GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

THREATS OF E WASTE: ENVIRONMENTAL APPROACH

Dr.Umesh Kumar[1], Dr. Laxmikanta[2] and Dr. Ramesh Kumar[3]
[1]Principal, Govt. Women's Polytechnic, Ranchi
[2]Asst. Professor, Chemistry, Sri Shankaracharaya Group of Institutions, Bhilai, Durg.
[3]Professor, Computer Sc & Enginering, BIT Durg. Chhattisgarh.

ABSTRACT

The rapid urbanization and technological development with no environment consideration, transmigration of E products, has lead to a situation where society is thinking of automation and rapid industrial growth. The producers including their team which includes dealers/ resellers and middle men etc are only thinking of business i.e. making profit is leading to disaster and we are ruining the atmosphere, environment in which we are finding our existence at stake. The hazardness / toxicity of materials used in popular EEE products are circulated, recycled and when they come to end of life stage, they are disposed off crudely. This disposal requires safe & sophisticated manner in the most appropriate technological manner as per their constituents. by unskilled workers. The return for their livelihood they get in return is meager in comparison to the risk of harm in terms of exposer or contamination they are subjected to. The involved constituents or substances / minerals are although essential for the safer n healthy life but its excess exposer and intake leads to hazardous & toxic situation leading to many complex and dangerous situations which may endanger our stake and detoriate the environment imminencely. The presence of constituent materials around disposal sites shows dangerously high presence of these substances posing threats of extreme nature. The efforts and strict enactment for regulatorory agencies, extended producers responsibility (EPR) i.e. buy back option by producers has to be developed and strictly adhered to. The safety of such is in the local agencies list, hence local Government should come with strong actions in terms of legislations & coordinate effort in tackling situation with cooperation of others. The development of appropriate environment friendly technology for production of eco friendly manufacturing of EEE appliances at one hand and their proper disposal facilities on other hand is becoming basic need. The transmigration of obsolete products of industrlised nations to third world nations in name of technology transfer should come to halt for environment protection. Efforts for recovery of materials from disposable EEE products must be on top of agenda.

Keywords- *Technology, Material, EEE, Hazardous, Regulations, Inventory, Environment, Development.*

I. INTRODUCTION

The desire of human kind for automation & luxury vis-a-vis expectations for an effortless life has lead to rapid growth Electrical & Electronic Equipment (EEE) and appliances marking advancement of applied technology whitout taking account of effect on environment. The world has become pool of multiple types of EEE and with advent of new sophisticated automated products in market has led to transmigration of used and near obsolete EEE products in name of technology transfer among the affluent and varied socio economic different strata nations in the world order. The globalization, development of IT Communication and cohesion among different parts of world in various names has lead to unprecedented growth of such product which are nearer to end of life of have virtually lost their credibility and life and are redundant and useless popularly classified as e waste. The latest UNEP survey and reports reveals thta annually 20 to 50 million tons of e-wastes are getting added to the stock every year. The obsolete EEE products constitute many hazardous & toxic materials which are threat to environment and individuals when they come in contact without proper knowhow and protection. The hazardous and toxic constituents are inclusive of heavy metals and organic compounds. Heavy metals and organic compounds mostly consist metals such as lead, cadmium chlorine bromine etc. These hazardous and organic compounds are serious threats to human health. The third world in general and Asian countries in particular where most of the EEE land in name of technology transfer, provision for socio economic status among fellows living here particularly meant for recycling and or dismantling or disposal in name of very cheaply available manpower for employment.

The situation was foreseen and realized by various sections in the developed and developing nations and many efforts have been taken and initiated to tackle these. In this area the European Union (EU) and individual countries have come up with regulations and legislations which as on date do not seem to be adequate. The regulatory and restriction measures for putting restriction and use of materials for EEE taken by the EU agency "Restriction of use of certain Hazardous Substances" (RoSH) and Waste of Electrical and Electronic Equipment Waste (WEEE) Directives are initial steps in this direction. The RoSH directive have laid down the upper limits for use of heavy metals and organic compounds like lead and Cadmium, Mercury, Hexavalant Chromium, Brominated Flame Retardants popularly known as BFRs etc. The WEEE directive emphasizes on setting up agencies and provisions for collection, finance and possible treatment of EEE by the producers / manufacturers or their agencies. Similar initiatives have been either initiated or are in practice in countries like India, China, Japan, Korea and likewise prominent EEE producers. The developed and

developing countries have agreed to the provisions of various e-waste regulating agencies by becoming signatory of the different international summits by United Nations (UN).
The e-waste being generated has many fold of operation. It is reported that even in EU only 25 % of generated e-waste is collected and treated. The figure for US is around 20 % , in India it is around 10 % observed i.e. 75 % in EU , 80% in US and 90 % in India it does not go to the Recycling / Disposal centre and get lost in the dusts creating serious hazardous environmental and health concerns. In case of EU and US the e-wastes to a greater extent illegally are transferred to developing and underdeveloped nations for recycle/disposal. In US some legitimacy has been provided in name of routine classification by US EPA.
The hazardous e-wastes, whether produce of national use or received through legal or illegal recycling / disposal activity, are done in informal unregulated small workshops which grossly lacks needed technology, knowhow and facilities for protection from ill effects. It is reported that only 10 % e-wastes are treated in the formal sector which has government / regulating agencies authority sanction / permission for such activities and are equipped with proper facilities. The major formal recycling / disposal units are located in major cities in India. The generation, collection and recycling / disposal efforts are constantly being observed in almost all parts of nation, irrespective of taking place in formal or informal ways. The major e-wastes maximum to a limit of 20 % are transported to the metros but the remaining 80 % e-wastes are dealt with the treatment in the slum areas, local waste collectors popularly known as "kabariwalas" who have their own ways and means of disposal and treatment. These kabariwalas often take out the valuable components or materials from the dismantled parts of e-wastes by extraction and dump the remains in the nearby areas particularly in rivers, lakes, landfills or dumping areas in the slums. The worst ill effect of the degradation due to hazardous waste constituents from the e-wastes can be seen in the effected river or dumping areas .
The Raipur, Bhilai, Korba and near area between Bhilai and Raipur area have been identified for study the hazardous effects. The areas have been identified as state capital representing the situation of state capitals of the nation, old established and emerging Industrial area leading to urbanization where life is fast and turnovers of EEE are largest among the green areas. The unplanned and un-thoughtful developed has lead to highly underdeveloped areas near the big cities to grow as larger slum areas and represent population of varied cosmopolitan nature.
The figure 1 shows a typical out line of contaminants, sources, its flow and approach for possible intention of minimization with outline of the flow through all the stack holders and groups associated with it.

