International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-3, Issue-1, March 2014

Electronic Waste: Threats & Concerns of Disposal

Umesh Kumar, D N Singh

Abstract: ***The development of electronic industry and electronic & electrical equipments (EEE) has eased man's life by automation at one end but has posed multiple threats at other end. The situation becomes critical when development alone is getting focus worldwide. Every product and its constituents which result in it have a life and stock. All efforts have to be made to preserve them and use in most optional ways. The situation when end of life of EEE products come we are left with two options, either to extend the life by reusing, recycling, extraction of constitutions and rebuilding or left with disposal options. The disposal of EEE can be result of accumulation of products from domestic market or from the exports from have ones in name of keeping their situation and environment safe. These disposable EEE have many toxic, hazardous substances which can be elemental or manmade. The manmade substances which are commonly known as organic substances are those who don't get decomposed and even on burning leave traces and residues which persist in environment and make the world dirtier and hazardous. The study reveals that the preposition of degradation goes with industrialization, demographic preposition of areas concerned and primarily on non strictness/ absence of the regulatory & monitoring enforcement agencies. The situation has not gone to worse and if one takes stringent measures even now, the world still can be made / retained safer to live in with sustained development keeping in mind that madness for automation is not the need of hour but existence and multiple threats and concerns which are griping us are the main concerns. The banned substances use in product manufacturing must be stopped. Use of environment friendly constituents and permitted components will give rise to safe products. The initiatives of buy back , extended producers responsibility must be exercised to maximum so that disposal is done in safe and highly technical manner in controlled and sustained environment causing very less or even no harm. The formal sectors role has to be highlighted and encouraged. General awareness among participants and public for the possible threats and concerns must be widely circulated.***

Keywords: Telecommunication, Contamination, Electronics, Chlorinated, Organic, E-waste, Toxicity, Hazard.

I. INTRODUCTION

Electronic industry is worldwide one of the most rapidly growing, flourishing and highly diversified segment of the industries with very fast innovation of adaptive innovative technologies dependent on growing customer desires, dependence and inclination towards automation & services.

Revised Manuscript Received on 30 March 2014.
* Correspondence Author
Umesh Kumar*, Department of Electronics & Communication Engineering, Dept. of Science & Technology, GWP Ranchi, Tharpakhana, Ranchi (Jharkhand), India.
Dr D N Singh, Joint Director, Department of Science & Technology, Bihar, cum Joint Secretary, SBTE, Patna (Bihar), India.

The Electronic industry in particular and Electric & Electronic Equipments (EEE) area in general has been experiencing remarkable and phenomenal advancements over the decades. The other industries are also getting affected by the development as the use of inherent technology of semi conductor is becoming unavoidable. The key segments of the electronic industry are electronic components, computer, automation equipments, telecommunications, industrial electronics consumer electronics and general power and standby power industries.

The EEE area of use and application can be various ones. The major areas can be identified as data processing, telecom or communication, Industry including the medical industry where EEE has the maximum say in research and development and production, automotive, aerospace and defense, home appliances, etc. The major share taken by the selected areas put for recognition or discussion can be seen as represented in the table1 which can be graphically represented as in figure 1.

EEE Area of Use	Percentage
Data processing	25
Telecom	21
Industry & Medical	18
Audio & Video	15
Automotive	8
Aerospace & Defense	7
Home appliances	6

Table 1 (EEE area of use and % thereof)

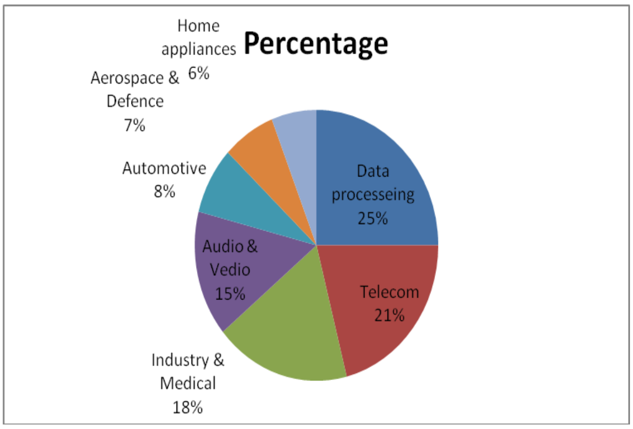


Figure 1. (EEE area of use and % thereof)

The start of Indian electronics industry could be traced to the sixties, when the Government took the initiatives of manufacturing space and defense electronic products. This was followed by developments in consumer electronics, mainly the manufacturing of transistor radios, black and white TVs, calculators and other audio products; later in 1980s, manufacture of colour televisions also started.

Late 1980s saw the advent of computers and telecom products. The hardware (HW) production has touched the figure of Rs 109940 to Rs 97260 from Rs 50500 crore in a period of 2004-05 to 2008-09 and 2009-10 indicating an increase of cumulative growth of 17.3 % annually upto 08-09 and 13% for the year after it. The growth has increased from 1.6 % in 2001-02 to 1.95% in 2009-10 of GDP in the years following and it is likely to grow further once the global recession is over.

The unprecedented growth of EEE in general and Electronic products in particular are being fuelled by high growth rate of the economy, younger generation aspirations, increased purchasing power, risk taking, faith in longevity, change in economic thought in terms of affordability of loans and going for it and relatively larger middle class. As on today the share of manufacturing is meager but Indian imminence potential to develop share technology and transfer to manufacture electronic hardware for the global markets for innovative gains in terms of share and earnings apart from meeting the country's requirement in the areas of information, consumer, industrial, application, software, communication and entertainment fields.

