A survey on Electronic waste management in Coimbatore

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Abstract: The IT industry has been one of the major drivers of change in economy over the last few decades and has contributed significantly to the digital revolution. New electric and electronic equipment has infiltrated all aspects of our daily life providing us with more comfort, health and security. The same technology that has made our lives better is on the downside creating more toxic problems for our society. With the growth of IT and related industries the usage and disposal of electrical and electronic equipment is all set to increase, which in turn will increase the quantity of ewaste generated, therefore it has become imperative to study the ewaste management practices that are being adopted. Coimbatore is set to become the next important IT destination after Chennai in Tamil Nadu, with the growth of IT industry and the economic growth the use of electric and electronic products are set to increase, as the usage increases so will the quantity of ewaste generated. Ewaste is of immense interest owing to the following factors such as increase in volume of ewaste due to changes in technology, it is relatively new form of waste that has to be dealt with when compared to municipal or biomedical wastes. The technique for safe disposal is still being evolved, the quantity of waste is enormous, and the components present in ewaste is not uniform for all kinds of wastes. The types of wastes that come under this category are varied. There are plenty of useful materials that can be recovered and reused. Most importantly the health and environmental effects due to the toxic substances that are a result of improper handling and disposal of ewaste is a cause for major concern.

Key words: Ewaste, Coimbatore, management practice, ewaste disposal

Introduction:

Coimbatore, is the third largest city in Tamil Nadu-India, it has more than 40,000 small, medium and large-scale industries, which serves the engineering needs of major parts of the country. The City is known for its dynamic people and excellent infrastructure. The entrepreneurial spirit of the business community here is renowned across the Country. Besides Textiles, the city today has evolved itself into a diversified economy with Engineering, Auto Components, Pumps and Motors (Out of every two water pumps produced in the country one is from Coimbatore), Foundries (One among the six major centers in India) and the educational institutions (the highest density in the country: 84 in 75 Square Km) which produce about 40,000 graduates of various disciplines a year. The city is the second largest software producer in Tamil nadu, next only to Chennai. The IT industry has been one of the major drivers of change in economy over the last few decades and has contributed significantly to the digital revolution. New electric and electronic equipment has infiltrated all aspects of our daily life providing us with more comfort, health and security. The same technology that has made our lives better is on the downside creating more toxic problems for our society. With the growth of IT and related industries the usage and disposal of electrical and electronic equipment is all set to increase, which in turn will increase the quantity of ewaste generated, therefore it has become imperative to study the ewaste management practices that are being adopted.

Ewaste is a nonspecific term that is used to refer to various forms of electric and electronic equipment that have reached the end of their life or have ceased to be of any use to their owners. “E-waste” is used as a generic term embracing all types of waste containing electrically powered components. E-
Waste contains both valuable materials as well as hazardous materials that require special handling and recycling methods. E-waste includes ever growing range of obsolete electronic devices such as computers, servers, main frames, monitors, TV's & display devices, telecommunication devices such as cellular phones & pagers, calculators, audio and video devices, printers, scanners, copiers and fax machines besides refrigerators, air conditioners, washing machines, and microwave ovens. E-waste also covers recording devices such as DVDs, CDs, floppies, tapes, printing cartridges, military electronic waste, automobile catalytic converters, electronic components such as chips, processors, mother boards, printed circuit boards, industrial electronics such as sensors, alarms, sirens, security devices, automobile electronic devices.

The abundance in volume of e-waste is primarily due to three main reasons, namely, increasing market penetration, replacement market and high obsolescence rate. Besides that, due to the increase in affordability of new products and technological advancements, it is easy to purchase rather than repair outdated equipment (Arora, 2008). Electronic waste or ewaste is an emerging problem as well as a business opportunity of increasing significance, given the volumes of ewaste being generated and the content of both toxic and valuable materials in them (Widmer, 2005). Currently, most consumer electronic devices (CEDs) end up in landfill sites without proper treatment because there is no segregation mechanism. Thus, more than 90% of ewaste was land filled while in other countries, a large fraction of ewaste from household’s ends up in waste incinerators. Many consumers do not immediately dispose of or recycle unused electronics since they think that the products still have value (Babu, 2007). Ewaste management is relatively widely practiced by the industrial sector. It is at the domestic or rather household level that ewaste management is an issue.

