Developing Country Perspective : Low Public Awareness and Data Gaps As drivers for Control of Chemicals in Articles and Products

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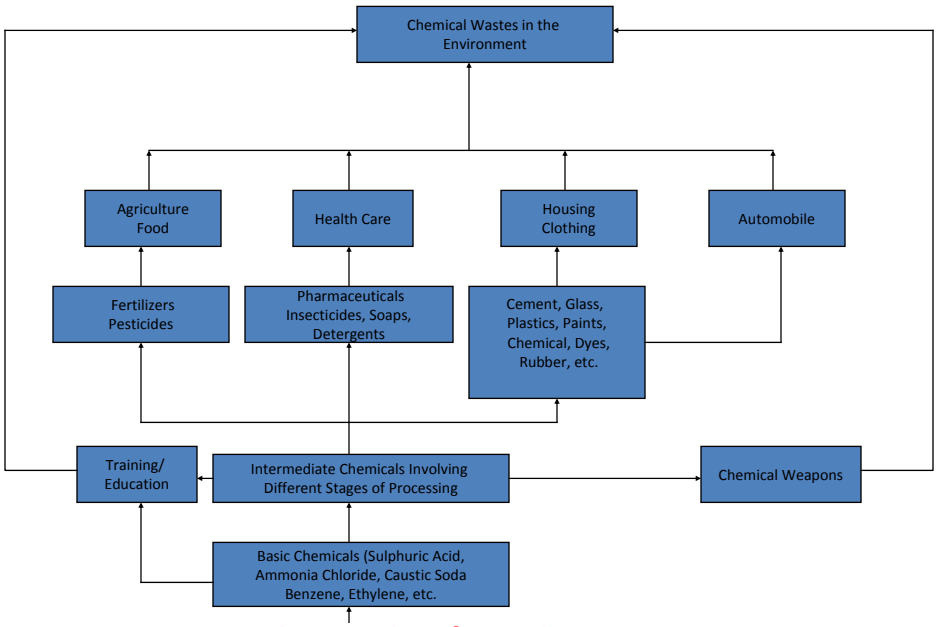
Outline Of Presentation

- Paradox of chemicals use
- Chemicals Situation In developing countries
- Chemicals in articles and products : e.g. dry cell batteries and electronic products (e.g. cell phones, computers) .
- Conclusion
- Recommendations

Paradox of Chemicals Use

- Chemicals are important to mankind and sustenance of life on earth
- There are multifarious uses in agriculture, medicine, industrial manufacturing, public health/vector control ,etc .
- Almost everything in our world today has chemical constituents at trace, minor, or major component levels.
- Exposure to chemicals through various pathways represents an important public health problem worldwide
- Concerns are raised on chemicals production, their use, trade and the potential risks of hazardous chemicals in their life cycle



Chemicals Life Cycle

Exposure Root Of Humans To Chemicals

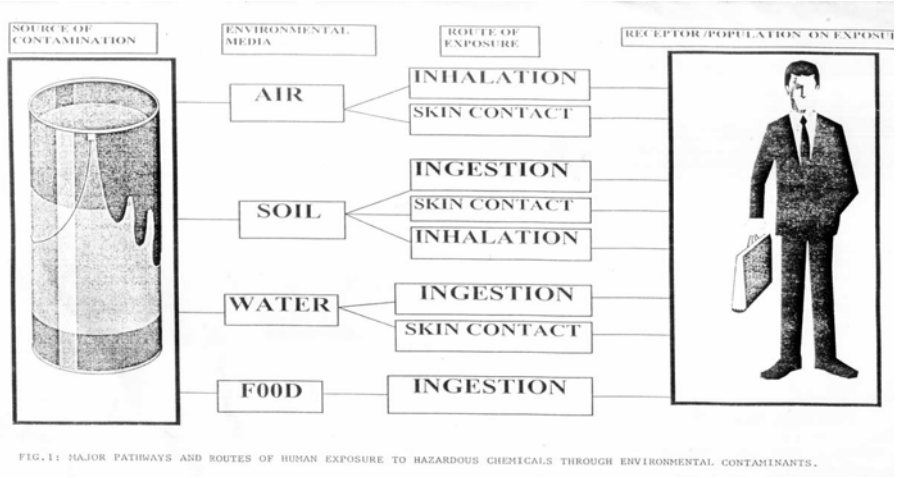


FIG. 1: MAJOR PATHWAYS AND ROUTES OF HUMAN EXPOSURE TO HAZARDOUS CHEMICALS THROUGH ENVIRONMENTAL CONTAMINANTS.

