MANAGEMENT OF E-WASTES

It is estimated that 75% of electronic items are stored due to uncertainty of how to manage it. These electronic junks lie unattended in houses, offices, warehouses etc. and normally mixed with household wastes, which are finally disposed off at landfills. This necessitates implementable management measures.

In industries management of e-waste should begin at the point of generation. This can be done by waste minimization techniques and by sustainable product design. Waste minimization in industries involves adopting:

- inventory management,
- production-process modification,
- volume reduction,
- Recovery and reuse.

Inventory management

Proper control over the materials used in the manufacturing process is an important way to reduce waste generation (Freeman, 1989). By reducing both the quantity of hazardous

Materials used in the process and the amount of excess raw materials in stock, the quantity of waste generated can be reduced. This can be done in two ways i.e. establishing material-purchase review and control procedures and inventory tracking system.

Another inventory management procedure for waste reduction is to ensure that only the needed quantity of a material is ordered. This will require the establishment of a strict inventory tracking system. Purchase procedures must be implemented which ensure that materials are ordered only on an as-needed basis and that only the amount needed for a specific period of time is ordered.

Production-process modification

Changes can be made in the production process, which will reduce waste generation. This reduction can be accomplished by changing the materials used to make the product or by the more efficient use of input materials in the production process or both. Potential waste minimization techniques can be broken down into three categories:

i) Improved operating and maintenance procedures,
ii) Material change and
iii) Process-equipment modification.

Volume reduction

Volume reduction includes those techniques that remove the hazardous portion of a waste from a non-hazardous portion. These techniques are usually to reduce the volume, and thus the cost of disposing of a waste material. The techniques that can be used to reduce waste-stream volume can be divided into 2 general categories: source segregation and waste concentration. Segregation of wastes is in many cases a simple and economical technique for waste reduction. Wastes containing different types of metals can be treated separately so that the metal value in the sludge can be recovered. Concentration of a waste stream may increase the likelihood that the material can be recycled or reused. Methods include gravity and vacuum filtration, ultra filtration, reverse osmosis, freeze vaporization etc.

For example, an electronic component manufacturer can use compaction equipments to reduce volume of waste cathode ray-tube.

Recovery and reuse

This technique could eliminate waste disposal costs, reduce raw material costs and provide income from a salable waste. Waste can be recovered on-site, or at an off-site recovery facility, or through inter industry exchange. A number of physical and chemical techniques are available to reclaim a waste material such as reverse osmosis, electrolysis, condensation, electrolytic recovery, filtration, centrifugation etc. For example, a printed-circuit board manufacturer can use electrolytic recovery to reclaim metals from copper and tin-lead plating bath.

However recycling of hazardous products has little environmental benefit if it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use nonhazardous materials, such recycling is a false solution.

Sustainable product design

Minimization of hazardous wastes should be at product design stage itself keeping in mind the following factors*

- **Rethink the product design:** Efforts should be made to design a product with fewer amounts of hazardous materials. For example, the efforts to reduce material use are reflected in some new computer designs that are flatter, lighter and more integrated. Other companies propose centralized networks similar to the telephone system.
- **Use of renewable materials and energy:** Bio-based plastics are plastics made with plant-based chemicals or plant-produced polymers rather than from petrochemicals. Bio-based toners, glues and inks are used more frequently. Solar computers also exist but they are currently very expensive.
- **Use of non-renewable materials that are safer:** Because many of the materials used are non-renewable, designers could ensure the product is built for re-use, repair and/or upgradeability. Some computer manufacturers such as Dell and Gateway lease out their products thereby ensuring they get them back to further upgrade and lease out again.

3.3.2 PLASTICS WASTE MANAGEMENT

Environmental Issues and Challenges

The quantum of solid waste is ever increasing due to increase in population, developmental activities, changes in life style, and socio-economic conditions, Plastics waste is a significant portion of the total municipal solid waste (MSW).
It is estimated that approximately 10 thousand tons per day (TPD) of plastics waste is generated i.e. 9% of 1.20 lacs TPD of MSW in the country.