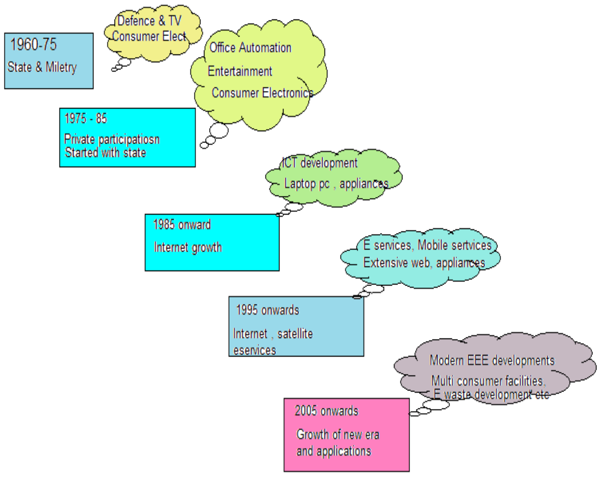
The growth of EEE has resulted in growth of obsolete products popularly known as e-waste. The general description of E-waste is the electronic good which have been so much used that now these are no longer in use or eventually has not been left in such condition that it cannot be re-usable. These can include old computers, Printers, electronic toys, home appliances, clocks and watches, medical devices, communication sets, mobiles and industrial equipments. These pave the ways and give a burden to mind for managing E-waste.

As per reports Mumbai tops the list of cities followed by Delhi, Bangalore, Chennai, Kolkata, Ahmadabad etc having 12,000, 10,000, 4,000 tonnes each of e-waste respectively. The challenge is emerging and is new at present but has started to grow into serious problems. The toxic and hazardous substances present in the EEE makes it more pronounced serious. The handling of these substances adds to the challenges and affects the persons involved in it. Still it can be said that challenge of managing E-waste in India is at nascent stage and have started to turn out to be a serious challenge at this and coming stage.

According to a Report by Centre for Environmental Studies, the best option for dealing with E-wastes is to reduce the volume of E-waste. Designers should ensure that the product is built for re-use, repair and/or upgradeability. Stress should be laid on use of less toxic, easily recoverable and recyclable materials, which can be taken back for refurbishment, remanufacturing, disassembly and reuse. Recycling and reuse of material are the next level of potential options to reduce E-waste. Recovery of metals, plastic, glass and other materials reduce the magnitude of E-waste. These options have a potential to conserve the energy, and keep the environment free of toxic material that would otherwise have been released.

II. EEE INITIATIVES, E-WASTE STOCK, RECYCLING AND DISPOSAL

The electrical and electronic equipments (EEE) have invaded the human life in almost all spheres. The development of this EEE can be back dated to Second World War period. The contribution to technological development s has been mostly reported in the war times. The industry and human friendly development of these EEE in fact globally started to take its turn and existence from the sixties and are continuing at unprecedented pace. The development of EEE affairs can be symbolized as depicted in the figure 2.



Growth of Electronics Initiatives round the globe after world war II

Figure 2 showing development of EEE

The growth of EEE initiatives has been noticed and observed globally. The basic region and area around us becomes a major source of technology development and poses competitiveness. The technology developed in earlier days took years and even sometimes war initiatives for transfer. The present days are different as the development of communication initiatives have converted the globe in a competitive village where each one is having knowhow of one another and development of any sphere is dependent of others initiatives in one area or other. The electronic industry can be divided into different classes or segments. These segments can be broadly classified as hardware, consumer electronic, communication, semi conductor devices etc. The contribution to different segments by major players of the **Asia Pacific Countries** area in terms of production has been reported as placed hereunder in table 2 and its graphical representation in figure 3.

Nations	*HW %*	*C Eleo %*	*Commn %*	*SC Dev %*
China	*49.9*	*43.8*	*44*	*49.5*
Japan	*25*	*34.7*	*11.5*	*31.3*
Rest of Asia pacific	*10.8*	*8.1*	*3.8*	*6.7*
South korea	*9*	*7.2*	*15.9*	*5.9*
India	*5.3*	*6.3*	*24.8*	*6.6*

Table 2. showing Contribution of Asia Pacific Countries in major Areas in terms of Production in percentage as per Datamonitor report

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

ISSN: 2277-3878, Volume-3, Issue-1, March 2014

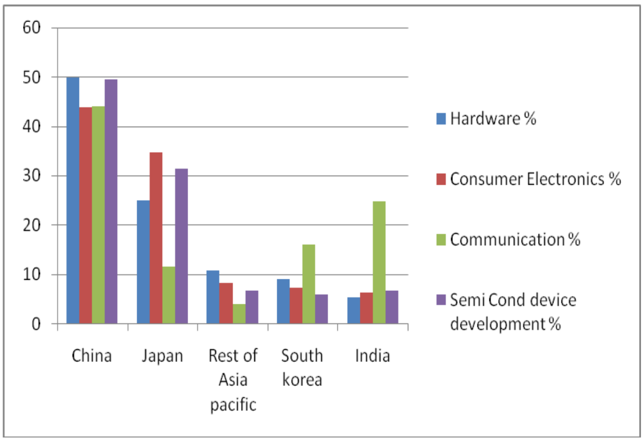


Figure 3. Contribution of Asia Pacific Countries in major Areas in terms of Production in percenta

Now from 2001 -02 to 2013-14 i.e. recent and will continue to remain so, India has developed as a major player in the EEE. The technology advancement and development is based in major imports and exports from various nations. The selected group from where major contribution in terms of exports or imports can be seeen is as shown in table 3. This is

the scenario of 2009-10 and sticks to almost same level even today in 2013-14 fiscal. The graphical representation for the table 3 has been depicted in figure 4. Where the tower representation of dependence on communication sector on China can be extraordinary noticed.

India's Major Export/ Import to	% Export	%Import
USA	14.8	6.4
Singapore	8.2	6.4
UAE	8.2	
Germany	6.7	4.7
Hongkong	5.8	3.2
Netherlands	4.9	
China	4.7	49.3
Indonesia	3.5	
Nigeria	2.9	
Romania	2.8	
Korea		5.3
Malaysia		3.9
Japan		3.4
Taiwan		2.5
Sweden		2.2

