"E-WASTE: ADVERSE IMPACT ON HEALTH &ENVIRONMENT"

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ABSTRACT

E-waste comprises of wastes generated from used electronic devices and house hold appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal. Such wastes encompasses wide range of electrical and electronic devises such

as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, air conditioners etc. E-wastes contain over 1000 different substances many of which are toxic and potentially hazardous to environment and human health, if these are not

handled in an environmentally sound manner.

E-waste toxic emission missed with soil and air and causing harmful effect on the environment either directly or indirectly. Direct impact includes release of acids, toxic compounds like heavy metals such as lead, mercury, arsenic, cadmium etc. And Indirect effects such as bio magnification of heavy metals. Many private firms are involved in collecting, dismantling, separation and exporting e-wastes for recyclers.

Most e-waste ended as rubbish in landfills even though recycling would make economic sense in most cases. Many people junked gadgets, often to buy an upgraded model or because repairs of anything from a toaster to a smart phone were more expensive than buying a replacement. There are organizations across the country that use electronics for recycling.

This paper is outcome of a review of various research studies carried out on Electronic Waste. This paper shows the adverse impact of human health and environment if electronic and electrical wastes are not handled properly in the developing country.

INTRODUCTION

E-waste or electronic waste is created when an electronic product is discarded after the end of its useful life. The rapid expansion of technology means that a very large amount of e-

waste is created every minute. Electronic waste may be defined as discarded computers, office electronic equipment, entertainment device electronics, mobile phones, television sets, and refrigerators.

Used electronics which are designed 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 materials such as lead, cadmium, beryllium, or brominated flame retardants. Recycling and disposal of e-waste may involve significant risk to health of workers and communities in developed countries and great care must be taken to avoid unsafe exposure in recycling operations and leaking of materials such as heavy metals from landfills and incinerator ashes.

COMPONENTS OF E WASTE

- Large Household Appliances
- Small Household Appliances
- IT & Telecommunication Equipment
- Consumer Equipment
- Lighting Equipment
- Electrical and Electronic tools (with the exception of large scale stationary industrial tools)
- Toys, Leisure & Sports Equipment
- Automatic Dispensers
- Monitoring and Control Instruments
- Medical Devices (with the exception of all implanted and infected products)

HEALTH HAZARDS

Harmful effects of toxic compound

- **LEAD**

Lead is used in glass panels and gaskets in computer monitors and in solder in printed circuit boards and other components. Lead causes damage to the central and peripheral nervous systems, blood systems, kidney and reproductive system in humans. It also affects the endocrine system, and impedes brain development among children. Lead tends to accumulate in the environment and has high acute and chronic effects on plants, animals and microorganisms (Metcalf & Eddy, 2003). The Adverse effects of lead exposure include impaired cognitive function, behavioral disturbances, attention deficits, hyperactivity, conduct problems, and lower IQ.

- **CADMIUM**

Cadmium occurs in surface mounted device (SMD) chip resistors, infra-red detectors, and semiconductor chips. Some older cathode ray tubes contain cadmium.Toxic cadmium compounds accumulate in the human body, especially the liver, kidneys pancreas, thyroid (Metcalf & Eddy, 2003, Basel Action Network, 2002). The inhalation of cadmium can cause severe damage to the lungs and is also known to cause kidney damage. Cadmium is also associated with deficits in cognition, learning, behavior, and neuromotor skills in children.

- MERCURY

It is estimated that 22 % of the yearly world consumption of mercury is used in electrical and electronic equipment. Mercury is used in thermostats, sensors, relays, switches, medical equipment, lamps, mobile phones and in batteries. Mercury used in flat panel displays, will likely increase as their use replaces cathode ray tubes. Mercury can cause damage to central nervous system as well as the foetus. The developing foetus is highly vulnerable to mercury exposure (Metcalf & Eddy, 2003). When inorganic mercury

spreads out in the water, it is transformed to methylated mercury which bio-accumulates in living organisms and concentrates through the food chain, particularly via fish (Basel Action Network, 2002).Health effects include sensory impairment, dermatitis, memory loss, and muscle weakness. Exposure in-utero causes fetal deficits in motor function, attention, and verbal domains. Environmental effects in animals include death, reduced fertility, and slower growth and development.

- **HEXAVALENT CHROMIUM / CHROMIUM VI**

Hexavalent Chromium is a known carcinogen after occupational inhalation exposure. 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.

