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REVIEW ARTICLE

E-Waste Hazardous: Impacts on Environment and Human Health

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ABSTRACT

E-waste contains several substances such as heavy metals, plastics, glass etc., which can be potentially toxic and hazardous to the environment and human health, if not handled in an environmentally sound manner. E-waste recycling in the non-formal sector by primitive methods can damage the environment. In this connection the present paper explores E- Waste Hazardous: Impacts on Environment and Human Health. Introduction, definition, e-waste generation international and Indian scenario, E- waste generation top ten state and top ten cities has been discussed in the first section. An E-waste hazardous, impact on environment and human health has been discussed in the second section. An E-waste management key challenge, elements of E-waste and regulation measure, conclusion and policy suggestion has been discussed in the third section.

Key words: E-Waste, Hazardous, Health, Environment. E-waste Management

INTRODUCTION

The electronic industry is the world's largest and fastest growing manufacturing industry during the last decade; it has assumed the role of providing a forceful leverage to the socio - economic and technological growth of a developing society. The consequence of its consumer oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge - the growing menace of "Electronics Waste" or "e waste" that consists of obsolete electronic devices [10]. The discarded and end-of-life electronics products ranging from computers, equipment used in Information and Communication Technology (ICT), home appliances, audio and video products and all of their peripherals are popularly known as Electronic waste (E-waste). E-waste is not hazardous if it is stocked in safe storage or recycled by scientific methods or transported from one place to the other in parts or in totality in the formal sector. The e-waste can, however, be considered hazardous if recycled by primitive methods. E-waste contains several substances such as heavy metals, plastics, glass etc., which can be potentially toxic and hazardous to the environment and human health, if not handled in an environmentally sound manner. E-waste recycling in the non-formal sector by primitive methods can damage the environment. (*www.greenpeace.org*)

DEFINITION

E-waste is a Popular, informal name for electronic products coming to the end of their "useful life". As per the Hazardous Wastes (Management and Handling) Rules, 2003, e-waste can be defined as "Waste Electrical and Electronic Equipment including all components, sub assemblies and their fractions except batteries falling under these rules [2].

E-WASTE GENERATION INTERNATIONAL SCENARIO

- In USA, it accounts 1% to 3% of the total municipal waste generation.
- In European Union (EU), e-waste is growing three times faster than average annual municipal solid waste generation. A recent source estimates that total amount of e-waste generation in EU ranges from 5 to 7 million tonnes per annum or about 14 to 15 kg per capita and is expected to grow at a rate of 3% to 5% per year.
- In developed countries, currently it equals 1% of total solid waste generation and is expected to grow to 2% by 2010.

Indian Scenario

The growth rate of discarded electronic waste is high in India since it has emerged as an Information Technology giant and due to modernization of lifestyle. We are using electronic products for last 60 years however, there is no proper disposal system followed in our country that has lead to enormous amount of e-waste.

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There is a need to find proper disposal and recycling technique so that environmental pollution and health hazards can be reduced.

- The total e-waste generated in India amounts to 1, 46,180 tons per year.
- Sixty-five cities in India generate more than 60% of the total e-waste generated in India.
- Ten states generate 70% of the total e-waste generated in India includes Maharashtra, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab.
- Among top ten cities generating e-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur.

In India, increased demand for the key products like PC, TV, and Telephones in last 5-10 year has been responsible for the increasing amount of e-waste generation.

E- Waste Generation in Top Ten States

S. No. States	WEEE (Tones)
Maharashtra	20270.59
Tamil Nadu	13486.24
Andhra Pradesh	12780.33
Uttar Pradesh	10381.11
West Bengal	10059.36
Delhi	9729.15
Karnataka	9118.74
Gujarat	8994.33
Madhya Pradesh	7800.62
Punjab	6958.46

Source: E-Waste Management in India- Consumer Voice, April 2009

E- Waste Generation in Top Ten Cities

S.No. City	WEEE (Tones)
Ahmedabad	3287.5
Banglore	4648.4
Chennai	4132.2
Delhi	9730.3
Hyderabad	2833.5
Kolkata	4025.3
Mumbai	11017.1
Nagpur	1768.9
Pune	2584.2
Surat	1836.5

