



A SURVEY ON LEVEL OF AWARENESS OF E- WASTE MANAGEMENT SYSTEM

Dr. N. Priya,

Assistant Professor, P.G. Department of Computer Science,
S.D.N.B Vaishnav College for Women,
Chennai, India
e-mail: cmtsahaana@yahoo.co.in

F. Christo Frenny,

Student, P.G. Department of Computer Science,
S.D.N.B Vaishnav College for Women,
Chennai, India
e-mail: christofrenny13@gmail.com

ABSTRACT:

Electronic waste (E-waste) is any types of electronics that have been discarded or in nonworking condition. E-waste contains precious elements like gold, aluminium, silver etc., and toxic substances like mercury, lead, cadmium etc., which is very harmful to environment and human health. Nowadays, the problem in electronic products has grown faster, while the lifespan of these products has become shorter. In the short period of time, the electronic product becomes waste. Due to the lack of awareness, most people are dumped the electronic waste in the land or kept in the home sentimentally. Very few people sell it to the recycler.

Electronic products [1] have been disposed by their original user is called electronic waste. It includes printers, scanners, televisions, monitors, computers, laptop, telephones etc. E-waste contains different toxic and non-toxic substances. The toxic materials presented in the electronic devices are lead, mercury, PCB (polychlorinated biphenyls), chlorofluorocarbons etc., which causes lung cancer, skin cancer, mental illness and affects human health when dismantle or segregate the E-waste. It also contains non-toxic or precious elements like gold, aluminium, silver etc., which is used for recycle. Metals consist of ferrous and non-ferrous metals. Plastics, glass, wood, plywood, printed circuit boards, concrete ceramics, rubber, Iron and steel are ferrous metals. Non-ferrous metals consist of metals like copper,

Hence E-waste management system is a major problem in the whole world. Many researchers analyzed various techniques with impact of E-waste and its effect on the environmental factors in various countries. This paper aims to study and analyze the disposal of E-waste using statistical techniques and also the review focuses on the awareness regarding impact of the E-waste in the environment and recycling the E-waste.

Keywords: E-waste, Recycling, Environmental hazards, Disposal, Toxic materials

INTRODUCTION

aluminium and precious metals, e.g. silver, gold, platinum, palladium, etc. India is the fifth largest generating an electronic waste. India produces 18.5 lakhs metric tons of E-waste every year but only 2.5% of it is reprocessed. Most of the E-waste is sent to Nigeria, Ghana, Pakistan, India, and China for processing due to lower environmental standards. In most of the cases, this is done illegally because of the precious elements in the E-waste [2]. According to Sahadat Hossain [3], the context of South Asian countries in 2012, India was the highest e-waste producer (2.75 MMT) within the region. The Maldives was found to be the lowest e-waste producer (1690 MT). E-waste generation shown in Figure I.