Paradox of Chemicals Use

- **Poisoning by chemicals is a major problem in developing countries. Unintentional poisonings led to 300,000 deaths worldwide in the year 2000 (WHO 2000).**
- **Certain populations and groups (e.g children, pregnant women, and elderly people) are more vulnerable to the effects of chemicals**
- **Thus chemicals are elixirs of life & harbingers of death depicting a sweet & sour story.**

Chemicals Situation In developing countries

- Developing countries economy is largely import dependent.
- Most countries don't manufacture but import chemicals largely from developed countries and parts of Asia
- Special problems for developing countries because they generally lack capacity for sound management of hazardous chemicals (e.g. heavy metals Pb, Cd, Hg) throughout their life cycle
- General lack of awareness by stakeholders of the hazards associated with hazardous chemicals in their life cycle

Chemicals Situation In developing countries

- Non-display of hazard signs or labels or notices to caution handlers
- Comprehensibility of hazard signs generally poor – from GHS 2005 study
- Most personnel in charge of chemicals handling generally lack knowledge of chemicals or have basic qualifications in chemistry.

Chemicals Situation In developing countries

- National infrastructure including regulatory framework for sound chemicals management is weak
- Lack of or weak enforcement of piece meal /non-comprehensive extant chemical laws.
- Inadequate database on chemicals classification, import and export
- General lack of information on toxic chemicals in articles/products

Chemicals In Articles/Products

- The use of toxic chemicals in articles/products is a growing concern in recent times because of effects on public health and the environment; and the potential exposure to chemicals from articles/products such as tires, personal computers, cellular phones, dry cell batteries and toys for children in their life cycle i.e production, handling, use, and disposal at the end of life.
- The articles containing heavy metals normally pose minimal health and environmental risk during proper use, until the articles reach end of life (EoL) or are dissipated or improperly disposed when the toxic metals constituents are released into the environment.
- The reduced use of hazardous chemicals is one of the key challenges in achieving sustainable consumption and production.

Chemicals In Articles/Products

- Articles/products containing toxic chemicals, e.g. heavy metals in their useful life are usually harmless to humans if handled properly.
- In most third world countries they are disposed with municipal solid waste, burned in open dumps and disposed at unlined landfills. A greater proportion of wastes are also disposed into surface water bodies causing pollution problems and human health concerns
- Case studies of heavy metals in dry cell batteries, and electronic products (cell phones and personal computers in particular) shall be used to highlight the various issues raised in the foregoing.

Case Study 1 :Dry Cell Batteries

- Dry cell batteries represent a large volume of toxic and hazardous materials , commonly used to power torch lights, clocks, radio sets, etc. There are different types belonging to carbon zinc, alkaline manganese, NiMH and Lithium chemical systems.
- They are largely non-rechargeable single use batteries. They constitute household hazardous waste when 'dead', or discarded, that is when the components have reached their equilibrium concentrations.
- The zinc anode of dry cells contain low percentages of Cd and Pb for improvement in strength and ductility. Small quantity of Hg is also alloyed with the Zn to control corrosion and provide current carrying capability.
- .

Case Study 1 :Dry Cell Batteries

- In 1991, the EU directive on batteries and accumulators (91/157/EEC) was introduced which requires that batteries containing more than 25mg of Hg, 0.025% of Cd and 0.4% Pb by weight be collected separately from household waste for recycling or special disposal. The manufacturers of alkaline batteries in Europe ceased the addition of Hg in 1992.
- In the US, about 2.5 billion household batteries are purchased each year. More than 90% of this is single use batteries that find their way into landfills and incinerators.