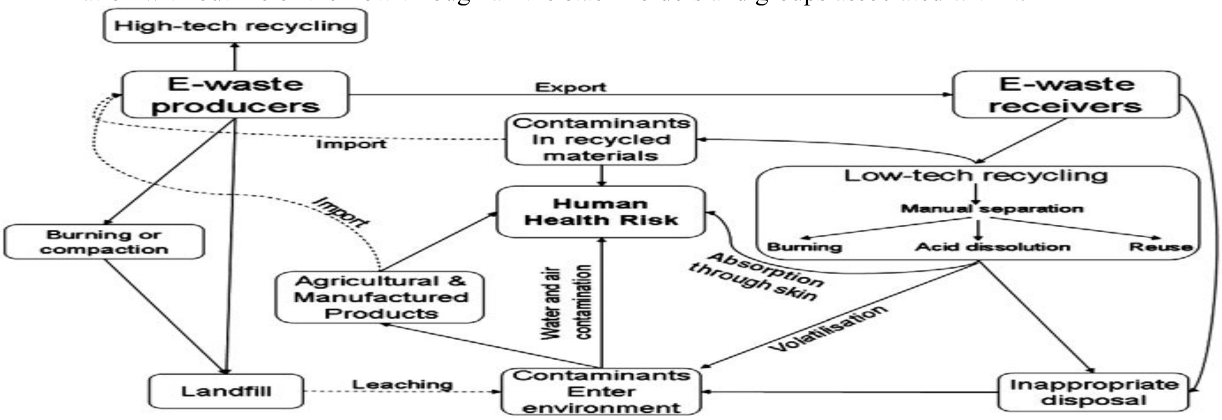

Figure 1 showing outline of contaminants associated with E-waste fluxes from producers to receivers and ultimately to humans.

II. E-Waste Stock Recycling & Disposal Scenario

The Manufacturers Association of Information Technology (MAIT), Toxic link and GTZ various reports have reveals that the e-waste stock in 2005 was 146000 tons, it increased to 400000 tons by 2010, further advanced to 800000 tons by 2012 and is expected to further grow, when extrapolated, with similar growth rate to 500 % by 2020 in India. The treatments of e wastes are carried out in both formal and informal sectors. The formal sector only constitutes 5 % of total e-wastes. The e-waste handling, redrassal and dealing is thus mostly taken up by informal i.e. unorganized sectors. Most of e-wastes (to the tune of 95 %) end up in the informal sector. The waste hawkers mostly known as kabariwalas or of radiiwalas & waste and scrap dealers who engage themselves for petty local earnings are handling the most deadly hazardous and sophisticated e wastes in most crud and unscientific manner. The non technical , having no knowhow of threat and skill manpower are engaged in most unprotected and unskilled manner for handling these e-wastes which may be responsible to ruin their own health and life in particular and environment which is resulted by will result in grave concerns to the pollutions in general. The pollution may affect atmosphere which includes the air which we breathe, water by spilling of contaminations of heavy metals and soluble infactants penetrating up-to the underground water by unknowingly dumps in the open near the river sites / lakes in general

Study reveals that 20 to 50 million tons of e-waste are added / generated every year worldwide. As per an estimate of 2009, just a small percentage i.e. 13 % amounting to around 53 million tons of e-wastes were in the recycling process. By end of 2015 the use of Computers worldwide will touch to a high of 2 billion which will constitute a major stake among the growing information technology giants like India, China in Asian and Brazil and Russia outside Asian region. The increased use of Computers and EEE will result in increased e-waste and by 2020 it is estimated that there will be increase of 200 – 400 % in case of South Africa and China and will touch a high of 500 % in case of India. The contribution of states in India will grow as per development of states in area of information technology growth and application in India.

The metros are the main centers for recycling and recovery from e-wastes in India in quantitative volumes. The smaller and local centers in the cities are small actors in themselves but overall contribute sizable volumes in these areas. The states have their own recycling and recovery centers. The activities of these centers are mainly to dismantle and disassemble old obsolete EEE for retrieval of reusable components and materials. The reusable materials mainly constitute isolatable metals like copper and aluminum which can be directly taken out or can be separated from plastic by burning these in open. This is supposed to be an unskilled work, hence the workers of tender age i.e. children are mostly involved in it without protective equipments. The extraction is done with the rudimentary tools only. The copper is sold at Rs 80-120 per kg against steep price of copper in original market. Use of solder recovery, acid leaching and plastic shredding for copper recovery from printed circuit boards (PCB) is in practice in India is semi and formal recovery and recycling centers.