E-waste comprises discarded electronic appliances, of which computers and mobile telephones are disproportionately abundant because of their short lifespan. The current global production of E-waste is estimated to be 20–25 million tones per year, with most E-waste being produced in Europe, the United States and Australasia. China, Eastern Europe and Latin America will become major E-waste producers in the next ten years (Robinson, 2009). With the increase in purchasing power and the generally affordable prices of EEE, people are able to own more than one type of EEE or multiple units of the same type of EEE such as mobile phones (Maculey, 2003) Ewaste is of immense interest owing to the, it is relatively new form of waste that has to be dealt with when compared to municipal or biomedical wastes. E-Waste is chemically and physically different from other forms of municipal or industrial waste; it contains both valuable and hazardous materials that require special handling and recycling methods to avoid environmental contamination and detrimental effects on human health. The technique for safe disposal is still being evolved, the quantity of waste is enormous, and the components present in ewaste is not uniform for all kinds of wastes. The types of wastes that come under this category are varied. There are plenty of useful materials that can be recovered and reused. Most importantly the health and environmental effects due to the toxic substances that are a result of improper handling and disposal of ewaste is a cause for major concern. Most E-waste is not recycled, because E-waste items tend to go out with household waste and receive no special treatment (Ladou and Lovegrove, 2008).

Recycling can recover reusable components and base materials, especially Cu and precious metals. However, due to lack of facilities, high labour costs, and tough environmental regulations, rich countries tend not to recycle E-waste. Instead, it is either land filled, or exported from rich countries to poor countries, where it may be recycled using primitive techniques and little regard for worker safety of environmental protection (Cobbing, 2008). Workers toil without goggles, masks or gloves (Li et al., 2008). These crude recycling techniques have resulted in widespread environmental contamination. Although illegal under the Basel Convention of 1992 (UNEP, 2009), E-waste exportation continues through stealthy operations, legal loopholes, and by countries that have not ratified the convention. E-waste contains valuable metals (Cu, platinum group) as well as potential environmental contaminants, especially Pb, Sb, Hg, Cd, Ni, polybrominated diphenyl ethers (PBDEs), and polychlorinated biphenyls (PCBs). Burning E-waste may generate dioxins, furans, polycyclic aromatic hydrocarbons (PAHs), polyhalogenated aromatic hydrocarbons (PHAhS), and hydrogen chloride.

The chemical composition of E-waste changes with the development of new technologies and pressure from environmental organizations on electronics companies to find alternatives to environmentally damaging materials. Most E-waste is disposed in landfills. Effective reprocessing technology, which recovers the valuable materials with minimal environmental impact, is expensive.

Environmental effects of ewaste:

E-waste being the cause of major health and environmental concern can be attributed to its hazardous nature when compared to municipal waste. This is mainly due to the fact that electronic gadgets contain components made of toxic chemicals and metals such as lead, cadmium, chromium, mercury, beryllium, antimony, brominated flame-retardants, polyvinyl chlorides (PVC), and phthalates. Long-term exposure to these
substances damages the physiological systems such as nervous systems, reproductive and endocrine systems. Some of them are carcinogenic and neurotoxic (EPTRI Report 2009).