Case Study 1 :Dry Cell Batteries

- The US-EPA estimated that in 1989, 88% of the 635 metric tonnes of Hg in urban trash in the US came from single-use batteries.
- One major concern is that the heavy metals contained by dry cells could leach from landfills into ground water, or shift to fly ash at open waste minimization/burning sites or at waste-to-energy plants

Case Study 1 :Dry Cell Batteries

- A recent study in Yaoundé, Cameroon by Tetsopgang & Kuepouo (2008) typifies third world scenario on the issue of metals in articles.
- 2287 discarded or spent assorted dry cell batteries imported from different countries collected from refuse dump were studied based on information contained in the labels. Most of the batteries were imported from Asia with China responsible for 66.3% of the imports.
- Fifty-two percentage of these battery waste units are labeled as containing 0.01–0.025% of mercury, and 3% marked as mercury-free; 45% have no labeling indicating the added mercury.
- For cadmium, 3% are marked cadmium-free, and 97% do not show any labeling on the added cadmium.

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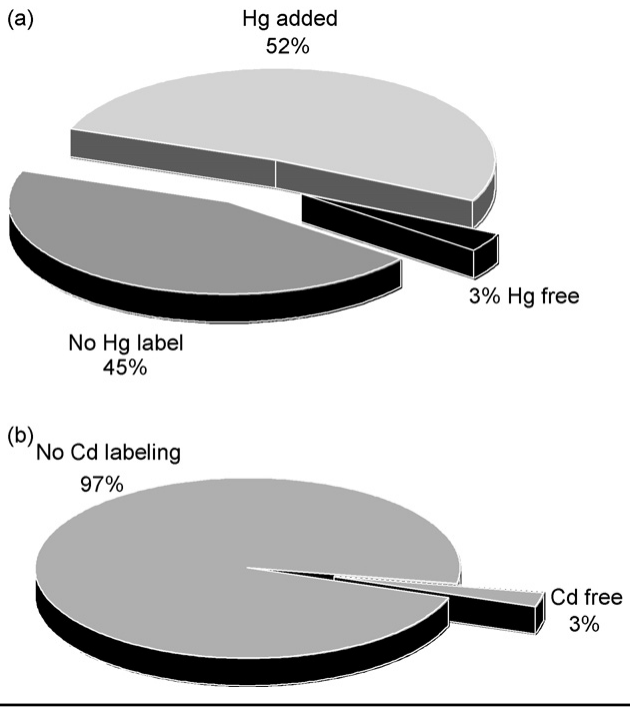


Case Study 1 :Dry Cell Batteries

- **In a Nigerian study of imported dry cell batteries 1980 -1998 (Nnorom & Osibanjo 2006), the average Pb and Cd content of the dry cells were 1051 mg/kg(range 42-3170 mg/kg) and 107.7 mg/kg (range 4.6-410 mg/kg) respectively. An estimated consumption emission of 1.16 metric tons Pb and 0.12 metric tons Cd are witnessed per decade from the importation of 11000 metric tons/year of battery.**
- **Batteries with labels indicating zero cadmium and lead were found on analysis to contain high concentration of these metals.**
- **The calculated emissions of 607 kg Pb and 62 kg Cd for 1987 accounts for about 42% of the estimated emissions witnessed for the period 1980-1998**

Table 2: Lead and Cadmium content of dry cell batteries imported into Nigeria from various countries

		Lead (mg kg^{-1})		Cadmium (mg kg^{-1})	
Country	N	Mean	Range	Mean	Range
China	14	1368.4	42-3170	151.5	30-410
Indonesia	2	1032.0	806-1258	84.4	71.2-97.6
Japan	5	715.2	168-1295	131.5	104.9-160
Korea	2	1137.5	493-1782	81.5	9.5-153.4
Malaysia	1	709.0	-	12.5	-
Spain	1	702.0	-	65.8	-
USA	1	303.0	-	11.1	-
Source not indicated	12	1070.3	100-2135	82.5	4.6-182.5
Entire study	38	1051.0	42-3170	107.2	46-410

Case Study 1 :Dry Cell Batteries

- Within this period, an estimated average of 1671 g/t Pb and 475g/t Cd were emitted annually into the atmosphere with fly ash particulate at municipal minimization sites. About 3400 g/t Pb and 41g/t Cd are released into the soil through ash and cinder at such sites with about 1% of these reaching the underground water per annum.
- These consumption emissions call for effective strategies to minimize emission into the environment of toxic heavy metals from improper management of hazardous dry cell battery waste.

