International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.9, pp 924-936, 2017

E-Waste Management & Assessment-A Review

S.Karthik[1], K.Vineeth Kumar[1], Y. Varthamanan[2] & V. E. Nethaji Mariappan[3]*

[1,2]Department Of Electronics & Communications,
[3]Scientist -F, Centre for Remote Sensing and Geoinformatics, Sathyabama University,
Rajiv Gandhi Road, Chennai, India

Abstract : Electronic waste or E-waste of a product is scrap or discarded electronic devices or electrical devices which has come to an end of their usage or life span. These E-waste contains lot of hazardous substances and contents which are harmful for humans as well as environment. In the recent years our nation is driving towards digitization there by leading in the generation of huge amount E-waste materials every year. Informal processing of E-waste in the developed countries like India will possess great threat to environment and there by leading to the environmental pollution. To address potential environmental problems that could stem from improper management of WEEE, many countries and organizations have drafted national legislation to improve the reuse, recycling and other forms of material recovery from WEEE to reduce the amount and types of materials disposed in landfills. Although most EEE waste is associated with the developing countries 'living standards'. One theory is that increased regulation of electronic waste and concern over the environmental harm in nature economies creates an economic disincentive to remove residues prior to export. Critics of trade in used electronics maintain that it is still too easy for brokers calling themselves recyclers to export unscreened electronic waste to developing countries, such as China, India and parts of Africa, thus avoiding the expense of removing items like bad cathode ray tubes. The developing countries have become toxic dump yards of e-waste.This paper relates the issue regarding the E-waste and methods & mechanism that can be deployed to assess E-waste in the region of concern.
Keywords : Global scenario, National scenario, Sources, Effects and Impacts, Management, Legislation, Conclusion

Introduction:-

Indiahas emergedas fifth largest electronic waste producer in the world. Computer sector nearly accounts 70% of E-waste followed by the Telecom sector which accounts up to 12%,Medical sector by 8% and other Electrical equipments being 7% in India. The Government, public sector companies, and private companies generate nearly 75% of this waste & the household contribution is around 16%.City wise **Mumbai**tops the list followed by **New-Delhi, Bangalore,Chennai, India.** State wise **Maharashtra** ranks first in E-waste generation, followed by **Tamil Nadu, Uttar Pradesh.**E-waste typically consists of discarded computer monitors, motherboard, cathode ray tube(CRT) printed circuit boards(PCB) mobile phones etc.

Around the world, a number of initiatives have arisen to address the issue of e-waste, by promoting the reuse of electronic device and mandating that safer alternatives to hazardous substances be used in their manufacture whenever possible. In Europe, legislation has been drafted to deal with the problem, including the Waste from Electrical and Electronic Equipment (WEEE) Directive and the Basel Convention.

This paper highlights the various sourceof E-waste and techniques which are to employed to assess the presence of E-waste in the region of concern.Further from this paper the norms to be implemented is been put forth to assess and detect the toxicity of the material and the extent of harm that can be caused by it. Nearly 95% of processing of electronic waste is carried out by unskilled informal sector [20].

Global Scenario :-

Africa:-

In Africa, the total e-waste generation was 1.9 Mt in 2014. Only Cameroon and Nigeria have enforced national e-waste related legislation, while Ghana, Ethiopia and Kenya still have legislation pending approval. The top three African countries with the highest e-waste generation in absolute quantities are Egypt (0.37 Mt), South Africa (0.35 Mt) and Nigeria(0.22 Mt). The top three African countries with the highest e-waste generation in relative quantities are Equatorial Guinea (10.8 kg/inh.), Seychelles (10.9 kg/inh.) and Mauritius (9.3 kg/inh.). In contrast with these relatively wealthy countries, the whole continent only generates 1.7 kg/inh. of e-waste domestically (excluding imports) annually. Very few official government reports are available on e-waste management in Africa. Of the continent, the e-waste challenge is on the political agenda the past couple of years, but there is generally a lack of e-waste management infrastructure, which is reflected by the absence of e-waste management laws. Here most of the generated e-waste is either stored in households, treated or dumped, according to the informal treatment sector Africa, particularly the western Africa, becomes the dumping destination for e-waste from various regions of the world. This is because the East and Southern African regions have gradually put measures to prevent the dumping of e-waste, and it started to take effect. Illegal import of e-waste or used electronics from all over the world is a major source of e-waste in countries like Ghana and Nigeria. This is driven by the demand of inexpensive EEE and secondary materials, as well as cheap dumping prices compared to the treatment with stricter standards in the export countries. The recycling activities of e-waste in Africa are usually carried out on an informal basis, often involving open burning in unmonitored dumpsites or landfills. This rudimentary recycling has caused substantial damage to the health of scavengers and local environment. If properly regulated andmanaged, recycling of e-waste can help to develop local economies and reduce poverty. However, it demands the strong cooperation in both the developing and developed world, in order to make sure that waste legislation and stringent complianceare adopted and enforced.[22]

