

E-Waste Toxic Agents Impact on Environment and Recycling Process by Nano Technology

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Abstract—Today the world is alarmed by global issues like toxic agent's production and exposure of radiation from several electronic equipment due to the vast development in the field of electronics. E. g. : electronic devices electronic gadgets like mobiles, PC etc. These devices are manufactured using chemical substances like aluminum mercury, lead, PVC, antimony, arsenic, chromium which are toxic in nature and hazardous substances. In order to increase the packing density of electronic devices Nanotechnology plays a key role. High durability and strength of electronic gadgets leads to less E-waste generation which will have less impact on the environment.

Every year several billion tons of E-Waste is generated across the world. In most of countries there activities are handled by unskilled persons by removing precious metals without safety norms, followed by activities like burning of electronics goods, wires, PCBs and extracting metals using high concentrated acids. Activities at low temperature creates additional toxins, such as halogenated dioxins. Most of these electronic goods are manufactured using hazardous chemical substances. The unskilled actives like E-waste directly impacts environment by exposing hazardous gases, by polluting water, soil, air, ozone. Global Studies suggests an increase of E-waste by 250% will be in next decade.

All electronic gadgets are made in Nano scales. Recycling may be possible for all these electronic gadgets at Nano level which is best solutions for electronic manufacture industry. Optimum utilization of recycled E-waste is important while material preparation from ores and raw material extraction process releases several toxic substances into the environment. Toxic agents impact on reproductive system, nervous system, child mental ability, cancer etc. Scope of using Nano materials is to improve durability and strength.

1. INTRODUCTION

Electronic industry over last decade onwards enormously developed, it is considered as world largest manufacturing industry as of now.

Even though the durability of electronic gadgets are on an average very less order of 5 to 10 years. It seems Damaged and not working electronic equipment devices known to be Electronic Waste or Waste electrical and electronic equipment (WEEE). Every year the percentage of electronic industry increasing production as well as E-wastages increased rigorously, United Nations in 2013 published report alarming global issue on toxicants. While manufacture of all electronic

goods, gadgets, devices several hazardous chemical substances and toxic substances involved those substances directly exposed in to environment without proper toxins treatment. These activities causes serious damage to environment by polluting water, air, soil, even substances like CFL, HCFL, gases substances damage ozone layer it causes global warming.

E-waste is global issue even though it properly managed it is best instant material generation sources, by natural available sources to required many policies permission and preparation need many chemical substances and many toxins involved in the process. The way to minimize toxic agents recycling followed by the filtrations at Nano scales, toxic substances, and water and air other harmful substances from E-waste. Ex- Aluminum, arsenic, beryllium, lead etc. They are very harmful for the biological systems. These hazardous substances toxic in nature while filtrations optimum chemical recovery possible by molecular levels in Nano Technology (membranes) plays a key role. Toxic agents, liquid and gas phases monitored at Nano level. Common classified disposed electronics are considered as secondary resource due to instant reusability. Electronic gadgets offered reasonable prices for all people the rate of purchasing capacity enormously increased demand of material also increased while preparation of materials several toxicants released those are damaging the environment.

2. E-WASTE GLOBAL SCENARIO

Several studies have been states to find out the inventory of E-waste across the globe. Several million tons of E-waste generated across the world UNEP (United Nations environmental program) under estimation growth rate by next decade 250 percentage. In U. S 2010 onwards 165\$ billion of consumer electronics are purchased and it is increasing on an average 16.3 percentage estimated by U. S environment protection agencies, EPA (environment protection agency) report says 300 millions of LED'S, LCD'S, CRT Monitors, computers and 1 million of cell phones are manufactured on an average of one year. A Report from ABI Research predicts that the market for recovering and recycling the used

electronic devices will reach \$14.7 billion only. In U.S. the waste economy increased enormously by 2017. The volume of E-products are expected to be 33% worldwide higher than 2012. UNEP (United Nations Environment Program) reported by titled recycling from E-waste to resources, the amount of E-waste being generated including mobiles and computers would go up by as much as 500% over the next decade in India and China. 30-70 million tons of average E-waste generated every year. The environmental protection agency estimates that only 15-20% of E-waste is recycled and the rest of E-waste is dumped in landfills. Across the globe 2% landfill trash of E-waste pollutes 70% of overall landfills by toxic waste.