Table 3. India's Major Export/ Import to nations

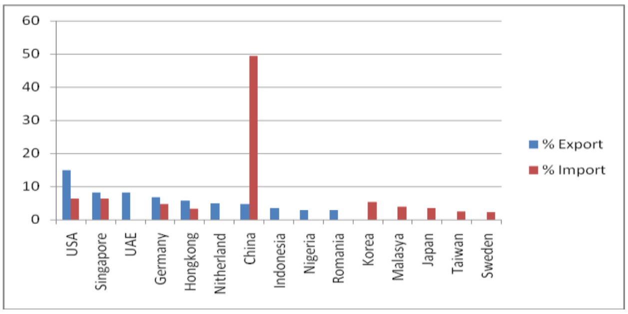


Figure 4. India's Major Export/ Import to nations

Regarding the after use of EEE i.e. outcome of these after the life span commonly known as electronic waste or e-waste one have to keep to in mind the various initiatives and reports available in this area. The Toxic link, GTZ, Manufacturers Association of Information Technology (MAIT) and other leading agencies reports reveals that stock of e-waste in 2005 was 146000 tons which grew to 400000 tons in 2010, advanced to 800000 tons in 2012 and with same pace is further growing and is expected to escalate to level of 500% by 2020 in India. The major handling of e wastes to the tune of 95% is done by informal i.e. unorganized sector and remaining 5 % is tackled by formal i.e. organized sector only. The informal and unorganized sector constitutes mostly kabariwalas / radiiwalas and waste & scrap dealers. They engage themselves for petty local earnings and mostly are unaware of the affects of handling the most deadly hazardous and sophisticated e wastes. They address these e-wastes in most crud and unscientific manner. The ill-skilled manpower, having no knowhow of threat and perception of contamination are engaged in most unprotected and unskilled manner for recycling / disposal of these e-wastes. This may ruin the environment in general and their own health and life in particular. The ill-treatment and mishandling of e-wastes can lead to degradation of environment and increase in pollution which may affect atmosphere. The crude disposal of e wastes or simply laying the e wastes in open or even in landfills can lead to spilling of contaminations of heavy metals and soluble infactants penetrating up-to the underground water and contaminate it. Even proper landfilling of e-wastes may not be safe. A typical land fill arrangement can be seen and visualized from any of the reports available.

The contamination of environment is not limited to water; it will penetrate to air and atmosphere also. A mismanaged and mishandled effect to recycle and disposal of e waste will result is degraded atmosphere and can cause various health threats. A typical degradation scenario can be visualized as per the figure 5 which has been taken in the evening time around an area engaged for unorganized disposal of e waste.

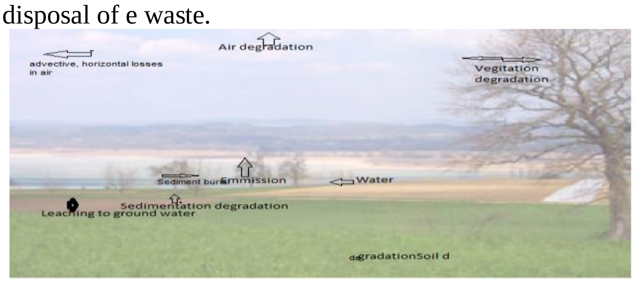


Figure 5. An evening view of disposal site of e-waste

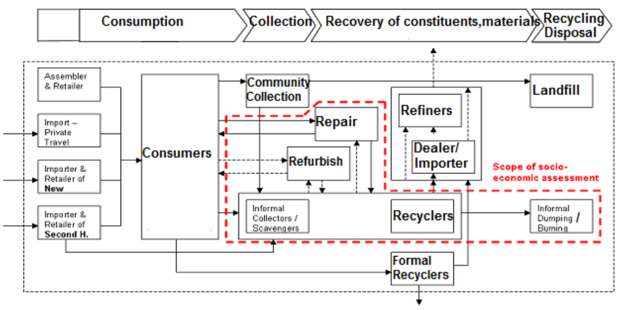


Figure 6. Typical consumption/collection etc of EEE

The figure 6 shows a typical flow chart of EEE product life cycle and its different stages from production to disposal.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

The overall view of sectors and positions can be identified from this layout.

Different study and reports testifies that worldwide annually 20 to 50 million tons of e-waste are getting added / generated. Only 13 % of the e-wastes amounting to 53 million tonnes were subjected to recycling in 2009. The efforts for increasing the percentage for reuse and extraction of costly constituents is a continuing process worldwide. By end of 2015 the use of Computers alone worldwide will touch to a high of 2 billion units. The computer alone will pose major source of production of e–waste. The major state holders of the information and communication technology (ICT) will be /are the growing information technology giants like India, China in Asian and Brazil and Russia. The increased use of EEE in general and Computers in particular will result in increased e-waste and by 2020 it is estimated that around 200 – 400 % increase will result in case of South Africa and China. It may touch a steep high of 500 % in case of India alone. The configuration and development of ICT in India among states is also varied and result in equivocal state as per application and admissibility as per population and literacy level and employment opportunity.

In any country the main cities are the major centers of recycling and disposal for the EEE. In India which has very diverse strata and demography, the state capitals, major rivers and lakesides become attraction sites for the abandoned wastes. The growths of e-wastes are also witnessed in the vicinity of development only. The major metros and old historical cities which are otherwise also developed becomes the centre for such activities. The state governmental and state sponsored agencies connected with such activities have also multiple centers and the major plants are located in the major destinations only. The major activities in these recycling / disposal centers are of segregation of components and valuable from the junks. Very often one can witness children persons who do not have any other work and are disabled get employment in such activities. The contamination, its level and hazards definitions and know how is meaningless for them as it is difficult to get two meals per day for them. The disposal activity mainly depends on extraction of valuables and these are done by breaking away the junks or by burning these. A view of such activities can be witnessed as mentioned in figure 7, 8, 9 and 10 here.

Figure 7. Vehicle carrying e waste to site

Figure 8. Cable striping view from e waste

Figure 9. E-waste Disposal Burning site view

Figure10. Copper extraction from e waste view

The taking out of the residuals or extraction is done with conventional and rudimentary tools only. The residues obtained from these sites by the mankind are sold for very low prices as they are not aware of the value of the valuables. The example can be seen that copper extracted from these sites are sold at Rs 80-120 per kg against steep price of copper in original market. The valuables which are not segrigatable from the junks are often burnt and these releases fumes and gases from the man made materials which are of main concern to us as this study is all about such only. Plastic, foams, plasticizers, additives and other man made materials which have no useful value as waste produce very toxic and hazardous outputs.