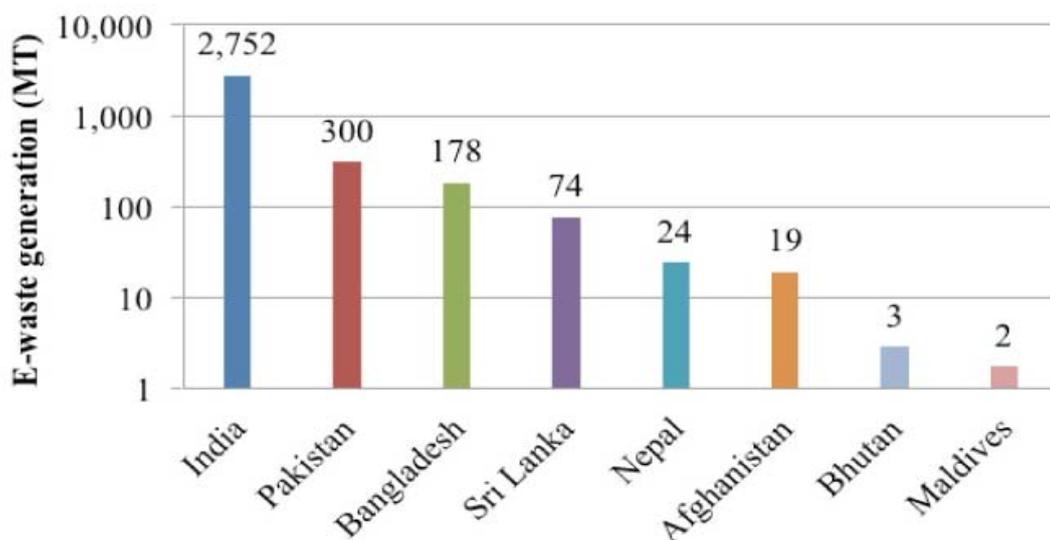


Figure I. Total e-waste generation in South Asian countries in 2012 [3]

According to the survey [4], it shows that the producer should be responsible for their product, extended the warranty of their product and also the government should encourage the recycling centers, set up regulatory agencies in each city to monitor the E-waste disposal. The Indian Government has organized national level workshops, programs and Policies are framed regarding E-waste management system. There is no proper recycling method followed in India and the lack of awareness getting a new electronic product until the replacement of the old one. Much illegal recycling of E-waste is done to extract precious elements like gold, silver and aluminium. After recycling the

E-waste, elements are used for making ornaments, musical instruments [5]. There is no perfect solution in E-waste management and transfer the E-waste to other places for recycle and reuse and also the E-waste is still landed on the landfills [6]. The three factors in E-waste management system namely reduce, reuse and recycle for disposing of the electronic waste and the life cycle is shown in the Figure II.

