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E-Waste and Its Impacts

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ABSTRACT: The discarded electronic items and gadgets which possesses no use are describes as electronic waste or e-waste. Exposure to these is disastrous due to the presence of hazardous and non – biodegradable substances present in them. The rate of generation of e-waste is not only a problem of both developing and developed countries. The exposure of e-waste causes various diseases such as hard metal lung diseases, berylliosis, Minamata disease, itai-itai disease etc. The hazardous components of e-waste not only affect human lives but also result in environmental degradation causing air, water and soil pollution. These consequences can be attributed to the dangerous discharges of lead, mercury, cadmium, etc. from the waste. Landfilling, incineration, recycling and bioremediation are some of the techniques used to treat e-waste. This review article overviews the scenario of e-waste generation, the health and environmental consequences caused and mechanisms to treat the e-waste production.

Key words: E-waste, scenario, hard metal lung disease, berylliosis, E-waste treatment, bioremediation,

Introduction

Electronic waste or e-waste is a term used to describe the electronic products which are of no use and are dangerous when exposed. It comprises of discarded cell phones, television sets, refrigerators, microwave ovens, computers and many more. This is because of the presence of certain materials and components which are hazardous, non-biodegradable and pose a great threat to living beings and environment **(Rao, 2014).**People's life style has changed drastically due to immense industrialization and globalization. This in turn has introduced an exponential increase in the use of electronic gadgets and products**(Bhoi et al., 2014)**.But it is to note that the rate of disposing electronic items is higher than the rate of using them due to their short life span. The factors which include growing demands of customers, advances in technology and an increase in markets which produce these products together can be considered as the key components of a lifestyle which is wholly electronically equipped.

The irony is when it comes to the use and implementation of technologies which are used for the disposal and recycling of these electronic wastes. This in together pose a new challenge to the environment and living beings which are unaware of the potential harmful effects of this e-waste.(3) When improperly landfilled and incinerated, e-waste poses an immense threat to environment due to the presence of harmful components in it. This may even cause asthma, neurological disorders and in extreme cases cancer which may be hard to treat. All this together gives rise to a great concern regarding the generation and disposal of electronic goods. Further, it has also been indicated that few countries dispose of their e-waste illegally and improperly in developing countries which leaves them in a situation prone to harmful diseases and hazard. A rise of 10% is estimated to increase globally per year by the US-EPA. The goal which lies ahead is the development of the unique and environment friendly solutions to prevent the ecosystem from being polluted **(Needhidasan et al., 2014; Sharma et al., 2012)**.

E-waste generation scenario

Indian scenario – the growth rate of discarded electronic waste is high in India which is due to the fact that it has become an Information Technology giant due to modernization of lifestyle. As there is no proper discarding system followed in our country, it has led to an enormous amount of e-waste generation. The preferred practice to get rid of obsolete electronic items is to get them exchanged for a new item. About 146,000 tons of e-waste is generated in India annually**(Sharma et al., 2012)**.

Global scenario –, 3.16 million tons of e-waste in the Unites States was generated and about 13.6% of this amount was recycled, according to the Environmental Protection Act (EPA). It is expected that developing countries will triple their output. 20-25 million tons of e-waste is generated per year globally**(Sharma et al., 2012)**.

Impact of e-waste on environment

- Wastes that are landfilled produce hazardous leachates polluting the soil and groundwater.

- Emission of toxic fumes and gases by incineration of e-waste eventually leads to air pollution.
- the local environment and broader local air currents, the toxic fall-out from open air burning affects both.
- Acids and sludge obtained from melting metals, if disposed on the ground cause acidification of the soil.

Diseases caused by e-waste

- Lead and cadmium present in printed circuit boards cause anaemia and emphysema.
- Mercury present in cathode ray tubes (CRTs) causes Minamata disease.
- Cadmium in switches and flat-screen monitors causes Itai-Itai disease.
- Polychlorinated biphenyls (PCBs) present in computer batteries causes Yusho disease.
- Bromine present in cable insulations or coatings affects the immune system badly.

So as to describe about diseases which have not been explored much, but can be of significant harmful impact in future, short studieswere done on hard metal lung disease and Berylliosis.

Hard metal lung disease

Hard metals are the groups of metals which are artificial in nature and composed of mainly tungsten carbide. Small amounts of cobalt and other metals such as molybdenum and titanium also found to be present in hard metals **(Montero et al., 2012)**. These metals are together named as hard metals due to their property of being extensively hard and resistant to heat. Industrial workers when are exposed to such metals while manipulating and converting them to useful equipment and tools can cause hard metal lung disease to themselves. Thus hard metal lung disease is referred to as an occupational disease.Exposure to these metals might cause asthma and lungs associated diseases**(Tanaka et al., 2014)**.

This disease is characterized by the presence of giant and multinucleated cells. In addition the centrilobular fibrosis to the cells a characteristic pattern is resulted which is also known as giant cell interstitial pneumonia (GIP). People suffering from GIP are usually younger in age and have a short duration of exposure to the hard metals**(Tanaka et al., 2014)**.The exposure of hard metal lung disease gives rise to usual interstitial pneumonia (UIP) which is generally characterized by the distortion, interstitial thickening and progressive scarring mainly in the upper lobe of the lungs. Mixture of various metal dusts may cause UIP in addition to cobalt and tungsten. People who are less sensitive towards hard metals may simply suffer from UIP or upper lobe fibrosis**(Tanaka et al., 2014; Moua et al., 2014)**.