The obsolete EEE find their way in local markets. The e waste recycling/dismantling takes place in small workshops or places of individual industries at home of workers/ technicians. The unusable or left outs of the e-wastes are dumped in lonely places in side of scrap markets or burnt in open or transported to other destinations for further extraction. The discarded e-wastes dumped / burnt mainly consists of plastic coated cables, plastic embedded PCB, insulators, plastic casing and broken plastic/ glass parts. The broken parts which have no significant value are disposed off or left as remains or buried in the landfills. These may be buried or kept aside or are subjected to stray fires after accumulation of sizable volume after certain time. For burning use of banned waste insulating foam of the disposed EEE and polyurethane

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

are common. These have very toxic and hazardous outcomes and are threatening to environment as it releases ozone depleting gases from the fumes. Extensive application of CFCs and polyurethane can cause serious hazards in terms of long lasting contamination at the sites of burning and nearby areas of these e-wastes disposal. The river sites or lake sites have their other associated problems in rainy season. Very easily it can be concluded that ill-treatment / crude disposal / retrieval of constituents from EEE which has turned to e-wastes in highly unskilled, non environmental friendly, unprotected and unsafe manner may cause threats of serious contamination of chemical intoxication and manmade substances in the area where it is being done, in nearby areas and even spread to other areas causing environmental threats to human and other living beings.

III. HAZARDOUS METALS , MATERIALS AND SUBSTANCES IN 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.

Apart from these metal and elemental substances there are manmade organic substances as constituents in the EEE and e-wastes. This electronic waste includes a variety of manmade **organic substances** ranging from the substances which can be put mainly in three segments, namely **Phthalates, Chlorinated compounds** and **Flame retardants**.

Phthalates which are more commonly and accurately known as phthalate dieters constitutes nonhalogenated chemicals having numerous applications ranging from being used as softeners /plasticizers in plastics/ PVC in form of covering of wires and cables, other flexible components, to constituents in inks, surface coatings, adhesives, sealants, personal care products etc. These phthalates may include discrete chemicals popularly known as diethylhexyl phthalate (DEHP), complex isomers mixtures diisononyl phthalate (DINP) etc. The phthalates main application / use are as plasticizers. These when disposed off result in large-scale indoor and outdoor losses to environment. One can easily say that these phthalates are undoubtedly one among major leading ubiquitous man-made chemicals put to use in the environment. These can be noticed in form of dust in air the indoor environment. One inhales and gets in contaminations through food also, so the traces can be very commonly found in human tissues, blood, as metabolites, in urine etc. Very rapidly these get metabolized to their monoester forms which are more deadly and toxic than the parent compound one.

The DEHP and deadly MEHP in particular which is the monoester form of DEHP are known reproductive toxins are capable of interfering in the development of female reproductive system in tender age itself. The other two common phthalates, namely Butylbenzyl phthalate (BBP) and Dibutyl phthalate (DBP) which also finds extensive use has been equally reported to be toxic to the reproduction systems by experts.

Monoethyl phthalate (MEP), mono-n-butyl phthalate (MBP), monobenzyl phthalate (MBzP), and monoisobutyl phthalate (MiBP) are the four phthalates which has been correlated to the decreased concentration of AGI.In case of DBP reports say that it cannot be taken up in food chain by crops as it affects physiology and morphology of crops during growth. The isomeric forms of phthalates particularly the DINP and DIDP (diisodecyl phthalate) have been reported to have adverse effects on the liver and kidney with increased contamination or inhalation as doses. Inspite of the toxicity of the phthalates, these continue to leach out of the products for their life time as these continue to find use without control on the markets throughout globe. The notional ban initially from 1999 and permanently from 2005 on the use of six phthalates in European Union (EU) these continue to be used in the children toys and child care articles. This is an indicative of fact that how industries are avoiding bans and continue to use the banned substances in the consumer products including EEE.

Chlorinated compounds The main members of this group are **Polychlorinated biphenyls** (PCBs) and **Chlorinated Benzenes**.

Polychlorinated biphenyls (PCBs) contain 209 individual organic chemical compounds. These compounds are widely known as congeners. These have diversified varying patterns of chlorine substitution in these chemicals. PCBs find very wide variety of uses and applications ranging from use in transformer oils (with tri & tetra chloro-benzenes as solvents), hydraulic fluids, dielectrics used in capacitors, plasticizers to printing inks. With the evidence of accumulation in environment and cause harmful effects its production was banned in 1977.It is reported that till date one third of the banned PCBs have leached into environment and two third are still waiting to penetrate when remaining old electrical equipments will come in the waste list and will get recycled/dismantled or disposed off through combustion. These PCBs persist in the environment when get released and cause harm for longer periods. The PCBs can affect the individuals through absorption from skins, dermal exposure, inhalation, ingestion or through foods. Wide range of hazardous toxic effects resulting in or giving rise to suppression of immunological system, retarded growth, delayed cognitive development, behavioral changes, tumor promotion, endocrine systems, neuro-toxicity, liver damage and effects on reproductive system on both male and females has been reported. To address this control of PCBs many international agencies through their conventions and declarations have come up with legal instruments. The BASEL, Stockholm, OSPAR, LRTAP conventions are worth noting.

Chlorinated Benzenes i.e. chlorobenzenes are having chlorine atoms ranging from one to six forming mono, di, tri, tetra, penta or hexa derivatives of benzenes .The mono, di , tri and hexa chlorinated derivatives have various uses or applications as solvents and intermediaries in manufacturing of dye, pigment, antioxidants, agricultural or pharmaceutical products. Despite ban the mono and dichlorobenzenes, these

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

continue to be manufactured even today. The chlorinated benzenes are persistent in environment when these get released while combustion of chlorinated plastic and can bioaccumulate/ exist in both terrestrial and aquatic systems. The effects of chlorobenzenes exposer are both chronic and acute. The hazardousness and toxicity increases with chlorination. The affects ranges from liver infection, central nervous system, thyroid and tumor promoter. The IARC has categorized it as 2B carcinogen. Hexachlorobenzene can have severe effect on immune system, CNS, liver, thyroid, nervous system, liver, developing fetus etc. The pentachlorobenzene is reported to be particularly potential substance for long range atmospheric transport. It is highly persistent bioaccumulator having very high eco toxicity and hazardousness.