Case Study 1 :Dry Cell Batteries

- The use of dry cells “black mix” (electrolyte + carbon black +graphite rod) for darkening classroom blackboards can expose school children to low doses of heavy metals.
- Studies of prevalence of elevated blood (PbB) levels in children 1-6 years old in Nigeria observed high average PbB levels in children 5 years old and attributed this to the tendency for this age group to play longer in contaminated outdoor environment. (Nriagu 1997).

Case Study 2 : Electronic Waste

- Electronic Waste is one of the topical environmental issues of the 21st century.
- E-waste has been identified as the fastest growing waste stream in the world; forecast to soon reach 50 million tonnes a year which will be enough to fill more than a line of tip trucks stretching halfway around the world !
- Advances in Information and Communication Technology (ICT) which has shaped human development phenomenally has unfortunately become the driver of toxic waste trade between developed and developing countries under the guise of bridging the digital divide.

Case Study 2 : Electronic Waste

- E-waste has become a problem of crisis proportion globally because it is hazardous.
- There are several bad effects of E-waste especially Health and environmental damage
- E-waste contains many hazardous and toxic materials. Substances include Brominated Flame Retardants, Lead, Mercury, Beryllium, Cadmium, Lithium, Bromine, Phosphorous, Antimony and Barium. In landfill this releases those substances into surrounding water and soil systems causing problems, which eventually lead to health and environmental hazards.
- Loss of resources - When E-waste ends up in landfill valuable materials and non-renewable resources such as metal, plastic, glass, gold and copper buried and lost forever, leaving us with the option of mining the earth for new resources.

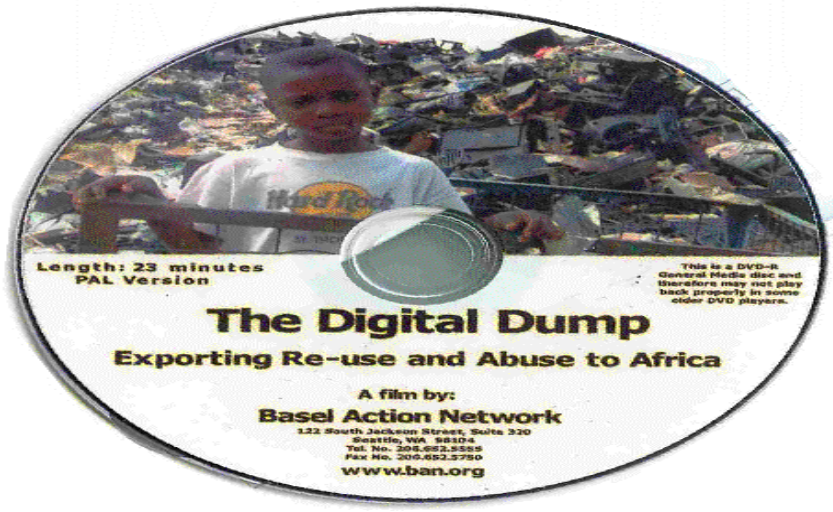
Case Study 2 : Electronic Waste

- Damage caused overseas and dumped on developing countries - More than 50% of computers globally are sent to developing countries either whole or disassembled form .
- Worldwide 500 million personal computers (PCs) reached the end of their life in the decade between 1994 and 2003.
- These contain approximately :

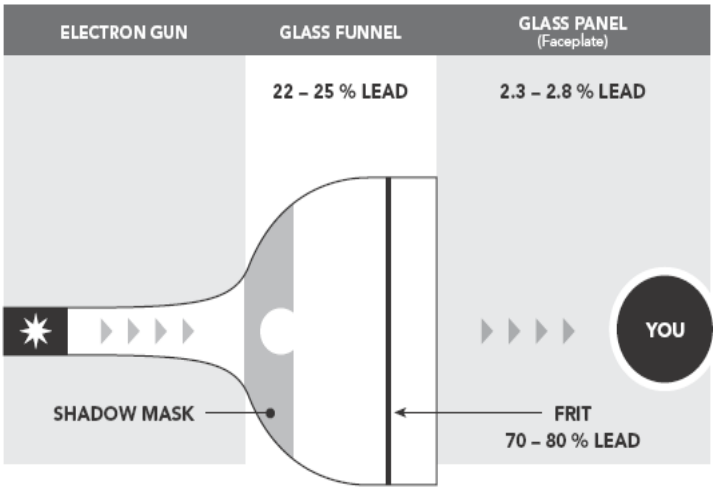
1. 2,870,000 ton of plastics,
2. 718,000 ton of lead,
3. 1,363 ton of cadmium and
4. 287 ton of mercury .