There are no indications that unsound recycling and disposal are practiced systematically. Although there are some hints that e-waste is disposed of in an uncontrolled manner, the majority of obsolete EEE is currently stored within government buildings, offices, international organizations and households or awaiting future solutions (Manhart et al. 2013). While there is no fully functional e-waste management system in place yet, some promising efforts serve as starting points for the creation ofenvironmentallysound e-waste management systems.[22]

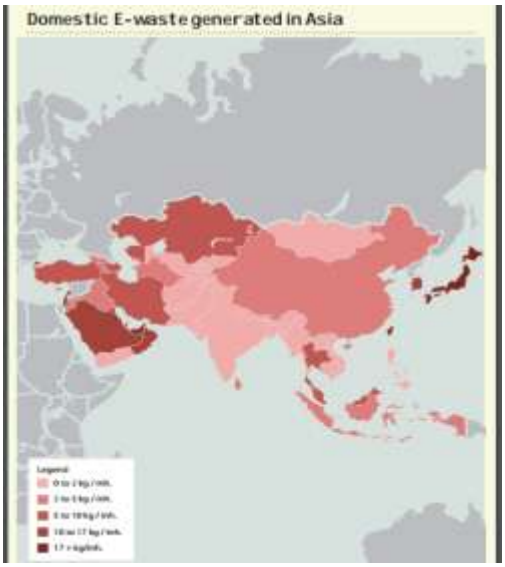
America

Americas including both North and South Amarecia, the total e-waste generation was 11.7 Mt in 2014. The top three countries in the region with the highest e-waste generation in absolute quantities are: the United States (7.1 Mt), Brazil (1.4 Mt) and Mexico (1.0 Mt). The top three countries in the Americas having the highest e-waste generation in relative quantities are: the United States (22.1 kg/inh.), Canada (20.4 kg/inh.) and the Bahamas (19.1 kg/inh.). Among Central America, Costa Rica has implemented national legislation to take back and recycle e-waste, South America: Peru, Bolivia and Ecuador already have national e-waste legislation, while Brazil and Chile have national laws pending approval. NorthAmerica, there are no federal mandates, but there are state-level e-waste laws in the United States, and 65 per cent of the U.S. population was covered by a state e-waste recycling law in 2013 (Electronics TakeBack Coalition 2014). Nine out of 14 provinces in Canada also have e-waste related legislation (covering 94 per cent of the population). The United States data exhibit 1 million tonnes of officially reported collected e-waste only represents 15 per cent of the total e-waste generated in 2012 (US EPA 2014)[22]. The low collection rate could be partly a scope issue, as not all categories of e-waste have been documented in governmental statistics. Nevertheless, there is also a lot of room to improve the official collection rates through formal take-back systems. Therefore, it is very important to track the e-waste being collected and treated outside the official take-back and treatment systems as it is likely that part of the e-waste collected by this approach is exported, as the United States did not ratify the Basel Convention that restricts the trans-boundary movement of international hazardous waste. As of 2010, it was estimated that 8.5 per cent of the collected units of computers, TV's, monitors, and mobile phones were exported as whole units (Duan et al, 2013). This was 26.5 kt in weight. Most larger electronic items, especially TVs and monitors, were exported overland or by sea to destinations such as Mexico, Venezuela, Paraguay and China, while used computers, especiallylaptops, were more likely to go to Asian countries. The main destinations for mobile phones were Hong Kong and countries in Latin America and the Caribbean.[22]

Asia:-

In Asia, the total e-waste generation was 16.0 Mt in 2014. China, India, Japan, Hong Kong, South Korea, Viet Nam, Bhutan, Cyprus and Turkey have national e-waste related laws. The Philippines and Jordan have regulations pending approval. The top three Asian countries with the highest e-waste generation in absolute quantities are China (6.0 Mt), Japan (2.2 Mt) and India (1.7 Mt). The top three Asian regions or countries having the highest e-waste generation in relative quantities are: Hong Kong (21.5 kg/inh.), Singapore (19.6 kg/inh.) and Brunei (18.1 kg/inh.). China plays a key role in the global EEE industry, including the manufacturing, refurbishment, and reuse of EEE and recycling of e-waste. Under the progressive development

