

Indian Scenario of E-Waste Recycling

Dr. Sunil D.Kahar

Assistant Professor, Department of Metallurgical & Materials Engineering, Faculty of Technology & Engineering,
The M S University of Baroda, Vadodara, Gujarat, India

ABSTRACT: Technological developments in electric/electronic industries have resulted in an increase in consumption compared with past generations. In other words, robust technical growth and market expansion yield high-end and short-lived electric/electronic durables, leading to a significant increase in the amount of waste comprising electrical and electronic products. India is rich in ores and mineral, but E-waste recycling is necessary due to the report of national and international studies, which cautioned on the generation, treatment and accumulation of e-waste in India. Current data indicate that the total domestic e-waste generation including imports is around 382979 MT, however waste available for recycling and actually recycled are 144143 MT and 19000 MT, respectively. In which recycling by non-formal and formal sector are 95% and 5%, respectively. On the other hand, India has developed expertise in handling verities of metallic wastes in an organized and safe manner. The development of individual process or combined processes for handling the e-waste is underway. Eco- friendly and energy-saving processes are necessary to comply with stringent environmental regulations. The paper includes the recent trend of e-waste generation, recycling process and its future prospects particularly in India.

KEYWORDS: Scenario of e-waste, PCBs, Potential Pollutants, E-Waste Dismantler, Recycling technology,

I. INTRODUCTION

Increased usage of gadgets, telecom, information and technology and appliances is collectively creating nearly 13 lakh tonnes of eWaste annually in India according to an August 2014 report by the industrial body ASSOCHAM. Another January 2015 report from Markets and Research has forecast that the Indian eWaste market will grow at 26.22% CAGR during 2014-2019. However, with so much electronic waste being generated in the country, a major portion is handled by the informal or unorganized sector using improper processes, which leads to environmental pollution and health hazards. By 2017 the annual volume of e-waste will increase by some 33 percent to an estimated 65.4 million tons - the equivalent in weight to 11 Great Pyramids of Giza - according to the UN-led public-private solving the E-Waste Problem initiative[1-2].

1.1 What Is E-Waste?

Like hazardous waste, 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.



Fig.1 E-waste comments

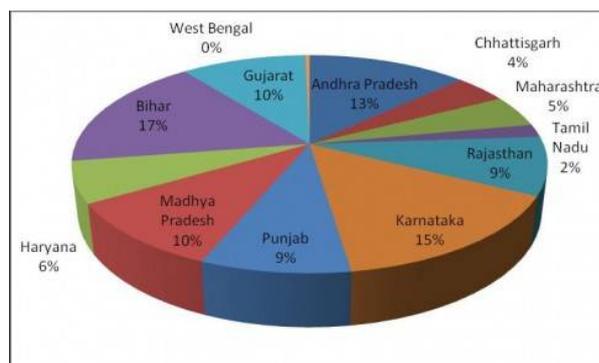


Fig.2 City wise E-waste Generation in India(Tonnes /Year)

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

The information technology has revolutionized the way we live, work and communicates 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. It comprises a whole range of electrical and electronic items such as refrigerators, washing machines, computers and printers, televisions, mobiles, i-pods, etc., many of which contain toxic materials[3].

II. SCENARIO OF E-WASTE IN INDIA

Due to lack of proper technology for the recycling of waste electrical and electronic equipments (WEEE), all around the world, the amount of generation of WEEE is increasing rapidly and comprises about 5% of all the solid waste [4]. In India also demand and supply of EEE increases at a tremendous rate. Fig. 3 shows that there is rapid increase in the number of sales of desktop in the period of 1994 to 2007 and the value reaches up-to 5.52 million [5]. Fig. 4 shows that mobile subscriber in India increases from 90 million to 433 million during the period 2006-11 and expected to touch 900 million in 2015-16 [6].