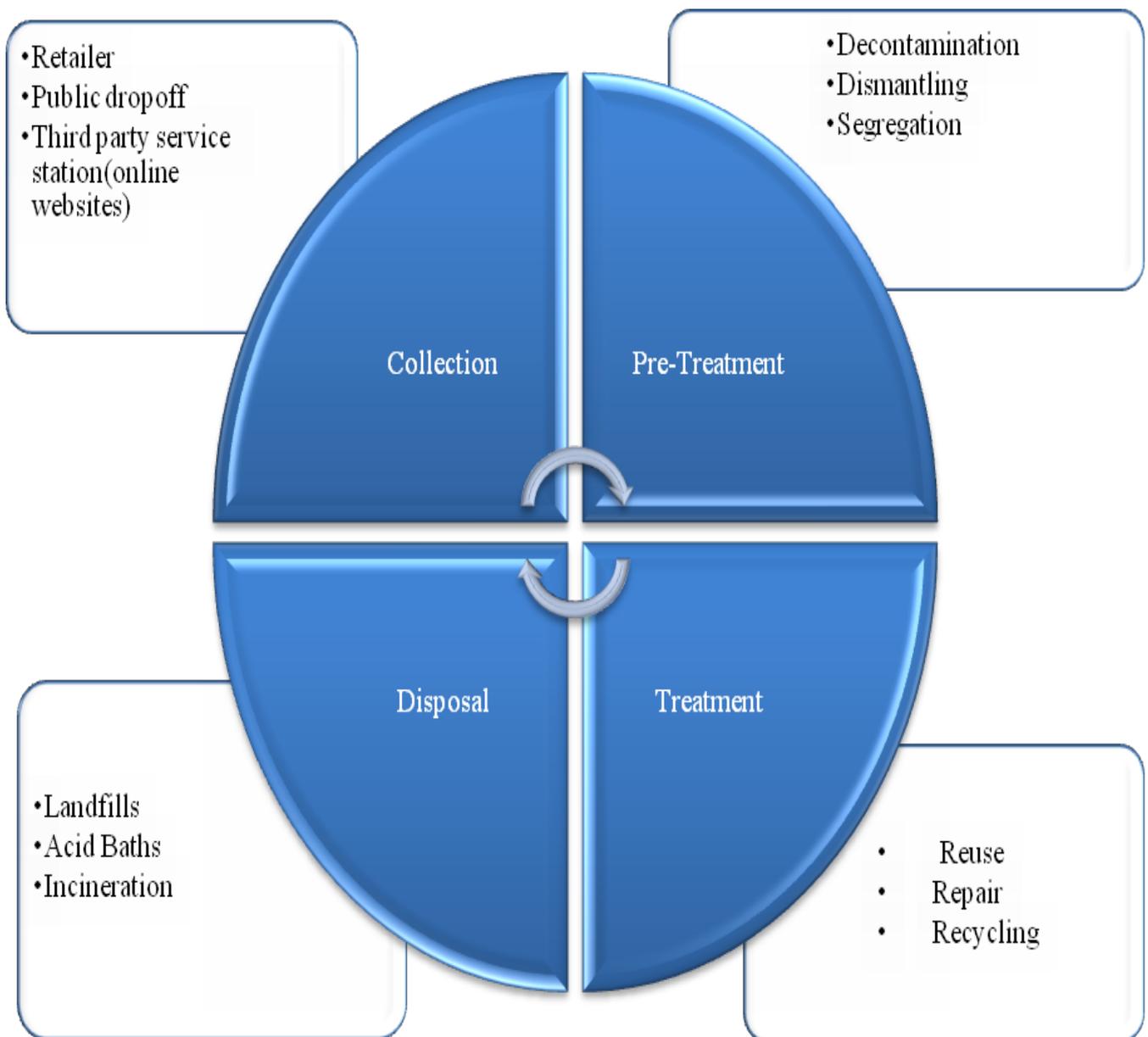


Figure II. Life cycle of electronic waste

Collection:

Electronic waste is the electronic goods which are not working or damaged. These discarded devices will be picked up from retailer, public drop-off and third part service station then materials are transported from collection centers to recycling unit. There are not much collection centers available in India. Few websites are available to book collection of E-waste, example: <http://attero.in/> Many NGOs are voluntarily involved in collection of E-waste [5]

A. Pre-treatment:

Collected electronic waste materials will be picked up by recyclers from collection centers. Pre-Treatment of E-waste includes process such as dismantling and segregation.[5]

B. Treatment:

Recycle units checks the segregated parts and finding whether it can be either reused or repaired.

- Reuse
- Repair
- Recycling

Reuse and repair are not done widely because of the less demand for refurbishment product. The last option is recycling. Recycling is the process of converting waste materials into new materials and objects. Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials by reducing the energy usage, air pollution (from incineration), and water pollution (from landfilling). Many recyclers import the E-waste from developed countries in the name of recycling to extract the precious metals and other compounds. According to the survey, the people working in the dismantling sites need to be educated properly. They have to be with proper masks, gloves and other equipment while recycling the E-waste. [4][5]

C. Disposal:

Illegal methods of disposal [4][5][7] may affect the environment as well as the people working at the disposal sites. Unorganized sector doing the recycling process in a hazardous manner results in various health problems for all people working in those sites.

1) Current disposal methods of E-waste

The current disposal methods of E-waste are

- Landfills
- Acid baths

- Incineration

a) Landfills

E-wastes are dumped in landfills are like as toxic time bomb. They may release to the environment after several years. These may reach the land water, reaches animals and humans and mixes with fresh water sources such as rivers and streams. Almost half of the E-wastes of US and Australia are dumped as landfills while the rest are exported to Asia and Africa. Landfills are banned in US and UK governments due to toxic nature of E-waste chemicals. [5][7]

b) Acid Baths

Acid bath [5][7] method is used to extract copper by placing the circuit board in sulphuric acid for about 14 hours. The precipitated copper sulphate is taken and processed. The resulting product is copper sludge. Acid baths also used to dissolve the lead and in the extraction of gold and silver.

c) Incineration:

Incineration [5][7] is destroying the waste through burning used in China, Africa, India and Pakistan. The emissions from the incinerator are extremely toxic which contain carcinogens and neurotoxins.