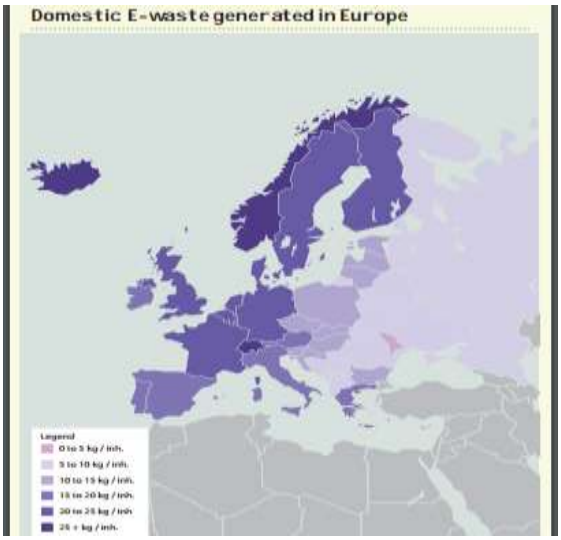
of pilot projects and domestic e-waste legislation over the past five years, the formal e-waste recycling industry in China has shown considerable growth in both treatment capacity and quality. However, due to a range of social and economic factors, the informal sector continues to play a major role in the collection and recycling of e-waste, and informal recycling often leads to detrimental effects on the environment and the health and safety of workers and local. The growth of the formal sector is important for lessening the environmental and health impacts of e-waste treatment. In the coming years, the formal and informal sectors will both continue to operate. China national e-waste legislation manages the collection and treatment of TV's refrigerators, washing machines, air conditioner.As of 2013, China officially collected and treated around 1.3 Mt of these five types of e-waste, which was 28 per cent of the total e-waste generated for all categories (Wang et al. 2013).[22]



Europe:-

Europe's total e-waste generation was 11.6 Mt in 2014. The European countries with the highest e-waste generation in absolute quantities are Germany (1.8 Mt), the United Kingdom (1.5 Mt), France (1.4 Mt) and Russia (1.2 Mt). The top three regions or countries with the highest e-waste generation in relative quantities are Norway (28.3 kg/inh.), Switzerland (26.3 kg/inh.) and Iceland (26.0 kg/inh.). In 2012, only 3.2 Mt of e-waste was officially collected in the 28 Member States of the European Union, whereas 9 Mt of e-waste was generated in 2012 in this region. The European Union is one of the few regions in the world where there is uniform legislation regarding the collection and processing of e-waste. This is formulated in the WEEE Directive. The successor of the WEEE Directive will come into force in 2019 (European Union 2012). Their targets is to collect 85 per cent of generated e-waste. In practice, most Member States do not reach that collection level yet. Among countries, Sweden, Denmark and Bulgaria currently collect more than 60 per cent of their e-waste generated. In practice, around 8 per cent of e-waste is discarded in the waste bin and part of the e-waste stream is mixed and recycled together with metal scrap, thus recycled outside the official take-back systems. This is estimated to account for about 20 per cent of the e-waste generated in France (Monier et al. 2013), about 30 per cent of the e-waste generated in Italy (Magalini et al. 2012), the Netherlands (Huisman et al. 2012) and Great Britain and about 10 per cent of the e-waste generated in Belgium (WRAP 2012) and (Wielenga et al. 2013). Finally, the e-waste can be exported for reuse. Although this has a higher priority in the waste treatment hierarchy, these exports can lead to improper recycling in thedestination countries. This is estimated to be about 10 per cent of the e-waste generated in Austria and the Netherlands and about 5 per cent of the e-waste generated in Great Britain, Belgium and Germany (Baldé et al. 2014).[22]

The situation in Russia and Belarus, Kazakhstan, Armenia, Kirgizstan is not quite clear. So far, they do not have any e-waste legislation or management system in place. However, in late December of 2014, the Russian Duma (the parliament) held a second discussion over the bill concerning the production and consumption waste. During this discussion, EPR (Extended Producer Responsibility) was introduced, and although this does not cover e-waste specifically, the potential new law is considered a first step in the right direction. Different interagencyworking groups on regulations are now working towards an implementation of the law.



Methodology Adopted in Italy:-

With the Decree No. 151, of July 2005, the Italian government converted the WEEE Directive 2002/96/EC and the EU Directive RoHS 2002/95/EC into law. The WEEE Directive requires producers to recycle waste and electronic equipment; the Directive on the Restriction ofHazardous Substances (RoHSs) bans the use of certain hazardous substances in electrical and electronic products. In addition to Italian law No.[151/2005, on waste management, there is law No. 152/2006, part 4, and law No. 59/2008.] [21]