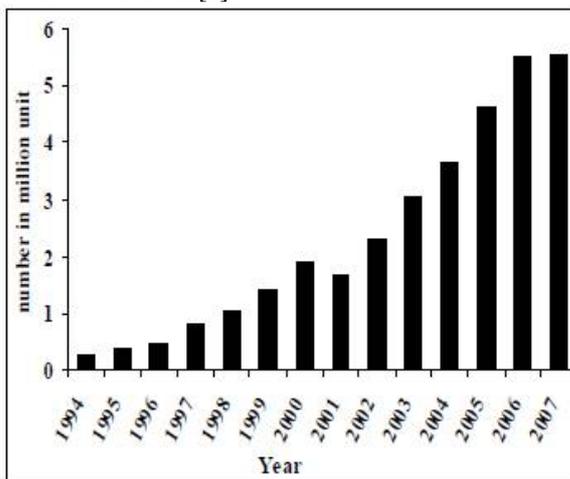


Fig. 3. Domestic sales data of electronic devices in India (in million units)

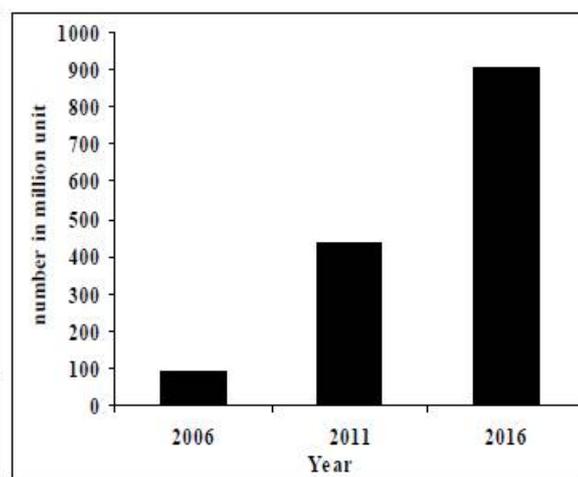


Fig. 4. Number of mobile phone subscriber in India (in million units)

Based on the logistic model, it is revealed that around 41-152 million units of computers will become obsolete by the end of 2020 [5]. However, total of 2.5 million tonnes of WEEE comprising of PC, television, washing machine and refrigerators are expected to generate during the period of 2007-11 [7]. These statistics will help the recyclers in building strategy for the recycling of e-wastes.

III. UNORGANIZED EWASTE PROCESSING IN INDIA – AN ENVIRONMENTAL HAZARD

Majority of the e-waste comprises computers, while telecom, electrical gadgets and health equipment account for the remainder. Apart from various toxic substances like lead, mercury and arsenic, electronic waste also contains valuable substances like gold, silver and rare earth elements. When it comes to managing e-waste, India is relying heavily on the unorganized sector which accounts for over 90 per cent of the entire e-waste recycling industry. Unorganized setups generally employ low paid workers, including over 4.5 lakh children, who are not trained properly to process e-waste.

3.1 Crude techniques worth mentioning are:

1. Physical dismantling using tools such as hammers, chisels, screw drivers and bare hands to separate different materials
2. Removing components from printed circuit boards by heating over coal-fired grills
3. Stripping of metals in open-pit acid baths to recover gold and other metals
4. Chipping and melting plastics without proper ventilation

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

5. Burning cables to recover copper, and burning unwanted materials in the open air
6. Disposing unsalvageable materials in fields and riverbanks.

These illegal methods to recover the precious metals expose the workers to harmful chemicals such as heavy metals, inorganic acid, polycyclic aromatic hydrocarbons, etc., which are potential pollutants and cause serious occupational health hazards that are listed in table -1 and fig 2 represents informal processing of e-waste[8].

Table 1: Potential pollutants and their occupation health hazards [9].

Potential Pollutants	Occupational health hazards
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 <i>Itai-itai</i> 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.

3.2 Step towards Responsible E-Waste Recycling – Organized e Waste Processing

In developing countries, the e-waste is dismantled manually and releasing the non degradable plastics and persistent chemical to the environment thereby contaminating the quality of air, water and soil. Deposits of precious metals in eWaste are 40-50 times richer than ores extracted from traditional mines according to a November 2013 report by Gemina Harvey published in The Diplomat. It is also cheaper and less carbon intensive to extract precious metals from e-scrap. Abundance of electronic waste in India and diktat by government stating that the onus of safe disposal of gadgets will be on producers and bulk consumers has attracted a lot of investment into startups doing e-waste recycling. Organized sector has grown from 3 per cent to 10 per cent approximately in last six years[10].

