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ENVIRONMENT AND HEALTH ISSUES ASSOCIATED WITH E-WASTE

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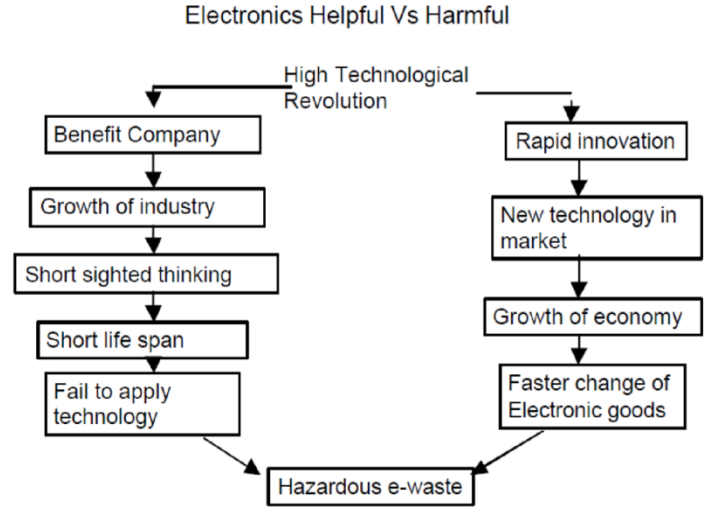
Abstract

In this paper the environmental problems related with the discarded electronic appliances, known as e-waste. The current and the future production of e-waste, the potential environmental problems associated with their disposal and management practices are discussed whereas the existing e-waste management schemes in Greece and other countries (Japan, Switzerland) are also quoted.

Introduction:-

In recent years, there has been increasing acknowledgment of our impact on the environment due to our fast lifestyle, while the need to adopt a more sustainable approach concerning of our actions,our consumption habits emerges as of particular significance. . This trend regards industrial sectors affecting the consumption habits and, especially, electronic industry where the short life cycles and the rapidly developing technology have led to increased e-waste volumes. The majority of e-waste elements are led to landfills However, their partial recyclability, due to their material composition along with the unavoidable restrictions in landfills, has led to the development of retrieval techniques for their recycling and re-use, highlighting the significance of e-waste recycling, not only from a waste management aspect but also from a valuable materials' retrieval aspect.



What is E-Waste:-

The electronics industry is the world's largest and fastest growing manufacturing industry [1]. In the last few years, it has played a significant part in socio-economic and technological growth of societies. The Basel convention

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defines wastes as substances or objects which are disposed of or are intended to be disposed of by the provisions of national laws.

"**Electronic waste** or **e-waste** describes discarded electrical or electronic devices. Used electronics which are destined for reuse, resale, salvage, recycling or disposal are also considered e-waste. Informal processing of e-waste in developing countries can lead to adverse human health effects and environmental pollution.

Electronic scrap components, such as CPUs, contain potentially harmful components such as lead, cadmium, beryllium, or brominated flame retardants.Recycling and disposal of e-wastemay involve significant risk to workers and communities in developed and developing countries[2]and great care must be taken to avoid unsafe exposure in recycling operations and leaking of materials such as heavy metals fromlandfills and incinerator ashes.[3]"