Flame retardants: The most common flame retardants are brominated flame retardants (BFR). These include variety of names and these days most of these are banned as they are highly toxic and hazardous and pose several health treats. Polybrominated diphenyl ethers (PBDEs) the most used of the several classes of brominated compound much common known BFRs are PBBs, PCB, Octa BDE, Penta BDE etc in widespread application and use. These find extensive use as additives in plastics and foams for flame retardants. The plastic casings of electronic equipment are the most common form of use. The use of number of bromine as molecules give them name and numbers as di, tri, tetra, tenta, hexa, octa, deca etc as congers. The pentabrominated, octabrominated and decabromінted congeners are mostly widely used ones. The lower ordered brominated diphenyl ethers (BDE) say penta BDE are known to be highly bio-accumulative. Irrespective of order of BDEs, all are environmentally persistent chemicals. The lose bonding of these with the additives of the plastics lead to easy presence in environment and can be easily seen as air dust at workplaces in high concentration. Very commonly these contaminations can be witnessed in human's blood and milk in the areas where these are commercial in use. The manpower which is engaged in the electronic recycling and disposal activities and the residents near the e-waste recycling / disposal / dismantling sites are reported to have much high risk and level of contamination of these. The presence of toxicity results in long term impact on memory, endocrine (hormonal) disruption, oestrogen & thyroid hormone systems affects, impairment in immune system, changes in learning and behavior are evident. The burning of plastic containing PBDEs incinerator or in open results in either formation of brominated dioxins / furans or bromochlro dixins / furans. These are more toxic than chlorinated dioxins. The EU framework directives have included penta BDE in the priority hazardous substance list. The octa and penta derivatives are banned substances in EU. The use of deca depravities and all PBDEs is under the prohibited list of substances under the Restrictions on Hazardous Substances (RoHS) directives for EEE directives.

The other most widely used flme retardant is the Triphenyl Phosphate (TPP). This TPP is one of the family members of triary phosphates. The phenolic & phenyene oxide base resinis find use in photographic films as plasticizers and constituents of hydraulic fluids & oils. The presence of TPP along with organo phosphorous in environment as a result of leaching from polymers has been noticed and reported. TPP can be present to the extent of 10 % of the weight of the plastic which is present as outer covers of select computer monitors. The burning of TPP, which is most acutely hazardous and toxic of the triaryl phosphates, in open can cause major concerns to environment contamination. The traces of TPP can be observed in human blood and it can be seen as strong inhibitor of monocyte carboxyl esterase, a key enzyme in human blood cells. It is an old contact dermatitis substance.

IV. SELECTION OF SAMPLES

Jharkhand was created in 2000 and is relatively mineral rich state of India. It has very wide varying demography. Diverse urban and rural industrialization are identity of the area. The industrial sections are located to limited areas. Traditional and upcoming products are manufactured here. The connectivity of the state major urban areas from the leading industrial centers is added advantage at one hand and disadvantage at other side. The state cities are well connected to national and international activities. The old industrial hubs are located in Dhanbad and Jamshedpur. These cities have very large slums and give a good mix culture and wide ranging economical strata. The diverse use of technology and varied purchasing power can be very well seen here. Ranchi is the capital of state and has many economic and industrial development centers. The technological advancement and inflow of latest gadgets and EEE products can be seen. The educational centers and research facilities are also getting stronger day by day. Seeing the potential and growth Ranchi cannot be ignored. The city will act as centre for transfer of advancement of technology to other areas through this region only. The well developed steel city Bokaro is also an important area which has giant industry and other associated ancillary units/industries. The EEE use can be seen at peak in the areas identified here. The natives and habitants are of mixed demography and cultures have access to diverse technology. The inflow of EEE can be seen as a result of imports from developed countries, other leading manufacturers of the country and even products of local manufacturers or assemblers.

The organized or formal availability of recycling or disposal centers is still a nightmare in this area. The e-waste have only limited destinations. The raddiwala, or the local workshops, bye back option, keeping in house at dumping place ors handing over to scrap dealers for transmigration to nearby metro Kalkota are available options. The local raddiwala or workshop owners perform the recycling and disposal activities locally in the manner explained earlier in the paper causing degradation of environment and resulting in exposer to locals to contaminations of unknown nature. The ill-effects can be well visualized by falling health and hygiene problems being reported from the affected pockets/areas. By default areas of disposal and burning centers are located near river / lake side or abandoned area of the cities near the slums and scrap dealers dumping yards where the poor, unskilled laborers are living for want of employment and in addition have 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 and earn some lively hood.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

The visual situation and degradation of the areas have also been major factors for selection of sample from the sites.

Sample No	Type	Location
RNC001	Recycling/Burning / destroying Place	Slum / scrap river site Ranchi
RNC02	Recycling/Dumping / Burning /disposal area	Ranchi Scrap dealers dumping area
DHN003	Recycling/Dumping / Burning/ disposal area	Dhanbad slum Market side
JSR004	Recycling/Dumping / Burning/disposal area	Jamshedpur slum Market side
JSR005	Sample from broken CRT glass within disposal area	Slum market area Jamshedpur
BKO006	Sediment from disposal and burning areas	Bokaro area

Table 4

V. SAMPLING

In order to get proper exposer for determination of extent of multiple levels contamination specially by manmade contaminants as a result of e-wastes which is main aim for this study proper sampling is required. In other words for exploration of extent of contamination by contaminants of surrounding, soils, texture, sediments and possible evaluation of content of contaminations specially by manmade substances needs collection of samples from the worst affected areas of the region in similar quantity from possibly similar conditions from all the sampling positions. The samples were gathered from the banks of river sides of Suwarnrekh and slum area site abandoned positions in Harmu in Ranchi, Kharkai river and poverty prone slum area of Mango in Jamshedpur, suitable places at river site of Bokaro and old area of Dhanbad. The selected sites from where samples has been obtained represent maximum contaminations available in surrounding so that worst effected data is obtained for analysis and consideration. Data available will enable to get true picture available in the region for proper representation. The contamination and presence of contaminants and its hazardous effects can ascertain the level of toxicity and affect on the persons living in the area.
The details of sampling and preposition and details of types and locations have been table 4. The weight and volume wise analysis was carried out and the outcome has been placed and discussed in the subsequent sections.