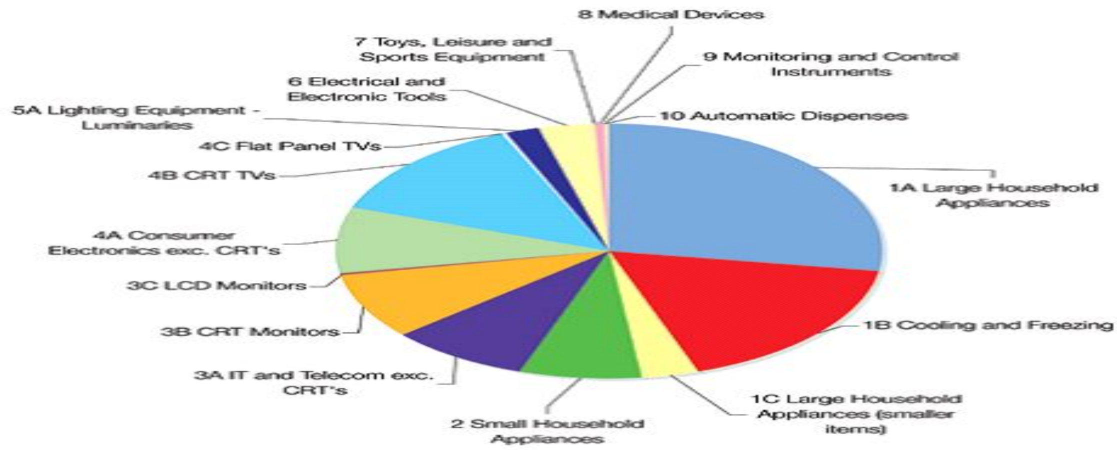

Figure 2. showing General Composition of EEE & E-Waste

A brief outline of what constitutes the e-waste can be seen from the figure 2. The figure shows the possible composition of EEE or e-waste. It is observed that processing of obsolete computers, monitors, television, mobile, washing machine, electric mixiees, electronic toys, electric motors, fans, regulators and similar EEE products find their way in local markets. These are manually worked upon needing sometimes winding done by semi automatic or automatic machines. The dismantling of e-wastes takes place in small workshops/tiny industries/even at home of workers/ technicians. The remains of the e-wastes are transported to river sides or to lonely places in the periphery of markets and burnt. The e-wastes mainly consists of plastic coated cables, plastic embedded PCB, insulators of electrical windings, plastic casing and broken parts. The metals are extracted out from the remains after burning. The broken parts which significantly have no valuable materials to be extracted or have lesser value extractants than effort are disposed off or left as remains to be buried or kept aside or to be placed in stray fires after accumulation after certain time. For sustained fires for burning, mostly the waste insulating foam of the disposed refrigerators and polyurethane are used. Even today frequently Chlorofluorocarbons (CFCs) are used as blowing agents even though it has been internationally banned as it releases ozone depleting gases from the fumes. The use of CFCs and polyurethane can cause deadly hazards in long term contamination at the sites of burning of these e-wastes. The river sites and the abandoned areas suffer multiple type of problem in rainy seasons. The rivers on getting flooded carry the hazardous materials to the other areas and spread the contamination over larger areas. The rain water mixes and spreads the waste remains to other areas which may not be desirable as it may spread to dwelling areas and cause the air and water pollution. Thus one can conclude that the ill-treatment of e-wastes in the unskilled and non environmental friendly manner may cause threats of chemical intoxication in the area where it is being done and can spread to other areas also.

III. Hazardous Metals, Materials and Substances in the E-Wastes

Commonly we classify the obtainable materials as metals and organic substances . The metals which are abundantly found in any e waste which have harmful effects when excessive dosages are inhaled , contacted or gets into body by any means are as listed herein **Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Cadmium, Chromium, Cobalt, Copper, Gallium , Germanium, Indium, Lead, Lithium, Mercury, Molybdenum, Nickel, Selenium, Silver, Sulphur, Tin, Vanadium ,Yttrium, Zinc etc.**

The other major part which are present in any electronic waste are the man made organic substances which includes a variety of substances ranging mainly in three segments as Phthalates, Chlorinated compounds and Flame retardants. Phthalates (or, more accurately, phthalate diesters) are nonhalogenated chemicals with a diversity of uses, dominated by use as plasticizers (or softeners) in plastics, especially PVC (e.g. in coated wires and cables and other flexible components). Other applications included uses as components of inks, adhesives, sealants, surface coatings and personal care products. Some phthalates are discrete chemicals, such as the well known di(2- ethylhexyl) phthalate (DEHP), while others are complex mixtures of isomers, such as diisononyl phthalate (DINP). All uses of phthalates, especially the major use as PVC plasticisers, result in large-scale losses to the environment (both indoors and outdoors) during the lifetime of products, and again following disposal. Within the EU alone, this amounts to thousands of tones per year (CSTEE 2001). As a result, phthalates are among the most ubiquitous man-made chemicals found in the environment. They are widely found in the indoor environment, including in air and dust (Otake et al. 2001, Butte & Heinzow 2002, Fromme et al. 2004).

Phthalates are commonly found in human tissues, including in blood and, as metabolites, in urine (Colon et al. 2000, Blount et al. 2000, Silva et al. 2004). In humans and other animals they are relatively rapidly metabolized to their monoester forms, but these are frequently more toxic than the parent compound (Dalgaard et al. 2001).