Disposal of e-wastes is a critical problem faced and poses a threat to both health and vital components of the ecosystem. The chemical composition of E-waste varies depending on the age and type of the discarded item. However, most E-waste is composed of a mixture of metals, particularly Cu, Al, and Fe, attached to, covered with, or mixed with various types of plastics and ceramics (Hoffmann, 1992). Most E-waste is currently land filled (Barba-Gutierrez et al., 2008). E-waste contaminants can enter aquatic systems via leaching from dumpsites where processed or unprocessed E-waste may have been deposited. Similarly, the disposal of acid following hydrometallurgical processes into waters or onto soils, as well as the dissolution or settling of airborne contaminants can also result in the contamination of aquatic systems. Many E-waste contaminants are spread into the air via dust. This is a major exposure pathway for humans through ingestion, inhalation and skin absorption (Mielke and Reagan, 1998). Acids and sludge obtained from unscientific burning or melting of computer chips, when disposed on the ground causes acidification of soil, leading to contamination of water resources. Incineration of e-wastes emits toxic fumes and gases, thereby polluting the surrounding air. Improper recycling and recovery methods can have major impact on the environment. Crude forms of dismantling can often expose the workers to the harmful substances as most of the workers do not wear protective equipment and also as they are unaware of the health effects of the detrimental substances found in the wastes. The toxic materials present in the equipments can be environmental as well as health hazard. Mercury will leach when certain electronic devices, such as circuit breakers are destroyed. Not only does the leaching of mercury pose problems, the vaporization of metallic mercury and methylene mercury is also of major concern. The same is true for polychlorinated biphenyls (PCBs) from condensers. Polybrominated diphenyl ethers (PBDEs) are flame-retardants that are mixed into plastics and components. There are no chemical bonds between the PBDEs and the plastics and therefore they may leach from the surface of E-waste components into the environment (Deng et al., 2007). PBDEs are lipophilic, resulting in their bioaccumulation in organisms and biomagnification in food chains (Deng et al., 2007). PBDEs have endocrine disrupting properties (Tseng et al., 2008). Obsolete refrigerators, freezers and air conditioning units contain ozone-depleting Chlorofluorocarbons (CFCs). These gases may escape from items disposed in landfills (Scheutz et al., 2004).

E-waste recycling involves the disassembly and destruction of the equipment to recover new materials (Cui and Zhang, 2008). Recycling can recover 95% of the useful materials from a computer and 45% of materials from cathode ray tube monitors (Ladou and Lovegrove, 2008). Mechanical separation of components is the first step in E-waste recycling. Components may be separated for reuse or metallurgical processing (He et al., 2006). This process can be automated or carried out by hand. In poor countries, there is a risk that children may be employed to separate E-waste components (Ladou and Lovegrove, 2008). An open flame is often used to free components (Manomaivibool, 2009), which may result in exposure to volatilized contaminants. In the light of the hazards caused by unscientific and improper disposal of ewaste a survey was undertaken in Coimbatore city to study the current ewaste management practices as Coimbatore is a fast developing information technology hub.

Methodology:
The increase in consumption of electronic and electric equipment is mainly due to the increase in economic status and the undeniable fact that everyday life has been simplified and the increased convenience has increased the usage, which directly explains the increase in the generation of ewaste. The management of ewaste has become an environmental concern in many developing countries as economic development and urbanization continues to take place. Hence, this study was conducted in Coimbatore City, which is next to Chennai in terms of economic development. A questionnaire was developed in Tamil and English and distributed by hand to the ewaste handlers identified in and around Coimbatore. The Survey was conducted during the period November 2009 to January 2010. To ensure a higher response rate, face-to-face interviews were employed for data collection, as the interview survey method would give better results than mail surveys, as the ewaste handlers have very limited educational qualification.

Results and Discussion:
From the survey it has been found that presently there is an absence of established ewaste management facility in Coimbatore. Ewaste processing is in a highly unorganized form. Mostly electronic scrap dealers carry out recycling in small scale. The big showrooms and small repair shops alike sell their waste to scrap dealers. These scrap dealers dismantle and sort manually to fractions such as printed wiring boards, cathode ray tubes (CRT), cables, plastics, metals, etc. The valuable fractions are processed to directly reusable components by
them or sold to secondary scrap dealers who do the reprocessing by a variety of refining and conditioning processes. No sophisticated machinery or personal protective equipment is used for the extraction of different materials. All the work is done by bare hands and only with the help of hammers and screwdrivers. In most cases young men with little or no education are employed, the dismantling and processing is done in small sheds or very small rooms with inadequate lighting and aeration.