VI. DETAILS OF SAMPLING AND DATA OBTAINED

The most affected areas were selected by visual inspection. Equal amount of samples were obtained from all the places. These collected samples were stored in pre cleaned and rinsed with proper chemicals to rule out contamination glass bottle. Proper cares for retention of organic substances were maintained so that no addition takes place at other conditions. The collected samples were taken to the technical laboratories for examination and evaluations of concentration of different types of organic constituents were administered. The experimental and analytical data's obtained from the examinations for these contaminations are listed in table 5 to 9.The examination and analytical results show that the contamination varies from place to place. It varies from traces to results which showed that toxicity and hazardous are to alarming levels in some cases. These deadly constituents are posing threat to health, hygiene to individual beings and are reasonably damaging to the environment. Level of toxicity, degradation, hazardous contents and level of toxicity warrants emergent need to develop such technology which reduces use environment friendly materials and avoid or reduce use of such materials. Only this initiative will enable to maintain environment safe and living beings well within safe limits. The manufacturers, agencies regulating safety measures and agencies for safeguarding mankind should take note of it. They should underline and undertake stock of alarming situation and address the problem by developing proper technology vis-à-vis making provisions for recycling and disposal in a environment friendly manner under strict vision of national and international welfare safeguard agencies.

VII. OBSERVATIONS AND ANALYSIS OF FINDINGS

Details of observations obtained from the samples collected from the various spots and positions have been produced below. Here it is important to note that the numbers represent number of compounds identified in the e-waste samples from the locations / samples . These include the level of traces even case of obtained in samples.

Organic Compounds	RCN001	RCN002	DHN003	JSR004	JSR005	BKO006
No. of organic compounds isolated	131	132	163	142	78	93
No. reliably identified	67	46	87	54	26	32

Table 5. Details of constituents obtained.

CHLORINATED AND BROMINATED SUBSTANCES	RCN001	RCN002	DHN003	JSR004	JSR005	BKO006
chlorinated benzenes:						
di-penta chlorinated	2	6	8			4
hexa chlorinated	1	1	1			1
polychlorinated biphenyls (PCBs)			7			
chlorinated alkyl benzenes			2			
chlorinated alkanes			1			

Table 6. Constituents of Chlorinated & Brominated substances

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Polybrominated-Diphenyl Ethers PBDE	RCN 001	RCN 002	DHN 003	JSR 004	JSR 005	BKO 006
Tri-hepta brominated	7	6	9		3	9
octa brominated	1					1

Table 7. Constituents of PBDEs.

Triphenyl Phosphate (TPP) & Phthalate Esters	RCN 001	RCN 002	DHN 003	JSR 004	JSR 005	BKO 006
triphenyl phosphate (TPP)	1					
DEHP	1		1		1	1
DBP, DiBP, DiNP	3					

Table 8. Constituents of Triphenyl Phosphate (TPP) & Phthalate Esters

Hydrocarbons & others	RCN 001	RCN 002	DHN 003	JSR 004	JSR 005	BKO 006
PAHs and derivates	5	3	9	2	4	6
biphenyl and derivatives	2	3	7	1	1	4
alkyl benzenes	3	11	14	6	3	6
alkanes and alkenes	15	12	18	16	5	11
steroids & hopanoids	2	3	2	4	1	7

Table 9. Constituents of Hydrocarbons & others.

Nitrogen compounds:	RCN 001	RCN 002	DHN 003	JSR004	JSR005	BKO 006
alkyl & alkyl benzene nitriles	1		3		2	
nitro derivatives				3		

Table 10. Constituents of Nitrogen compounds.

Oygenated Benzene Derivatives	RCN 001	RCN 002	DHN 003	JSR004	JSR005	BKO 006
phenyl ketones	1	2	1	4		2
phenol & derivatives	1		1			4
benzoic acid ester				1		1

Table 11. Constituents of Oygenated benzene derivatives

All samples more or less contained numerous man made organic substances which have been listed in the various tables listed against different segments/ classes of constituents for ease of discussion. Sample 1,2,3 and 6 contained chlorinated benzenes where as only sample 3 contained PCBs. The PBDEs are obtained in the 1,2,3,4 and 6 samples only. The traces are only available in PBDEs case. The sample no 1 has presence of TPP and DBP, DiBP and DNP while 1,3,5 and 6 showed presence of DEHP. The presence of hydrocarbons which includes PAHs and derivates, biphenyl and derivatives, alkyl benzenes, alkenes and alkenes and steroids & hopanoids can be seen in all the samples. Among nitrogen compounds constituents alkyl & alkyl benzene nitrides was seen in 1, 3 and 5 while nitro derivatives are available in sample 4 only. The Phenyl ketones are present in all except sample 5 while benzoic acid ester is available in 4 and phenol & derivatives are available in the odd samples only.

Examination of Polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs for the 2,3,7,8 substituted congeners) for sample 3 and 6 was particularly taken up for quantitative analysis to estimate range of PCDD/Fs toxicity in terms of toxicity equivalents (TEQs). The TEQs gives the concentration equivalents for the most toxic congener 2,3,7,8- tetrachlorodibenzo-p-dioxin or TCDD. The mass equivalents are also obtained to get account of toxicity of individual congeners. The total TEQs for the two samples obtained are as follows:

Analytical results of quantification of 2, 3, 7, 8 - substituted PCDD/Fs available in samples DHN003 and BKO006