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

Table-2 Market Value of the Metal Recovered from 1000 Kg of PCBs

Recovered metal	Weight	Approximate cost (US\$)
Gold	279.93 g	6115 (@685.00 per 31 g)
Precious metals(Pt,Pd,In)	93.31 g	3852(@1284 per 31 g)
Copper	190.512 Kg	1470(@3.5 per 453.59 g)
Aluminum	145.152 Kg	448((@1.28 per 453.59 g)
Lead &Tin	30.844 Kg	144.16(@2.12 per 453.59 g)
Silver	450 g	213.15(@14.70 per 31 g)

Table -3: List of Registered E-Waste Dismantler/Recycler in the country

Sr. No	State	Number of Registration Recycler Unit
1	Andra Pradesh	2
2	Chhattisgarh	1
3	Gujarat	7
4	Haryana	13
5	Karnataka	52
6	Maharashtra	22
7	Madhya Pradesh	2
8	Rajasthan	9
9	Tamil Nadu	14
10	Uttar Pradesh	11
11	Uttarakhand	4
12	West Bengal	1
	Total	138

IV. RECYCLING OF E-WASTE

Recycling options for managing plastics from end-of-life electronics are of three types.

- Chemical recycling
- Mechanical recycling
- Thermal recycling.

Any recycling process involves dismantling, that is, removal of different parts of e-waste containing dangerous substances such as PCB, Hg, separation of plastic, removal of cathode ray tube (CRT), segregation of ferrous and nonferrous metals and printed circuit boards. Recyclers use strong acids to remove precious metals such as copper, lead, gold. The value of recycling from the element could be much higher if appropriate technologies are used. The recyclers are working in poorly-ventilated enclosed areas without mask and technical expertise results in exposure to dangerous and slow poisoning chemicals.

4.1 Hazardous effects due to recycling

- Potential threat to human health and the environment
- Lead causes damage to the central and peripheral nerve system, blood system and kidneys in humans
- Mercury impacts brain functioning and development[11].

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

V. CONCLUSION

It is the responsibility of the government to turn away more e-waste flowing from informal to formal sectors and to achieve positive utilization of informal collection networks for collecting e-waste from households thereby developing efficient incentive system for poor collectors and recyclers. Technical improvements of informal recycling processes coupled with proper training in handling E-waste has to be offered to the local industry and community so to obtain better environmental performance without sacrificing the economic and social benefits. This will provide a remedy for the occupational health hazards related to the informal recycling of e-waste. Developing a better understanding of informal recycling and implementing more supportive policies for the informal sector that could result in hundreds of job opportunities for low-skilled workers in a complete safe environment is a sustainable solution for the current issue. Educating the children who are actively involved in e-waste processing in their own line creates e-experts for future generation and can handle this hazardous waste and turn in to the valuable resource.

REFERENCES

- [1] Performance Audit on "Management of Wastes in India", www.cag.gov.in/html/reports/civil/2008_PA14_SD.../chap_1.pdf, Report No. PA 14 of 2008
- [2] Schwarzer S., A.D. Bono et al, 'E-waste, the hidden side of IT equipment's manufacturing and use', Environment Alert Bulletin (UNEP Early Warning on Emerging Environmental Threats), No. 5, 2005.
- [3] Tom Young, 'E-waste a growing problem for China and India', <http://www.computing.co.uk>, 22 February 2010
- [4] H. Gaule, "Recovery of precious metals from electronic waste," Report U04CH115, Sardar Vallabhbhai National Institute of Technology, Surat, India.
- [5] M. Dwivedy, R.K. Mittal, "Future trends in computer waste generation in India", Waste Management, , pp. 2265-2267, 2010
- [6] S.K. Singh, "The diffusion of mobile phones in India", Telecommunications Policy, pp 642-651, 2008
- [7] M. Dwivedy, R.K. Mittal, "Estimation of future outflows of e-waste in India", Waste Management, pp. 483- 484, 2010
- [8] New e-waste rules ignore unorganized waste', The Pioneer, New Delhi, 19 May, 2010.
- [9] 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
- [10] Report on "Managing Electronics Waste (2007). Dumping old TV? First read the rule", The Hindustan Times, New Delhi Edition, , 15 October, <http://www.industelegraph.com/story/2005/9/2/33438/17285,p.1>, 2005
- [11] K.K. Sahu, and A. Agrawal, "Environment friendly recycling of electronic waste – A challenge before developing nations", Journal of Metallurgy and Material Science, pp. 107-118, 2008
- [12] Manis Kumar Jha1, Abhishek Kumar1, Vinay Kumar1, Jae-chun Lee, Prospective Scenario of E-Waste Recycling in India, Recycling of Electronic Waste II, Proceeding of the second symposium ,The Minerals, Metals& Materials Society , pp. 76-77, 2011