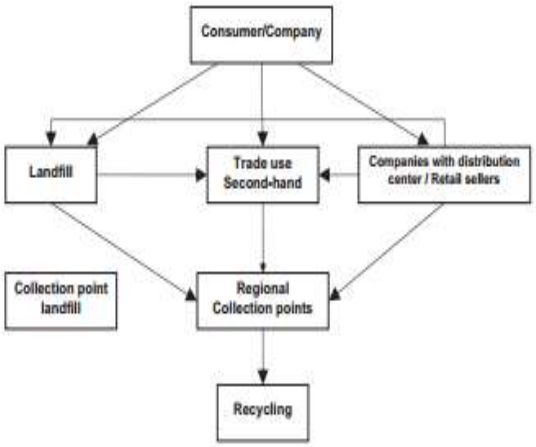


Fig. 1. WEEE scheme in ITALY

Moreover the Ministerial Decree No. 8/3/2010 introduced simplified procedures for factories that withdraw WEEE, while compulsory withdrawal (one-to-one principle) is regulated by Ministerial Decree No. 17/12/2009. This regulation divides the WEEE on the basis of the manufacturing date: there is the so called ‘‘historical’’ (built before January 1st 2006) and the ‘‘current’’WEEE (built after that date). There is no obligation to withdraw historical WEEE, while for the current there is another classification based on the owner’s category: Domestic WEEE (from domestic use) to be freely sent to collection centres. Professional WEEE (from factory use) to be collected by an authorized waste collector. The Ministerial Decree No. 185/2007 grouped WEEE into five main groups according to the type of treatment, environmental dangerousness, and to how easy separation was at the collection centers:

R1: Refrigerators and air conditioning systems.
R2: Large householdappliances.
R3: TV sets and displays.
R4: Small household appliances, consumer electronics, office automation, computer appliances, lighting devices.

R5: Light sources (no incandescent lamps). [21]

In order to offer financial support for WEEE treatment and final disposal, it is possible to apply a WEEE eco-contribution to every new device sold. This eco-contribution may be applied openly to the ‘‘big whites’’ (refrigerators, washing machines, dish washers) until february 13th 2013. Otherwise, the producers may include, in the selling price, the fee for appropriate WEEE disposal. For professional WEEE, the producer/distributor has to join a consortium or another organization which provides WEEE disposal; the membership requires the payment of an annual fee.[21]

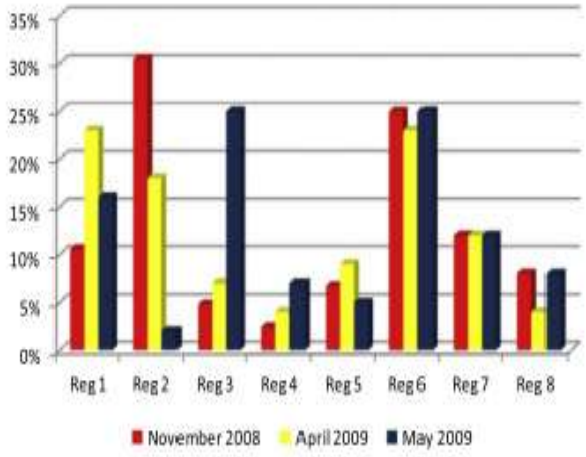


Fig. 2. Percentages of WEEE collection during the event at the end of 2008 and during the first and second event in 2009.

Table 3
Recovery of other materials through the WEEE separate collection in Italy in 2008.

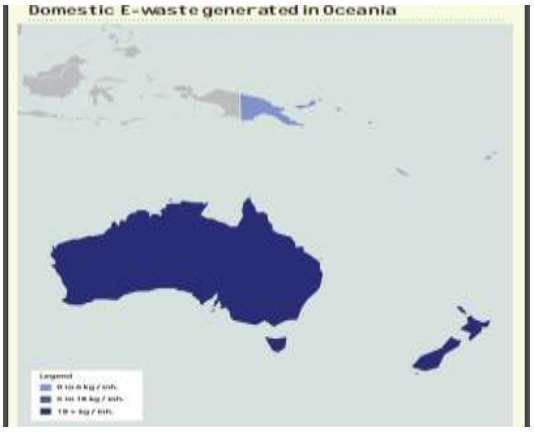
Materials	Industrial recovery (%)	Quantity (tons)
Iron	43.04	83181
Glass	17.88	34558
Aluminum	1.97	3811
Plastics	25.57	49419
Other recyclable materials	2.99	5782
Other not recyclable materials	8.54	16504

WEEE collection is becoming increasingly relevant in countries, such as Romania, that show an increase in GDP. Indeed, economic development changes the habits of the population both in terms of the domestic use of EEE, and in terms of the lifetime of thesebut in Italy the interest in recycling is typically related to large household appliances. Taking into account theevolution of the composition of WEEE, it is clear that, today, a focus also on lighting equipment is central to an optimized strategy. The experience of organizing WEEE collection in countries like Italy can provide a good reference point for emerging countries for optimizing the timing and structure of the regulation. In both cases, the WEEE sector shows interesting potential for material recovery that can be included in the concept of urban mining.[21]