The plastics waste constitutes two major categories of plastics;

(i) Thermoplastics: Thermoplastics, constitutes 80% and thermoset constitutes approximately 20% of total post-consumer plastics waste generated in India. The Thermoplastics are recyclable plastics.
Eg: Polyethylene Terephthalate (PET), Low Density Poly Ethylene (LDPE), Poly Vinyal Chloride (PVC), High Density Poly Ethylene (HDPE), Polypropylene (PP), Polystyrene (PS) etc.

(ii) Thermoset plastics: Thermoset plastics contains alkyd, epoxy, ester, melamine formaldehyde, phenolic formaldehyde, silicon, urea formaldehyde, polyurethane, metalised and multilayer plastics etc.

The environmental hazards due to mismanagement of plastics waste include the following aspects:

- Littered plastics spoil beauty of the city and choke drains and make important public Places filthy;
- Garbage containing plastics, when burnt may cause air pollution by emitting polluting Gases;
- Garbage mixed with plastics interferes in waste processing facility and may also cause Problems in landfill operations;
- Recycling industries operating in non-conforming areas are posing unhygienic Problems to the environment.

Main Features of the Plastics Manufacture and Usage(Amendment) Rules, 2003

Regulation of plastics waste, particularly manufacture and use of recycled plastics carry bags and containers is being regulated in the country as per "Recycled Plastics Manufacture and Usage Rules, 1999 and as amended in 2003. According to these Rules:

1.No person shall manufacture, stock, distribute or sell carry bags made of virgin or recycled plastic bags which are less than 8 x 12 inches in size and having thickness less than 20 microns.

2. No vendor shall use carry bags/containers made of recycled plastics for storing, carrying, dispensing or packaging of food stuffs

3. Carry bags and containers made of recycled plastic and used for purposes other than storing and packaging food stuffs shall be manufactured using pigments and colorants as per IS 9833:1981 entitled "List of pigments and colorants for use in plastics in contact with food stuffs, pharmaceuticals and drinking water"

4. Recycling of plastics shall be undertaken strictly in accordance with the Bureau of Indian Standard specification: IS 14534:1998 entitled "The Guidelines for Recycling of Plastics"

5. Manufacturers of recycled plastic carry bags having printing facilities shall code/mark carry Bags and containers as per Bureau of Indian Standard specification: IS 14534:1998 (The Guidelines for Recycling of Plastics).

6. No person shall manufacture carry bags or containers irrespective of its size or weight unless the occupier of the unit has registered the unit with respective SPCB/PCC prior to the commencement of production.

7. The prescribed authority for enforcement of the provisions of these rules related to manufacturing and recycling is SPCB in respect of States and the PCC in Union Territories and for relating to use, collection, segregation, transportation and disposal shall be the District Collector/ Deputy Commissioner of the concerned district

Options for Plastic Waste Management

Recycling of plastics through environmentally sound manner:

Recycling of plastics should be carried in such a manner to minimize the pollution during the process and as a result to enhance the efficiency of the process and conserve the energy. Plastics recycling technologies have been historically divided into four general types -primary, secondary, tertiary and quaternary.

- **Primary** recycling involves processing of a waste/scrap into a product with characteristics similar to those of original product.
- **Secondary** recycling involves processing of waste/scrap plastics into materials that have characteristics different from those of original plastics product.
- **Tertiary** recycling involves the production of basic chemicals and fuels from plastics waste/scrap as part of the municipal waste stream or as a segregated waste.
- **Quaternary** recycling retrieves the energy content of waste/scrap plastics by burning / incineration. This process is not in use in India.