Substantial concerns exist with regard to the toxicity of phthalates to wildlife and humans. For example, DEHP, one of the most widely used to date, is a known reproductive toxin, capable (in its monoester form MEHP) of interfering with development of the testes in early life. In addition, adverse impacts on female reproductive success in adult rats and on development of the young have been reported following exposure to this chemical (Lovekamp-Swan & Davis 2003). Butylbenzyl phthalate (BBP) and dibutyl phthalate (DBP) have also been reported to exert reproductive toxicity (Ema & Miyawaki 2002, Mylchreest et al. 2002). Both DEHP and DBP are classified as “toxic to reproduction” within Europe. Recent research has revealed a correlation between phthalate exposure during pregnancy and decreased ano-genital index (distance from the anus to the genitals) in male children (Swan et al. 2005). Decreased AGI
correlated with concentrations of four phthalate metabolites, namely monoethyl phthalate (MEP), mono-n-butyl phthalate (MBP), monobenzyl phthalate (MBzP), and monoisobutyl phthalate (MiBP).

It was also found that DBP can not only be taken up by crops and enter the food chain, but also affects the physiology and the morphology of some crops during growth (Liao 2006). Other commonly used phthalates, including the isomeric forms DINP and DIDP (diisodecyl phthalate), are of concern because of observed effects on the liver and kidney, albeit at higher doses.

At present, there are few controls on the marketing and use of phthalates, despite their toxicity, the volumes used and their propensity to leach out of products throughout their lifetime. Of the controls which do exist, however, probably the best known is the EU-wide ban on the use of six phthalates in children’s toys and childcare articles, first agreed as an emergency measure in 1999 and finally made permanent in 2005 (EC 2005). While this addresses one important exposure route, exposures through other consumer products remain unaddressed, including electrical and electronic equipment

Chlorinated compounds

Polychlorinated biphenyls (PCBs) Polychlorinated biphenyls (PCBs) are a group of organic chemicals that contain 209 individual compounds (known as congeners) with varying patterns of chlorine substitution. PCBs have been used in a wide variety of applications, including transformer oils, capacitor dielectrics, hydraulic fluids, plasticisers. and printing inks (ATSDR 2000). Use in transformer oils (frequently with tri- and tetrachlorobenzenes as solvents, Swami et al. 1992) and capacitors accounted for the greatest tonnages (de Voogt & Brinkman 1989). Production of PCBs was banned in 1977 when their ability to accumulate in the environment and to cause harmful effects became apparent (ATSDR 2000). At least one third of the PCBs that have been produced are now estimated to have entered the environment (Swedish EPA 1999). The other two thirds remain in old electrical equipment and in waste dumps, from which they continue to leach into the environment, including when obsolete equipment is dismantled, recycled and/or disposed of. PCBs can also be produced during the combustion of chlorinated organic materials, including PVC (Hedman et al. 2005, Wikstrom & Marklund 2001).

Once released to the environment from whatever source, PCBs are highly persistent. Furthermore, PCBs that are taken up by organisms accumulate in them, for aquatic organisms and fish levels can reach many thousands of times higher than levels in surrounding water (ATSDR 2000, Jones et al. 1988). PCBs can also be absorbed through the skin as well as through ingestion and inhalation. For the general population today, food is undoubtedly the primary route of exposure to PCBs (see e.g. review by Allsopp et al. 2000), although dermal exposure may be dominant amongst those directly handling PCBs or PCB-contaminated materials (Lees et al. 1987).

PCBs exhibit a wide range of toxic effects in animals, including immunosuppression, liver damage, tumor promotion, neurotoxicity, behavioral changes and damage to both male and female reproductive systems (Seegal and Shain 1992, Safe 1993, Rice 1999). PCBs may also affect many endocrine systems (Brouwer et al. 1999). Although it is difficult to

assess the impact on animal populations in the wild, not least because they are exposed to complex mixtures of chemical contaminants, some immunological and reproductive disorders in marine mammals have nevertheless been linked to elevated levels of persistent organochlorines, in particular the PCBs (see reviews by Allsopp et al. 1999, 2001a, Have et al. 2003). In humans, the greatest body of research on the toxic effects of PCBs has come from two incidents in Japan and Taiwan where people consumed cooking oil that was contaminated with PCBs and other organochlorines. A recent review of data for children born to mothers exposed to PCBs and PCDFs in the Taiwan incident notes higher incidences of retarded growth, delayed cognitive development and behavioral problems than in children of unexposed mothers (Guo et al. 2004). In young men with prenatal exposure there was also significantly increased abnormal morphology of sperm. Studies on the general populations of the Netherlands and the Arctic and families of Swedish fishermen suggested that even relatively low levels of exposure to PCBs can
result in impacts on the immune system growth retardation and neurological effects (Allsopp et al. 1999, Allsopp et al. 2001a, Weisglas-Kuperus et al. 2004).

The control of PCBs is addressed under many international legal instruments relating to environmental pollution (inter alia, the Barcelona, Helsinki, Basel, Bamako, Rotterdam, OSPAR and LRTAP Conventions and the International Joint Commission on the Great Lakes). In addition, PCBs are targeted for global production ban under the 2001 Stockholm Convention on persistent organic pollutants (POPs), an instrument which also requires proper controls on destruction of stockpiles and the handling of wastes.

Chlorinated Benzenes

Chlorinated benzenes, or chlorobenzenes, are chlorinated derivatives of benzene, possessing between one and six chlorine atoms (i.e. mono- to hexachlorobenzene). Chlorobenzenes, especially mono-, di-, tri- and hexachlorinated forms, have had a variety of uses, including as solvents (e.g. in commercial PCB formulations) and intermediates in the manufacture of other chemicals such as antioxidants, dyes and pigments, pharmaceuticals and agricultural chemicals (Budavari et al. 2000, ATSDR 2002). Today only mono- and dichlorobenzenes continue to be manufactured in substantial quantities. In addition, chlorinated benzenes can be emitted during the combustion of the chlorinated plastic PVC (Grimes et al. 2006).