Oceania:-

The total e-waste generation was 0.6 Mt in 2014. The top three countries with the highest e-waste generation in absolute quantities are Australia (0.47 Mt), New Zealand (0.09 Mt) and Papua New Guinea (0.0008 Mt). The top three regions or countries with the highest e-waste generation in relative quantities are Australia (20.0 kg/inh.), New Zealand (19.0 kg/inh.) and the Marshall Islands (5.5 kg/inh.). Landfill disposal of large amounts of mercury-containing lamps is forbidden in some states. There is a national voluntary scheme

for recycling mercury-containing lamps from the commercial and public lighting sectors (Australian government 2014). During 2012 and 2013, 40,813 tonnes of waste televisions and computers were recycled in Australia, which was equivalent to 98.8 per cent of the predefined national recycling target (41,327 tonnes for two types of waste products) (Australian government 2014). However, this collected amount is only 8.7 per cent the totalamount of e-waste generated for all product categories.[22]



National Scenario:-

Rapidly growing E-waste is about 4,34,000 metric tons.It is reported that in India, about 1,46,180 tonnes of E-waste is generated from computers, TVs, refrigerators and washing machines during 2005. 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. Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab in the list of E-waste generating states in India. Among top ten cities generating E-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur. The growth rate of computer has been estimated to be 25% and all other items in the range of 15 to 20% annually. It was established that the forthe recycling of e-waste, India heavily depends on the unorganized sector, as only a handful of organized e-waste recycling facilities are available. Over 95% of the e-waste is treated and processed in the obsolescence rate of computers is seven years, for TV, washing machine and refrigerator is fifteen years. There is no large scale organized E-waste recycling facility in India and the recycling exists in un-organized sector. In this context, an entrepreneur in India embarked on establishing a E-waste treatment facility with an annual capacity of 7200 tonnes per annum near a major urban centre, which is generating more than 25,000 tonnes per annum E-waste in India. [2]

Majority of urban slums of the country, where untrained workers carry out the dangerous procedures without personal protective equipment, which are detrimental not only to their health but also to the environment. [2]

Growing EEE Industry in India:-

i. Information and telecom sector fastened growing industry verticals.
ii. PC sales growing at 18% annually 2009-iii. Notebook sales at 65% annually 2009-10.
iv. Consumer electronics market growing at 13%-15% annually.
v. 120 million installed base of TV's.
vi. Cellular subscriber up by 96.86% in 2009; Installed base crossed 300 million in 2010. [2]

E-waste Generation in India :-

i. Annual e-Waste: 3,82,979 MT (2007).
ii. 8, 00,000 MT 2012 (CPCB estimates).
iii. Total e-Waste available for recycling and refurbishing: 1, 44,143 MT (2007).
iv. Actual e-waste Processed: 19000 MT. [2]

Source of E-Waste

Materials In India :-

The main source of electronic

waste in India are:-

- IT And Telecom Equipment
- Large Household Appliances
- Small Household Appliances
- Consumer & Lighting Appliances
- Electrical & Electronic Tools
- Toys, Leisure & Sport Equipments
- Medical Devices
- Monitoring & Control Instruments. [1]

Effects of E-Waste:-

India is now confronted with the huge problem of e-waste - both locally generated and internationally imported - and also both a lucrative industry and yet also a serious threat to human health and the environment. [3]

While there have been some initiatives to set regulations for e-waste management, overall, these hazardous wastes are still typically dismantled and recycled by hand in India in unorganized scrapyard settings that lack safeguards and government guidelines. [3]

Today a major amount of e-waste is generated by the old computer and its accessories. In the developed western and European countries, there is a new trend of donating their old computer and equipment to nearly third world countries. due to charity on electronic items people feel good at having helped the under privileged. But it turns out to be a big problem as it passes downstream costs (waste removal) to under-developed countries, which most often do not have adequate environmental regulations.

Poor countries simply accumulate the dangerous hazards of electronic waste. The “donations” end up not being recycled, but as hazardous waste. E-waste constitutes the element used for the manufacture of electronic goods which are responsible for large environmental damage. It contain various dangerous materials such as lead, mercury, and hexavalent chromium which are constituent in cathode ray tubes(CRT), batteries, liquid crystal display(LCD)[4]. Dangerous constituent of lead, brominates flame retardants are present in all electronics equipment which contain printed circuit board. Lead has reached into the ground water by the land filling of e-waste. Toxic fumes emit into air if CRT is crushed and burned. No refined machinery or personal protective equipment is used for the extraction of different materials which have ill effect on human health[5]. The e-waste contain many toxics such as heavy metals, including lead, cadmium, mercury, Poly Chlorinated Biphynyles (PCB), Poly Vinyl Chloride (PVC) etc. in some component. [6].The ill effect of these if disposed of in improper and non eco friendly manner is shown below[7]:

Table shows:E-waste contents, its effect and sources[8].Waste Element Effect on Human Being SourcesofE-waste.