Congener	**conc pg/g _s3**	**TEQ pg/g _s3**	**Log TEQ _s3**	**conc pg/g _s6**	**TEQ pg/g _s6**	**Log TEQ _s6**
2378-TCDF	**15.1**	**1.5**	**0.17609126**	**321**	**32.1**	**1.506505**
12378-PCDF	**113.8**	**5.67**	**0.75358306**	**426.6**	**21.3**	**1.3283796**
23478-PCDF	**21**	**10.5**	**1.0211893**	**751.5**	**375.7**	**2.5748412**
123478-HxCDF	**29.6**	**3**	**0.47712125**	**773.9**	**77.4**	**1.888741**
123678-HxCDF	**17**	**1.7**	**0.23044892**	**643**	**64.3**	**1.808211**
234678-HxCDF	**33.3**	**3.3**	**0.51851394**	**663.8**	**66.4**	**1.8221681**
123789-HxCDF	**18.9**	**1.9**	**0.2787536**	**285.8**	**28.6**	**1.456366**
1234678-HpCDF	**194.2**	**1.9**	**0.2787536**	**1794.9**	**17.9**	**1.252853**
1234689-HpCDF	**112.1**	**1.1**	**0.04139269**	**214**	**2.1**	**0.3222193**
OCDF	**951**	**1**	**0**	**1695.7**	**10.7**	**1.0293838**
2378-TCDD	**3**	**3**	**0.47712125**	**54.8**	**54.8**	**1.7387806**
12378-PCDD	**3.4**	**1.7**	**0.23044892**	**272.2**	**136.1**	**2.1338581**
123478-HxCDD	**16.1**	**1.6**	**0.20411998**	**264.6**	**26.5**	**1.4232459**
123678-HxCDD	**24.9**	**2.5**	**0.39794001**	**676.1**	**67.6**	**1.8299467**
123789-HxCDD	**16.5**	**1.6**	**0.20411998**	**374.2**	**37.4**	**1.5728716**
1234678-HpCDD	**137.5**	**1.3**	**0.11394335**	**6524.1**	**65.2**	**1.8142476**
OCDD	**1461.7**	**1.5**	**0.17609126**	**7968.3**	**8**	**0.90309**
		44.77			**1092.1**	

Table 12. Analytical results of samples 3 and 6

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

OPEN ACCESS
International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-3, Issue-1, March 2014

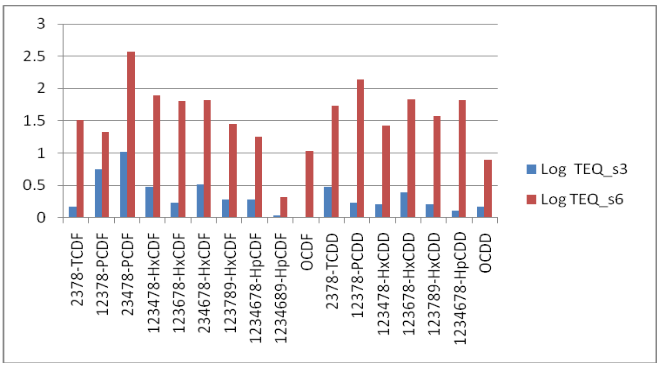


Figure 11. Showing the details of different constituents quantitatively obtained in log scale in sample 3 and 6

One can conclude that level of PCDD/Fs in sample 3 was 44.77 pg/g TEQ which is lower than reported from the sites of e waste sites in China but is in range of what is available in Indian other areas. The normal ranges of the combustion residues range between 80 to 180 pg/g TEQ and can go upto 675 pg/g in most of the cases. The PCDD/Fs level of sample 3 site is of moderate in nature. The normal ranges reported are below 1 pg/g TEQ and rarely above 10 pg/g TEQ.

The site 6 is however indicator of the very high level of contamination i.e. of the order of 1092.1 pg/g TEQ. The sites very level of PCDD/Fs can be result of accumulation of contaminants from other areas and unburnt or under burnt e-wastes. The level of 1000 pg/g TEQ is reported to be threshold level for serious contamination. The individual PCDD/Fs compounds profiles are almost similar in two samples. The similarities can be indicator of similarities of volumes and prepositions left after open burning of e-wastes from primary sources.

VIII. CONCLUSION

The rapid industrialization, growth of EEE with unprecedented technical advancements, intent of copying leading giants in name of growth of civilization for ease of life vis-a-vis establishing technological foothold warrants some precautions. The situation has alarmingly become grave. Its graveness can be judged if one looks at the stock of piling e-waste which are day by day becoming threat to health, environment their degradation levels and highlights need for skillful use of technology and development of technology in safe and friendly manner. The present position as it looks from the study presses that we need to change our mindset and keep breaks on madness for development and play for 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 unregulated, unplanned use of resources and development pattern is resulting in environmental degradation and risking the workers for serious consequences. The mindset of mankind of throwing away garbage to most uncared manner has resulted in large scale contamination of nearby areas. The areas where such activities are taking place have become 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 of the site and spread to the localities nearby. The study results reveals that the manmade contaminants , popularly known as organic substances in the EEE, e-wastes improper handling are threats to workers and local residents in particular and human kid of the entire globe as the pockets are shrinking and pollution is making a uniform layer. The workforce which mostly constitute children are the worst effected individuals as they are more affected by the toxicity present in their blood. The ill management and poor handling and lack of far sightedness of regulatory/ monitoring and enforcing agencies authorities are evident in almost all the cases and studies. The need to redesign new EEE products by minimizing use of hazardous contents and restriction on transboundry movements which becomes the major source of someone else's garbage as headache of locals add to such waste needs urgent identification and attention. The regulatory mechanism and legislation / regulations enacted by the agencies and government here are far from adequate and need necessary clauses to be added and sometimes new acts have to be enacted. Well thought of and planed phasing out of the disposable EEE and old products which has banned substances and are threatening to environment has to be addressed. The planned approach and disposal pattern of such products can lead to a situation where sustained e-wastes are generated and addressed. A global initiative is need of hour for proper technology transfer, fixing responsibility of exporters & importers so that globally overall e-waste is reduced and handled in phased and planned manner without unduly affecting the environment and posing threat and dangers of hazardousness on living beings. The non availability of reliable data for the EEE e-waste is also a problem. 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 EPR and buy back policy enforcement needs a total submission for proper tackling & minimization of e-waste in proper and purposeful way. By creating awareness among the masses situation can be better handled and this creation of awareness can be achieved by inclusion of topics in curricula of professional courses of environmental concerns. The self regulation, contentment, avoiding madness for new products, stress on manual works in name of exercises, morale and motivation to fight any menace are the best available tools 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 run for discarded products and pave way towards contribution for lessening of e-waste stocks and generation/production.

The combined efforts, proper enactment of proper regulation, public participation, general awareness, improvement/ updation of curricula, garnering general awareness, developing habit for restraint from having out of phase product will effectively reduce the e-waste and reduction of e-waste will lessen the need of recycling & disposal and ultimately reduce

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

the contamination of environment, individual suffering and improve health and hygiene and lessen toxicity / hazardous amounting in the areas where we live.

