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E-WASTE & IT'S CHEMICAL EFFECTS

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ABSTRACT

The electronic and electrical industry is the world's largest growing manufacturing industry of modern age. We use a lot of electronic equipments which is fulfilled with latest technology, but rarely think what should be done after use, how much toxic it is, how to dispose. Electrical and electronic waste (e-waste) is currently the largest growing waste flow. It is very harmful, complex and more expensive to treat in an environmentally sound manner, and there is a general lack of legislation or enforcement surrounding it. Today, most e-waste is being discarded in the general waste flow which may affect badly. In developed countries the e-waste is sent for recycling, 80 % of them is being moved to developing countries where it is recycled by millions of unofficial workers. So e-waste has unpleasant effect on environmental and health implications. It is clear that the future of e-waste supervision depends not only on the effectiveness of local government or international authorities functioning with the operators of recycling services but also on the public contribution, along with national, local and global initiatives. The solution to the e-waste problem is not simply the prohibition of trans- boundary movements of e-waste, as household generation accounts for a major proportion of e-waste in all countries. Fundamental of a sustainable solution will be tackling the fact that current practices and the illegal deal provide cost-effective motivation in the developing countries. In considering solutions to the e-waste problem, this paper focuses on chemical effect of e waste.

Keywords—Chemical effects, harmful EW.

I. INTRODUCTION

In the last two decades, the global growth in electrical and electronic equipment production and consumption has been increased exponentially. This is largely due to increasing market penetration of products in developing countries, development of a replacement market in developed countries and a generally high product obsolescence rate ,together with a decrease in prices and the growth in internet use. Today, electrical and electronic waste is the fastest rising waste flow. The rate of increment is about 4 per cent increase a year. About 40 million tones of e-waste is created each year. E-waste comprises electrical appliances such as fridges, air conditioners, washing machines, microwave ovens, and fluorescent light bulbs; and electronic products such as computers and accessories, mobile phones, television sets and stereo equipment. As environmentally responsible waste management options are highly technological and require high financial investment, there is currently a high level of transboundary, often illegal, movement of e-waste into developing countries for cheaper recycling. Transboundary movement of e-waste is primarily profit driven. Recyclers and waste brokers are taking advantage of lower recycling costs in developing economies and at the same time avoiding disposal responsibilities at home. It is estimated that up to 80 per cent of all e-waste sent for recycling in developed countries ends up in informal e-waste recycling sites in developing countries, primarily in Africa and Asia. In receiving countries, crude and harmful methods of recycling are used, jeopardizing people's health and the environment.

It contains more than 1000 different substances which fall into "harmful" and "non-harmful" categories; significantly, the toxicity of many of the chemicals in e-waste is unknown. Broadly speaking, electronic products consist of ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50 per cent of e-waste followed by plastics (21 per cent), non ferrous metals (13 per cent) and other constituents . Electronic products often contain several persistent, bio accumulative and toxic substances including heavy metals such as lead, nickel, chromium and mercury, and persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs) and brominated flame retardants . The urgency of the problem is evident: worldwide, in the decade between 1994 and 2003, about 500 million personal computers containing approximately 718,000 tonnes of lead, 1,363 tonnes of cadmium and 287 tonnes of mercury, reached their end-of-life.

Significant concern

⇒ Large production rate – High volumes are generated due to the rapid obsolescence of gadgets combined with the high demand for new technology .As integration technology changes newer and faster technology is adopted by us and previous one is left.

