E-WASTE MANAGEMENT

E-waste

→ discarded materials of electrical & electronic gadgets → any materials, that runs on potential

How is e-waste generated?

- generated during production of electronics & electrical devices
- end of life of house-hold appliances

If e-waste not disposed properly,

i) it contaminates / pollutes the environment as e-waste is non-eco friendly
ii) it threatens human health

Causes of e-waste

i) fast growing technology
ii) change in style & fashion
iii) improper handling of electronic & electrical devices

Types of E-waste [Sources of E-waste]

1) Large household appliances
2) Small household appliances
3) IT & telecommunication equipment
4) Lighting devices
5) Medical devices
6) ~~Sports~~
6) Toys and sports equipments

1) large household appliances
eg:- refrigerators, washing machine, AC, etc.

2) Small
hair dry
eg:- iron box
vacuum
kettle
coffee m

3) IT & T
equipmen
eg:- TV,
laptop
xerox
scanner
printer
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solar pa
loud sp

4) Light
eg:- flo
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5) Medical
eg:- use
of

6) Toys &
equipme
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Telecommunicatio
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2) Small household
hair dryer
eg: iron box
vacuum cleaner
kettle
coffee makers

3) IT & telecom equipments
eg:- TV, phone
laptop, cellular phones
xerox machine
scanner
printer
semi conductor devices
solar panel etc
loud speakers

4) Lighting devices
eg:- ~~flat~~ ~~tent~~
fluorescent bulbs/ lamps

5) Medical devices
eg:- used in treatment of injury

6) Toys & sports equipment
eg:- battery

Composition of E-waste materials

- alloys
- glass
- organic polymers
- ferrous metals / non-ferrous
- valuable materials like gold, palladium, rhodium platinum, etc. (these do not pollute environment) & even Cu & Ni don't pollute environment
- toxic metals - Pb (lead), tin, antimony mercury, cadmium, beryllium, arsenic chromium, barium, they pollute environment

in sim card

→ used in integrated circuits

PCB → has Cu, Ni & Au

Why Au?? → to avoid corrosion as they are nobel metals

& also ↑ conductivity

Silica, Sodium Oxide & Calcium → glass → toxic?

Organic pollutants
→ PVC ⊖ poly vinyl chloride
→ poly aromatic hydrocarbon
→ on burning produces large amt of HCl gas & causes chronic respiratory & skin problems
→ can't burn completely

Methods of disposal of E-waste

1) Land filling
2) Incineration
3) Recycling
4) Re-use

1) Land-filling
→ burrying the materials in empty sites
→ traditional methods (non-scientific) but not very effective
→ As this method, pollutes soil & causes soil pollution
→ this harms the ground water & causes water pollution

2) Incineration
→ indirect burning
→ produces a lot of toxic metal gases when we burn directly
→ an incinerator is used to burn the e-waste material at 900 - 1200 °C (as melting point of metal is very high)
→ we burn it in order to reduce some volume of e-waste.
i.e. reduce small amt of emission of toxic gases
→ Thus better than land filling
→ also a traditional method

3) Recycling
→ dismantling electrical & e devices & end process using many
→ It is better ① & ②
→ can reduce e-waste but even whi dismantling, elements are

4) Re-use
→ the best
present
→ minimize problems
→ without di certain mater we use - then

• life span of EE goods are very
∴ we need to life span
so, we need them

3) Recycling
→ dismantling the electrical & electronic devices & then and processing them using many techniques
→ It is better than ① & ②
→ can reduce volume of e-waste
but even while dismantling, toxic elements are released

4) Re-use
→ the best method present
→ minimize e-waste problems
→ without disposing certain materials, we use them again

• life span of EE & Electronics goods are very low
∴ we need to ↑ life span
So, we need to re-use them.

eg:- • cartridge from printers can be re-filled & re-used instead of disposing it.
Thus, life span of cartridge is increased
• we can also give it back to the manufacturers.

EPR
Extended Producer Responsibility

some policy
• manufacturers should take back materials from people & re-use it

Thus, Re-use, best method.

Key factors for success of e-waste management
→ at end of chapter

Q. Effect of e-waste on (7/8M)

i) environment

3 components : soil, water, air

- Burning e-waste, produces lots of toxic gases & pollute air (In Incineration) Thus causing air pollution
- toxic materials penetrate soil & causes soil pollution (In land-fills & recycling)
  - that further penetrates ground water & thus causes water pollution

carcinogen
solvent → benzene

formic acid → strong
pKa (3.7) weak acid

acetic acid
(4.7)

pKa ↑ less strength

ii) Human health → (atleast 4 metals & health impact)

Substance	Applied in E-waste	Health impact
1) Pb - metal	• solder • lead-acid battery • CRT (cathode-ray tube) • PCB (printed circuit board) • fluorescent tubes	• brain damage • nervous system, kidney & causes respiratory problems
2) Hg	• battery • backlight lamps / bulbs • flat panel displays • switches	damages brain & kidney