Case Study 2 : Electronic Waste

- The toxic metals in EEE in previous slide will be released into the environment if the EoL computers are not properly managed.
- More than 50% of computers globally are sent to developing countries either whole or disassembled form under the guise of bridging the digital divide
- Damage caused overseas as used and end of life (EoL) computers are dumped on developing countries which lack the resources for environmentally sound management of e-waste.
- BAN (205) has shown in a study in Nigeria that about 5 million used computers are imported through the Lagos port annually. About 25% of the imports are working while the remaining 75% is thrash.



CATHODE RAY TUBE, CRT:A MAJOR SOURCE OF LEAD IN E-WASTE : CONTAINS 2-4kg LEAD (POWELL, 2002)



PRINTED WIRING BOARD: ANOTHER SOURCE OF HEAVY METALS POLLUTION

Material Composition of Computer printed wiring board (PWB)

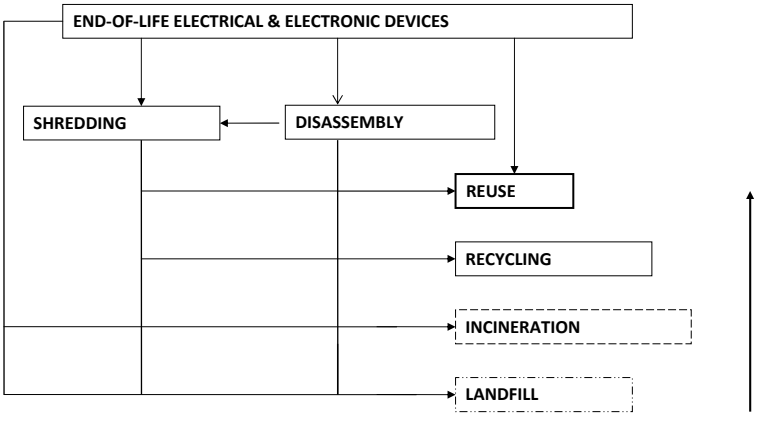
Component group	Composition by weight (%)						
Metals (30%)	Cu	Fe	Ni	Sn	Pb	Al	Zn
	10.9	7.7	2.5	3.9	1.5	1.7	1.1
Precious Metals‡		Au		Ag		Pd	
		0.00498		0.00818		0.002	
Metal oxide (40%)	Silica	Oxides†		Alumina		Other oxides	
	15	6		6		13	
Plastics (30%)	CHO Polymers*			Halogenated polymers**		N-containing polymers***	
	< 25			< 5		< 1	

†Alkaline and alkaline earth oxides; ‡ metals + precious metals = 30%. *Polymers including polyesters, phenol-formaldehyde etc. **Polymers mainly PVC, traces of PTFE, and polybromo compounds etc. ***Polymers including nylon and polyurethane. Source: Oh et al, 2003.

Case Study 2 : Electronic Waste

- **Analysis of different e-wastes imported into Nigeria indicate that a good majority contain Pb, Ni, Cd, Cu at concentrations greater than levels of Restricted Hazardous Substances (RoHS) set for electronic products.**
- **However e-waste is not managed in an environmentally sound manner in Nigeria and other developing countries as the wastes are disposed on land in refuse dumps or unlined landfills or burnt openly, or the use of crude methods for precious metals recovery**
- **These unwholesome practices cause the release of toxic heavy metals and organics into the environment thereby exposing humans to toxic chemicals while also causing environmental pollution**