Chlorobenzenes are relatively persistent in the environment and can bioaccumulate in both terrestrial and aquatic systems. Both acute and chronic effects have been reported in a wide range of aquatic organisms and in mammals. Effects of exposure vary depending on the chlorobenzene in question, though common impacts include those on the liver, thyroid and central nervous system (CNS). In general terms, toxicity tends to increase with increasing degree of chlorination (WHO 2004). For tri- and tetrachlorobenzenes, impacts on liver, kidney and thyroid are among the most commonly reported in mammals (Giddings et al. 1994a, b). Some evidence for fetal and developmental toxicity has been reported for both tetra- and pentachlorobenzenes (Giddings et al. 1994c). Hexachlorobenzene (HCB) is toxic to plants, animals and humans. It is listed by the IARC as a Group 2B carcinogen, i.e. possible carcinogen to humans, and also appears to be a tumor promoter. Hexachlorobenzene may damage the developing foetus, liver, immune system, thyroid, kidneys and CNS, with the liver and nervous system the most sensitive to its effects. (Newhook & Meek 1994, van Birgelen 1998, ATSDR 2002). HCB has been shown to be an endocrine disruptor in laboratory animal studies (Ralph et al. 2003), and research suggests that HCB has dioxin-like toxicity (van Birgelen 1998) and that it could therefore make a substantial contribution to overall dioxin-type toxic effects in humans and wildlife (Pohl et al. 2001).

Hexachlorobenzene is the most regulated chemical among all chlorinated benzenes, and is included as one of twelve priority POPs covered by the 2001 Stockholm Convention on persistent organic pollutants (POPs). Pentachlorobenzene is one of the priority substances under the EU Water Framework Directive (EU 2001).

Recently pentachlorobenzene was proposed as a candidate for inclusion in the UNECE Protocol on POPs (under the LRTAP Convention), based on its potential for long-range atmospheric transport, persistence (in water, sediment and soil), bioaccumulation and (eco)toxicity (van de Plassche et al. 2002)

Flame retardants

Polybrominated diphenyl ethers (PBDEs) Polybrominated diphenyl ethers (PBDEs) are one of several classes of brominated compound in widespread use as flame retardant additives in plastics and foams, including plastic casings of electronic equipment (OECD 2003). There are many different chemicals (congeners) included in this group, differing in the numbers and positioning of bromine atoms in the molecules. Those in common commercial use are “penta” (i.e. a mixture rich in pentabrominated congeners), “octa”, (rich in octabrominated congeners) and “deca” (almost exclusively the decabrominated congener).

PBDEs are environmentally persistent chemicals. Some, especially the lower brominated congeners (e.g. “penta-BDE”), are also highly bioaccumulative. Their manufacture and use as additives in plastics and other polymers, in which they are not tightly bound to the polymer matrix, has led to their widespread presence in the environment. PBDEs can be detected in indoor air and dusts in the workplace and in the home (Santillo et al. 2003 a & b). They also occur in almost every part of the environment, including sediments (Allchin & Morris 2002), freshwater and marine fish (Asplund et al. 1999a, b), birds eggs (Hites 2004) and even whales from the deep oceans and the Arctic (Ikonomou et al. 2002).

PBDEs have also been reported as common contaminants in humans, including reports from Sweden, Spain, Finland and North America (Lindstrom et al. 1997, Meneses et al. 1999, Strandman et al. 1999, She et al. 2000). Concentrations of lower brominated PBDEs have shown increasing levels in both blood and breast milk in recent decades, particularly in regions in which "penta" remains in commercial use (Alaee et al. 2003, Meironyte et al. 1999, Thomsen et al. 2002). Workers in electronics recycling facilities in Europe have been found to have higher blood levels of PBDEs than other workers, probably as a result of inhalation of contaminated dust (Sjödin et al. 2001, Sjödin et al. 2003). Similarly, elevated levels have been reported in the blood of workers (Qu et al. 2007) and local residents (Bi et al 2007) at an e-waste recycling area in China. For the general population, exposure to PBDEs probably occurs through a combination of food contamination and direct exposure to chemicals from consumer products and/or contaminated dusts (Harrad et al. 2004). While their acute toxicity is considered low, chronic exposure to certain PBDEs (especially in the womb) has been associated with abnormal brain development in animals (Eriksson et al. 2002), with possible long-term impacts on memory, learning and behavior (Darnerud 2003, Eriksson et al. 2001, 2002, Viberg et al. 2004).

There are concerns that similar effects may be of relevance in humans (Branchi et al. 2003). PBDEs also exhibit endocrine (hormone) disrupting properties, interacting with both oestrogen and thyroid hormone systems either as the parent compound or as metabolites (Meerts et al. 1998, 2001, Legler & Brouwer 2003). Effects on the immune system have also been reported (Birnbaum & Staskal 2004, Darnerud 2003). Furthermore, when plastics containing PBDEs are burned, either in an incinerator or by open burning, the potential exists for formation of brominated dioxins/furans (IPCS 1998) or mixed bromochloro dioxins/furans (Söderström & Marklund 2002), which appear to be of equivalent or even greater toxicity to chlorinated dioxins (Olsman et al. 2007).

Because of these environmental and human health concerns, controls are increasingly being placed on the use of PBDEs (along with some other brominated fame retardants) in some regions.

Penta-BDE is included as a "priority hazardous substance" under the EU Water Framework Directive (EU 2001) and remains under consideration for inclusion as a POP (persistent organic pollutant) under the 2001 global Stockholm Convention (Peltola & Yla- Mononen 2001, UNEP 2006a). Both "penta" and "octa" are now banned from use in Europe (EU 2003), and specifically within the electronics sector the use of all PBDEs, including "deca", is prohibited under the Restrictions on Hazardous Substances in electrical and electronic equipment Directive (RoHS) (EU 2002a).