3) Cd (Cadmium)

4) As (Arsenic)
- carcinogenic materials

5) Sb (Antimony) (carcinogenic)

6) Organic pollutants
- PVC (poly vinyl chloride)

7) Beryllium - Be (carcinogenic)

8) Barium

9) Chromium

3) Cd (Cadmium)	• Ni-Cd battery • semi conductor chips • IR detector ↓ eg:- PMT (Photo multiplier tubes) converts optical radiation signals to electrical signals	• damages kidney
4) As (Arsenic) • carcinogenic material	• GaAs is (Gallium Arsenide) used in LED	• skin diseases & lung cancer
5) Sb (Antimony) (carcinogenic)	• melting agent in CRT (cathode ray tube) glass • plastic computer house	• stomach pain, vomiting & diarrhoea, stomach ulcer.
6) Organic pollutant • PVC (poly vinyl chloride)	• monitors, keyboards, cabling & plastic computer house	• respiratory problem & skin diseases (chronic effect)
7) Beryllium - Be (carcinogenic)	• power supply boxes • mother boards	• lung cancer • skin diseases
8) Barium		
9) Chromium		

Extraction of Gold from e-waste material

- used in PCB to increase conductivity
- high corrosion resistance

PCB has 3 layers of :- Cu, Ni, Au

↓

Incinerate (at 900-1200°C)

↓

~~Crushing~~

Crushing

↓

Aqua Regia

- acts as leachant (method of making it soluble in gold with suitable solvent & the solvent is leachant)
- (HNO_3 & HCl) ↓ strongest oxidising acid
- HCl → dissolves Cu & Ni present in PCB → slow process
- HNO_3 → dissolves gold → high conc. of HNO_3 to fasten process

I st stage of leaching

$$Au_{(s)} + 3HNO_{3\,(aq)} + 4HCl_{(aq)} \rightleftharpoons H[AuCl_4]_{(l)} + 3NO_{2\,(g)}\uparrow + 3H_2O_{(l)}$$

$H[AuCl_4]$ — tetra chloro aurnate hydrogen

NO_2 — (non-toxic)

II stage leaching of Gold

$$Au_{(s)} + HNO_3 + 4HCl \rightleftharpoons H[AuCl_4] + NO_{(g)}\uparrow + H_2O$$

(NO — toxic)

3) • environmental decision making tool

4) EPR
- environmental policy
- responsibility of producer to take back products used by people (user)

Adv → cheap method
→ no side effect

Disadv →
→ toxic gas i.e. NO released
→ slower method

- where $Au + HNO_3 \rightarrow Au$
- $Au^{3+} + HCl \rightarrow [AuCl$

Confirming (not in syllabus)

→ % & purity of gold

Characterisation Techniques:

i) X-ray diffraction →

ii) EDAX method (Energy Dispersive) → to find composit

Strategies

1) LCA (Life Cycle Asse
2) MFA (Material Flo
3) MCA (Multi
4) EPR (Extended

1) - to design eco friendly
2) - study route of flow of (investigate flow of e-waste)

-waste material

stage of leaching

$Au_{(s)} + 3HNO_{3\,(aq)}$

$4HCl_{(aq)}$

$\rightleftharpoons$

$H[AuCl_4]_{(e)}$

tetra chloro auronate hydrogen

$+ 3NO_{2\,(g)} \uparrow$

(non-toxic)

$+ 3H_2O_{(e)}$

stage leaching of Gold

$Au_{(s)} + 1HNO_3 + 4HCl$

$\rightleftharpoons H[AuCl_4] +$

$NO_{(g)} \uparrow + H_2O$

(toxic)

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environmental decision making tool

EPR

environmental policy responsibility of producer to take back products used by people (user)

→ Advantage → cheap method
→ no side effect

→ Disadvantage →
→ toxic gas i.e. NO released
→ slower method

Other methods
- Hydro metallurgy
- Pyro metallurgy
- Aqua regia

- When $Au + HNO_3 \rightarrow Au^{3+}$ ions
- $Au^{3+} + HCl \rightarrow [AuCl_4]$

Confirming (not in syllabus)

→ % & purity of gold

Characterisation Techniques:

i) X-Ray diffraction → to confirm if gold, for % & morphology

ii) EDAX method (Energy Dispersive X-ray analysis)
→ to find composition of element

Strategies

1) LCA (Life Cycle Assessment)
2) MFA (Material Flow Analysis)
3) MCA (Multi Criteria Analysis)
4) EPR (Extended Producer Responsibility)

1) - to design eco friendly electronic devices
2) - study route of flow of e-waste material into disposal site (investigate flow of e-waste)

Key factors for success of e-waste management (in syllabus)

i) design & produce eco friendly devices

ii) proper collection of e-waste & proper
   a) recovery of nobel metals
   b) recycling by suitable & safe methods
   c) disposals by different techniques

iii) to create awareness among user & consumer abt effects of e-waste in environment