© 2016 IJSRSET | Volume 2 | Issue 3 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

E-Waste Management and Public Health : A scenario of Indian Cities

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ABSTRACT

Electronic waste has turned out to be a critical environmental health issue because of the large and growing volume of E-Waste and inadequate management policies. In the last two decades, there has been an exponential growth in the production and consumption of electrical and electronic equipments. The rapid growth of technology along with up gradation in technical innovation has lead to high rate of obsolescence in electronic industry. This has made e-waste as one of the fastest growing waste streams not only in India but on a global scale. E-waste contains hazardous components which are handled in an environment unfriendly manner, thus causing a threat of deterioration in environmental conditions and human health. In this paper, we present an overview of the various lethal substances present in e-waste, their potential environmental and human health impacts along with the strategies currently being used for e-waste management.

Keywords: E-waste, Hazardous Substance, LCA, MFA, MCA, EPR, E-Waste Management

I. INTRODUCTION

"E-waste" is a popular, informal name for electronic products nearing the end of their "useful life" [1]. It comprises of electrical and electronic devices such as computers, cell phones and other devices which are destined for recycling or disposal. The categories of E-Waste as per European Council include[2] large household appliances, small house hold appliances, IT and telecommunications equipment, Consumer equipment, Industrial tools, Lighting equipment, Toys, leisure and sports equipment, Medical devices (with the exception of all implanted radiotherapy equipment), Monitoring and control instruments, Automatic dispensers.

The creation of innovative and new technologies and the globalization of the economy have made a whole range of products available and affordable to the people changing their lifestyles significantly. But on the other hand, it has also led to unrestrained resource consumption and an alarming waste generation. According to the Comptroller and Auditor- General's (CAG) report, over 7.2 MT of industrial hazardous waste, 4 lakh tonnes of electronic waste, 1.5 MT of plastic waste, 1.7 MT of medical waste, 48 MT of municipal waste are generated in India annually [3]. There are 10 States that contribute to 70 per cent of the total e-waste generated in the country, while 65 cities generate more than 60 per cent of the total e-waste in India. Among the 10 largest e-waste generating States, Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab. Among the top ten cities generating e-waste, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur [4]. The main sources of electronic waste in India are the government, public and private (industrial) sectors, which account for almost 70 per cent of total waste generation. The contribution of individual households is relatively small at about 15 per cent; the rest being contributed by manufacturers [5].

The mismanagement of such immense quantities of e-waste has lead to problems of environmental pollution and adverse health impacts. There is no large scale organized e-waste recycling facility in India and the entire recycling exists in unorganized sector [6]. Hence, there is an urgent need of implementation of proper e-waste management system in India.

II. METHODS AND MATERIAL

1. Impact of E-Waste

The main risks to human health and the environment arise from the presence in e-waste of heavy metals, POPs, flame retardants and other potentially hazardous substances. The materials are complex and have been found to be difficult to recycle in an environmentally sustainable manner. The figure below shows the common toxic substances and their health impacts

Metal	Danger
Lead	A neurotoxin that affects the kidneys and the reproductive system. High quantities can be fatal. It affects mental development in children. Mechanical breaking of CRTs (cathode ray tubes) and removing solder from microchips release lead as powder and fumes.
Plastics	Found in circuit boards, cabinets and cables, they contain carcinogens. BFRs or brominated flame retardants give out carcinogenic brominated dioxins and furans. Dioxins can harm reproductive and immune systems. Burning PVC, a component of plastics, also produces dioxins. BFR can leach into landfills. Even the dust on computer cabinets contains BFR.
Chromium	Used to protect metal housings and plates in a computer from corrosion. Inhaling hexavalent chromium or chromium 6 can damage liver and kidneys and cause bronchial maladies including asthmatic bronchitis and lung cancer.
Mercury	Affects the central nervous system, kidneys and immune system. It impairs foetus growth and harms infants through mother's milk. It is released while breaking and burning of circuit boards and switches. Mercury in water bodies can form methylated mercury through microbial activity. Methylated mercury is toxic and can enter the human food chain through aquatic.
Beryllium	Found in switch boards and printed circuit boards. It is carcinogenic and causes lung diseases.
Cadmium	A carcinogen. Long-term exposure causes *Itai-itai* disease, which causes severe pain in the joints and spine. It affects the kidneys and softens bones. Cadmium is released into the environment as powder while crushing and milling of plastics, CRTs and circuit boards. Cadmium may be released with dust, entering surface water and groundwater.
Acid	Sulphuric and hydrochloric acids are used to separate metals from circuit boards. Fumes contain chlorine and sulphur dioxide, which cause respiratory problems. They are corrosive to the eye and skin.