List of major Hazardous components of E-waste:-

E-Waste Component	Processed Used	Adverse Health Effects
Americium	The radioactive source insmoke alarms.[5]	It is known to becarcinogenic
Lead	Solder, CRT monitor glass,lead-acid batteries, some formulations of PVC. A typical 15-inch cathode ray tube may contain 1.5 pounds of lead,but other CRTs have been estimated as having up to 8 pounds of lead.	Adverse effects of lead exposure include impaired cognitive function, behavioral disturbances, attention deficits, hyperactivity, conduct problems and lower IQ. These effects are most damaging to children whose developing nervous systems are very susceptible to damage caused by lead, cadmium, and mercury.
Mercury	Found in fluorescent tubes (numerous applications), tilt switches (mechanical doorbells,thermostats),[8] and flat screen monitors.	Health effects include sensory impairment, dermatitis, memory loss, and muscle weakness. Exposure in-utero causes fetal deficits in motor function, attention and verbal domains.[6] Environmental effects in animals include death, reduced fertility, and slower growth and development.
Cadmium	Found in light-sensitive resistors, corrosion-resistant alloys for marine and aviation environments, and nickel-cadmium batteries. The most common form of cadmium is found in Nickel-cadmium rechargeable batteries. These batteries tend to contain between 6 and 18% cadmium. The sale of Nickel-Cadmium batteries has been banned in the European Union except for medical use. When not properly recycled it can leach into the soil, harming microorganisms and disrupting the soil ecosystem. Exposure is caused by proximity to hazardous waste sites and factories and workers in the metal refining industry.	The inhalation of cadmium can cause severe damage to the lungs and is also known to cause kidney damage.[7]Cadmium is also associated with deficits in cognition, learning, behavior, and neuromotor skills in children
Hexavalent chromium	Used in metal coatings to protect from corrosion.	A known carcinogen after occupational inhalation exposure.[6] There is also evidence of cytotoxic and genotoxic effects of some chemicals, which have been shown to inhibit cell proliferation, cause cell membrane lesion, cause DNA single-strand breaks, and elevate Reactive Oxygen Species (ROS) levels.

Sulphur	Found in lead-acid batteries.	Health effects include liver damage, kidney damage, heart damage, eye and throat irritation. When released into the environment, it can create sulphuricacidthrough sulphur dioxide.
Brominated Flame Retardants (BFRs)	Used as flame retardants in plastics in most electronics. Includes PBBs, PBDE, DecaBDE,OctaBDE, PentaBDE.	Health effects include impaired development of the nervous system, thyroid problems, liver problems.[9] Environmental effects: similar effects as in animals as humans. PBBs were banned from 1973 to 1977 on. PCBs were banned during the 1980s.
Beryllium oxide	Filler in some thermal interface materials such as thermal grease used on heatsinks for CPUs and power transistors,[11] magnetrons, X-ray-transparent ceramic windows, heat transfer fins in vacuum tubes, and gas lasers.	Occupational exposures associated with lung cancer, other common adverse health effects are beryllium sensitization, chronic beryllium disease, and acute beryllium disease.[10]