Waste Element	Effect on Human Being	Sources of E-waste
Lead	Central and peripheral nervous system, Blood system, kidney and reproduction system	Glass panel, Gasket in computer monitors, solder in PCB and other component
Cadmium	Kidney	SMD chip registers, infra red detectors and semiconductor chips
Mercury	Brain, Kidney, Foetus	Electrical and electronic equipment thermostats, sensors, relays, switches, medical equipment, lamps, mobile phone, batteries, flat panel display
Barium	Brain swelling, muscle weaknesss,damage to heart, liver and spleen	Used in computer in front panel of a CRT
Beryllium	Lung cancer, skin diseases	Motherboard, finger clips
Toners	Respiratory treat irritation	Plastic printer cartridge
Hexavalent chromium	Damage to DNA	Untreated steel plant

Health Environmental Impacts of E-Waste:-

On Humans:-

The researchers found that e-waste pollution in the air, that workers in these e-waste dumps breath in constantly, cause inflammation and stress that lead to heart disease, DNA damage and possibly even cancer.on continuous exposure of pollutionto the cultured lung cells to the organic-soluble and water-soluble constituents of the samples, the researchers tested for the level of Interleukin-8 (IL-8), a key mediator of inflammatory response, and Reactive Oxygen Species (ROS), chemically reactive molecules that can cause extensive damage in excess.

The samples were tested for the expression of the p53 gene a tumour suppressor gene that produces a protein to help counteract cell damage. If there is evidence of this gene being expressed it can be seen as a marker that cell damage is taking place. [23]

The Elements That Effects Are:-

Lead: is found in a wide variety of cell phone components including the circuit boards, batteries and as a stabilizer in PVC products. Lead exposure can cause damage to the reproductive, blood and nervous systems.

Mercury: is used in the cell phone's battery, crystal displays and circuit boards. A single cell phone contains up to 2 grams of mercury. Mercury exposure contributes to brain and kidney damage.

Arsenic: is found in the microchips of many electronic devices including mobile phones. In high doses, arsenic poisoning is lethal. Low levels of exposure cause negative impacts on skin, liver, nervous and respiratory systems.

Cadmium: is used in the battery of a cell phone. It is associated with defects in cognition, learning, behavior and neuromotor skills in children. It has also been linked to kidney damage.

Chlorine: is a component of plastics used in cell phones, specifically polyvinyl chloride (PVC). PVC makes up about 30% of the cell phone. Exposure to improperly disposed chlorine causes tissue damage and the destruction of cell structure.

Bromine: is a component in a group of fire retardant chemicalsknown as brominated flame retardants. It is associated with cognitive and developmental deficits. Studies have shown that bromine contributes to the disruption in the thyroid hormone balance, brain damage and cancer. [24]

Management Of E-Waste:-

Recycling of e waste :-

A big chunk of Indian population has access to mobile phones, laptops and desktops, which when crosses its life span, indiscriminately discarded, form e waste. If it is not tackled in the proper manner, can lead to several serious health hazards. The most effective solution to the growing e waste problem is recycling raw materials from rejected electronics.[9]

Resale and reuse of computers continues to be high as does dependency on assembled machines. No reliable figures are available as yet to quantify the e-waste generation. Increasingly as computers are becoming more affordable and there is greater access to technology, the turnover of machines could definitely be higher. Apart from the consumer end, another source of more obsolete computers in the market is from the large software industry where use of cutting edge technology, greater computing speed and efficiency necessarily increase the rate of obsolescence. In the same way as the standard of living is growing high / dealers are providing monthly payment/ instalment facilities / banks are providing loans in a comparatively easy way, affordability of televisions, mobile phones and other house hold appliances are enormously increasing. As the consumption pattern increases, e- waste generation also increases.[10]

E Waste Disposal Practise in India:-

A.Formal Sector:-

E-waste is collected and disposed by government authorised agency or company which do the E-waste management work in environment friendly way. These organizations perform the e-waste management by using proper equipment and also provide proper safety measures to the worker and on the recycling site.

B. Informal Sector:-

E-waste is collected and disposed by unauthorised people. They collect the e-waste from the household and market and then separate the useful and useless part by breaking the e-waste in improper way, this is very harmful to the environment because they keep the useful part and either dump the remaining waste or burn it . They also do not use any safety measures which increase the risk to the health of the worker. They do this work in slum area of big metros and in metro cities either by making small workshop or from their home which pollute the surrounding of their living area[11].