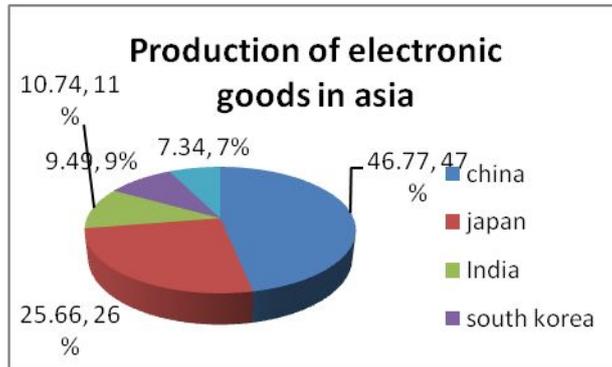
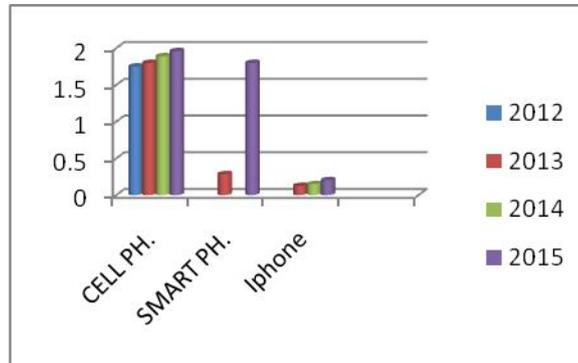


Fig.: production of electronics goods in million tones & percentage

Fig. : sales of mobile phone in billions



⇒ Poisonous design – E-waste is classified as harmful waste having adverse health and ecological implications. Approximately 40 % of the weighty metals found in landfills comes from e- waste.

⇒ Poor design and complexity – E-waste imposes many challenges on the recycling industry as it contains many different materials that are mixed, bolted, screwed, snapped, glued or soldered together. Toxic materials are attached to non-toxic materials, which makes separation of materials for reclamation difficult. Hence, responsible recycling requires intensive labour and/or sophisticated and costly technologies that safely separate materials .

⇒ Labour concerns – These include occupational exposures, informal sector domination causing health and environmental problems, lack of labour standards and rights.

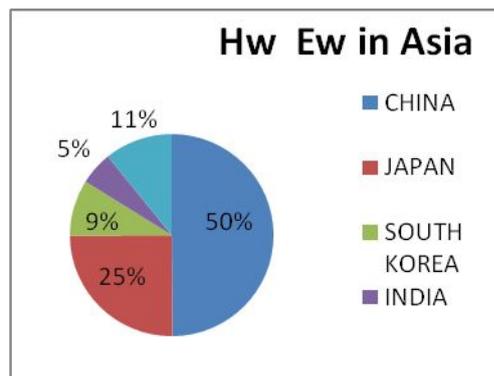


Fig.: % HW E-waste in asia

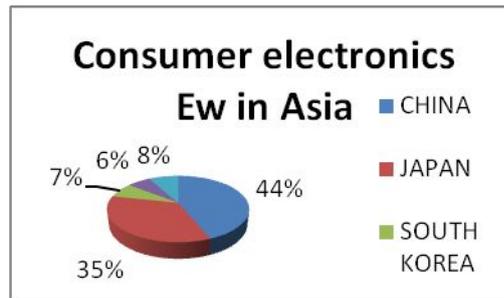


Fig. : % CE EW in asia

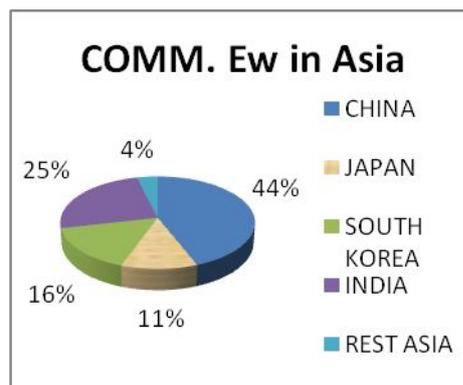


Fig. :% Communication EW in Asia

⇒ economic incentives – In general, there is not enough value in most e-waste to cover the costs of managing it in a responsible way. However, in line with EPR policies, new opportunities can be realized with the rise in the price of many of the materials in electronics, such as gold and copper. Furthermore, with rising e-waste quantities, formal recyclers are increasingly entering the e-waste recycling sector.

⇒ require more rule regulations – Many nations either less sufficient rules regulations applying to this relatively new waste flow, or less valuable enforcement of new e-waste regulations.

