury and Lead causes damage to human nervous system, Cadmium harms kidneys, PAH affects lungs, skin and bladder and is also a cause for cancer.

V.MANAGEMENT OF E-WASTE

Analysis of components of E-waste shows that it contains very harmful elements and materials which are hazardous to human life and environment. Every year 40-50 million tons of e waste are generated worldwide and surveys say that 90% of it is illegally dumped. It is estimated that 75% of electronic items are stored due to uncertainty of how to manage it. The need of implementing management measures was felt as this electronic junk left abandoned in offices, stockrooms, houses, etc. and finally their end life is in a landfill. It is a fact that problem of E-waste can be solved but it is also true that it will need combined and continuous efforts of all. These efforts should be on following levels –

- 1) *At the point of generation* i.e. at the time when the electrical goods and electronics are being manufactured in the factory, the design should be such in which the issue of e-waste generation is considered. This can be done in following ways –
 - **Inventory management:** In this process while manufacturing any electronic item, the amount of hazardous material and the excess raw materials in stock are reduced and in this way the e-waste generated at end life can be minimized.
 - **Production - Process modification:** Production process is modified in such a way that it results in reduction of waste generation. This can be accomplished by replacing the hazardous materials with other less hazardous materials in product manufacture or by using more efficient substitutes used in production process, or both. Potential waste minimization techniques can be broken down into three categories:
 - i) Improved operating and maintenance procedures,
 - ii) Material change and
 - iii) Process-equipment modification

- Volume reduction: In this various techniques are used that includes removal of hazardous part from non hazardous part. these techniques result in volume reduction and thereby reducing the cost of disposable material. The techniques that can be used to reduce waste-stream volume can be divided into 2 general categories: source segregation and waste concentration. Burning of PVC cables to recover copper can be the example of source segregation.
 - Recovery and reuse. In this different techniques are adopted to eliminate waste disposal costs, raw material cost reduction and increased income by selling waste. On – site or off- site waste recovery or inter industry exchange, etc. can contribute in waste recovery. The reclamation of waste, can be achieved by using different physical and chemical techniques such as electrolytic recovery, electrolysis, centrifugation, reverse osmosis, etc. Metals can be recovered by some other methods like Acid leaching, wet chemical processing, heat treatment.
- 2) *Governments* on their level can make firm policies and strict laws for treatment and disposal of E-waste. Campaigns and awareness programs can be conducted by government to educate general public about it. Entrepreneurs and recycling industries should also be promoted.
 - 3) *Schools and universities* can include the study of management of E-waste as a subject in their curriculum. They can also contribute by promoting students and researchers to bring new ideas and to work on new technologies to manage the E-waste.
 - 4) *We as a consumer* should adopt the theory of 3 Rs i.e. Reduce, Reuse and Recycle.

Reduce the consumption of devices which generates e waste. In other words - buy less, buy sensibly.

Re-use the devices where there is possibility after minor repair work. If it is not of our use, we can donate or sell it so that other person may reuse it.

Recycle – We should beware of the local recycling options and educate others too. This is not the option on which we can do much directly but indirectly, we should assure that any discarded or obsolete device first go to recycler as it is a valuable source for secondary raw materials if treated properly.

VI. RECOVERY FROM THE E WASTE

The e waste can either be subjected to recycling or recovery. Recycling is affected by factors like type of material and its complex city, the metal content and volume. It has following steps: classification in which the material is classified on the basis of metal content and its recoverability. Next step will be

enrichment, to remove the critical component from the e waste to avoid unnecessary contamination and dilution of the toxic substances during further processing. This is followed by mechanical processing which is done by crushing units, shredders, magnetic- and eddy-current- and air separators. The gaseous emissions are sent into the environment after filtering and treating the gas so as to have minimum effect on the air quality. Chemical stripping of the precious metals using cyanides which work on the surface of the material being treated and basically strip the metal surface content into solution. Milling, refining, leaching and incineration are few more methods.

VII. CONCLUSION

Everything in the world has pros and cons so as the technology. The problem of increasing E-waste is one of the cons of technology. It is not the problem of a city or a state or a country but it is a problem being faced globally. The fundamental cause due to which it has become a massive threat today is lack of awareness among general public and among engineers and scientists as well.

Now things are changing and countries are trying to understand the concerns of this issue. Not just development but the sustainable development is the need of hour. We will have to ensure that new technologies and appliances be such that minimize the use and waste of scarce resources. Recycling, Reusing and Reducing the consumption is the key to Sustainable development.

E-waste is undoubtedly a very serious threat which we are going to face in coming years but at present it is not that vast that it is going to be in near future. Therefore if proper and effective planning is done, this threat can also be turned into an opportunity. It can generate a considerable number of employments, give rise to new waste management industries and can open up new areas of study for students and many more. So we all should become part of this and try on our own level to overcome the problem of E-waste.

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