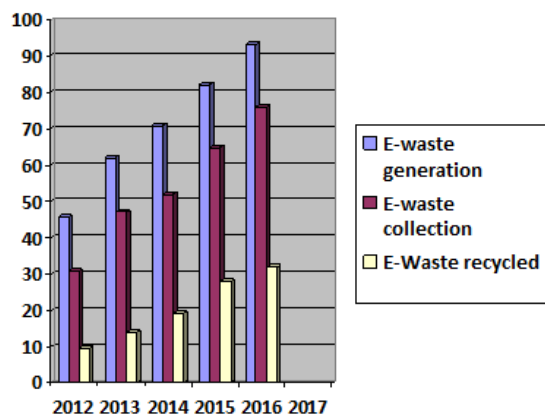


Fig. 1: E-waste Generations in Million Tones

2.1 Toxicants in E-waste

Electronic waste is not just waste, it contains some of the most toxic substances such as mercury, lead, cadmium, arsenic, beryllium, and brominated flame retardants. When these are burned at low temperature they create additional toxicants such as halogenated dioxins and turn some of the most toxic substances unknown to mankind. The toxic materials in electronic gadgets are described as plastic contains phthalate. Insulators contain insulation ODS in foam, asbestos, refractory ceramic fiber. CRT display contains lead, antimony, mercury, phosphorus. LCDs contain mercury. Wires and electrical connectors contain phthalate plasticizer, lead, brominated flame retardants (BFR). Circuit board contains lead, beryllium, antimony, BFR. Fluorescent lamp contains mercury, phosphorus, flame retardants. Thermostat contains mercury. Batteries contain lead, lithium, cadmium, mercury, CFC, HCFC, HFC, HC. External electric cables contain BFRs, plasticizers.

2.2 Toxicants in Cell Phone and Laptop

All electronics contain toxic materials that can be harmful to people and the planet. A lot of this hazardous stuff lives in the circuit board, including lead (in the solder), mercury (in switches and relays), and brominated flame-retardants. Some

electronics, like smartphones and laptops, contain heavy metals like cadmium, beryllium, hexavalent chromium, and arsenic, which have been shown to build up in our bodies and the environment. Also, the wires and cables that run through all this stuff are often coated with PVC, which contains toxic additives called phthalates.

3. IMPACT ON ENVIRONMENT

Impacts of Informal Recycling

As we know electronic gadget mixture of toxins those PCB, wires, IC, etc. Burning and precious metal extractions like gold, aluminum, silver, lead, etc. Followed by activities dissolving and melting of high concentrated acidic solutions without safety norms. It causes hazardous gases exposed to the environment. Informal recyclers working in poorly ventilated enclosed areas without masks and technical expertise, result in exposure to dangerous and slow poisoning chemicals. Most e-waste "recycling" involves small enterprises that are numerous, widespread, and difficult to regulate. They take advantage of low labor costs due to high unemployment rates, internal migration of poor peasants, and the lack of protest or political mobilization by affected villagers who believe that e-wastes provide the only viable source of income or entry into modern development pathways.

3.2 Soil

Toxic nature substances damage the quality of fertilization of seed, it causes land and food grains in toxic nature. The polluted soil and air contaminates our vegetables, crops, flowers, grasses, herbs, plants, saplings, shrubs & trees.

Water

Water contaminated by toxic agents totally damages the biological systems.

Ozone layer

Gases like CFL, HCFC are going to damage the ozone layer.

Impact on human organ systems by Toxic agents

Lead is toxic to the kidneys, accumulating in the body and eventually affecting the nervous and reproductive systems. Children's mental development can be impaired by low-level exposure to lead. When burned, PVC produces dioxins, some of the most hazardous carcinogens known. Brominated flame retardants have been linked to fetal damage and thyroid problems. Barium produces brain swelling after a short exposure. It may cause weakness in muscles as well as heart, liver, and spleen damage. Hexavalent chromium damages kidneys, liver, and DNA. Asthmatic bronchitis has been linked to this substance. Mercury is known to harm developing fetuses and is passed through mothers' milk to newborns. In

adults, it can cause brain and kidney damage. Beryllium causes acute or chronic beryllium disease, a deadly ailment affecting the lungs. Cadmium is a carcinogen and long-term exposure leads to kidney and bone damage

Environmental pollution role of electronic

Electronic Manufacturing industries

While preparation electronic gadgets involve several chemicals and toxins with different concentration level of toxic substances and doped elements. In the manufacture process some of toxins Exposed, some waste outcomes substances are mixed with environment in form of gases and liquid phase mixed in watersources. It damages biological system by polluting water. Ex: mercury in japan coastal areas minamata, fish contain mercury etc.

Dumping of e-waste land fills

Damaged, not working electronics placed in remote landfills. Every year billion tons of E-waste across the world generated. The E-waste production ratio increasing year by year in this case standard recycle maintains difficult which leads garbage like E- waste not treated because toxins chemical presence those are easy to react with environment and exposing toxin into environment , while rainy season water react with e-waste substances it causes concentrated toxins directly damage the environment. Animals facing genetically disorders, several problems because of contaminated drinking water.