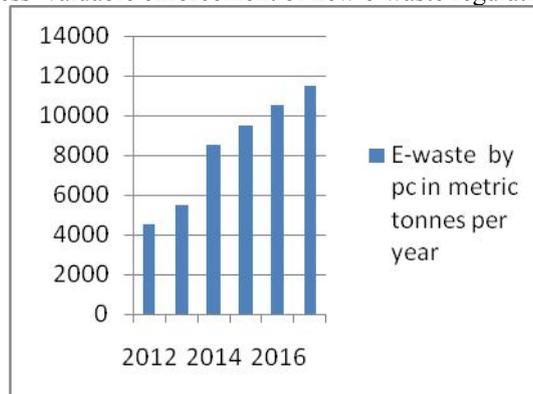


Fig. : EW by PC in metric tonnes

Chemical effects

Antimony (Sb): widely used in CRTs , PCBs, etc.

Antimony is very dangerous metal to human especially people who work with antimony can suffer from the effects of exposure by breathing in antimony dusts. Human exposure to antimony can take place by breathing air, drinking water and eating foods that contain it, but also by skin contact with soil, water and other substances that

contain it. Breathing in antimony that is bond to hydrogen in the gaseous phase, is what mainly causes the health effects. Exposure to relatively high concentrations of antimony (9 mg/m^3 of air) for a longer period of time can cause irritation to the eyes, skin and lungs. If exposure continues for more time serious health effects may occur, such as lung diseases, heart problems, diarrhea, severe vomiting and stomach ulcers. Antimony is used as a medicine for parasitic infections, but people who have had too much of the medicine or were sensitive to it have experienced health effects in the past. These health effects have made us more aware of the dangers of exposure to antimony.

Arsenic(As): Used to make transistors.

Arsenic is one of the most toxic elements that can be found. Despite their toxic effect, inorganic arsenic bonds occur on earth naturally in small amounts. Humans may be exposed to arsenic through food, water and air. Exposure may also occur through skin contact with soil or water that contains arsenic.

Levels of arsenic in food are fairly low, as it is not added due to its toxicity. But levels of arsenic in fish and seafood may be high, because fish absorb arsenic from the water they live in. Luckily this is mainly the fairly harmless organic form of arsenic, but fish that contain significant amounts of inorganic arsenic may be dangerous to human health. Exposure to inorganic arsenic can cause various health effects, such as irritation of the stomach and intestines, decreased production of red and white blood cells, skin changes and lung irritation. It is suggested that the uptake of significant amounts of inorganic arsenic can intensify the chances of cancer development, especially the chances of development of skin cancer, lung cancer, liver cancer and lymphatic cancer. A very high exposure to inorganic arsenic can cause infertility and miscarriages with women, and it can cause skin disturbances, declined resistance to infections, heart disruptions and brain damage with both men and women. Finally, inorganic arsenic can damage DNA.

Barium(Ba): Used to make Front panel of CRTs .

Barium metal used in radiographic purpose and not found in food material. People with the greatest risk to barium exposure with additional health effects are those that work in the barium industry. Most of the health risks that they can undergo are caused by breathing in air that contains barium sulphate or barium carbonate etc. Many hazardous waste sites contain certain amounts of barium. People that live near them may be exposed to harmful levels. The exposure will then be caused by breathing dust, eating soil or plants, or drinking water that is polluted with barium. Skin contact may also occur. The health effects of barium depend upon the water-solubility of the compounds. Barium compounds that dissolve in water can be harmful to human health. The uptake of very large amounts of barium that are water-soluble may cause paralyses and in some cases even death.

Beryllium(Be): Used to make Computer's Motherboards.

Beryllium is not an element that is crucial for humans; in fact it is one of the most toxic chemicals we know. It is a metal that can be very harmful when humans breathe it in, because it can damage the lungs and cause pneumonia. The most commonly known effect of beryllium is called berylliosis, a dangerous and persistent lung disorder that can also damage other organs, such as the heart. In about 20% of all cases people die of this disease. Breathing in beryllium in the workplace is what causes berylliosis. People that have weakened immune systems are most susceptible to this disease. Beryllium can also cause allergic reactions with people that are hypersensitive to this chemical. These reactions can be very heavy and they can even cause a person to be seriously ill, a condition known as Chronic Beryllium Disease (CBD). The symptoms are weakness, tiredness and breathing problems. Some people that suffer from CBD will develop anorexia and blueness of hands and feet. Sometimes people can even be in such a serious condition that CBD can cause their death.