![Image]

**Figure 1: Quantity of ewaste generated per month**

Figure 1 shows the quantity of ewaste generated on monthly basis, it has been found that the quantities of small household appliances (mixer grinder, grinder, ovens, vcd players, etc) were found to be maximum. In second position is IT and communication equipments (telephones, mobile phones, remote controls, chargers etc) which were discarded by the users. The quantity of large household equipments (refrigerators, washing machines, air conditioners television sets) and toys and other entertainment equipments (video games, electric and electronic toys) were found to occupy the third position. The least quantity was found to be miscellaneous equipments such as lamps, medical equipments, etc.

![Image]

**Figure 2: Quantity of waste generated varying with seasonality**

Seasonality was noted in the quantity of waste generated, maximum quantity was found to be during the first and last quarter i.e., January to March and October to December this surge in the volume can be attributed to the festival season, as many retailers offer discounts, exchange offers and end of season sale during these months. Therefore large quantities of wastes were sent to the recyclers. During the second quarter from March to June there was a slight increase that can be once again attributed to the discounts offered.
Figure 3 shows the waste disposal methods generally followed in Coimbatore, about 25% of the waste constituted mainly by washing machines, grinders, air conditioners, ovens etc that reached the scrap dealers were serviced, slight repairs if required were made and sold to second hand goods dealers. This though in a small scale contributes to a major source of income to the scrap dealers. Goods that cannot be resold were dismantled and portions of the usable parts were sold to scrap dealers the rest was discarded. Most often the unusable parts or parts that could not be readily resold were dumped into nearby water bodies such as wells, lakes or garbage dumps. Wires and PCB’s from which copper could be extracted were burnt in open pits and the extracted metal was sold to scrap dealers.

Conclusion:

There is no denying the fact that ewaste generation is universal. The unusual chemical composition of the waste poses difficulties in determining its quantity at both local and global scales. It has been observed that effects of contamination associated with E-waste has already caused considerable environmental degradation in the ewaste recycling countries and negatively affected the health of the people who live there. Decontamination of large contaminated sites is probably unfeasible, since they have been heavily contaminated with numerous contaminants, many of which are poorly studied.

The most realistic options available for organizing this sector is by enforcement of extended producer responsibility or levying collection fees by recyclers so that they can afford to instill appropriate equipments for safe recycling. The major factor that contributes to the increase in quantity of ewaste generated is the ever changing technology, change in consumption pattern and unavailability of recycling options. Inappropriate handling of ewaste can be attributed to reasons such as the lack of regulations, need for huge investments, absence of large players with adequate resources, the hesitation on the producers and the consumers to pay a nominal fees for the expenses involved in proper disposal.

The ewaste management is a multi step process that involves public, government and commercial agencies. It has been observed that there is a lack of basic awareness; Government agencies have to play an important role to check the unscientific dismantling and disposal methods. Regulations have to be in place to control the flow of ewaste as with the growth of IT and related services the quantity of waste generated is set to grow in large proportions. The collection and disposal system has to evolve in to an organized sector.

List of abbreviations

CD Compact disk
CFC Chlorofluorocarbon
CRT Cathode Ray Tube
DVD
EEE Electrical and Electronic equipment
IT Information Technology
LCD Liquid Crystal Display
PAH polycyclic aromatic hydrocarbon
PBB polybrominated biphenyl
PBDE polybrominated diphenyl ether
PCB polychlorinated biphenyl
PCDD polychlorinated dibenzo-p-dioxin
PCDF  polychlorinated dibenzofuran
PHAH  polyhalogenated aromatic hydrocarbon
PVC  Poly vinyl chloride
UNEP  United Nations Environment Programme
WEEE  Waste Electrical and Electronic Equipment

References