Chromium VI is used as corrosion protector of untreated and galvanized steel plates and as a decorative or hardener for steel housings. Chromium VI can cause damage to DNA and is extremely toxic in the environment. Long term effects are skin sensitization and kidney damage(Metcalf & Eddy, 2003).

- **SULPHUR**

It effects the health which include liver damage, kidney damage, heart damage, eye and throat irritation. It can create sulphuric acid through sulphur dioxide when get released into the environment.

- **Plastics (including PVC)**

The largest volume of plastics (26%) used in electronics has been poly vinyl chloride (PVC). PVC elements are found in cabling and computer housings. Many computer moldings are now made with the somewhat more benign acrylonitrile butadiene (ABS) plastic. Dioxins are released when PVC is burned (Basel Action Network, 2002).

- **Brominated Flame Retardants (BFRs)**

BFRs are used in the plastic housings of electronic equipment and in circuit boards to prevent flammability. BFRs are persistent in the atmosphere and show bioaccumulation. Concerns are raised considering their potential to toxicity (Basel Action Network, 2002).

It effects the health which comprise impaired development of the nervous system, thyroid problems, liver problems.

Environmental effects shows similar effects as in animals as humans. PBBs were banned from 1973 to 1977 and PCBs were banned during the 1980s.

- **PFOA(PERFLUOROOCTANOIC ACID)**

The studies have found a rise maternal PFOA levels to be associated with an increased risk of spontaneous miscarriage, abortion and stillbirth.

- **Barium**

Barium is a soft silvery-white metal that is used protect users from radiation. Studies have shown that short-term exposure to barium causes brain swelling, muscle weakness, damage to the heart, liver, and spleen.

- **Beryllium**

Beryllium is commonly found on motherboards and finger clips. Exposure to beryllium can cause lung cancer. Beryllium also causes a skin disease that is characterized by poor wound healing and wart like bumps. Studies have shown that people can develop beryllium disease many years following the last exposure. It is used as a copper-beryllium alloy to strengthen connectors. Barium is a soft silvery-white metal that is used to protect users from radiation. Occupational exposures associated with lung cancer, other common adverse health effects are beryllium sensitization, chronic beryllium disease and acute beryllium disease.

- **Phosphor and additives**

Phosphor is an inorganic chemical compound that is applied as a coat on the interior of the CRT faceplate. Phosphor affects the display resolution and luminance of the images that is seen in the monitor. The phosphor coating on cathode ray tubes contains heavy metals, such as cadmium, and other rare earth metals, for example, zinc, vanadium as additives. These metals and their compounds are very toxic. This is a serious hazard posed for those who dismantle CRTs by hand

- **POLYVINYL CHLORIDE**

In the manufacturing phase, toxic and hazardous raw material, including dioxins are released. PVC such as chlorine tends to bio accumulate. Over time, the compounds that contain chlorine can become pollutants in the air, water and soil. This poses a problem as human and animals can ingest them. Additionally, exposure to toxins can result in reproductive and developmental health effects.

E-WASTE RECYCLING WORKERS

The Occupational Safety & Health Administration (OSHA) has summarized several potential safety hazards of recycling workers in general, such as crushing hazards, hazardous energy released, and toxic metals.

Hazards applicable to Recycling in General

a) Slips, Trips and falls: They can happen during collecting and transporting e-wastes.

b) Crushing Hazards: Workers can be stuck or crushed by the machine or the e-waste. There can be traffic accidents when transporting e-waste. Using machines that have moving parts, such as conveyors and rolling machines can also cause crush accidents, leading to amputations, crushed fingers or hands.

c). Hazardous Energy Released: Unexpected machine startup can cause death or injury to workers. This can happen during the installation, maintenance, or repair of machines, equipment, processes, or systems.

d). Cuts and Lacerations: Hands or body injuries and eye injuries can occur when dismantling e-wastes that have sharp edges.

e). Noise: Working overtime near loud noises from drilling, hammering, and other tools that can make a great noise lead to hearing loss.

f).Toxic Chemicals (Dusts): Burning e-waste to extract metals emits toxic chemicals (e.g. PAHs, lead) from e-waste to the air, which can be inhaled or ingested by workers at recycling sites. This can lead to illness from toxic chemicals.