Berylliosis

Beryllium is a naturally occurring element that when extracted from ores is processed into metal, oxides, alloys, and composite materials**(Balmes et al., 2014)**.Beryllium finds application in electronics, tele-communications, computers and industrial based metal machinery. Beryllium is a potential human carcinogen, constant exposure of which can lead to lung cancer. The primary health concern is the inhalation of mist, dust and fumes coming out in the form of emissions in where beryllium is being processed. Constant exposure of beryllium causes Chronic Beryllium Disease or Berylliosis. The inhalation of beryllium consisting dust particles can lead to the formation of granulomas whichresult in a non-specific immune response. Individuals who suffer from berylliosis remain unaware of the fact of being suffering from the disease and the disease remains undetected for several weeks.

Berylliosis can be further subdivided into two categories one of which is acute beryllium disease and other being chronic beryllium disease. Acute berylliosis has a sudden, rapid onset. Severe inflammation of the lungs, breathlessness and coughing are certain characteristics of it**(Cummings et al., 2009)**. On the other hand, chronic berylliosis develops slowly and remains undetected for many years. The more common, chronic form of the disease is characterized by the abnormal formation of inflammatory masses. This leads to the irreversible scarring of the lung tissue and thus the ability of the lungs to transfer oxygen is reduced**(Clayton et al., 2014)**.

As the industrial hygiene measures have improved significantly, acute beryllium disease has virtually disappeared but chronic beryllium disease continues to occur in workers of industries where beryllium is processed.

Management of e-waste

It has been observed that due to the unavailability of effective and useful measures of dealing e-waste, a large scale of junk is collected as a result. About 75% of e-waste generated accounts for this uncertainty of how to manage it **(Ramachandra et al., 2004)**.The different ways with which e-waste has been treated till now are as follows :

Land filling –this method is the widely used to disposeoff the electronic waste. It involves the process of creating deep trenches and depositing the discarded waste materials into them. Sometimes, it also leads to the elevation in ground level. But dumping of e-waste into these trenches fives rise to major problems, one of being them the leachate obtained from these wastes. Setting up a layer of clay or plastic may somehow prevent the leachate being collected to be drained out directly to the treatment plants. But leakage in the created layers can result in the outbreak of the leachate into the soil thus affecting the behaviour of soil and

making it acidic in nature. Lead (Pb) from cathode ray tubes in television sets and cadmium (Cd) from switches and flat – screen monitors are some of the obtained leachates from the landfilled sites.

Incineration – the main strategy behind incinerating waste material is to reduce the hazardous organic substances present in it into the less harmful ones. This leads to the reduction of amount of e-waste and the utilization of the energy content present in them. It involves the combustion of waste substances in specially designed incinerators at a temperature of about 1000ºC**(Pradhan, 2013)**.Though being a useful strategy to reduce the substantial amount of e-waste the main disadvantage is the emissions of poisonous gases out of these incinerators. The air pollution thus caused, can be attributed to the release of annual emissions from mercury, cadmium and lead.

Recycle and Reuse – apart from consisting of the dangerous substances such as lead, cadmium, mercury, etc., e-waste comprises of a substantial amount of valuable components such as gold, silver, copper, aluminium and iron. Thus, electronic waste can be subjected to recycling using strong acids and appropriate technologies to extract out the valuable material present in them.

And finally so as to reduce the overspreading amount of e-waste one can subject them to be reused. Donations and second-hand selling of the electronic gadgets and items to someone who need it would definitely help in reducing the e-waste generation and maintaining the ecological system.

Bioremediation – it is referred to the processing and thereby treatment of waste materials with the help of naturally occurring microorganisms. These organisms help in breaking down the toxic and harmful chemicals and metals into the less toxic and harmful substances present in soil or groundwater. The process is further enhanced by addition of nutrients and certain enzymes along with the microorganisms **(Karigar, 2011)**.Sometimes plants such as red clover and water lettuce are also used to absorb the toxic metals landfilled in the soil into their roots and thereby decreasing the deleterious effects caused by those metals. This process of using plants as remediates is known as phytoremediation.

Bioremediation serves as a cost-effective and less labour intensive method of treatment over others. However this method is not able to remove all kind contaminants such as hard metals from the soil and groundwater. In addition the process takes weeks to months to complete and therefore, is slow. But it is strongly believed that bioremediation can surely improve the current scenario of generated e-waste over other methods.

Conclusion

E-waste has been proven to contain many cancer causing agents such as lead, mercury, cadmium and beryllium. Diseases like chronic beryllium disease and hard metal lung disease and there cases have been recorded in the past. Both these diseases are pulmonary lung diseases.Berylliosis is an environment based inflammatory disorder of lungs caused by inhalation of beryllium dusts. The diseases caused by hard metals like tungsten carbide show various pathological patterns like GIP and UIP in our case. The amount of E-Waste generated has to be reduced or controlled or the cases of the inflammatory diseases and that of environmental degradation will increase uncontrollably and acquire sever forms. With help of bioremediation these problems can be tackled and reduced to a certain extent. Production of electronic items with an approach to design equipment that have a longer shelf – life, contain less toxic substances and can be subjected to recycling and reuse should be adopted. Thus, creating awareness in different sectors of our society being that of producers and consumers is a necessary to sustain the use of electronic items.

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