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E-Waste management and its safe recycling : remains a pipe dream in India

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Abstract : Electronic waste or e-waste is one of the rapidly growing problems of the world and India as well. E-waste comprises of a multitude of components, that containing a number of substances. Some of which are toxic and have an adverse impact on human health and the environment if not handled properly. In India, e-waste management is of greater significance not only due to the generation of its own e-waste but also because of the dumping of e-waste from developed countries. This is coupled with India's lack of appropriate infrastructure and technology for its disposal and recycling. There is an urgent need of detailed assessment of current and future scenario including quantification, characteristics, existing disposal practices, need of latest technology for maximum explanation with least environmental impacts etc. Establishment of e-waste collection, exchange and recycling centre should be encouraged. Policy level interventions should include development of e-waste regulation, control of import and export of e-wastes and facilitation in development of infrastructure. An effective take back programme providing incentives for producers to design product having less wasteful, contain fewer toxic components and are easier to disassemble , re-use and recycle may help in reducing e-wastes. End-of-life management should be made a priority in the design of new electronic products.

Key words: E-waste, End-of-life management, brominated flame retardants, hexavalent chromium, white goods, grey goods, brown goods, , take back, extended producers responsibility.

INTRODUCTION

Environmental pollution and waste management is global problem and is evidenced by loss of vegetation cover and biological diversity, excessive concentration of harmful chemicals in the ambient atmosphere and in food grains, growing risks of environmental calamities and threats to life support system. Pollutants may defined as any solid, liquid or gaseous substance present in such concentration as may be or tend to be injurious to environment [Indian Environment (protection) act, 1986]. Disposal of solid-waste has become one of the major problems for today world.

The electronic industry is the world's largest and fastest growing manufacturing industry (Radha, 2002; DIT, 2003). Rapid economic growth, coupled with urbanization and a growing demand for consumer goods, has increased both the consumption and the production of electrical and electronic equipment. Technological advances are a new environmental challenge – the growing menace of "Electronics Waste" or "e-waste" that consists of obsolete electronic devices. It is an emerging problem as well as a business opportunity of increasing significance, given the volumes of e-waste being generated and the content of both toxic and valuable materials in them. The dumping of e-waste, into India from developed countries, because the latter find it convenient and economical to export waste has further complicated the problem with e-waste management. All this has made e-waste management an issue of environment and health concern.

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What is E-Wastes and Its Impact

Electronic waste or e-waste is the term used to

describe old, end of-life electronic appliances such as large household appliances (refrigerator, washing machine etc), accounts 42%; information and communications technology equipments (PC, monitor & laptop etc) accounts 33.9%, and consumer electronics (TV etc) accounts 13.7%. The bove three categories of waste electrical and electronics equipment (WEEE) account for 90% of the generation (e-waste Guide).

Different components of electronic products contains more than 1000 different substances fall under 'Hazardous' 'non-hazardous', categories (Mehra, 2004). Hazardous materials such as lead, mercury and hexavalent chromium in one form or other are present in such wastes. Although it is hardly known that e – waste contains toxic substances such as lead and Cadmium in circuit boards; lead oxide and cadmium in monitor Cathode Ray Tubes (CRT), mercury in switches and flat screen monitors, cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and Polyvinyl Chloride (PVC) cable insulation that releases highly toxic dioxins and furans when burned to retrieve copper from the wires. Printed ciruit boards, and essential constituent of all electronic equipments, are hazardous because of their content of lead (in solder), Brominated flame retardants (5-10% by weight) and antimony oxide, present as a flame retardant (1-2% by weight). (Devi et al 2004)

The electronic and electrical goods are largely classified under three major categories as, 'white goods' (comprising of household appliances like air conditioners, dishwashers, refrigerators and washing machines); 'brown goods' (comprising of TVs, camcorders cameras, etc) and 'grey goods' (comprising of computers printers, fax machines, scanners etc). The grey goods are comparatively more complex recycle due to their toxic composition[2]. Often, these hazards arise due to the improper recycling and disposed processes used[8]. Waste from the white and brown goods is less toxic as compared to grey goods. A computer contains highly toxic chemicals like lead, cadmium, mercury, beryllium, BFR, poly vinyl chloride and phosphor compounds[2].

Land filling of e – waste is much more dangerous due to leaching of hazardous waste into the ground water. Such as the cadmium from one mobile phone battery is enough to pollute 600 m^3 of water (Trick 2002). Contamination of ground water due to leaching of lead is also significant. Several type of e – wastes contain rechargeable battery, which contain toxic substances that can contaminate the environment when burned in cinerators or disposed of in landfills. Plastic 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.

Magnitude of E – Waste in India

So far the Indian union ministry has no data on how much e-waste the country generates, let alone any information on how many manufacturers or importers of computers, mobile phone and other electronic items are ensuring proper disposal of their products or recycling of the end-of – life products.