Cadmium (Cd) :manufacturing of Chip resistors and semiconductors.

Human uptake of cadmium takes place mainly through food. Foodstuffs that are rich in cadmium can greatly increase the cadmium concentration in human bodies. Examples are liver, mushrooms, shellfish, mussels, cocoa powder and dried seaweed. An exposure to significantly higher cadmium levels occurs when people smoke. Tobacco smoke transports cadmium into the lungs. Blood will transport it through the rest of the body where it can increase effects by potentiating cadmium that is already present from cadmium-rich food. Other high exposures can occur with people who live near hazardous waste sites or factories that release cadmium into the air and people that work in the metal refinery industry. When people breathe in cadmium it can severely damage the lungs. This may even cause death. Cadmium is first transported to the liver through the blood. There, it is bond to proteins to form complexes that are transported to the kidneys. Cadmium accumulates in kidneys, where it damages filtering mechanisms. This causes the excretion of essential proteins and sugars from the body and

further kidney damage. It takes a very long time before cadmium that has accumulated in kidneys is excreted from a human body. Other health effects that can be caused by cadmium are..

- Diarrhoea, stomach pains and severe vomiting
- Bone fracture.
- Reproductive failure and possibly even infertility
- Damage to the central nervous system
- Damage to the immune system
- Psychological disorders
- Possibly DNA damage or cancer development

Chlorofluorocarbons (CFC): Generated in older fridges and coolers.

CFCs contribute greatly to the loss of the protective ozone layer, which blocks ultraviolet rays from the sun, spending too much time in this direct sunlight can cause skin cancer. According to the University of Georgia, one in five Americans develops skin cancer. Even without the occurrence of skin cancers, some individuals experience premature aging -- meaning the skin becomes wrinkled, thick or leathery -- from too much sun exposure. Also, increased contact with ultraviolet rays can cause cataracts, macular degeneration and other eye damage. Inhalation of CFCs affects the central nervous system, according to the New Hampshire Department of Environmental Sciences. The result is intoxication similar to alcohol intake and also includes lightheadedness, headaches, tremors and convulsions. Inhalation of CFCs can also disturb heart rhythm, which can lead to death. Exposure to large amount of CFCs could potentially cause asphyxiation, according to the Centers for Disease Control and Prevention. CFCs is linked to negative effects with the central nervous system, these substances can generally impair the human immune system. Problems might include difficulty breathing or injury to the heart, kidneys and liver. The University of Georgia also reports that overexposure to the sun suppresses overall immune function or the skin's natural defenses.

Cobalt(Co): Used in Rechargeable batteries and coatings for hard disk drives. As cobalt is widely dispersed in the environment humans may be exposed to it by breathing air, drinking water and eating food that contains cobalt. Skin contact with soil or water that contains cobalt may also enhance exposure. Cobalt is beneficial for humans because it is a part of vitamin B₁₂, which is essential for human health. Cobalt is used to treat anemia with pregnant women, because it stimulates the production of red blood cells. The total daily intake of cobalt is variable and may be as much as 1 mg, but almost all will pass through the body unabsorbed, except that in vitamin B₁₂. High concentrations of cobalt may damage human health. When we breathe in too high concentrations of cobalt through air we experience lung effects, such as asthma and pneumonia. This mainly occurs with people that work with cobalt. Health effects that are a result of the uptake of high concentrations of cobalt are:

- Vomiting and nausea
- Vision problems
- Heart problems
- Thyroid damage

Health effects may also be caused by radiation of radioactive cobalt isotopes. This can cause sterility, hair loss, vomiting, bleeding, diarrhoea, coma and even death. This radiation is sometimes used with cancer-patients to destroy tumors. These patients also suffer from hair loss, diarrhea and vomiting

Copper(cu) :Used as a conductor. Copper can be found in many kinds of food, in drinking water and in air. Because of that we absorb eminent quantities of copper each day by eating, drinking and breathing. The absorption of copper is necessary, because copper is a trace element that is essential for human health. Copper concentrations in air are usually quite low, so that exposure to copper through breathing is negligible. But people that live near smelters that process copper ore into metal, do experience this kind of exposure. Long-term exposure to copper can cause irritation of the nose, mouth and eyes and it causes headaches, stomachaches, dizziness, vomiting and diarrhea. Intentionally high uptakes of copper may cause liver and kidney damage and even death. Whether copper is carcinogenic has not been determined yet.