REFERENCES

[1]. Datamonitor report of 2009-10
[2]. WEEE recycling report 2013 available on website
[3]. Arwidsson Z et al Remediation of metal-contaminated soil by organic metabolites from fungi II-metal redistribution. Water, Air and Soil Pollution 2009
[4]. Raghupathy, L., 2007. E-waste management in India. (Website viewed on www.env.go.jp /recycle/
[5]. Toxics Link. E-Waste in Chennai Time is running out. 2004 Available from: w.toxicslink.org [2011]
[6]. Gupta RK: E-waste recycling and health effects: a review. Centre for Education and Communication- 2007.
[7]. E-waste management in India. Pandve HT. An emerging environmental and health issue. Indian J Occup Environ Med 2007
[8]. India together: UN report spotlights India's e-waste pile up - 31March 2010.Available from:indiatogether.org/2010/ mar /env-unewaste
[9]. WEEE Recyle India Available on www.weeerecycle.in
[10]. Alaee et al 2003. An overview of commercially used brominated flame retardants, their applications, their use patterns in different countries/regions and possibly modes of release. Environment International 29 (6):
[11]. Cobbing, M. 2008 Toxic Tech: Not in our backyard: Uncovering the hidden flows of e-waste. Greenpeace International, The Netherlands. www. greenpeace. org
[12].. Recyclers' Association Kirtika Suneja / New Delhi. May 20, 2010. Available from: www.business-standard.com
[13]. Umesh Kr et. al. in recent International journal on topics of E waste available online 2013,2014
[14]. Chen A, et al 2011 Developmental neurotoxicants in Ewaste:an emerging health concern. Environmental Health Perspectives
[15]. Satyamurthy, K., 2006. Managing e-waste without harmingenvironment(hinduonnet.com/thehindu/thscrip/ print
[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]. UNEP, 2007, ―Vol- I: E- Waste Inventory and Assessment Management Manual‖
[19]. UNEP, 2007, ―Vol- II: E- Waste Management Manual
[20]. Guidelines for Environmentally Sound Management of Electronic Waste by Central Pollution
[21]. Green peace 2008. An Assessment of E-waste Take back in India, Take back Blues, Bangalore.
[22]. Notification in the Official Gazette of India, The E-Waste (Management & Handling) Rules, 2011, MOEF
[23]. Environmental law and policy, edited by arunavenkat. Published phi learning pvt. Ltd., 2011
[24]. WEEE recycling report 2013 available on website
[25]. Arensman, Russ, Nov 2000"Ready for Recycling?" Electronic Business, The Management Magazine for the Electronics Industry.
[26]. Matthews et al 1997 Disposition and End-of-Life Options for Personal Computers, Carnegie Mellon University Green Design Initiative Technical Report #97-10, July 7
[27]. Fowler BA, et al 1974 : Arsenic poisoning. New England Journal of Medicine 1974, 291 (22)
[28]. Handbook of environment law, edited by p. B. Sahasranaman. Published oxford university press, 2009
[29]. Silicon Valley Toxics Coalition, Just Say No to E-Waste: Background Document on Hazards and Waste From Computers
[30]. Andersson, P. 2004 Small and large scale fire experiments with electric cables under well-ventilated and vitiated conditions. Fire Technology
[31]. Carlsson, H et al 2000 Video display units: an emission source of the contact allergenic flame retardant triphenyl phosphate in the indoor environment. Environmental Science and Technology 34(18):
[32]. ATSDR 1998 Toxicological profile for chlorinated dibenzo-p-dioxins (CDDs), United States Public HealthService, Agency for Toxic Substances and Disease Registry, December 1998
[33]. EU 1991 Directive 91/338/EEC of 18 June 1991 amending for the 10th time Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations. Official Journal L 186, 12/07/1991:
[34]. IPCS 1998 Polybrominated dibenzo-p-dioxins and dibenzofurans, Environmental Health Criteria, No. 205,
[35]. International Programme on Chemical Safety, UNEP/ILO/WHO, ISBN 92 4 157205
[36]. Silicon Valley Toxics Coalition, op. cit. see also National Safety Council
[37]. Baba A, 2010 et al Study of metals dissolution from a brand of mobile phone waste. Metalurgija –Journal of Met
[38]. Sheng PP, et al 2007: Recovery of gold from computer circuit board scrap using aqua regia. Waste Management and Research
[39]. EU 2006 Directive 1013/2006/EC of the European Parliament and of the Council of 14 June 2006 on shipments of waste. Official Journal L 190, 12/07/2006: pp. 01-98 [http://eurlex.europa.eu
[40]. Barbosa FJ et al : 2005 A critical review of biomarkers used for monitoring human exposure to lead: advantages, limitations, and future needs. Environmental Health Perspectives
[41]. Silicon Valley Toxics Coalition, op. cit
[42]. National Safety Council, op. cit
[43]. Babu R et al : Electrical and electronic waste: a global environmental problem. Waste Management & Research 2007
[44]. Balabanic D et al : 2011 Negative impact of endocrine disrupting compounds on human reproductive health. Reproduction, Fertility and Development
[45]. Microelectronics and Computer Technology Corporation 96. Electronics Industry Environmental Roadmap. Austin, TX: MCC
[46]. Various other related materials from Internet various web sites

AUTHOR PROFILE

Umesh Kumar graduated in Electronics Engineering in 1984, completed M.E in 1993, PGDPM(MBA) in 2000, PGHR, MBA (F&B) and LLB. As excellence to professional contribution served as Hon. Chairman of IETE Jharkhand centre for 2 years besides being Hon. Secretary for five years. Member of more than 15 leading professional bodies and has numerous papers in national, international journals besides contributions in conferences/seminars/symposia etc. Associated with central university, Jharkhand, IIM Ranchi , National Law University at Ranchi and technical expert of ATI. Since 1985 he is serving the Dept of Science & Technology, Bihar and now Jharkhand in various capacity and regular faculty member including officiating as Principal of technical institute in the technical education area.

Dr D N Singh graduated in 1973, completed Masters in 1988 and Ph.D later. Since 1975 worked as faculty in various capacity including Principal in Dept of Science &Technology, Bihar, Jharkhand and once again in Bihar. Served as Secretary of SBTE. As a professional has membership of almost all leading bodies. Represented as member of national executive council of ISTE. Has number of papers in national, international journals besides contributions to national internationals seminars, conferences and symposia.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)