Source: E-Waste Management in India- Consumer Voice, April 2009

E- Waste Hazardous

WEEE equipments are made up of a number of components – some containing toxic substances which can have an adverse impact on human health and the environment if not handled properly. Often these hazards arise due to the improper recycling and disposal processes used. For instance, Cathode Ray Tubes (CRT) has high content of carcinogens such as lead, barium, phosphor and other heavy metals. When disposed carefully in a controlled environment, they do not pose any serious health or environmental risk. However, breaking, recycling or disposing off CRTs in an uncontrolled environment without the necessary safety precautions can result in harmful side effects for the workers and release toxins into the air, soil and groundwater. Another dangerous process is the recycling of components containing hazardous compounds such as halogenated chlorides and bromides used as flame-retardants in plastics, which form persistent dioxins and furans on combustion at low temperatures (600-800 degrees centigrade). Copper, which is present in printed circuit boards and cables act as a catalyst for dioxin formation when flame-retardants are incinerated. The PVC sheathing of wires is highly corrosive when burnt and also induces the formation of toxins. Land-filling of e-waste, one of the most widely used methods of disposal, is prone to hazards because of leachate which often contains heavy water resources. Mercury, cadmium and lead are among the most toxic leachate. Mercury, for example, will leach when certain electronic devices such as circuit breakers are destroyed. Lead has been found to leach from broken lead-containing glass. In addition, landfills are also prone to uncontrolled fires which can release toxins.

Hazardous Substances, their Occurrence and Impacts on Environment and Human Health

Substance	Occurrence in e-waste	Environmental and Health relevance
PCB (polychlorinated biphenyls)	Condensers, transformers	Cause cancer, effects on the immune system, reproductive system, nervous system, endocrine system and other health effects. Persistent and

		bioaccumulataion
TBBA (tetrabromobisphenol-A) • PBB (polybrominated biphenyls) • PBDE (polybrominated diphenyl ethers)	fire retardants for plastics (thermoplastic components, cable insulation) TBBA is presently the most widely used flame retardant in printed wiring boards and covers for components	can cause long-term period injuries to health acutely poisonous when burned
Chlorofluorocarbon (CFC)	Cooling unit, insulation foam	Combustion of halogenated substances may cause toxic emissions.
PVC (polyvinyl chloride)	cable insulation	High temperature processing of cables may release chlorine, which is converted to dioxins and furans
Arsenic	small quantities in the form of gallium arsenide within light emitting diodes	acutely poisonous and on a long-term perspective injurious to health
Barium	Getters in CRT	may develop explosive gases (hydrogen) if wetted
Beryllium	power supply boxes which contain silicon controlled rectifiers, beamline components	Harmful if inhaled
Cadmium	rechargeable NiCd-batteries, fluorescent layer (CRTscreens), printer inks and toners	acutely poisonous and injurious to health on a long-term perspective
Chromium VI	data tapes, floppy-disks	acutely poisonous and injurious to health on a long-term perspective causes allergic reactions
Gallium arsenide	light-emitting diode (LED)	injurious to health
Lead	CRT screens, batteries, printed wiring boards	causes damage to the nervous system, circulatory system, kidneys causes learning disabilities in children
Lithium	Li-batteries	may develop explosive gases (hydrogen) if wetted
Mercury	is found in the fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches	acutely poisonous and injurious to health on a long-term perspective
Nickel	rechargeable NiCd-batteries or NiMH batteries, electron gun in CRT	may cause allergic reactions
Rare earth elements (Yttrium, Europium)	fluorescent layer (CRT-screen)	Irritates skin and eyes
Zinc sulphide	is used on the interior of a CRT screen, mixed with rare earth metals	toxic when inhaled
Toxic organic substances	condensers, liquid crystal display	
Toner Dust	toner cartridges for laser printers / copiers	Health risk when dust is inhaled risk of explosion

(Source: Report on Assessment of Electronic Wastes in Mumbai-Pune Area- MPCB, March 2007)

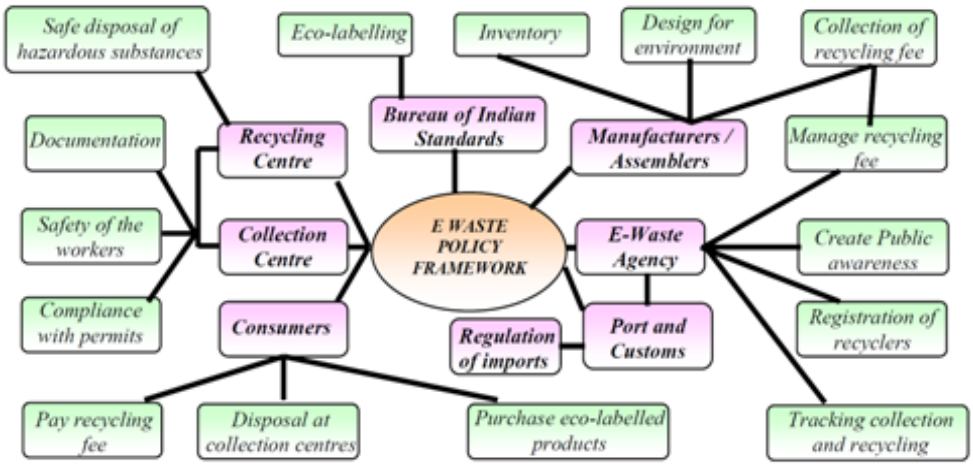
E-waste management: key challenges in India