Dioxins: Created when electronics are burnt in open air .

It is highly toxic and it can cause

- chloracne,
- reproductive and
- developmental problems,
- damage the immune system,
- interfere with hormones and
- cancer

Gallium (Ga):Used in Integrated circuits, optical electronics, etc. Gallium is an element found in the body, but it occurs in a very small amount. It has no proven benefit towards the function of the body, and it most likely is only present due to small traces in the natural environment, in water, and in residue on vegetables and fruits. Several vitamins and commercially distributed waters have been known to contain trace amounts of gallium with less than one part per million. Pure gallium is not a harmful substance for humans to touch. It has been handled many times only for the simple pleasure of watching it melt by the heat emitted from a human hand. However, it is known to leave a stain on hands. Even the gallium radioactive compound, gallium [67Ga] citrate, can be injected into the body and used for gallium scanning without harmful effects. Although it is not harmful in small amounts, gallium should not be purposefully consumed in large doses. Some gallium compounds can actually be very dangerous, however. For example, acute exposure to gallium(III) chloride can cause throat irritation, difficulty breathing, chest pain, and its fumes can cause even very serious conditions such as pulmonary edema and partial paralysis.

Hexavalent chromium: Used as oxidization protection of unprocessed and galvanized steel plates and a decorator or hardener for steel housings .

it can cost kidneys, the liver and DNA. Asthmatic bronchitis is also caused by this element. it causes the annoyance of the respiratory system (asthma) and skin, liver and kidney damage, increased or reduced blood leukocytes, eosinophilia, eye injury, and also carcinogen (lung cancer)

Indium(In): Manufacturing of LCD screens

Indium Can be absorbed into the body by breathing or intake. It is annoying to the eyes and respiratory zone and may have long-term effects on the kidneys. Environmental effects have not been investigated and information on its effects on human health is deficient; therefore highest care must be taken.

Lead (Pb): Used to solder of printed circuit boards, glass panels and gaskets in computer monitors

Lead is a soft metal that has known many applications over the years. It has been used widely since 5000 BC for application in metal products, cables and pipelines, but also in paints and pesticides. Lead is one out of four metals that have the most damaging effects on human health. It can enter the human body through uptake of food (65%), water (20%) and air (15%).Lead can enter (drinking) water through corrosion of pipes. This is more likely to happen when the water is slightly acidic. That is why public water treatment systems are now required to carry out pH-adjustments in water that will serve drinking purposes. Lead can cause several unwanted effects, such as.

- Disruption of the biosynthesis of hemoglobin and anemia.
- A rise in blood pressure.
- Kidney damage.
- Miscarriages and subtle abortions.
- Disruption of nervous systems.
- Brain damage.
- Declined fertility of men through sperm damage.
- Diminished learning abilities of children.
- Behavioral disruptions of children, such as aggression, impulsive behavior and hyperactivity

Lithium(Li) :Used in Rechargeable batteries.

The substance is corrosive to the eyes, the skin and the respiratory tract. Corrosive on ingestion. Inhalation of the substance may cause lung edema. The symptoms of lung edema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation is therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be considered. The substance can be absorbed into the body by inhalation of its aerosol and by ingestion. Inhalation risk: Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Mercury (Hg):Used in Relays, switches and printed circuit boards .