Figure 1: Common toxic substances associated with e-waste and their health impacts [5]

Landfilling of e wastes leads to leaching of lead into the ground water. If the CRT is crushed and burned, it emits toxic fumes into the air [7]. These products contain several rechargeable battery types, all of which 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^3 of water [8]. The quantity of cadmium in landfill sites is significant, and considerable toxic contamination is caused by the inevitable medium and long-term effects of cadmium leaking into the surrounding soil [9]. Because plastics are highly flammable, the printed wiring board and housings of electronic products contain brominated flame retardants, a number of which are clearly damaging to human health and the environment.

2. Issues Related to E-waste Management in India

The major issues related to e-waste in India are [10]:

1. The amount of lead in bloodstream to be 10 times of the expected level.
2. A water sample revealed levels of lead 190 times as high as the drinking water standard set by the World Health Organization.
3. The average e-waste scenario in India is 1-20 kg per person/p.a and is growing at a rate 3 times faster than the municipal waste.
4. Thousands of children throughout the India are attending schools that were built on or near toxic waste sites, with increased risk of developing asthma, cancer, learning disorders and other diseases linked to environmental pollutant
5. 20 million electronic household appliances including TV, washing machines, PCs etc and 70 million cell phones reach end-of-life every year. Memory devices, MP3 players, iPods, ipads etc. are the newer additions.
6. About 70% of the heavy metals (mercury and cadmium) and 40% lead, in landfills in India come from e-waste
7. 22% of the yearly world consumption of mercury is used in electronics manufacture.
8. Indians upgrade or exchange their cell phones every 18 months, meaning there are approximately 16 million unused mobile phones stashed away at home or in the office.
9. E-waste is exported to India because of major reasons like cheap labour, weak environmental laws and driven by the potential for corporate benefits.

III. RESULTS AND DISCUSSION

E-Waste Management Strategies

The various e-waste management strategies are:

A. Life Cycle Assessment (LCA)

Life Cycle Assessment is a tool used to design environment friendly electronic devices and to minimise e-waste problems [11]. Since the 1990s considerable research has been conducted on the LCA of electronic devices in terms of eco-design, product development and environmental impact. LCA is a powerful tool for identifying potential environmental impacts to develop eco-design products such as printers, desktop personal computers, heating and air conditioner devices, washing machines and toys. It is also a systematic tool to define many environment impact categories such as carcinogens, climate change, ozone layer, ecotoxicity, acidification, eutrophication and land use, to improve the environmental performance of products.

B. Material Flow Analysis (MFA)

Material Flow Analysis is a decision support tool for environmental and waste management [11]. This tool can be applied to develop appropriate e-waste management. This includes a consideration of the flow of e-waste and its assessment in terms of environmental, economic and social values.

C. Multi Criteria Analysis (MCA)

MCA is a decision-making tool developed for considering strategic decisions and solving complex multi-criteria problems that include qualitative/quantitative aspects of the problem [11]. MCA models have been applied to environmental problem including those of e-waste management, to provide optional e-waste management strategies. Although, MCA is not widely used for e-waste management, it is commonly used for solid waste and hazardous waste management. MCA has been recommended for social response to e-waste management and to this end it is a useful tool in combination with other tools being used for E-waste management.

D. Extended Producer Responsibility (EPR)

Extended producer responsibility (EPR) is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of the product's life cycle, including its final disposal [12]. The goals of the product designer could include reducing toxicity, reducing energy use, streamlining product weight and materials, identifying opportunities for easier reuse, and more. Manufacturers have to improve the design by: (i) the substitution of hazardous substances such as lead, mercury, cadmium, hexavalent chromium and certain brominated flame retardants;(ii) measures to facilitate identification and re-use of components and materials, particularly plastics; and (iii) measures to promote the use of recycled plastics in new products. Manufacturers should give incentives to their customers for product return through a "buy back approach". Collection systems are to be established so that e-waste is collected from the right places ensuring that this directly comes to the recycling unit. Collection Centres may only ship wastes to dismantlers and recyclers that are having authorization for handling, processing, refurbishment, and recycling meeting environmentally sound management guidelines.