Waste Management Approaches for End of Life Electronics



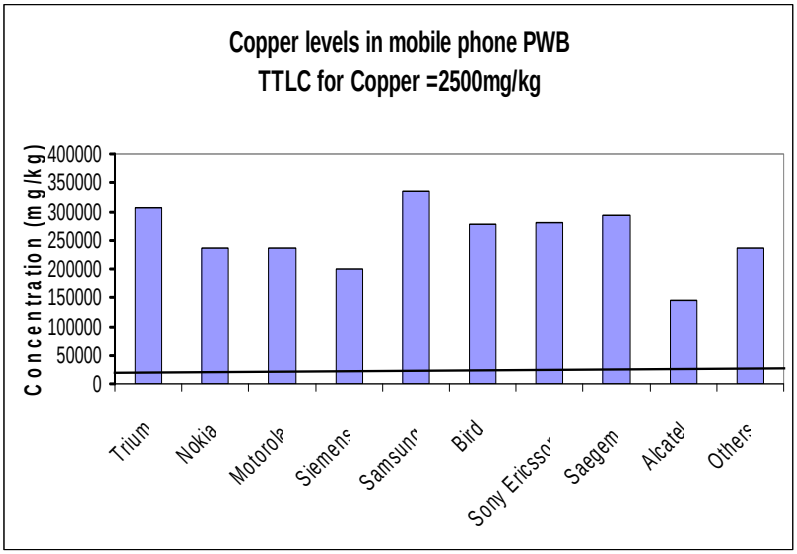
Heavy Metals In e-wastes

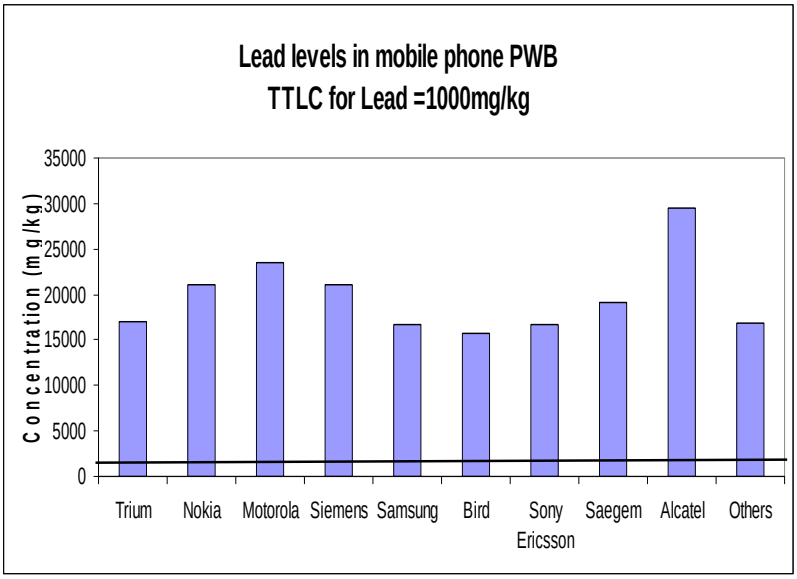
components studied

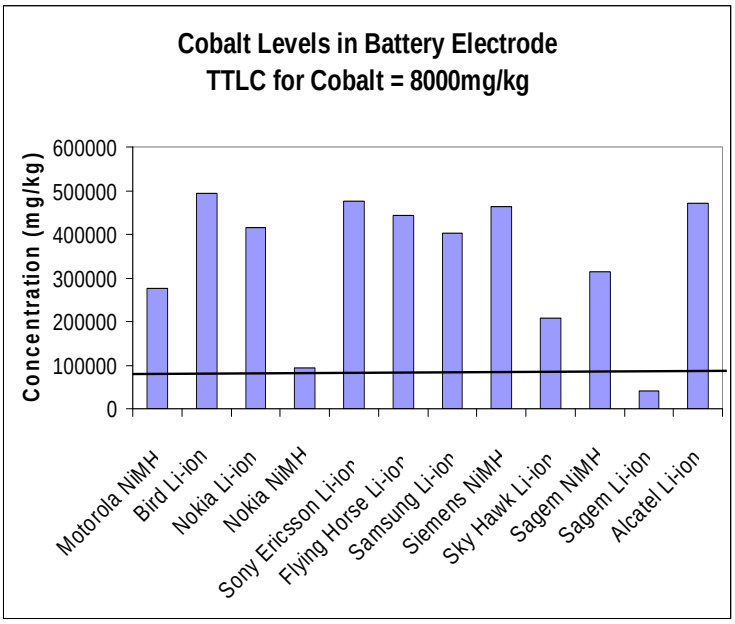
1. **Mobile phones– plastic and PWB,**
2. **Mobile phone rechargeable battery (electrode and PWB)**
3. **Computer monitors – Plastic, PWB, CRT**
4. **Keyboard – plastic, PWB**
5. **Computer motherboards**
6. **Soils and plants from dumpsites where e - waste is burnt**