Metallic mercury is used in a variety of household products, such as barometers, thermometers and fluorescent light bulbs. The mercury in these devices is trapped and usually does not cause any health problems. However, when a thermometer will break a significantly high exposure to mercury through breathing will occur for a short period of time while it vaporizes. This can cause harmful effects, such as nerve, brain and kidney damage, lung irritation, eye irritation, skin rashes, vomiting and diarrhea. Mercury has a number of effects on humans, that can all of them be simplified into the following main effects:

- Disruption of the nervous system
- Damage to brain functions
- DNA damage and chromosomal damage
- Allergic reactions, resulting in skin rashes, tiredness and headaches

- Negative reproductive effects, such as sperm damage, birth defects and miscarriages
Damaged brain functions can cause degradation of learning abilities, personality changes, tremors, vision changes, deafness, muscle incoordination and memory loss. Chromosomal damage is known to cause mongolism.

Nickel (Ni):Used in rechargeable batteries.

Nickel is a compound that occurs in the environment only at very low levels. Humans use nickel for many different applications. The most common application of nickel is the use as an ingredient of steel and other metal products. It can be found in common metal products such as jewelry. Foodstuffs naturally contain small amounts of nickel. Chocolate and fats are known to contain severely high quantities. Nickel uptake will boost when people eat large quantities of vegetables from polluted soils. Plants are known to accumulate nickel and as a result the nickel uptake from vegetables will be eminent. Smokers have a higher nickel uptake through their lungs. Finally, nickel can be found in detergents. Humans may be exposed to nickel by breathing air, drinking water, eating food or smoking cigarettes. Skin contact with nickel-contaminated soil or water may also result in nickel exposure. In small quantities nickel is essential, but when the uptake is too high it can be a danger to human health. An uptake of too large quantities of nickel has the following consequences:

- Higher chances of development of lung cancer, nose cancer, larynx cancer and prostate cancer
- Sickness and dizziness after exposure to nickel gas
- Lung embolism.
- Respiratory failure
- Birth defects
- Asthma and chronic bronchitis
- Allergic reactions such as skin rashes, mainly from jewelry
- Heart disorders

Nickel fumes are respiratory irritants and may cause pneumonitis. Exposure to nickel and its compounds may result in the development of a dermatitis known as “nickel itch” in sensitized individuals. The first symptom is usually itching, which occurs up to 7 days before skin eruption occurs. The primary skin eruption is erythematous, or follicular, which may be followed by skin ulceration. Nickel sensitivity, once acquired, appears to persist indefinitely.

Perfluorooctane sulfonate (PFOS/F) : Manufacturing of Photo resistant and anireflectant coating
Persistent, bio accumulative and poisonous to mammalian group; linked to increases in the occurrence of bladder cancer .

Phthalates Used to soften plastics.

It disrupts the endocrine system, reproduction system, fertility and birth, and has developmental effects. Also has organ system toxicity and is linked to liver cancer and effects on the brain, nervous system and immune system.

Polybrominated diphenyl ethers (PBDEs): Used in brominated flame retardants (BFRs) Plastic housing of electronic equipments and circuit boards to reduce flammability.

PBDEs are of concern because of their high lipophilicity and high resistance to the degradation processes. Hepatotoxicity, embryo toxicity and thyroid effects seem to be characteristic endpoints in animal toxicity, and behavioral effects have been demonstrated . BFRs in general have been shown to disrupt endocrine system functions and may have an effect on the levels of thyroid stimulating hormone and cause genotoxic damage, causing high cancer risk

Polychlorinated biphenyls (PCBs): Used in insulating material in older electronic products.

It can be caused to reproductive failure and suppression of the immune system.

Polyvinyl Chloride (PVC): Manufacturing of cabling and computer housing plastics contain PVC for its fire-retardant properties.

PVC Produces dioxins when burnt. It causes reproductive and developmental problems, immune system damage and interferes with regulatory hormones.

Silver (Ag): Used in Wiring of printed circuit boards, etc.