2) SAFE METHODS FOR E-WASTE DISPOSAL

The recycler should wear protective masks, gloves, safety glass mandatory when dismantling the E-waste. Avoid easy methods of extraction such as incineration which results harmful fumes, avoid dumping and avoid using acid baths, and implementing strict rules against dumping E-wastes in landfills. Proper storage system should be followed for collected and extracted E-wastes until it is reused as products. NRDC, Basel Action Network(BAN) are the Environmental groups have created a certification system for recycling, refining and refurbishing companies assures the recyclers keep up the standards which allow the recycling process in a way that protects workers health and the environment.[7]

A STUDY OF AWARENESS ON ELECTRONIC WASTE

The study conducted[8] by SindhuBala et.al, to know the awareness regarding existence of E-waste, danger of E-waste, E-waste management in the professional and non-

professional stream of college students in Noida city. Data

Table 1: Ways of disposing the E-waste[11]

<i>Ways of handling E-waste</i>	<i>percentage</i>
Throw away	30%
Recycle the E-waste	22%
Sold to scrap collector	19%
Storage	48%

were collected through the questionnaire method. Sample 200 students were selected in both streams. The E-waste management awareness inventory (EWMAI) was used to check the awareness of students. Statistical techniques such as means and T-test were used to interpret the data samples. In the result all the students are having awareness of existence of E-waste. The professional stream students are having more awareness of danger of E-waste than the non-professional stream and both the professional and non professional stream are unaware of proper E-waste management.

The economic growth changes in it for past 25 years and the electronic product has generated massive amount of E-waste affecting the people and earth due to the hazardous chemicals in E-waste. Cynthia.Subhprada [9] collected and analyzed the awareness of E-waste among medical students using questionnaire method. Questionnaire is taken based on whether the person known on health, environmental hazards, government policy regarding E-waste and it is entered in MS-Excel and analyzed chi-square test. In the result, only 35% of 96 (total number of students) public have awareness on E-waste hazards. To create awareness regarding the hazards and management of E-waste is the need of the hour to reduce, reuse and recycle E-waste

The Electronic items are disposed improperly because of lack of knowledge about their management. The study conducted by SachanRitu[10], analyzed the knowledge of young adults towards E-waste. In Lucknow city, total of 120 respondents were selected. The data was collected using questionnaire method and contains 36 questions and each question has 3 alternatives like correct, Partially Correct and Incorrect. Knowledge scale is divided into three categories that are low, medium, high knowledge of the respondents. The data was coded, tabulated and analyzed to test the hypothesis, percentage, T-test, Annova and coefficient correlation by using SPSS. In the result, the respondents of semi urban are having more knowledge than respondents of urban area.

Survey carried out at Shah Alam[11], Malaysia shows that only 57% of the respondents are aware of E-waste and half of the respondents have no idea about E-waste and do not know how to dispose E-waste. They either dispose the

E-waste as keeping it until it can be sell at a better price or as house rubbish. The percentage of different ways handling the E-waste is shown in the Table I

According to the survey [12], the author explores the level of awareness of the regulation, disposal of E-waste and dangers due to improper handling among importers, households and scavengers. The data were collected through the questionnaire method and were coded using **Likert Scale Analysis**. Totally, 176 respondents-importer (11), scavengers (55) and householder (110). This analysis focused on the various respondents' level of awareness of government regulation-waste management and concern about the environment and the result is shown in the Table II.

Table II. Awareness of importers, scavengers and householders[12]

<i>Category</i>	<i>Concerned about the environment</i>	<i>Awareness</i>	<i>Total number of respondents</i>
Importers	82%	18%	11
Scavengers	70%	6%	55
Householders	96%	22%	110