IV. CONCLUSION

In this paper, we have reviewed scenario of e-waste in India, its hazardous effects on environment and human health and the strategies of e-waste management. E-waste is omnipresent. Contamination associated with e-waste has already caused considerable environmental degradation and adversely affected the health of the people. The ever-increasing amount of e-waste associated with the lack of awareness and appropriate skill is deepening the problem. Most waste is inherently dangerous. It can degrade to produce leachate, which may contaminate ground water, and create landfill gas, which is explosive. For e-waste management many technical solutions are available, but to be adopted in the management system, prerequisite conditions such as legislation, collection system, logistics, and manpower should be prepared. Thus handling of e-waste undeniably requires better management and improved working environment guided by strict regulation.

V. REFERENCES

[1] http://wgbis.ces.iisc.ernet.in/energy/paper/ewaste/ewaste.html

[2] P. Pak, "Haste Makes E-Waste: A Comparative Analysis of How the United State Should Approach the Growing E-Waste Threat," Cardozo J. Int. Comp. Law, vol. 16, 2008

[3] Ravi Agarwal, "A Policy? Rubbish", The Hindustan Times, 4 May 2010

[4] Rajya Sabha Unstarred Question no. 1887, dt. 07.12. 2009, "Disposal of e-waste". Sanjay Jog, "Ten states contribute 70% of e-waste generated in India", The Financial Express, 13 March 2008

[5] Research Unit (Larrdis), "E-Waste In India", Rajya Sabha Secretariat,New Delhi, June 2011

[6] "Guidelines For Environmentally Sound Management Of E-Waste" (As approved vide MoEF letter No. 23-23/2007-HSMD dt. March 12, 2008)

[7] Ramachandra T.V , Saira V. K. , "Environmentally sound options for waste management", Envis Journal of Human Settlements, March 2004

[8] Trick J., "A mobile is not just for Christmas", Tuesday,24th December 2002, http://news.bbc.co.uk accessed on 19th August 2005

[9] Envocare, "Mobile Phone Recycling" at www.envocare.co.uk accessed on 28th August 2005

[10] Shagun, Ashwani Kush, Anupam Arora, "Proposed Solution of e-Waste Management", International Journal of Future Computer and Communication, Vol. 2, No. 5, October 2013

[11] Peeranart Kiddee,Ravi Naidu, Ming H. Wong , "Electronic waste management approaches: An overview", Elsevier, Waste Management 33 (2013) 1237–1250

[12] Kurian Joseph , "Electronic Waste Management In India–Issues And Strategies", Centre for Environmental Studies, Anna University, Chennai, India

[13] Kristen Grant, Fiona C Goldizen, Peter D Sly, Marie-Noel Brune, "Health consequences of exposure to e-waste:a systematic review", Lancet Glob Health 2013;1: e350–61

[14] Ms. Sukeshini Jadhav, "Electronic Waste: A Growing Concern In Today's Environment Sustainability", International Journal of Social Science & Interdisciplinary Research, ISSN 2277 3630, Vol.2 (2), February(2013)

[15] Ahsan Shamim1, Ali Mursheda K, Islam Rafiq, "E-Waste Trading Impact on Public Health and Ecosystem Services in Developing Countries", International Journal of Water Resources, 2015, 5

[16] Pawan Kumar Chaurasia, "E-Waste Management Approaches in India", International Journal of Engineering Trends and Technology (IJETT) – Volume 15 Number 1 – Sep 2014

[17] A. Jayapradha, "Scenario of E-waste in India and application of new recycling approaches for E-waste management", Journal of Chemical and Pharmaceutical Research, 2015, 7(3):232-238

[18] Munam Ali Shah, Rakhshanda Batool, "An Overview of Electronic Waste Management, Practices and Impending Challenges", International Journal of Computer Applications (0975 – 8887) Volume 125 – No.2, September 2015

[19] Vijay N.Bhoi1, Trupti Shah, "E-Waste: A New Environmental Challenge", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 2, February 2014, ISSN: 2277 128X