Scope of Nano technology in E-waste management

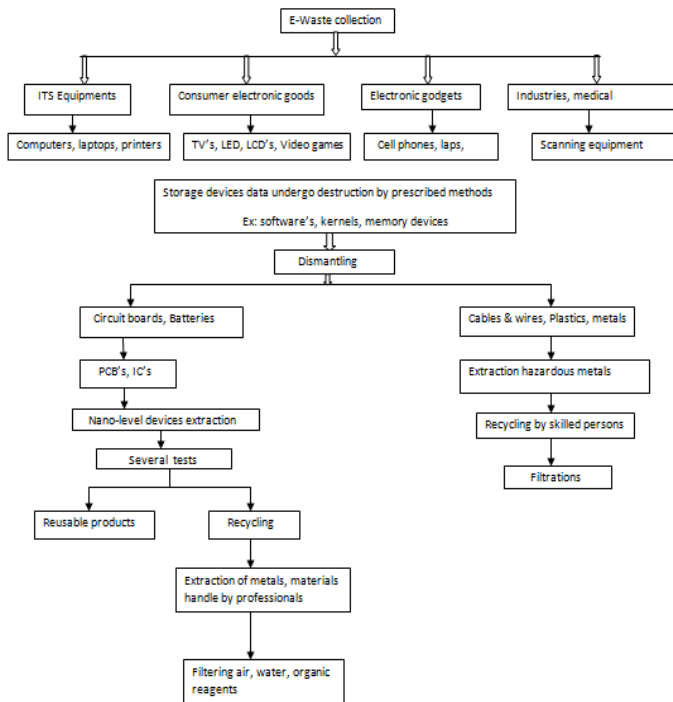


Fig. 2: Nano scaled level Recycling process

Any electronic gadget are basically embedded systems different functionalities and different blocks are work together final outcome electronic goods. If any functional element damages entire product replacing as of now it is a main reason for E-waste growth rate increasing drastically

Filtrations by Nano membrane

It separates in molecular level liquids and gas substances filtered by 100nm level. Nano membrane acting like a mesh it restricts different nanoscale molecules and toxic substances. Nano membrane helps to filtering the hazardous substances.

Self-Assembled Nano Structures

Self-assembled structure is bridge strategy of Nano structure it allows regular organized patterns of molecules order of 1-6nm, at Nano scale organic compounds be acting as conductors and semiconductor. It reduces bridges of circuitry fabrications.

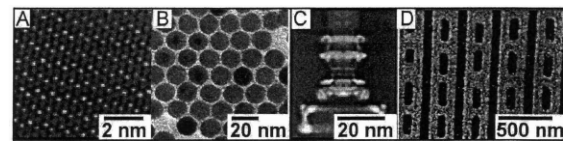


Fig. 3: Self Assembled Nano structures

Nano Materials

Nano composites increases the performance level of doping concentrations used to improve the performance were as at nanoscales new materials improvised characteristics possible. It leads high packing density and better performance achieved.

4. DURABILITY AND STRENGTH

Now average electronic gadgets lifetime is 5-10 years. New composite nano materials increase the strength and lifetime. Durability increase across the world E-waste and toxicants can be minimized

5. GLOBAL INITIATIVES ON E-WASTE

As far as E-waste management across the world concerned Switzerland is first country to implement organized E-waste management system. Extended producer responsibility (EPR) and advanced recycling fee (ARF) are back bones of E-waste management system in Switzerland. Other developing countries like USA, UK, and Frances are generated 1. 5 to 3million tones. Annually, these countries also have standardized E-waste process in place proper E-waste management from efficient sourcing and collecting right up to extraction and disposal of materials due to very stringent environment standards the cost of collection preprocessing recycling and disposal are pretty high.

So far every organized recycler in first world countries, there are quite few who pose as recyclers and mere brokers to ship developing countries sell as second hand goods with very ambiguous laws related to environmental protection. India , china and few African countries have become dumping sites there are many countries that have already started “ taken-back” system for electronic products they have dedicated law on e-waste management.

- In USA national electronics action plan has initiated by US Environmental protection agency addressed various e-waste related issues.
- Two important initiative taken by E. U(European union) WEEE directives and restriction of use of certain hazardous substances (ROHS) 27- Countries E. U to recycle these e-waste.
- Basel convention is also nice step taken by UNEP to control. Trading of hazardous waste India and china are signatory for this situation

6. E-WASTE MANAGEMENT IN INDIA

Despite a wide range of environmental legislation in India there are no specific laws or guidelines for electronic waste or computer waste (Devi et al. , 2004). As per the Hazardous Waste Rules (1989), E-waste is not treated as hazardous unless proved to have higher concentration of certain substances. Though PCBs and CRTs would always exceed these parameters, there are several grey areas that need to be addressed. Basel Convention has Waste electronic assemblies in A1180 and mirror entry in B1110, mainly on concerns of mercury, lead and cadmium. Electronic waste is included under List-A and List-B of Schedule-3 of the Hazardous Wastes (Management & Handling) Rules, 1989 as amended in 2000 & 2003. The import of this waste therefore requires specific permission of the Ministry of Environment and Forests.

7. CONCLUSIONS

E-waste management is environmental issue. All developed nations take initiative on standardized recycled processing unit's establishments across the world. Government semi Government NGOS organization come to forward for regular monitoring Toxic agent , serving public health condition, pollutants levels toxic agents, awareness on E-waste clean E-waste collection center. Science and technology concern research encouragement on eco-friendly electronic gadgets, nanostructured electronic devices which are more compact, durable and strength, requirement toxic agents minimized. The manufacturing industry should take the responsibility and contribute several initiatives like take-back products and reusability recycling process. To Protect environment.

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