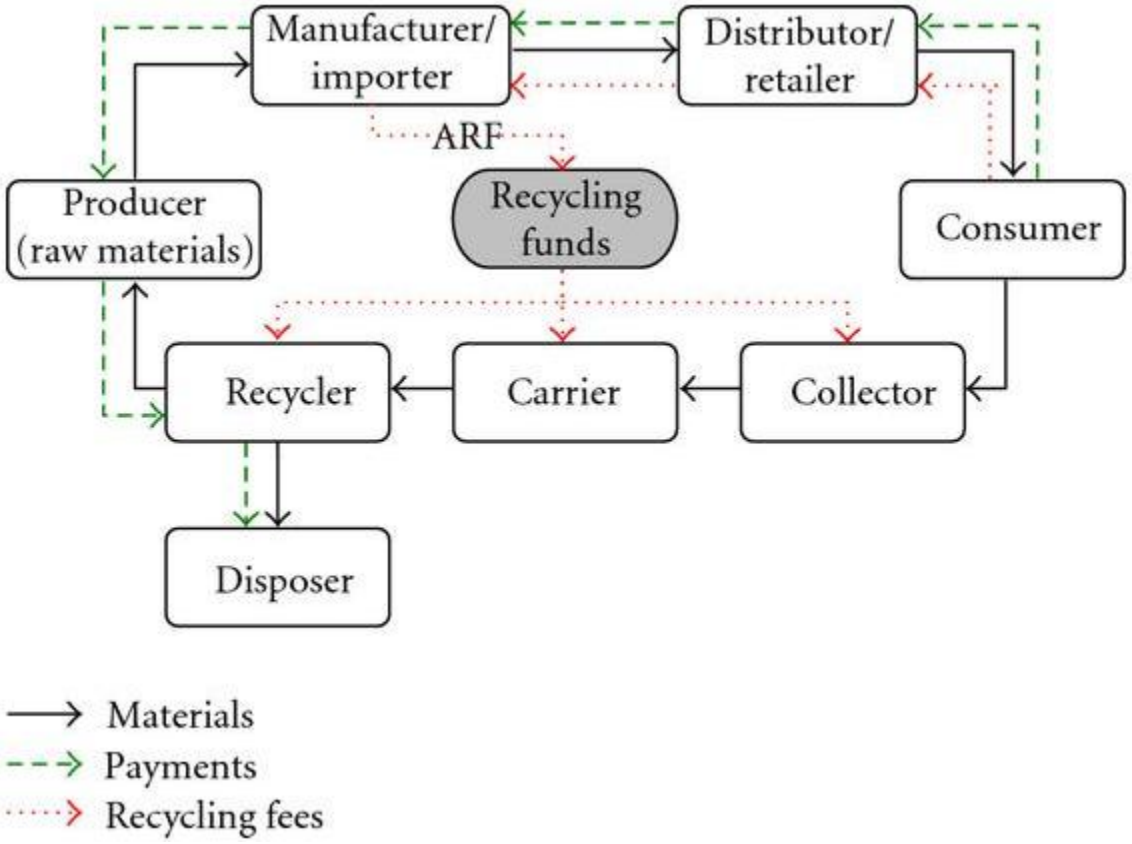
Generally non-hazardous:-

E-Waste Component	Process Used
Copper	copper wire, printed circuit board tracks, component leads.
Zink	plating for steel parts.
Aluminium	nearly all electronic goods using more than a few watts of power (heatsinks), electrolytic capacitors.
Germanium	1950s–1960s transistorized electronics (bipolar junction transistors).
Gold	connector plating, primarily in computer equipment.
Tin	solder, coatings on component leads.

The environmental impact of the processing of different electronic waste components[11]:-

E-Waste Component	Process Used	Potential Environmental Hazard
Cathode ray tubes (used in TVs, computer monitors, ATM, video cameras, and more)	Breaking and removal of yoke, then dumping	Lead, barium and other heavy metals leaching into the ground water and release of toxic phosphor
Printed circuit board (image behind table – a thin plate on which chips and other electronic components are placed)	De-soldering and removal of computer chips; open burning and acid baths to remove metals after chips are removed.	Air emissions and discharge into rivers of glass dust, tin, lead, brominated dioxin, beryllium cadmium, and mercury
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid and burning of chips	PAHs, heavy metals, brominated flame retardants discharged directly into rivers acidifying fish and flora. Tin and lead contamination of surface and groundwater. Air emissions of brominated dioxins, heavy metals, and PAHs
Plastics from printers, keyboards, monitors, etc.	Shredding and low temp melting to be reused	Emissions of brominated dioxins, heavy metals and hydrocarbons

Process of E-waste:-



Source: E-waste Inventory Project in Malaysia Report,2009

E-waste Global scenario:-

As far as global e-waste management is concerned, Switzerland is the first country to implement the organized e-waste management system in the world. Extended Producer Responsibility (EPR) and Advance Recycling Fee (ARF) are the backbone of e-waste management system in Switzerland and other developed countries Advanced countries like USA, UK, France & Germany generate 1.5 to 3 million tons of e-Waste annually and are among the largest generators of e-Waste. But these countries also have standardized e-waste management processes in place. Proper e-Waste management, from efficient sourcing and collection right upto extraction and disposal of material, has ensured that this huge pile of junk turns into a lucrative business opportunity

E-Waste Scenario in India:-

Increased usage of gadgets, telecom, information and technology and appliances is collectively creating nearly 13 lakh tons of e-Waste annually in India according to an August 2014 report by the industrial body ASSOCHAM. The report also highlighted that Delhi-NCR, Mumbai and the IT capital of India, Bengaluru collectively produce over 2 lakh tons of e-Waste per year. Another January 2015 report from Markets and Research has forecast that the Indian e-Waste market will grow at 26.22% CAGR during 2014-2019. However, with so much electronic waste being generated in the country, a major portion is handled by the informal or unorganized sector using improper processes, which leads to environmental pollution and health hazards.