While the overall challenges regarding management of e-waste in India are the same faced by other developing economies, the vast geographical diversity and economic isparities between regions often make e-waste management challenges unique in India. A few of the key challenges faced are:

- Rapidly increasing e-waste volumes, both domestically as well as generated through imports. Imports are often disguised as second-hand computer donations towards bridging the digital divide, or as metal scrap
- Limited accuracy in the estimates of the quantity of e-waste generated and recycled
- Low level awareness among consumers about the hazards of incorrect e-waste Disposal
- Widespread e-waste recycling in the informal sector using rudimentary techniques such as acid leaching and open air burning resulting in severe environmental damage
- E-waste workers have little or no knowledge of toxins in e-waste and are exposed to serious health hazards, etc.
- There are two small e-waste dismantling facilities functioning in Chennai and Bangalore.
- Five e-waste recyclers around Chennai have been recognized by the Tamil Nadu Pollution Control Board — Thrishyiraya Recycling India Pvt Ltd, INAA Enterprises, AER World Wide (India) private Ltd, TESAMM Recyclers India Pvt Ltd and Ultrust Solution (I) Pvt Ltd.

- In Mumbai, Eco Reco Company that has been authorized by Maharashtra Pollution Control Board is involved in the management of e-waste. It collects e-waste across India and recycles it in an environment friendly manner. TCS, SBI, Castrol, M & M, Oberoi Groups of Hotels, Gati, Alfa Laval, Pfizer, HDFC, Aventis Pharma, GPEC, Tata Ficosa are recycling their e-waste with the help of Eco Reco.
- SIMS Recycling Ltd. a multinational company has submitted a proposal to Pune Municipal Corporation (PMC) to solve the problem of e- waste in Pune city. It will collect and treat the e-waste in their recycling plant outside India [3].

Elements of E-Waste management strategies in India



Source: Sardinia 2007, eleventh international waste management and landfill symposium

Measure of Regulations

Electronic waste is being partly covered under the broad regulatory framework related to hazardous waste in India. The Ministry of Environment and Forests, Government of India, is the nodal agency at the central level for policy, planning, promoting and coordinating the environmental programs. The Environment (Protection) Act 1986, umbrella legislation covers hazardous waste and provides broad guidelines to address it. The policy statement on the abatement of pollution issued by the government of India in 1992 reiterated its commitment towards waste minimization and control of hazardous wastes. India is a signatory to Basel Convention on the control of transboundary movement of Hazardous Wastes and Disposal. India ratified and acceded to it in 1992. The ratification of this convention obliges India to address the problem of transboundary movement and disposal of dangerous hazardous wastes through international cooperation. The Ministry of Environment and Forests ("MoEF") has issued the following notifications related to hazardous waste:

- Hazardous Wastes (Management and Handling) Rules, 1989/ 2000/ 2002
- MoEF Guidelines for Management and Handling of Hazardous Wastes, 1991
- Guidelines for Safe Road Transport of Hazardous Chemicals, 1995
- The Public Liability Act, 1991
- Batteries (Management and Handling) Rules, 2001
- The National Environmental Tribunal Act, 1995
- Bio-Medical Wastes (Management and Handling) Rules, 1998
- Municipal Solid Wastes (Management and Handling) Rules, 2000 and 2002
- The Recycled Plastic Manufacture and Usage (Amendment) Rules 2003
- SIMS Recycling Ltd. a multinational company has submitted a proposal to Pune Municipal Corporation (PMC) to solve the problem of e- waste in Pune city. It will collect and treat the e-waste in their recycling plant outside India.

CONCLUSION

Most of the e-waste is recycled in India in unorganized units, which engage significant number of manpower. Recovery of metals from PCBs by primitive means is a most hazardous act. Proper education, awareness and most importantly alternative cost effective technology need to be provided so that better means can be provided to those who earn the livelihood from this. A holistic approach is needed to address the challenges faced by India in e-waste management. A suitable mechanism needs to be evolved to include small units in unorganized sector and large units in organized sector into a single value chain. One approach could be for units in unorganized sector to concentrate on collection, dismantling, segregation, whereas, the metal extraction,

recycling and disposal could be done by the organized sector.

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