Reusing E- waste:-

In order to reduce the volume of e waste generation, reusing of equipment after little modifications is a method of waste disposal in India. Usually used for computers and cell phones, this can be effective for reducing e waste.[9]

Landfill

It is one of the methods of e waste disposal in India, although it can invariably pose serious threats to the environment.[9]

Incineration

A controlled combustion process, this is a method in which the waste material is burned in specially designed incinerators at a very high temperature. It reduces the waste volume and some of the environmentally hazardous substances are transformed into less hazardous ones[9].

E-Waste Legislation in India:-

In India, a lot of discussion and concern has now started regarding the e-waste management. A report of parliamentary standing committee on science and technology on the functioning of central pollution control board (CPCB) states that e-waste is going to be a big threat in future due to modern life style and increase in the living standards of people and rise of economic growth. The solid waste management process is defined in the Indian constitution under twelfth schedule and in municipal solid wastes (management & handling) rules, 2000 enacted by central government. These rule provide guidelines for the management of the e-waste and can be used as a model in the e-waste recycling and disposal scheme such as house to house collection of waste, proper collection of waste from slums and squatters, hotels restaurants, office complexes and commercial areas, organizing awareness programmes for segregation of wastes; adopting suitable waste processing technologies; and restricting land filling of nonbiodegradable inert waste. But there is no proper rule or regulation mainly for e-waste treatment. Some of the rules and regulation which are made related to e-waste are as follows[12].

A. The Hazardous Waste (management and handling) Rules, 2003

This rule categorized e-waste or its constituents under "hazardous" and non"hazardous" waste. As per the rules, "hazardous waste" is defined as any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, alone or when in contact with other wastes or substances[13].

B. The Hazardous waste (Management. Handling and Transboundary Movement) Rules, 2008

These rules provide the registration process of hazardous waste recycler. According to these rules, every person desirous of recycling or reprocessing hazardous waste including electronic and electrical waste is required to register with the central pollution control board (CPCB). The e-waste handler is required to register with the CPCB. The authorized recycler or re-processer or re-user should have environmentally sound facilities for recovery of metal and plastic and the waste. Under these rule the Ministry of Environment and Forest is the nodal ministry to deal with the transboundary movement of the hazardous wastes and to grant permission for transit of the hazardous wastes through any part of India[12].Part A of Schedule III (Basal No. 1180) consists of list of e-waste applicable for import with prior informed consent. Part B of schedule III (Basal No. 1110) deals with list of e-waste applicable for import and export not requiring prior informed consent[14].

C. Guideline for Environmentally sound management of e-waste, 2008.

The guideline are given by the Government of India and approved by Ministry of Environment and Forest and central pollution control board. The objective of these guideline is to provide guidance for identification of various sources of e-waste and the approach and methodology for handling and disposal of e-waste in an environment friendly manner. These Guidelines include details such as e-waste composition and recycle potential of items of economic value, identification of possible hazardous contents in ewaste, the recycle, re-use and recovery options, treatment and disposal options and the environmentally sound e-waste treatment technologies. The guideline also covers the concept of Extended Producer Responsibility[15]. After the approval of company's bill 2012 in the RajyaSabha, it has become compulsory for the corporations to spend 2% of the net profits on Corporate Social Responsibility (CSR) activities. This will promote the equitable and sustainable growth in the country[16].

D. The e-waste (Management and Handling) Rules, 2011.

The primary objective of these rules is to channelize the e-waste generated in the country to make the recycling of the e-waste in environmentally sound manner. The concept of extended producer responsibility is introduced in these rules by placing the main responsibility of e-waste management on the producer of the electrical and electronic equipment. These rules had notified in May 2011 and get implemented from 01 May

2012, that are applicable to every producer, consumer involved in the manufacture, sales purchase, and processing of electrical and electronic equipment or components, collection centres, dismantlers and recyclers of e-waste comes under this law[17].The is law is also applicable on the people involved in purchase and processing of electrical and electronic equipment or components[15]. According to the newspaper (Business Standard, Dec 25, 2013) a study "e-waste management in India- Role of state agencies" done by Toxics Link reveal that most of the Indian states have failed to implement e-waste rules in the country which came into being in 2011[18]. The study also reveals that lack of efforts and action is made by most state pollution control board and committees. This shows that ewaste (management and handling) rules, 2011 are not properly implemented in the country[19].