HAZARDS CONTROLS

For occupational health and safety of e-waste recycling workers, both employers and workers should take actions. Suggestions for the e-waste facility employers and workers given by California Department of Public Health are illustrated in the following table:

Safety suggestion for e-waste recycling facilities employers and workers

Hazards	What must employers do	What should workers do
General	Actions include: 1. determine the hazards in the workplace and take actions to control them; 2. check and make correction to the workplace condition regularly; 3. supply safe tools and PPE to workers; 4. provide workers with training about hazards and safe work practice; 5. a written document about injury and illness prevention.	Suggestions include: 1. wear PPE when working; 2. talk with employers about ways to improve working conditions; 3. report anything unsafe in the workplace to employers; 4. share experience of how to work safely with new workers.
Dust	Actions include:	Protective measures include:

	1. offer a clean eating area, cleaning area and supplies, uniforms and shoes, and lockers for clean clothes to the workers; 2. provide tools to dismantle the e-waste. If the dust contains lead or cadmium: 1. Measure the dust, lead and cadmium level in the air; 2. Provide cleaning facilities such as wet mops and vacuums; 3. Provide exhaust ventilation. If it is still not sufficient to reduce the dust, provide workers with respirators; 4. Provide workers with blood lead testing when lead level is not less than 30 mg/m3.	1. clean the workplace regularly, and do not eat or smoke when dealing with e-waste; 2. don't use brooms to clean the workplace since brooms can raise dust; 3. before going home, shower, change into clean clothes, and separate the dirty work clothes and clean clothes; 4. test the blood lead, even if the employers don't provide it; 5. Use respirator, check for leaks every time before use, always keep it on your face in the respirator use area, and clean it properly after use.
Cuts and lacerations	Protective equipment such as gloves, masks and eye protection equipments should be provided to workers	When dealing with glass or shredding materials, protect the hands and arms using special gloves and over sleeves.
Noise	Actions include: 1. measure the noise in the workplace, and use engineering controls when levels exceed the exposure limit; 2. reduce the vibration of the working desk by rubber matting; 3. Provide workers with earmuffs when necessary.	Wear the hearing protection all the time when working. Ask for the employer about the noise monitoring results. Test the hearing ability.
Lifting injuries	Provide facilities to lift or move the e-waste and adjustable work tables.	When handling e-waste, try to decrease the load per time. Try to get help from other workers when lifting heavy or big things.

ENVIRONMENTAL IMPACT

NEED FOR GUIDELINES FOR ENVIRONMENTALLY SOUND MANAGEMENT

The saying waste is misplaced wealth is true in the case of e-waste. The recyclability of e-waste and the precious metals that can be extracted from the waste make recycling a lucrative business. But recycling using environmentally sound means costly business and so majority of the e-waste is recycled via the informal sector. Informal recycling involves minimal use of technology and is carried out in the poorer parts of big cities.

The standard recycling drill involves physically breaking down components often without any protective gear, burning poly vinyl chloride (PVC) wires to retrieve copper, melting of lead and mercury laden parts. The extraction of gold and copper requires acid processing. The plastic parts, which contain brominated flame retardants (BFR) are also broken into small pieces prior to recycle. All these processes release toxic fumes into the atmosphere and polluted water into soil and water bodies leading to contamination. Most of those who work in the recycling sector are the urban poor with low literacy lacking awareness of the hazards of the toxic ewastes. Children and women are routinely involved in the operations. Most of the work is done by bare hands. Waste components which do not have resale value are openly burnt or disposed off in open dumps. Rapid pace of product obsolescence resulting in short life span of computers and other electronic equipments coupled with exponential increase in consumption of such products will result in the doubling of waste over next five to six years. The toxicity of constituents in e-waste, lack of environmentally sound recycling infrastructure and the large scale current practice of informal recycling highlight the urgent need for guidelines for environmentally sound management of e-waste.

CONCLUSION

India is placed in a very interesting position. The need of the hour is an urgent approach to the e waste hazard by technical and policy-level interventions, implementation and capacity building and increase in public awareness such that it can convert this challenge into an opportunity to show the world that India is ready todeal with future problems and can set global credible standards concerning environmental and occupational health. As long as this is a necessary evil, it has to be best managed to minimize its adverse impacts on environment.

Manufacturers & Suppliers to set goals for reducing electronic waste. Encourage them to buy back old electronic products from consumers. Disposing bulk e-waste only through authorized recyclers. Send non tradable e-waste to authorized private developers for final disposal. Store the electronics products in store houses which are not in use. This is one of the techniques to protect environment from hazardous waste gases.

It is our duty to protect our environment from the hazardous waste to better life of further generation. It can also protectable to whole ecosystem.

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