

Electronic Waste & Its Present Scenario for Pune City

K. R. Takale¹, S. M. Gawande², P. J. Rangari²

P.G. Student, M.E. (Environmental Engineering), Anantrao Pawar College of Engineering, Parvati, Pune, India.¹

Assistant Professor, Department of Civil Engineering, Anantrao Pawar College of Engineering, Parvati, Pune, India.²

ABSTRACT: Electronic waste or E-waste consists of discarded or unwanted electrical or electronic parts or equipment. Increase in penetration rate & rapid obsolescence will create crises in developing nations like India. In India most of E-waste is generated in metropolitan cities like Mumbai, Bangalore, Delhi, Kolkata, Pune etc. In Maharashtra Pune, the city known as Oxford of East and home of different industries especially in IT sector, figures prominently in the list of cities that generates huge E-waste in India. Most of the E-waste in Pune is dumping in landfills or it's incinerated by kabadiwalas, while on other hand formal sector facing problems due to insufficient supply of E-waste. According to study Pune city generates approximately 4500 tons of E-waste in year 2015. E-waste generation rate is highly increases day by day especially some major items due to change in technology, fashion, per capita income of citizens. There existed half hearted efforts of Pune Municipal Corporation and some organizations managing only a small percentage of the total E-waste generated. E-waste Management is very essential task as E-waste becomes a threat to human being. Government has passed a law for E-waste management and handling in 2011, but lack political wills it would not get implemented properly. While the E-waste rules were implemented in 2011, even after four years the problem of domestic E-waste disposal and recycling remains. This paper discusses the rate of generation and the status of E-waste practices by various contributors of the system in Pune city and indicating absence of broad system.

KEYWORDS: E-waste, Obsolescence Rate, WEEE.

I. INTRODUCTION

E-waste problem has become an immediate and long term concern as its increase in rate of generation and recycling can lead to serious environmental problems endangering human health. The information technologies have revolutionized the way we live, work and communicate bringing countless benefits and wealth to all its users. 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. New electronic products have become an integral part of our daily lives providing us with more comfort, security, easy and faster acquisition and exchange of information. But on the other hand, it has also led to unrestrained resource consumption and an alarming waste generation. Both developed countries and developing countries like India face the problem of E-waste management. The rapid growth of technology, rise in per capita income of people in developing nation, up gradation of technical innovations and a high rate of obsolescence in the electronics industry have led to one of the fastest growing waste streams in the world which consist of end of life electronic waste products. It comprises a whole range of electrical and electronic items such as refrigerators, washing machines, computers and printers, televisions, mobiles, etc. many of which contain toxic materials.

Solid waste management, which is already a creating lot of problems in Pune, has become more complicated by the invasion of E-waste. Pune city, with a population of more than 3.3 million, has got a huge growing market electronic waste. The annual E-waste generated in Pune is approximately 4500 tons in year 2015 and is showing an increasing trend [1]. Improper disposal or contact with E-waste can lead to contamination of the surrounding ecosystem and can be a major health hazard [2]. However land filling of E-wastes can lead to the penetration of heavy metals in ground water. Burning of CRT emits toxic fumes into the air [3]. All electronic equipments contain printed circuit boards

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

which are hazardous because of their content of lead (in solder), brominated flame retardants (typically 5-10% by weight) and antimony oxide, which is also present as a flame retardant (typically 1-2% by weight) [4]. Recycling of electronic waste takes care of both waste treatment and valuable material recovery and hence has both ecological and economic relevance.

Precious metals recovered from E-waste have a wide application in the manufacture of electronic appliances, serving as contact materials due to their chemical stability and their good conduction properties. On a broader scale, analyzing the environmental and societal impacts of E-waste reveals a mixture of benefits and costs [5]. This will further improve the region's progress towards prosperity. This study focuses on management and disposal of E-waste in Pune city. Identify to improved practices based on present scenario of E-waste generation and management system in Pune city.