Findings &Conclusion:-

Most of the developing countries, especially India faces a problem of continuous rise in the amount of e-waste due to the change in the lifestyle of the people which now more depends on electrical and electronic equipment in which continuous improvement has been made and the products are becoming obsolete rapidly especially in case of computer and its peripheral devices. This has arises a big challenge of managing the e-waste. A major amount of ewaste is managed through informal sector which done the ewaste management job in the way which has bad effect on the environment and very small amount of e-waste are managed by formal sector in environment in a friendly manner. Unfortunately there is no large scale organised sector to do the recycling work and it is performed only by unorganised sector. Because of it the risk of damage to human health and natural environment increases and no precaution is taken while performing the recycling work and also the involvement of women and children has worsen the condition. The import of e-waste from other countries has ill-effect on environment. Due to lack of awareness among people about e-waste, the measures like ERP and Take back policy is very difficult. The legislation work regarding ewaste had been done lately in time and it is not performing well. Therefore the awareness of the people about e-waste need to be increase and the rules should be properly implemented to control the rise in e-waste in future.

Acknowledgement

This research was supported by the management of Sathyabama University, moral support and infrastructural facilities for conducting research in my capacity. Thanks are due to our Scientsits and JRF's of the Centre their support in completion of this work. The authors thank the anonymous reviewers for their insightful comments and suggestions.

Reference:-

1. "E-waste effects on environment and its management", by MD MUSTAFA KAMAL at https://www.slideshare.net/mdmustafakamal9/ewaste-ppt.
2. "National scenario on e-waste", by DR.Ashokk.rathoure at http://www.scind.org/33/Environment/national-scenario-of-e-waste.html.
3. "E-waste in india: A growing industry and environmental threat", at http://www.treehugger.com/clean-technology/e-waste-in-india-a-growing-industry-environmental-threat.html.
4. Report on "E-waste in India", Research Unit (LARRDIS), RajyaSabhaScretariat, New Delhi, June 2011, rajyasabha.nic.in/.
5. Kurian Joseph, "Electronic Waste Management in India – Issue and Strategies", Center for Environment Studies, Anna University, Chennai.
6. Nainsi, "E-waste management in India", Jouranal of Information System and Communication, Volume 3, 2012, pp 251- 264.
7. AjeetSaoji, "E-waste Management: An emerging environmental and health issue in India" , Natinal Journal of Medical Research, Volume 2, Issue 1, January-March 2012,pp 107- 110.
8. Envis Newsletter Parisara "E-waste", Issue 24 January-June 2011, ENVIS Centre Karnataka.
9. https://budli.in/blog/what-are-the-important-methods-of-e-waste-disposal-in-india,
10. "Electronic Waste (E-Waste) Management in India" : A Review Dr.KousarJahanAra Begum at IOSR Journal Of Humanities And Social Science (IOSR-JHSS) .

11. S.Chatterjee& Krishna Kumar, "Effective electronic waste management and recycling process involving formal and non formal sector" ,International Journal of Physical Sciences Vol. 4(13), December 2009,pp 893-905.
12. TanviPradhan, "E-waste generation and management in India", Recent Research in Science and Technology 2013,pp:83-87
13. Priyadharshini S, B Haganesh, Dr. T. Meenamabal, "Overview of E-waste management Practice and their legislation in India", International Journal of Engineering Research & Technology, volume 1, Issue 7, September 2012, pp 1-6
14. Reena Gupta, Samgita and KaurVerinder, "Electronic waste: A case study", Research Journal of Chemical Sciences, Volume 1(9), December 2011, pp 49-56.
15. AnweshaBorthakur, Pardeep Singh, "Electronic waste in India: Problem and Policies", International Journal of Environment Science, Volume 3, 2012, pp 354-362
16. "E-waste recycling could get new boost in India with new CSR law" by Admin on September 9,2010 in E-waste, www.atterobay.com.
17. Rashmi Kumar, Dahyald J Shah, "Current Status of Recycling of Waste Printed Circuit Boards in India", Journal of Environmental Protection", January 2014, pp 9-16.
18. "States Fail to implement e-waste handling rules, says study", Business standard, New Delhi, July 9, 2013, www.businessstandard.com/
19. "Electronicn waste rules: In Letter, but without spiri"" by GokulChandrasekar, May 17,2012, blogs,reuters.com
20. "Electronicwaste":fromhttps://en.wikipedia.org/wiki/ Electronic waste
21. Global scenario in Italy : from https://irinsubria.uninsubria.it/retrieve/handle /11383/1789811 /2563/ Management_weee.pdf
22. Global Scenario : from https://i.unu.edu/media/unu.edu/news/52624/UNU-1stGlobal-E-Waste-Monitor-2014-small.pdf
23. https://www.treehugger.com/clean-technology/e-waste-harms-human-health-new-research-details-how.html.
24. https://www.e-cycle.com/tag/e-waste-effects-to-the-human-body.

*****