Conclusion

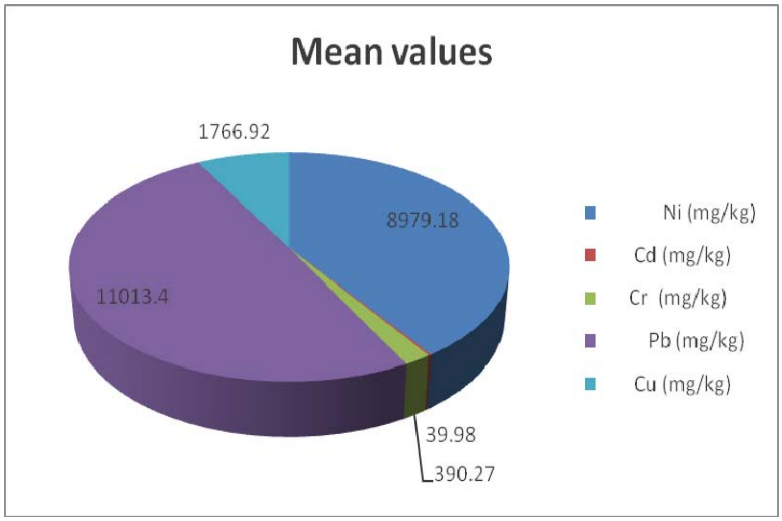
- **Globalization in particular has opened up developing countries economies to large imports of articles /products containing toxic chemicals while local regulatory control of these commodities are lacking or weak.**
- **Population explosion and globalization of trade are major drivers for consumption and production of articles/products.**
- **The trade is generally between developed and developing countries and the high volume of goods involved makes the issue a global one.**
- **Most developing countries lack national/regional legislative mandatory requirements of disclosure of information on toxic chemicals in articles/products from exporting countries.**
- **National data on toxic chemicals in articles is lacking**


Copper levels in mobile phone PWB
TTLC for Copper =2500mg/kg
Concentration (mg/kg)
400000
350000
300000
250000
200000
150000
100000
50000
0
Trium
Nokia
Motorol
Siemens
Samsung
Bird
Sony Ericsso
Saegem
Alcatel
Others


Lead levels in mobile phone PWB
TTLC for Lead =1000mg/kg
Concentration (mg/kg)
35000
30000
25000
20000
15000
10000
5000
0
Trium
Nokia
Motorola
Siemens
Samsung
Bird
Sony Ericsson
Saegem
Alcatel
Others



Computer Mother Board



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Conclusion

- Special problems for developing countries because they generally lack capacity for sound management of hazardous chemicals and chemical wastes (e.g. heavy metals Pb, Cd, Hg) throughout their life cycle
- Because environmental legislations are non-existent or lax in the developing countries, consumer products such as dry cell batteries, electronic products and automotive tires that contain hazardous materials are not appropriately managed at their end-of-life (EoL).
- Consequently they complicate municipal solid waste management problems, cause multimedia environmental pollution, pose threat to human life and worsen poverty.
- The organization of this meeting is timely and auspicious .

Recommendation

- The issue of toxic chemicals in articles/products is just emerging into international consciousness. Therefore there is need for intense awareness raising and education of governments, industry, civil society and other stakeholders.
- Proper labeling of articles/goods with hazard signs and information on toxic chemicals components and ESM at EoL should be mandatory
- Need for toxics reduction in articles, promotion of Cleaner Production Technologies and ESM of waste articles

Recommendation

- There is a need to develop internationally standardized information systems on chemicals in articles.
- An international policy framework to address the issues in an integrated manner with other policy issues on chemicals and wastes should be formulated as soon as possible.
- Capacity building for developing countries and countries with economies in transition is critical to enable them participate effectively in follow up programs and activities
- Cooperation among Secretariats of MEAs on Chemicals and Wastes is important for future work on this important issue within on-going global relevant initiatives such as SAICM, GHS and the Marrakech Process.

THANK YOU

FOR YOUR KIND ATTENTION