II. LITERATURE REVIEW

Electronic Waste Management System at Pune

A comprehensive study conducted by author on the existing E-waste management system in Pune. The study gives idea about the present E-waste practices of the various stakeholders in the system. Figure 1 illustrates the existing E-waste management system in Pune and the following paragraphs discuss the same.

Informal Sector:

The waste collectors or kabadiwalas or rag pickers are the most important link in electronic waste flow and they are collecting most of electronic waste in Pune city from household users as well as from manufacturers. There is another set of operators, waste traders with better financial capacity, who bid for larger volumes of waste being discarded by companies and organization through auctions. The waste then flows down to scrap dealers; first they are dismantling E-waste into different components, collect useful components and then shift the other waste to plastic recyclers or thrown on open land.

The E-wastes produced in small and medium sectors mainly end up with the informal recyclers where recycling is done in hazardous manner causing danger to not only to the environment but also to the people involved in the recycling activity. However E-waste has been kept away from the dump sites so far. But, its activity still generates a high environmental and social impact (use of toxic chemicals, poor working conditions, child labour, etc.). Rag-picker picks discarded waste from local garbage dumps or open fields. In the existing system the E-wastes collected by the Rag picker or the Kabadiwalas end up in the hands of informal recyclers through Local Waste Marts and the Mumbai Market. Thus, it is necessary to develop new path and to modify the existing system to ensure that E-wastes end up with authorized recyclers.

Formal Sector:

In contrast to the threat presented by informal sector, the opportunities presented by the Organized Sector are immense. The formal recycling needs the joint efforts of all the stakeholders including WEEE producers, Domestic users, and other consumers so that an eco friendly management and recycling should be carried out. By use of proper tools, machinery, equipments without damaging health of labour which is finally resulting in efficient management of E-waste. Life cycle of the electronic and electrical equipments starting from the birth at manufacturing sector reaches the consumers and after their consumption at user end, these equipments enter the chain of recycling at the collection centers designated by companies and thus reaching authorized recyclers and dismantler's. To replace informal sector by formal one for recycling, government of India enacted rules [2]. Various recycling companies have evolved out in India which has been granted authorization by concerned pollution control boards and they maintain all standards as prescribed by the central pollution control board.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

Very few formal E-waste collecting and dismantling centers are running successfully in Pune city. According to Maharashtra Pollution Control Board (MPCB), Pune officials there are three E-waste recyclers. Approximately 1000 Tons of E-waste was processed and recycled in these recycling units. The registered recycle centers of E-waste, in and around Pune are:

1. Hi-Tech recycling India (P) Ltd. Bhugaon, Pune.
2. Eco-credible Enviro Solutions Pvt. Ltd, Pune.
3. Green IT- Recycling Centre (P) Ltd, Ranajangaon, Pune.

These three E-waste recycling centers are working as per MPCB guidelines. While the MPCB has permitted Eco-credible to recycle 2000 Tons per year, the company has been able to recycle only 150 Tons wastes this year, because of E-waste availability is insufficient manner. Since most electronic and electrical products have a value at the end of their useful life, the informal sector is able to pay the consumer to acquire this waste. The formal sector, because of its larger infrastructure and operational costs, finds it hard to compete with the informal sector.



Fig.1. E-waste collection van by formal recycler

Household Users:

Approximately 500 Tons to 1000 Tons E-waste generated in Pune city is of domestic nature, maximum 300 Tons is being collected. Rest of all E-waste is added to the municipal solid waste. According to the study of some households in Pune using random sampling most of citizens of Pune are not aware about E-waste and its hazards. The focus of the study was to know the disposal techniques of the electronic waste products and to assess the E-waste awareness among the domestic users. The different families in Pune according to living standard were considered for the study.