According to manufacturers Association of Information Technology, India generates 4.7 lakh tones of e – waste every year [2] (IT's underbelly, Down to Earth May 16-31, 2010). An additional 50,000 tones of e – waste is illegally imported into the country. The projected growth for e – waste generation in India is about 34% per year (toxics link 2003-2004) 2, 3 & 4.

Of the total e-waste generated in the country, western India accounts for the largest proportion of 35%, while the southern, northern and eastern regions accounts for 30%, 21% and 14% respectively. The top states in order of highest contributor of e – waste are Maharastra, Andhra Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab, while in city wise ranking the largest e-waste generator in descending order is Mumbai, Delhi, Bengaluru, Chennai, Kolkata, Ahmadabad, Hyderabad, Pune, Surat & Nagpur[3] . According to a UN report India's e – waste from old computers alone will jump 500 per cent by 2020, compared to 2007.

Processing centre in India and Technology Adopted

There are very few recycling units in India. In India the process is cheap as it involves manual labor. Northern India is not a leading generator, but has the leading processing center of e – waste in the country. The biggest

e – waste recycling unit in the country, Roorkee – based Altero Recycling, has the capacity to treat 12000 tonnes of e – waste in a year. There are a few more, such as Mumbai – based Eco-Recycling limited and Bengaluru-based E-Parisaraa Private Ltd. which have capacities of 7,200 tonnes per annum and 1800 tonnes per annum respectively.

In India e–waste collection centres (scrap dealers) pose the biggest challenge for such formal collection system (recycling companies). They offer better prices for used electronic goods compared to the formal sector and collect 95 % of e – waste generated. Though the number of formal recyclers have been increasing at a rapid pace – from a single firm in 2005 to 90 in 2013, though the total recycling capacity of these authorized facilities is way less than the e-waste generated. Secondly, even the established facilities are not getting volumes of electronic waste up to their full capacity (Altero is operating at only 20 percent of its capacity).

There are only 19 authorized e-waste recyclers in Karnataka to cater to the needs of more than 450 electronic goods manufacturing industries. Most of these recyclers are in Bangalore that generates bulk of e – waste.

E – Waste Management Legislations Policy and Consequences

The existing regulations are –

a) Draft Hazardous materials (Management, Handling and Trans-boundary movement) Rules 2007 (Dated 28th September 2007), part of the environment protection Act 1986.
b) India is a signatory to the Basal convention (it is the United Nations Environment Programme) on the control of Transboundary movement of hazardous wastes and their disposal.

Union environment ministry introduced e-waste management rules in May-2012. The rules placed India on a par with a select few developing counties that have laws in place to safely handle and dispose of the growing volume of electronic waste.

The rules for the first time put the onus of reducing and recycling these e-wastes on manufacturers and importers of electronic items. They made them legally responsible for making people aware of these hazardous components and inform consumers about proper disposal system so that they do-not mix e-waste with domestic waste. The industry was also entrusted with the responsibility of setting up e-waste collection centers and introducing "take back" systems as extended producers responsibility (EPR).

The ministry gave the producers of electrical and electronic equipment a breathing period of one year to enable them to set up collection centers for e – waste and implement the take – back system. "But little has been done despite this grace period" Rules entrust the entire responsibility of end of-life management on the producer through EPR, but the mechanism is not clear.

Some manufacturers have put in place a collection centre but in absence of target, not fully operational. In European countries, companies are provided e – waste related targets, while in India there is no such mechanism in the Indian rules.

The industry feels imposing responsibility only on the producers is not the solution to the e – waste problem, since if a consumer use thousands of electronic equipment, they are not accountable for recycling and disposal of e-waste. All they have to ensure is that the e-waste is taken back by suppliers.

Secondly, appropriate technology is essential for ensuring the success of the e – waste management rules. "The optimum use of technology can go a long way in ensuring not just environment friendly products, but also end-to-end process in the manner in which an organization conducts its business operations like e – waste recycling"

Thirdly, companies should evolve a system for certifying or declaring the end – of – life of a product and legal format for issuing destruction certificate for an electronic item.

In the meantime Central Pollution Control Board (CPCB) plans to begin a nationwide survey along with state pollution control boards. This will help to i) identify the challenges faced by the government as well as private companies in managing e – waste; ii) determine the type of waste, its source, destination and aspects related to its treatment and recycling. Earlier survey, done in 2005, was confined to top 10 cities in the country. This time the aim of CPCB is to reach smaller cities. Before start of survey state pollution control boards are trying to put in place an inventory of manufacturers and suppliers of electronic

items and e – waste recycling companies in the country. But the way of functioning in our country is so casual that only Jammu and Kashmir has completed the inventory. Andhra Pradesh has done it for only three districts. Himachal Pradesh has submitted a draft report while Maharashtra and Karnataka, two of the states that generate most of the e – waste, are yet to begin the work. (Down to Earth, march 16-31, 2013). Any delay in the effort could mean manufactures and consumers will improperly dump e-waster, contaminating the environment.