Triphenyl Phosphate (TPP)

Triphenyl phosphate, one of a number of so-called triaryl phosphates, has long been used as flame retardant, primarily in phenolic and phenylene oxide-based resins (IPCS 1991). Other applications include use as a plasticiser in photographic films and as a component of hydraulic fluids and oils. Loss of TPP to the environment as a result of leaching from polymers in which it is incorporated has long been recognised. Carlsson et al. (1997) reported the presence of TPP, among other organophosphorus flame retardants, as a contaminant of indoor air in buildings with different uses in Sweden (Carlsson et al. 2000). Further investigations revealed that TPP was present at levels up to 10% by weight of the plastic in the outer covers of some computer monitors. Combustion of polymers containing TPP may also be a major source to the environment (IPCS 1991).

TPP is the most acutely toxic to aquatic life of all the triaryl phosphates in common use (IPCS 1991). It has been reported as a contaminant in human blood (Jonsson et al. 2001) and is a strong inhibitor of a key enzyme (monocyte carboxyl esterase) in human blood cells (Amini & Crescenzi 2003). Recent research has also indicated an ability to inhibit human androgen hormone reception in vitro (Honkakoski et al. 2004). Contact dermatitis following exposure to TPP has been reported by several authors, with some cases dating back to the 1960s (Carlsson et al. 1997 and Sanchez et al. 2003)

IV. Selection of Samples

Chatisgharvery new state having fast growth rate with varying demography. The urban and rural areas with varied industrialization are identity of the area. The old industrial hubs such as located in Bhilai, Raipur and nearby areas have well developed slums and give a good mix culture of metros. The use of technology and high purchasing power can be very well evident. The capital of state i.e. Raipur cannot be ignored as it is supposed that any advancement will transfer to other areas through this region only. Korba is also an important area which has power and other ancillary industries. The EEE use can be seen as at peak in the areas mentioned here. The habitants are of mixed culture and have access to varied technology by all means including the imports from developed countries to developed EEE products from the local manufacturers or assemblers.

The formal availability of recycling or disposal centers cannot be observed. Most of the e-wastes get transmigrated to nearby metro Mumbai which is a larger destination but still the recycling and disposal activities can be observed here locally in all the major cities identified. The recycling and disposal activities take place locally as explained earlier in the paper and degradation of environment and ill-effects can be well visualized in certain pockets and areas. The areas of disposal and burning centers are mostly located in the river / lake side and abandoned area of the cities near the slums where the unskilled laborers are living and have the best option of finding the products from all means and after they get irreparable are left with no option to throw or burn as it becomes liability. The visual degradation of the areas has been major for selection of the sites.

V. Sampling

Proper exposer for determination of extent of contamination as a result of e-wastes is the main aim for this study. The exploration of contamination of surrounding, soils, texture, sediments and possible evaluation of content of contaminations needs collection of samples in similar quantity from possibly similar conditions. The samples were collected from the river sides flowing through the cities and slum sides of larger cities. The sites are so selected that the samples obtained from the area represent maximum contaminations available in the area so that a worst effected data is available and the discussion will enable us to have scenario suited for proper representation. The level of contamination and its hazardous effects on the persons living nearby and working in the atmosphere are our target and motive.
The details can be put as mentioned in table 1 which shows the details of description of samples obtained and collected from e-waste dumping / disposal burning / disposal sites in the specified areas. The separate samples for identification of un-burnt parts of plastics and mixes of glasses which may cause harm to the persons working there in is also collected. The volumetric and weight-wise analysis will be done on it and the outcome will tell us that how physically it is difficult to work in these areas.

Sample No	Type	Location
NC01	Burning / destroying Place	Slum /Market side
NC02	Dumping site / Burning /disposal area	Scrap dealers dumping area
NC03	Dumping site / Burning/ disposal area	Slum Market side
NC04	Dumping site / Burning/disposal area	Slum Market side
NC05	Soil Below broken CRT glass within disposal area	Slum market area
NC06	Sediment of lake adjacent to disposal and burning areas,	City area

Table 1.

VI. Details of Sampling and data obtained

Samples collected were stored in properly pre cleaned and rinsed with nitric acid and analytical grade pentane glass bottles. The collected samples were taken to the technical laboratories for examination and evaluation of concentration of different types of constituents. Proper care for isolation of organic substances was done. The analytical datas obtained from the examinations for metals are listed in table 2.The data obtained and the examinations reveals that the hazardous constituents are very much present and are alarmingly high for posing threat to health , hygiene to individuals and damaging to the environment. The degradation and level of toxicity and hazardous contents needs to develop technology to reduce the level of threats and keep the environment safe and under limit. The manufacturers and the agencies regulating the safety measures should take note of alarming situation and address the problem by making provisions for recycling and disposal in a environment friendly manner under strict vision of the welfare agencies. The fairer examination can lead to better results and will be more alarming and eye catching. Utmost care has been taken to collect the samples from the places which show that maximum level of contamination visually. The volumes for physical examinations were also collected. From the physical examinations the content wise un-burnt parts of plastic, glasses and soil texture was analyzed. The evaluation showed that the un-burnt parts of plastic and glass pieces makes the environment and situation even worse so that one gets cuts and injuries when he / she moves naked or bare footed. The chances of intoxication and inhalation through these cuts and wounds are even more enhanced. Volume wise it was observed that un-burnt plastic and glasses constituted to around 9 to 12 % as per sample and sites.

VII. Observations and analysis of findings

Details of observations obtained from the samples collected from the various spots and positions.