IMPACTS ON E-WASTE

Electronic products are a mixture of several tiny components, many of which contain hazardous chemicals. These chemicals are a strain on human health and the environment. Most of the electronic componentS contain Most of the components in electronic devices contains aluminum (Al), arsenic (As), bismuth (Bi), cadmium (Cd),chromium (Cr), mercury (Hg), nickel (Ni), lead (Pb) and antimony (Sb). beryllium etc., , the combustion of these e-wastes releases polycyclic aromatic hydrocarbons (PAH), brominated flame retardants (BFRs), poly-brominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs) and polychlorinated dibenzop-dioxins and furans (PCDD/Fs) gases that effect some or all bio-physical environments (soil, atmosphere, aquatic).etc., TVs, video and computer monitors use CRTs, which have significant amounts of lead and the long term exposure to these substances can damage the nervous system, kidney and bones and the reproductive and endocrine systems and some of them are carcinogenic. These E-wastes will have long lasting effects on the environment, when improperly disposed (incinerated/land filled instead of recycling) with domestic waste, without any controls, can contaminate the soil, water and air. E-waste contains toxic substances that have an impact on human health and the environment if not handled properly. Often, these hazards arise due to the improper recycling and disposal processes used. In general the electronic goods/gadgets are classified under three

White goods: Household appliances

Brown goods: TVs, camcorders, cameras

Grey goods: Computers, printers, fax machines, scanners etc.

white and brown goods waste is less toxic compared to grey goods. Even a personal computer contains highly toxic chemicals like lead, mercury, cadmium, etc., [8]. According to Devika[13], Scientific methods of disposal of E-waste should be carried out for reducing the environmental damage. Planting trees can help the earth recover from its damages. Every PC is made up of 0.001 kg of Silver, 0.00022 kg of Gold, 0.00008 kg of Palladium, 0.5 kg of Copper, 0.065 kg of Cobalt shown in the Figure III .

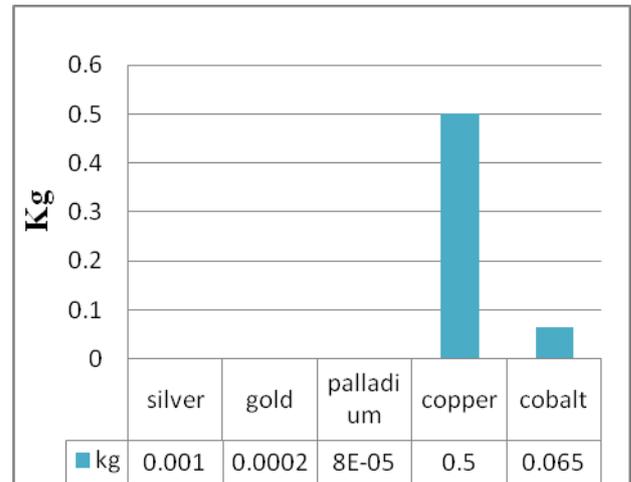


Figure III. Metals in one PC[13]

Toxic metals present in various types of E-waste and their effects on humans [14] and shown in Table III.

Table III. Types of e-waste and its effect[14]

Materials	Location	Effects
Lead	Acid battery,CRT	Kidney failure, central and peripheral nervous systems, damage to the reproductive systems
Cadmium	Battery,CRT,housing	Long term cumulative poison, Bone disease
Mercury	Batteries,switches,housing	Chronic damage to brain, liver damage, causes damage to the central and peripheral nervous systems as well as the fetus
Chromium VI	Decorative hardener	DNA damage, lung cancer
Plastic	Computer moldings,cablings	Generates dioxins and furans
Nickel	Rechargeable batteries and electronic guns	Allergic reaction, effects in their blood and stomach aches

CONCLUSIONS AND FUTURE WORK

India produces 18.5 lakh metric tons of E-waste every year but only 2.5% of it is reprocessed. Most of the E-wastes are exported to India, China etc. Most cases this is done illegally because of extracting the valuable metals like gold, silver etc. Due to the lack of awareness, improper disposal methods are followed in India. Many researchers analyzed the awareness regarding E-waste using statistical analysis. The main key of this study is to avoid the hazardous of E-waste is to develop eco-friendly devices, properly collect E-waste, recover and recycle material by safe methods, disposal of E-waste by suitable methods and raise awareness of the impact of E-waste. The future work of the study is to collect the data and implement data mining techniques from the various stakeholders of E-waste companies in Chennai and create an awareness regarding the recycle and reuse of the e-waste.

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