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ELECTRONIC WASTE MANAGEMENT: SUSTAINABLE SOLUTIONS

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ABSTRACT

The innovation in science and technology coupled with the change in lifestyle of an individual has made an incredible change in the electronic industry show casing an assorted range of new products every day to the world. India too has been impacted by this digital revolution where consumption of electronics goods grows at a rapid rate producing a large amount of waste electrical and electronic equipment. This substantial generation of electronic waste referred to as e-waste accompanied with the lack of stringent environmental laws and regulations for handling the hazardous e-waste has resulted in the cropping of number of informal sectors. Over 95% of the e-waste is treated and processed in the 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. This paper focuses on the occupational health hazards due to the informal recycling of e-waste and then proceeds to show the safe disposal methods for handling the large quantities of e-waste generated in this electronic era and thus finds a sustainable solution for the formal processing of e-waste.

Keywords- E-waste, Informal sectors, Occupational health hazards, Recycling, waste electrical, Electronic equipment

I. INTRODUCTION

E-waste comprises of waste electrical and electronic products, which cannot continue for their original intended use and are directed for reuse, recycle and recovery or disposal. It is one of the fastest growing waste streams in the world. The waste electrical and electronic equipment's (WEEE) constitute 8% of the municipal waste stream. It includes a wide range of consumer electronics such as refrigerators, air conditioners, washing machines, microwave ovens, televisions, VCRs, stereos, electric lamps, audio equipment and batteries besides IT and telecommunications equipment which includes discarded computers, cell phones, copiers, fax machines, etc. The industrial revolution, followed by urbanization has resulted in massive generation of electronic waste. The electronic goods are discarded generally due to the following:

- Innovation in science and technology
- Changes in lifestyle of an individual

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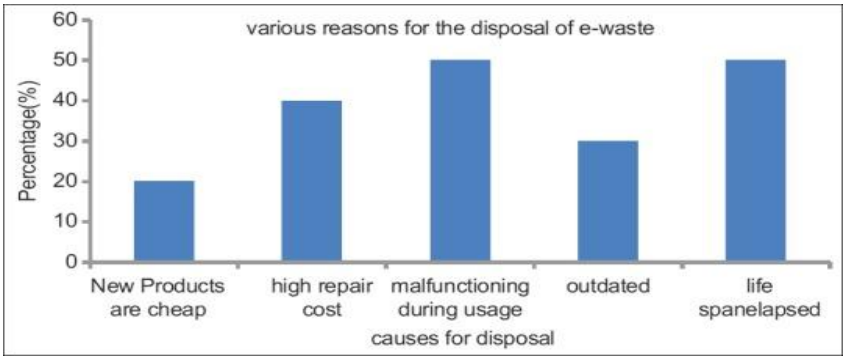
- Nearing the end phase of their intended usage.

The various reasons for which the electrical and electronic equipment discarded are given as a graphical representation as



The e-waste has been identified as hazardous waste by the Basel Convention and developed a framework for control on trans-boundary movement of such waste. The massive generation of e-waste on one side accompanied with the lack of stringent legal policies and environmental regulations for managing the hazardous e-waste has resulted in the formation of number of informal sectors. These unorganized sectors continue to use rudimentary processes and practices such as open burning, acid baths and heating of circuit boards, resulting in emissions and release of toxic elements into the environment.

These clusters have been operational for many years and have been handling extensively large volumes of e-waste without any personal protective equipment's and not using proper pollution-control devices or measures to capture the pollutants being released into land and water sources in and around the area.[1] The spent acid with residual metals is discharged into open land and finally absorbed by soil and surface water. Even though the damage caused by informal e-waste recycling activities in India is immense, there is no specific law in places that regulates the e-waste and thus poses a serious occupational health risk. This study attempts to reveal the various occupational health hazards related to the informal recycling of e-waste and takes a special interest in creating the public awareness especially for children who are actively involved in e-waste processing.

II. COMPOSITION OF E-WASTE

The composition of e-waste differs from product to product. Broadly it consist of diverse of materials which includes ferrous and nonferrous, metals, plastics, glass, wood and plywood, printed circuit board, rubber, ceramics and other items. Iron and steel constitutes 50% of the e-waste, plastics 21%, nonferrous metals 13%, and the rest other constituents. Nonferrous metals consist of metals such as copper, aluminum and precious metals such as gold, silver, platinum, palladium, etc. The presence of elements such as lead, mercury, arsenic, cadmium, selenium, hexavalent chromium and flame retardants beyond the threshold limit in e-waste classifies them as hazardous waste.