Metal/ Substances	CN01_mg/kg	CN02_mg/kg	NC03_mg/kg	NC04_mg/kg	NC05_mg/kg	NC06_mg/kg
Antimony	145	210	413	10	6	214
Arsenic	12	14	18	7	8	18
Barium	217	873	892	67	72	280
Beryllium	0.14	0.54	0.17	0.23	0.34	0.53
Bismuth	15	17	17	11	12	10
Cadmium	2	6	8	0.7	1.2	0.6
Chromium	42	43	31	19	31	33
Cobalt	11	56	87	94	26	27
Copper	11065	7456	8713	1276	2397	1756
Gallium	13	17	18	12	16	16
Germanium	24	21	19	26	23	27
Indium	16	13	18	15	16	14
Lead	2354	3485	4512	3197	1211	1937
Manganese	231	312	217	132	157	193

Mercury	**0.4**	**0.6**	**0.4**	**0.3**	**0.5**	**0.45**
Molybdenum	**3.4**	**3.2**	**3.7**	**3.91**	**2.6**	**4.2**
Nickel	**6**	**12**	**19**	**23**	**21**	**26**
Selenium	**26**	**26**	**21**	**29**	**25**	**27**
Silver	**1.1**	**5.1**	**4.6**	**3.8**	**1.8**	**1.7**
Tin	**696**	**1126**	**1093**	**665**	**821**	**1167**
Vanadium	**21**	**32**	**8**	**24**	**31**	**25**
Yttrium	**1.1**	**6.8**	**1.5**	**2.9**	**23.1**	**7.1**
Zinc	**1432**	**5612**	**9523**	**23185**	**2246**	**2315**

Table 2. Details of constituents obtained.

The variation of substances which are abundantly found in the samples i.e. Copper, Lead, Zinc and Tin is represented in the figure 3 below. The copper content is maximum in Bhilai followed by Raipur sample and once again of Bhilai only. The amount of copper is least for Korba. The recyclable e-waste of Bhilai is transported to nearby Kolkata. The demography of Raipur is cosmopolitan as the residents come mostly from other states hence the wastes get transferred to other places. The scenario of lead and zinc is also almost same. The alarming level of zinc in Raipur and Bhilai is probably because of the fact that the industrial wastes which contains these are getting mixed in the soil/ash and are reflected in this case. The case of Tin is similar throughout.

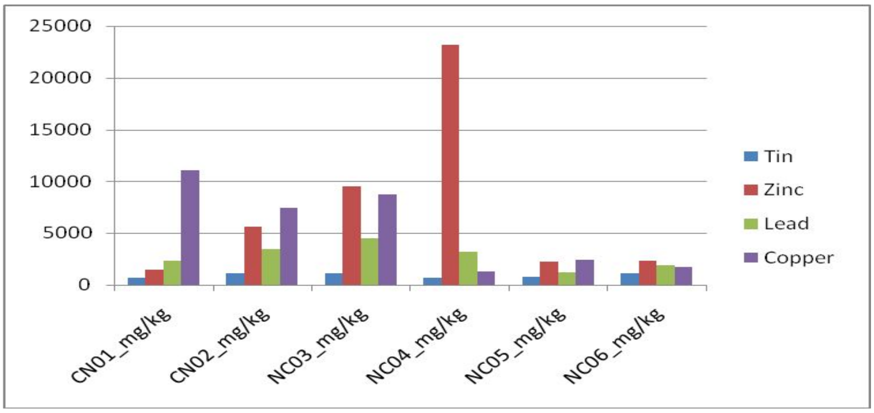

Figure3. for variation of Copper, Lead, Zinc and Tin

The variation of nickel, Molybdenum, Cadmium, Silver, Yttrium, Mercury and Beryllium can be seen in the next graphical i.e. figure 4. The variation shows that the Nickel is one substance which is present in the entire sample in study reveals that the presence of Yttrium is excessive in Bhilai sample. The levels of constituents in the samples are more or less indicators of the industrialization and waste added by e-wastes. The mercury and Beryllium shows a uniform pattern in all the samples. The variation of cadmium is much. The Bhilai and Korba showed least levels. The silver content in Raipur and Bhilai is higher for the reason that the disposal of mobiles etc is more. The presence of Molybdenum is almost uniform.

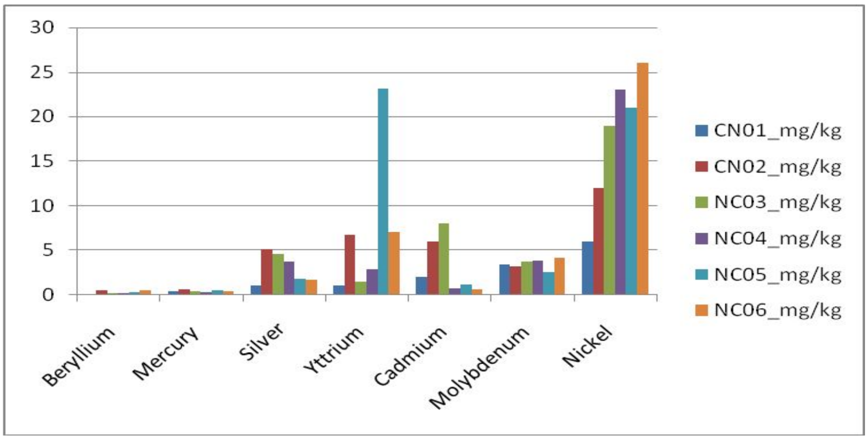

Figure 4 of variation of Nickel, Molybdenum, Cadmium, Silver, Yttrium, Mercury & Beryllium

The next variation of Manganese, Barium and Antimony is shown in figure 5. The level of Barium in Raipur and Bhilai is eye catching. The presence of antimony is throughout with variation.