Unorganized e-Waste Processing in India – An Environmental Hazard[12]:-

Majority of the e-waste comprises computers, while telecom, electrical gadgets and health equipment account for the remainder. Apart from various toxic substances like lead, mercury and arsenic, electronic waste also contains valuable substances like gold, silver and rare earth elements. When it comes to managing e-waste, India is relying heavily on the unorganized sector which accounts for over 90 per cent of the entire e-waste recycling industry. Unorganized setups generally employ low paid workers, including over 4.5 lakh children (ASSOCHAM report), who are not trained properly to process e-waste. Working conditions in these informal e-scrap processing setups are

gravely hazardous. Dismantling or recycling of e-waste in the informal sector using crude and primitive methods with bare hands and no facemasks, like acid stripping and open air incineration releases numerous lethal components like polyvinyl chloride, chlorofluorocarbons, arsenic, nickel and barium, among others, into the environment causing medical conditions like cancer, asthma, bone diseases and brain diseases.
Majority of the global waste is produced by the developed nations. Recycling of e-Waste in western countries is exponentially high as compared to developing nations like India which have abundant space to absorb any kind of waste. It is ten times cheaper to ship electronic waste to Asia than recycling for USA. United States of America (42%) tops the list of nations from which India imports e-Waste followed by China (30%) and European Union (18%) as reported in the ASSOCHAM paper. Import of e-waste for recycling is prohibited in India – however, according to a MAIT-GTZ survey 50,000 tons of electronic scrap is imported annually through miss declaration by companies making India one of the biggest yards of e-waste.

Need for the Guidelines for Environmentally Sound Management:-
Environmentally sound recycling/re-processing[14] of e-waste starts with decontamination/ dismantling where the concentration of hazardous material/chemical is reduced followed by recycling and recovery of the material of economic value and then disposal of the residue in TSDF (Treatment, storage & Disposal facility). The second category equipment like refrigerators, air conditioners and washing machines primarily contain steel plastics and copper wiring. It also contains potentially harmful substance such as CFCs/HCFCs gases which have high ozone depletion potential. The compressor oils are hazardous waste that need proper disposal at TSDFs or can be processed in cement kilns. Environmentally sound recycling is required to ensure safe collection and disposal of these substances.

MoEF/CPCB after consulting various stake holders felt the need for preparing a guidance document for implementation of the provisions of the E-Waste (Management & Handling) Rules, 2011 that may help the Producers, Consumer & Bulk Consumer, Collection Center, Dismantler, Recycler and Regulatory agencies (SPCBs/PCCs) for effective compliance/implementation of these rules. This document also provides guidance on setting up collection mechanism, dismantling and recycling operations. As the E-waste Rules place main responsibility of e-waste management on the producers of the electrical and electronic equipment by introducing the concept of "extended producer responsibility"(EPR). The scope of implementing such EPRs is also discussed in these guidelines.

The collection centre has to comply with following legal requirements:-
- To obtain an authorization from the concerned SPCBs/PCCs
- To ensure that the e-waste collected by them is sent to registered dismantlers or recyclers in a secured manner.
- To maintain records of the e-waste handled in Form 1
- To file annual returns in Form 2
- To make the records available for scrutiny by the SPCBs/PCCs

Conclusion:-
Despite the various new technologies that are emerging for e-waste disposal, landfilling still remains the most common pracice in the society. The establishment and closure of landfills could pose a potential hazard to ground water, due to leachate seepage, and air quality due to gases released. Unless proper maintenance and management is sustained for a fairly long time (30 years), public health may be compromised as a result. Such management is costly and potentially dangerous if faulty. Thus, a safer and more sustainable approach may be used for minimizing the number of landfills constructed and insuring their longevity so as not to continue taking viable land for waste disposal. It is therefore critical to divert waste from landfills through reduction and recycling.

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