In the growing economics, e-waste which is flowing from the wastes imports not only offers a business opportunity, but also satisfies the demand for cheap second-hand electrical and electronic equipment. An entire new economic sector is evolving around trading, repairing and recovering materials from redundant electronic

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devices. Though it is a source of livelihood for the urban and rural poor, it often causes severe risks to humans and the local environment.

It is imperative that developing countries and India in particular wake up to the monopoly of the developed countries and set up appropriate management measures to prevent the occupational health hazards and mishaps due to mismanagement of e-wastes.

III. METHODOLOGY

The company PES Ltd. Manufactures smart meters which are electronic device and produce electrical waste was visited for seeing the effect of e-waste on employees and sustainable solutions the company is following. This company produce electric meter.An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device.

Electric utilities use electric meters installed at customers' premises to measure electric energy delivered to their customers for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour [kWh]. They are usually read once each billing period. When energy savings during certain periods are desired, some meters may measure demand, the maximum use of power in some interval. "Time of day" metering allows electric rates to be changed during a day, to record usage during peak high-cost periods and off-peak, lower-cost, periods. Also, in some areas meters have relays for demand response load shedding during peak load periods.

IV.SMART METERS

Smart meters go a step further than simple AMR (automatic meter reading). They offer additional functionality including a real-time or near real-time reads, power outage notification, and power quality monitoring. They allow price setting agencies to introduce different prices for consumption based on the time of day and the season.Another type of smart meter uses nonintrusive load monitoring to automatically determine the number and type of appliances in a residence, how much energy each uses and when. This meter is used by electric utilities to do surveys of energy use. It eliminates the need to put timers on all of the appliances in a house to determine how much energy each uses.

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V. HEALTH HAZARDS DUE TO INFORMAL RECYCLING OF E-WASTE

Since the e-waste is blend of plastics and chemicals, improper handling of e-waste is harmful to the environment as well as mankind. For the recycling of e-waste, India heavily depends on the unorganized sector as only a handful of an organized e-waste recycling facilities are available. Over 95% of the e-waste is treated and processed in the 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.

In developing countries, the e-waste is dismantled manually and releasing the non-degradable plastics and persistent chemical to the environment thereby contaminating the quality of air, water and soil.

Examples of such crude techniques worth mentioning are:

1) Physical dismantling using tools such as hammers, chisels, screw drivers and bare hands to separate different materials

2) Removing components from printed circuit boards by heating over coal-fired grills

3) Stripping of metals in open-pit acid baths to recover gold and other metals

4) Chipping and melting plastics without proper ventilation

5) Burning cables to recover copper, and burning unwanted materials in the open air

6) Disposing unsalvageable materials in fields and riverbanks.

These illegal methods to recover the precious metals expose the workers to harmful chemicals such as heavy metals, inorganic acid, polycyclic aromatic hydrocarbons, etc., which are potential pollutants andcause serious occupational health hazards.

VI. SAFE DISPOSAL METHODS

The various disposal methods available to manage the e-waste heaps are:

Landfilling

Incineration

Recycling and

Reuse.

6.1 Land filling

It is one of the most widely used methods for disposal of e-waste. In landfilling, trenches are made on the flat surfaces. Soil is excavated from the trenches and waste material is buried in it, which is covered by a thick layer of soil. Modern techniques like secure landfill are provided with some facilities such as impervious liner made up of plastic or clay, leachate collection basin that collects and transfer the leachate to wastewater treatment plant. The degradation processes in landfills are very complicated and run over a wide time span.

6.2Hazards of land filling

Leaking landfills Leachate contaminating soil and groundwater Chemical reactions Vaporization Uncontrolled fires. Thus land filling does not appear to be an environmentally sound treatment method for substances, which are volatile and not biologically degradable (Cd, Hg, CFC), persistent (polychlorinated biphenyls [PCB]) with

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unknown behavior in a landfill site (brominated flame retardants). As a consequence of the complex material mixture in e-waste, it is not possible to exclude environmental (long-term) risks even in secured land filling Incineration It is a controlled and complete combustion process, in which the waste material is burned in specially designed incinerators at a high temperature (900–1000°C). Advantage of incineration of e-waste is the reduction of waste volume and the utilization of the energy content of combustible materials. Disadvantage of incineration is the emission to air from substances escaping flue gas and the large amount of residues from gas cleaning and combustion process. E-waste incineration plants contribute significantly to the annual emissions of cadmium and mercury. In addition, heavy metals are not emitted into the atmosphere and are transferred into slag and exhaust gas residues which can reenter the environment on disposal. Therefore, e-waste incineration will increase these emissions if no reduction measures like removal of heavy metals are taken.