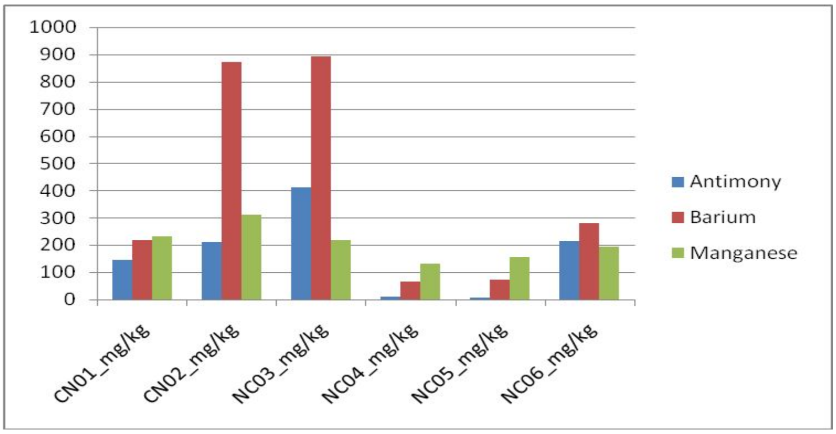

Figure5. showing variation of Manganese, Barium and Antimony

In figure 6 the presence of cobalt is important in all the samples. This is followed by chromium. The remaining materials are showing their increased presence. The e wastes are showing marked increase in levels of hazardous substances. The informal and unorganized sectors which are disposing the e-waste in unskilled manner is the sole reason for the rise in level to alarming contents. This is going to affect environment and health in significant way.

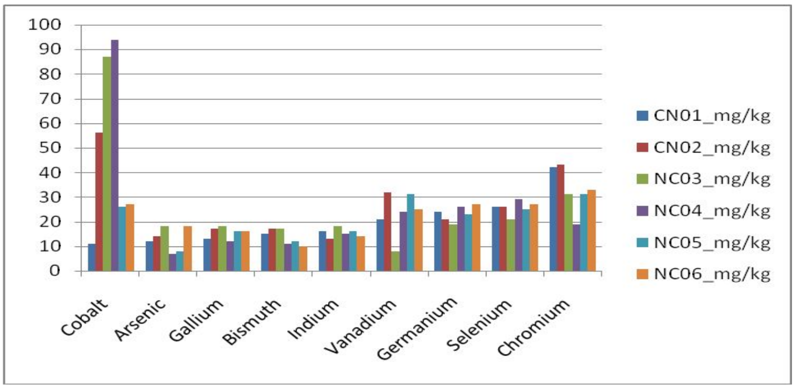

Figure 6 of variation of Chromium, selenium, Ge, Vanad, Indium, Bismuth, Gallium, Arsenic and Cobalt

The overall observation is that the constituents of the substances discussed above are sometimes 100 to 1000 times higher in limits which are desirable for the existence. The very high increased levels of metals and substances make the situation alarming and grave. All means and precautions are needed for bringing the level back to permissible limits and only then we can say the area will remain safe to live in. The bad aspects of localized urbanization and mad rush for automation and ease must come to an end. The environmental limits and stretching of limits internationally be fixed and re-fixed/ re-administered so that sustained development of all individual, technology, and society takes place irrespective of region and parity we live in.

VIII. Conclusion

The growth of EEE, rapid industrialization with technical advancements, copying of leading giants in name of civilization for ease of life and establishing technological foothold warrants some precautions also. The graveness of situation can only be judged if one looks at the stock of situation on what he or they are paying or causing to the nearby and situation where we are living in. The health, environment their degradation level highlights the need for skillful use of technology and development of technology in safe manner. The stock of situation need be done for such. The present position as it looks from the study presses that we need to change our mindset and keep breaks on madness for development. We need sustainable development for safe and purposeful development with proper match of health, hygiene and environment.

The resource recovery from the wastes or recyclable remains needs to be carried out in a technical and skilled manner. The present unplanned, unregulated pattern is resulting in environmental degradation and risking the workers for the serious consequences. The areas where such activities are taking place are highly contaminated by the pollutants of the e-wastes. The crude recovery processes, particularly by burning the e wastes in common places are main cause for degradation. The study results reveals that the contaminants in the EEE, e-wastes improper handling are threats to workers and local residents. The children are the worst effected individuals as they are more affected by the toxicity present in their blood compared to adults. The ill management and poor handling and lack of far sightedness of authorities are evident. The need to redesign new EEE products by minimizing use of hazardous contents and restriction on transboundry movements which add to such waste needs urgent attention. The legislation and regulations enacted by the agencies and government here are inadequate, necessary clauses and acts have to be enacted. The planed phasing out of the disposable EEE can lead to a situation where sustained e-wastes are generated. A global initiative is need of hour so that technology transfer, responsibility of exporters & importers are fixed and addressed so that overall e-waste is reduced. The divide between formal and informal handling is the actual cause of non availability of reliable data for the EEE products and unless one have reliable data, one cannot come out with proper strategy, strength and options for tackling this situation. The inventory of such EEE products needs to be regularly updated and maintained. The initiative of Extended Producers Responsibility needs a total submission for proper tackling & minimization of e-waste in proper and purposeful way. Making persons aware of the situation is the best way of creating general awareness, mentality and here the inclusion of such efforts need to be put in curricula of professional courses of environmental concerns. The self regulation, morale and motivation to fight any menace are the best tool to handle the situation. The satisfaction and restraint from running towards ease and automation will lead to a situation where in name of ease one will not press for discarded product and contribute towards lessening of e-waste production.

The combined efforts for proper enactment of proper regulation, public participation, general awareness, improvement in curricula, creating general awareness, restraint from having out of phase product will effectively reduce the e-waste and reduction of e-waste will lessen the need of recycling and disposal and ultimately reduce the contamination of environment, individual suffering and improve health and hygiene.

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