The study gave valuable inputs regarding awareness of the toxic substances present in the E-waste and knowledge of the hazards to human health and the environment and the people's expected value from the products that were disposed and/or recycled. The analysis shows that most of the people are not aware of the hazardous materials present in the electronics products but only a few actually knew the practices adopted to recycle this waste. In Household disposal of E-waste in Pune most of waste is disposed with household waste as well as sold to kabadiwalas.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

Government:

The government of Maharashtra has taken various initiatives for E-waste management under MPCB with municipal corporations of major cities in Maharashtra. But the major problems in E-waste management are lack of awareness, high rate of generation of E-waste, lack of infrastructure in E-waste management. Government has passed a law for E-waste management and handling in 2011, but lack political wills it would not get implemented properly. While the E-waste rules were implemented in 2011, even after three years the problem of domestic E-waste disposal and recycling remains.

Pune city's solid waste management system has to bear an extra 30 per cent load of electronic waste (E-waste) not being separated, collected or recycled by government institutions. As the MPCB did not carry any studies of E-waste since 2008, the officials could not give any accurate figures and estimated that the E-waste generation has increased from 1950 Tons in 2008 to 4500 Tons in year 2015. Thus, it is the responsibility of government as well as citizens to do the systematic E-waste management and disposal.

III. APPROACH & METHODOLOGY

The Market Supply method used to find out the approximate E-waste generation in Pune city. Pune city's approximate market size has been estimated based on sales data. This data is used in different calculations to give theoretical electronic waste generation for the selected items such as mobiles, computer, refrigerator, television etc. Finally, using average weights and an average composition of the waste stream, total WEEE for Pune has been extrapolated.

The Market Supply method was first used in Germany for assessment of Waste Electrical and Electronics Equipments. It is based on the extrapolation of waste arising by using sales figures together with the typical lifetime of an appliance [1]. As per this method, WEEE generated in a year can be represented by the following simple equation;

$$\text{WEEE Generation in year } x = \text{Sales } n \text{ years previously}$$

$$(n = \text{average life time of item})$$

Obsolescence rate/average lifetime can be calculated based on depreciation and book value/economic value of the EEE. Obsolescence means the fact that a product is intentionally designed and made so that it will not last for a long time. The obsolescence rate for electronic items has been taken as shown in Table 1.

Table 1: Obsolescence rate for electronic items

Sr. No.	Electronic Item	Obsolescence Rate (years)	
1.	Cellular Phone	2	4
2.	Personal computer	5	7
3.	Refrigerator	15	17
4.	Television	15	17

These obsolescence rates consist of both active and passive life of electronic item. Here we considered the obsolescence rate in active life time for calculating E-waste generation. Based on these obsolescence rates the E-waste inventory of Pune has been estimated in following sections.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

E-waste Projection in Pune

a. Cell Phone

The data obtained from Cellular Operators Association of India (COAI), Telephone Regulatory Authority of India (TRAI) and Census of India for the time dependent increase of installed base and yearly additions of cell phone in Pune is calculated.

The number of cellular phones introduced into the E-waste market from the installed base in the region was further augmented by considering the external factors. It includes the number of cellular phones brought into Pune market from other sources. The average weight of cellular phones has been taken as 102.86 gm. Based on the secondary data review for cellular phones, considering obsolesce of 2 years the amount of E-waste in Pune by year 2015 is estimated and projected to be 44.49 tons.

b. Personal computer

The data obtained from Census of India and MAIT for the time dependent increase of installed base and yearly additions of personal computer in Pune is calculated. The average weight of PC has been taken as 27.2 kg. For Personal computer based on the secondary data review, considering obsolesce of 5 years the amount of E -waste generation in Pune by year 2015 is estimated and projected to be 1183 tons.

c. Refrigerator

The data obtained from Census of India and TeleVision Veopaar Journal, India from 1987, for the time dependent increase of installed base and yearly additions of refrigerator in Pune is calculated. The average weight of refrigerator has been taken as 48 kg. For refrigerator based on the secondary data review, considering obsolesce of 15 years the amount of E-waste in Pune city by year 2015 is estimated and projected to be 1949.5 tons.

d. Television

The data obtained from Census of India and TeleVision Veopaar Journal, India from 1987, for the time dependent increase of installed base and yearly additions of television in Pune is calculated. The average weight of TV has been taken as 36.5 kg. For refrigerator based on the secondary data review, considering obsolesce of 15 years the amount of e-waste in Pune by year 2015 is estimated and projected to be 1395.5 tons.