Silver may cause severe corneal injury if liquid comes in contact with the eyes. Skin contact: may cause skin irritation. Repeated and prolonged contact with skin may cause allergic dermatitis. Inhalation hazards: exposure to high concentrations of vapors may cause dizziness, breathing difficulty, headaches or respiratory irritation. Extremely high concentrations may cause drowsiness, staggering, confusion, unconsciousness, coma or death. Liquid or vapor may be irritating to skin, eyes, throat, or lungs. Intentional misuse by deliberately concentrating and inhaling the contents of this product can be harmful or fatal. Ingestion hazards: moderately toxic. May cause stomach discomfort, nausea, vomiting, diarrhea, and necrosis. Aspiration of material into lungs if swallowed or

if vomiting occurs can cause chemical pneumonitis which can be fatal. Target organ: chronic overexposure to a component or components in this material has been found to cause the following effects in laboratory animals:

- Kidney damage.
- Eye damage.
- Lung damage.
- Liver damage.
- Anemia.
- Brain damage.

Chronic overexposure to a component or components in this product has been suggested as a cause of the following effects in humans:

- Cardiac abnormalities.
- Reports have associated repeated and prolonged overexposure to solvents with permanent brain and nervous system damage.
- Repeated breathing or skin contact of methyl ethyl ketone may increase the potency of neurotoxins such as hexane if exposures occur at the same time.

Thallium (Th): Manufacturing of Batteries, semiconductors, etc.

Thallium occurs in the environment naturally in small amounts. It is not applied very widely by humans, merely as rat poison and as a substance in electro-technical and chemical industries. These applications can cause human exposure to thallium substances. The human body absorbs thallium very effectively, especially through the skin, the breathing organs and the digestive tract. Thallium poisoning is mainly caused by accidental uptake of rat poison, which contains large amounts of thallium sulphate. Consequently, stomachaches will appear and the nervous system will be damaged. In some cases the damage is so irreversible that death will soon follow. When a human survives thallium poisoning often consequences of disturbances of the nervous system, such as trembling, paralysis and behavioral changes will remain. With unborn children thallium poisoning can cause congenital disorders. Due to accumulation of thallium in the bodies of humans, chronic effects consist, such as tiredness, headaches, depressions, lack of appetite, leg pains, hair loss and disturbances of the sight. Further effects that can be related to thallium poisoning are nerve pains and joint pains. These are consequences of thallium uptake through food.

Tin (Sb): Used in lead-free solder.

Tin is mainly applied in various organic substances. The organic tin bonds are the most dangerous forms of tin for humans. Despite the dangers they are applied in a great number of industries, such as the paint industry and the plastic industry, and in agriculture through pesticides. The number of applications of organic tin substances is still increasing, despite the fact that we know the consequences of tin poisoning.

The effects of organic tin substances can vary. They depend upon the kind of substance that is present and the organism that is exposed to it. Tri ethyl tin is the most dangerous organic tin substance for humans. It has relatively short hydrogen bonds. When hydrogen bonds grow longer a tin substance will be less dangerous to human health. Humans can absorb tin bonds through food and breathing and through the skin.

The uptake of tin bonds can cause acute effects as well as long-term effects. Acute effects are:

- Eye and skin irritations
- Headaches
- Stomachaches
- Sickness and dizziness
- Severe sweating
- Breathlessness
- Urination problems

Long-term effects are:

- Depressions
- Liver damage
- Malfunctioning of immune systems
- Chromosomal damage
- Shortage of red blood cells
- Brain damage (causing anger, sleeping disorders, forgetfulness and headaches)

Zinc (chromates) : Used in Plating material.

Zinc is a trace element that is essential for human health. When people absorb too little zinc they can experience a loss of appetite, decreased sense of taste and smell, slow wound healing and skin sores. Zinc-shortages can even cause birth defects. Although humans can handle proportionally large concentrations of zinc, too much zinc can still cause eminent health problems, such as stomach cramps, skin irritations, vomiting,

nausea and anemia. Very high levels of zinc can damage the pancreas and disturb the protein metabolism, and cause arteriosclerosis. Extensive exposure to zinc chloride can cause respiratory disorders. In the work place environment zinc contagion can lead to a flu-like condition known as metal fever. This condition will pass after two days and is caused by over sensitivity. Zinc can be a danger to unborn and newborn children. When their mothers have absorbed large concentrations of zinc the children may be exposed to it through blood or milk of their mothers.