E-Waste and Precious Metals

A number of e – waste contain atleast 17 precious and semi-precious metals that can be extracted. Mobile phones have precious metals such as gold, silver and palladium; special metals as cobalt, indium and antimony; and metals such as copper and tin. These are present in individual phones in traces, but one tone of mobile phones has as much as 340 grams of gold, 3.5 kilograms. of silver, 140 grams of palladium and 130 kilograms of copper [UNEP: United Nations Environment Programme report 2009]

A report of Global e- Sustainability Initiative (GeGI) says that computers, mobile phones and other electronic products use a staggering 320 tonnes of gold and more than 7,500 tonnes of silver annually worldwide. Often, these are 40 to 50 times richer than their ores.

One tonne of scrap from discarded computers contains more gold than can be produced from 17 tonnes of gold ore. A mobile phone contains five to 10 times more gold than ore.

The country produces 65,000 tonnes of e-waste from mobile phones in a year. But there are very few recycling units in India to recover these, so scrap dealer extract as much as they can and export the rest. The country thus loses 70% of recoverable previous metals present in electronic junk. Secondly, the exporters get value for only four elements – gold, silver, copper and palladium instead 17 precious and semi-precious metals. In this way country faces dual loss.

95 % of the country's e-waste is recycled by scrap dealers, who use recycles methods that are one side extremely harmful to environmental and human health and other side extract not more than 15% of the precious metals. The process is cheap in India as it involves manual labour. Dismantlers, however extract only a small amount. Here dismantlers either immerse printed circuit boards and electronic parts into chemical solutions or burn them to obtain metal extracts. Both of these processes release toxic gases. Besides harming the environment it is an occupational hazard. (Down to Earth May 31,2010).

Some of the most sophisticated e-waste treatment plants in the world are Umicore Precious Metals Refining in Belgium, SIMS recycling solution in Singapore, Boliden at Sweden, Xstrata in Canada and DOWA in Japan. These companies, which have been set up with huge amounts of investment, are pre dominantly mining companies, which also extract precious metals from e – waste recyclers.

Table – I, Metals in LCD monitors

Metal	*Content per LCD monitor (CCFL4) mg.*	*Content per LCD monitor (LED5) (mg)*
Silver	520	520
Gold	200	200
Indium	79	82
Palladium	40	40
Yttrium	16	3.2
Gallium	0.00	3.30
Europium	1.200	0.06
Lanthanum	1.000	0.00
Cerium	0.680	0.20
Gadolinum	0.096	1.50
Terbium	0.340	0.00
Praseodymium	*L* 0.019	0.00

Table – II, Metals in Smart Phones

Metal	*Metal per smart phone in gm.*	*Components*
Cobalt	6.300	Battery
Silver	0.305	PCB
Gold	0.030	PCB
Palladium	0.011	PCB
Neodymium	0.050	Loudspeaker magnet
Praseodymium	0.010	Loudspeaker magnet

CCFL4 and LED5 are LCD technologies.

Where is Government support?

E-waste (Management and Handling) rules 2011 that became effective in 2012 is inadequate and does not say much on export and import of e – waste. It result precious metals easily go out of the country while developed nation dump their e-waste in the country often in the name of charity.

Recycling units in the country do not get enough e-waste because they do not pay as much for the junk as scrap dealers do. Companies are scared of making a large – scale investment in a state of-the –art e-waste management facility in India many have setup collection centers after the e-waste (management and handling), Rule 2011 extended the responsibility of e- waste management to the producers. Many firms sell the collected junk to the unorganized sector while electronics giant lenovo claims the multinational has recycled 46000 tones of e – waste returned by customers since 2005.

After E-waste rules 2011 came into effect, many collectors, dismantlers and recyclers started approaching state pollution control boards to get them registered. Since only registered collectors are supposed to handover e – waste to registered dismantlers or recyclers. They will recycle e-waste using environmentally sound technology and export the rest to countries with better e-waste treatment facilities. But till end of 2012 only about 100 registrations have been made.

According to Alexis Vandndaelen of Unicore Precious Metals Refining of Belgium, e-waste should be seen as opportunity rather than burden. The phrase "waste management" should be replaced with "resource management". The ideal way of resource management would be to first make local pre-processing efficient, followed by maximum recovery of materials and proper treatment of residual waste in countries with the best technologies for the job, with proceeds shared fairly and equitably. (Down to Earth, March 1-15, 2013).

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