6.3.Incineration hazards

Dioxin formation

Heavy metal contamination.

Contaminated slag,

fly ash and flue gases Health and safety hazards.

6.4.Recycling of e-waste

Recycling options for managing plastics from end-of-life electronics are of three types. Chemical recycling. Mechanical recycling. Thermal recycling. Any recycling process involves dismantling, that is, removal of different parts of e-waste containing dangerous substances such as PCB, Hg, separation of plastic, removal of cathode ray tube (CRT), segregation of ferrous and nonferrous metals and printed circuit boards. Recyclers use strong acids to remove precious metals such as copper, lead, gold. The value of recycling from the element could be much higher if appropriate technologies are used. The recyclers are working in poorly–ventilated enclosed areas without mask and technical expertise results in exposure to dangerous and slow poisoning chemicals, Monitors and CRT, keyboards, laptops, modems, telephone boards, hard drives, floppy drives, Compact disks, and mobiles, fax machines, printers, CPUs, memory chips, connecting wires and cables can be recycled.

6.5 Hazardous effects due to recycling

Potential threat to human health and the environment Lead causes damage to the central and peripheral nerve system, blood system and kidneys in humans Mercury impacts brain functioning and development. Therefore, recycling is the best possible option for the management of e-waste.

6.6 Reuse

It constitutes direct second-hand use or use after slight modifications to the original functioning equipment. It is commonly used for electronic equipment such as computers, cell phones, etc. Inkjet cartridge is also used after refilling. This method also reduces the volume of e-waste generation.

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VII. DISCUSSION

The high tech boom has brought with it a new type of waste – electronic waste, a category that barely existed 20 years ago. Now e-waste represents the biggest and fastest growing manufacturing waste. The black and white TV turned to colour, the basic mobile phone needed a camera, personal organizer and music, and who wants last year's computer when it can't handle the latest software? As we continually update and invent new products the life of the old ones is getting shorter and shorter. Like shipbreaking, e-waste recycling involves the major producers and users, shipping the obsolete products to Asia, Eastern Europe, and Africa. But instead of being "green" we are exporting a sack full of problems to people who have to choose between poverty or poison.

7.1 Story of e-waste: The computer: On average a computer is 23% plastic, 32% ferrous metals, 18% non-ferrous metals (lead, cadmium, antimony, beryllium, chromium and mercury), 12% electronic boards (gold, palladium, silver and platinum) and 15% glass. Only about 50% of the computer is recycled, the rest is dumped. The toxicity of the waste is mostly due to the lead, mercury and cadmium – non-recyclable components of a single computer may contain almost 2 kilograms of lead. Much of the plastic used contains flame retardants, which makes it difficult to recycle.

7.2 How do you recycle a computer?

In many countries entire communities, including children, earn their livelihoods by scavenging metals, glass and plastic from old computers. To extract the small quantity of gold, capacitors are melted down over a charcoal fire. The plastic on the electrical cords is burnt in barrels to expose the copper wires. All in all each computer yields about US $6 worth of material (Basel Action Network). Not very much when you consider that burning the plastic sends dioxin and other toxic gases into the air. And the large volume of worthless parts are dumped nearby, allowing the remaining heavy metals to contaminate the area.

VIII. CONCLUSION

It is the responsibility of the government to turn away more e-waste flowing from informal to formal sectors and to achieve positive utilization of informal collection networks for collecting e-waste from households thereby developing efficient incentive system for poor collectors and recyclers. Technical improvements of informal recycling processes coupled with proper training in handling WEEE has to be offered to the local industry and community so to obtain better environmental performance without sacrificing the economic and social benefits. This will provide a remedy for the occupational health hazards related to the informal recycling of e-waste.

Developing a better understanding of informal recycling and implementing more supportive policies for the informal sector that could result in hundreds of job opportunities for low-skilled workers in a complete safe environment is a sustainable solution for the current issue. Educating the children who are actively involved in e-waste processing in their own line creates e-experts for future generation and can handle this hazardous waste and turn in to the valuable resource.

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