II. SUGGESTION & CONCLUSION

Reuse and recycling option: we should ask the manufacturer or relative company to reuse and recycling options and if they don't have any option avoid those product.

Stay away from disposable products: the products those are durable, repairable and have a good warranty should be bought by users.

Rental option: If there is any rental equipment that can be returned to the manufacturer when it is no longer needed ,we have to use this .

Refill component: contact the service providers who replace and refill components of leased equipment when they have been used.

Use of biodegradable substances: Toners and some inks are now being formed with biodegradable oils such as soybean oil, which are much less poisonous than gasoline based toners and inks.

Prefer to repair than purchasing new: Where cost-effectively sufficient, repair apparatus, appliances and equipment in preference to purchasing new equipment.

Reprocess: search around local schools/charities to see if they can use your additional appliances.

Search Company: There are many companies that will smarten up your old computer equipment for use by those who cannot pay for new items.

Many ink cartridges can be refilled with ink for reuse using toner refill kits.

Alkaline batteries can be re-energized.

Recover: Take electrical goods and scrap such as copper wiring to electronic recyclers.

Recycling CRTs: Cathode ray tubes of televisions and computer screens can be recycled.

A no. of committee provides e-waste recycling services or knows of confined businesses that do. we should contact them if we are in uncertainty on what to do with our e-waste.

REFERENCES

- 1) *The global impact of e-waste : addressing the challenge ILO , Geneva 2012*
- 2) *E-waste Manual: Volume 1, compiled by UNEP (United Nations Environmental Programme) Study on E-waste recycling in Delhi Region, conducted in 2003-04 by IRGSSA in collaboration with Toxics Link and EMPA Swiss Federal Labs*
- 3) *E-waste in India, research unit(larrids) Rajya sabha secretariat new Delhi june2011*
- 4) Babu, B.R.; Parande, A.K.; Basha, C.A. 2007. "Electrical and electronic waste: A global environmental problem", in *Waste Management and Research*, Vol. 25, pp. 307–318.
- 5) *The Basel Action Network (BAN) at <http://www.ban.org>*
- 6) *Environmental Investigation Agency (EIA). 2011. System failure: Te UK's harmful trade in electronic waste. Available: http://www.greencustoms.org/docs/EIA_E-waste_report_0511_WEB.pdf [5 May 2012].*
- 7) *Electronic waste: threats and concerns of disposal by Umesh Kumar and D.N. Singh.*
- 8) *India together: UN report spotlights India's e-waste pile up -31March 2010.Available from:indiatgether.org/2010/mar/env-unewaste*
- 9) *Alexander Janz and Bernd Bilitewski, 'Hazardous substances in waste electrical and electronic equipment' in Rakesh Johri, e-waste: Implications, regulations and management in India and current global best practices, TERI, New Delhi, 2008*
- 10) *Mumbai: Choking on e-waste—A study on the status of e-waste in Mumbai', Toxics Link, 23 February, 2007.*
- 11) *Tom Young, 'e-waste a growing problem for China and India'.*
- 12) *E-waste management in India. Pandve HT. An emerging environmental and health issue. Indian J Occup Environ Med 2007*
- 13) *"Facts and figure on E-waste and recycling " from www.electronicstakeback.com.*
- 14) *Chen A, et al 2011 Developmental neurotoxicants in E-waste: an emerging health concern. Environmental Health Perspectives*

- 15) *Electronic Waste Status in Jharkhand Cities by Umesh Kumar, and Dr D N Singh*
- 16) *Birnbaum, L.S. & Staskal, D.F. (2004). Brominated flame retardants: cause for concern? Environmental Health Prespect*
- 17) *Darnerud, P.O. 2003. Toxic effects of brominated flame retardants in man and in wildlife. EnvironmentInt 29 (6)*
- 18) *Donation of used Computers and Reduce E-Waste, e-nam (EWA Newsletter for Awareness & Management), Volume 1: Issue 3,*
- 19) *Data monitor report of 2009-10*
- 20) *E-waste (Management and Handling) Rules, 2011-GOI, Ministry of Environment and forest.*