IV. EXPERIMENTAL RESULTS

Electronic waste inventory in Pune

Final inventory giving the quantity of E-waste from the four electronic items in Pune considering a combination of obsolescence rates confirmed through this technique is given below. The analysis of below data shows that the E-waste generation exceeds 4573.43 tons / year in Pune. The E-waste generation analysis has been described in Table 2 & WEEE / E-Waste projections till 2015 for Pune are shown in chart 1.

Table 2: E-Waste Generation in 2015

Items	Obsolescence Rate	E-Waste in Tons/year
Cell Phone	2	44.50
Personnel Computer	5	1183.90
Refrigerator	15	1949.48
Television	15	1395.55
Total		4573.43

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

From above data, we get approximate electronic waste generation in Pune city in year 2015 for major four items. Most of E-waste is generated by refrigerator and television but obsolescence rate is more for these two items. According to obsolescence rate major E-waste generation is due to Personal computers in Pune city. The E-waste projection from year 2006 to 2015 for major four items is given in below Fig. 2.

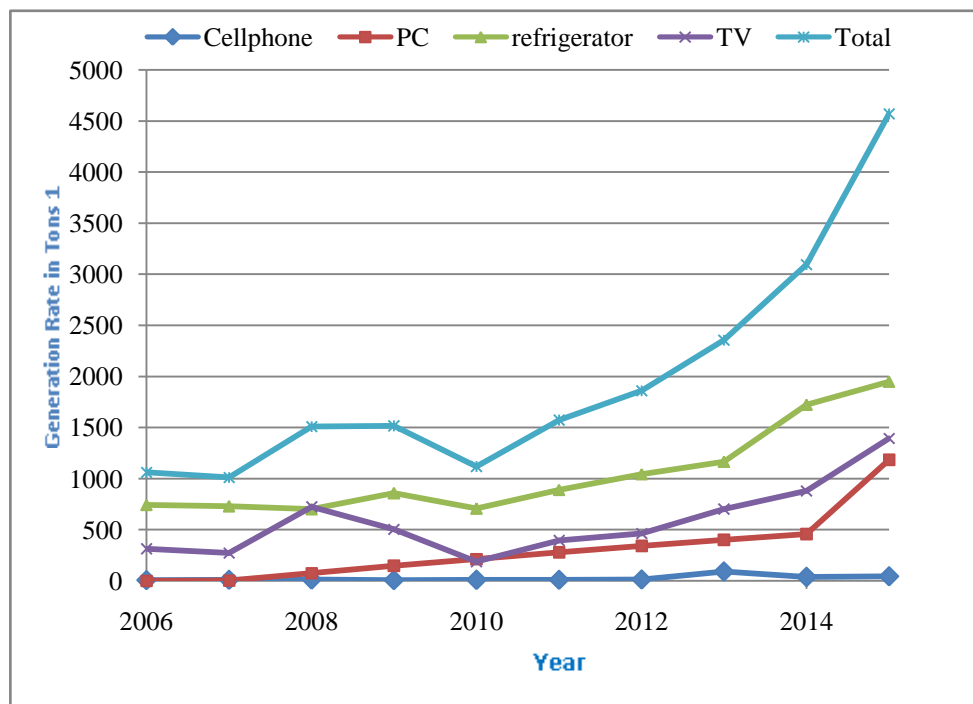


Fig. 2: WEEE / E-Waste projections till 2015 for Pune

Above figure gives the Electronic waste projections of some major electronic materials such as Cell Phone, Personnel Computer, Refrigerator and Television etc, till 2015 for Pune city. It shows Television has more fluctuation in the rate of generation of E-waste comparing other materials. Rate of generation of refrigerators in E-waste is comparatively stable. After 2010 the E-waste generation rate is highly increases for all four items.

V. CONCLUSION

This paper discusses the rate of generation and the status of E-waste practices by various consumers of the system in Pune city and indicating absence of broad system. Most of peoples in Pune are unaware about E-waste and hazards due to the E-waste. E-waste generation rate is highly increases day by day especially some major items due to change in technology, fashion, per capita income of citizens. There existed half hearted efforts of Pune Municipal Corporation and some organizations managing only a small percentage of the total E-waste generated. Most of E-waste is dumping with Municipal solid waste landfill directly. On other side formal sector faces problems of insufficient supply of E-waste.

Participation of informal sector in authorized channel is very important for success of E-waste management programme. The authors thinking that combine efforts by various contributors in electronic waste management programme are required to evolve and implement proper E-waste management system in Pune.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2015

REFERENCES

- [1] Report on Assessment of Electronic Wastes in Mumbai- Pune Area, prepared by IRG Systems South Asia Pvt. Ltd., New Delhi, Maharashtra Pollution Control Board, Mumbai, March 2007.
- [2] C K Nagendra, Guptha and G L Shekar, "Electronic Waste Management System in Bangalore – A Review" JK Journal of Management & Technology, ISSN 0975–0924 Volume 1, Number 1, pp. 11–24- 2009.
- [3] Ramachandra, T.V. and V.K. Saira, 2004.Environmentally sound options for waste management. Environ. J. Hum. Settl., pp: 3-11.
- [4] Devi, B.S., S.V. Shobha and R.K. Kambla, 2004. E-Waste: The hidden harm of technological revolution. J. IAEM., 31: 196-205.
- [5] Alastair, I., 2004. Mapping environmental justice in technology flows: computer waste impacts in Asia, Massachusetts Institute of Technology. Glob. Environ. Pol., 4(4): 76-107.
- [6] Viraja Bhar and Yogesh Patil, E-waste consciousness and disposal practices among residents of Pune city, Elsevier Procedia - Social and Behavioral Sciences 133 (2014) 491 – 498, 2014.
- [7] Gao Z, Li J, Zhang HC, Electronics and the Environment, IEEE International Symposium pp.234-241, 2004.
- [8] Xuefeng W, Yuemin Z, Chenlong D, Xiaohua Z, Hongguang J, Shulei S (2005). Study on metals recovery from discarded printed circuit boards by physical methods, Electronics and the Environment, Proceedings of IEEE International Symposium, May, pp.121- 128, 2005.
- [9] E-waste Volume II: E-waste Management Manual, United Nations Environmental Programme, 2007.
- [10] Shubham Gupta, Gaurav Modi, Rahul Saini and Vijaya Agarwala, A review on various electronic waste recycling techniques and hazards due to its improper handling.
- [11] S. Chatterjee and Krishna Kumar, Effective electronic waste management and recycling process involving formal and non-formal sectors, International Journal of Physical Sciences Vol. 4 (13) pp. 893-905, December, 2009.
- [12] Johan Sohaili, Shantha Kumari Muniyandi, Siti Suhaila Mohamad, A Review on Printed Circuit Boards Waste Recycling Technologies and Reuse of Recovered Nonmetallic Materials, International Journal of Scientific & Engineering Research, Volume 3, Issue 2, February-2012.
- [13] A. Agrawal, M. Perween, Shubhajit Pramanik and K.K. Sahu, Recovery of Copper From PCB Leach Solution By Solvent Extraction Proceedings of the XI International Seminar on Mineral Processing Technology -2010.