Steps Involved in the Recycling Process

1.Selection: The recyclers / reprocessors have to select the waste / scrap which are suitable for recycling /reprocessing.
2.Segregation: The plastics waste shall be segregated as per the Codes 1-7 mentioned
3.Processing: After selection and segregation of the pre-consumer waste (factory waste) shall be directly recycled. The post consumer waste (used plastic waste) shall be washed, shredded, agglomerated, extruded and granulated

Polymer Coated Bitumen Road
The CPCB has undertaken a project in collaboration with Thiagarajar College of Engineering Madurai to evaluate the performance of polymer coated built roads laid during 2002-2006 in different cities.
The observations are as below:

- The coating of plastics over aggregate improves Impact, Los Angels Abrasion and Crushing Value with the increase in the percentage of plastics.
- The extracted bitumen showed almost near value for Marshall stability.
- The entire road was having good skid resistance and texture values.
- All the stretches in the roads have been found reasonably strong.
- The unevenness index values of these roads are nearly 3000 mm/km, which indicate a good surface evenness.
- The plastic tar roads have not developed any potholes, rutting, raveling or edge flaw, even though these roads are more than four years of age.
- Polymer coated aggregate bitumen mix performs well compared to polymer modified bitumen mix.
- Higher percentage of polymer coating improves the binding strength of the mix.
- Foam plastics have better binding values.

3.4 WATER CONSERVATION

Water being one of the most precious and indispensable resources needs to be conserved. The following strategies can be adopted for conservation of water.

1. **Decreasing run-off losses:** Huge water-loss occurs due to run-off on most of the soils, which can be reduced by allowing most of the water to infiltrate into the soil.
This can be achieved by using contour cultivation, terrace framing, water spreading, chemical treatment or improved water-storage system.

a) Contour cultivation: on small furrows and ridges across the slopes trap rainwater and allow more time for infiltration. Terracing constructed on deep soils have large water-storage capacity. On gentle slopes trapped run off is spread over a large area for better infiltration

b) Conservation-bench terracing: It involves construction of a series of benches for catching the runoff water.

c) Water spreading is done by channeling or lagoon-leveling, In channeling, the water flow is controlled by a series of diversions with vertical intervals. In lagoon leveling, small depressions are dug in the area so that there is temporary storage water

d) Chemical wetting agents (Surfactants): These seem to increase the water intake rates when added to normal irrigated soil.

e) Surface crop residues, tillage, mulch, animal residues etc. help in reducing run-off by allowing more time for water to penetrate into the land.

f) Chemical conditioners like gypsum ($CaSO_4.2H_2O$) when applied to sodic soils improve soil permeability and reduce run off. Another useful conditioner is HPAN(hydrolyzed polyacrylonitrile)

g) Water-storage structures like farm ponds, dug-outs etc. build by individual farmers can be useful measures for conserving water through reduction of runoff.

2. **Reducing evaporation losses:** This is more relevant in humid regions. Horizontal barriers of asphalt placed below the soil surface increase water availability and increase crop yield by 35-40%. This is more effective on sandy soil but less effective on loamy sand soils. A co-polymer of starch and acrylonitrile called ‘super slumper’ has been reported to absorb water up to 1400 times its weight. The chemical has been found to be useful for sandy soils.

3. Storing water in soil: Storage of water takes place in the soil root zone in humed regions when the soil is wetted to field capacity. By leaving the soil fallow for one season water can be made available for the crop grown in next season.

4. **Reducing irrigation losses:**

a) Use of lined or covered canals to reduce seepage

b) Irrigation in early morning or late evening to reduce evaporation losses

c) Sprinkling irrigation and drip irrigation to conserve water by 30-50%

d) Growing hybrid crop varieties with less water requirements and tolerance to saline Water help conserve water.

5. **Reuse of water:**

a) Treated wastewater can be used for ferti-irrigation

b) Using grey water from washings, bath-tubs etc. for watering gardens, washing cars or paths help in saving fresh water.

6. **Preventing wastage of water:** This can be done in households, commercial buildings and public places.

a) Closing taps when not in use
b) Repairing any leakage from pipes
c) Using small capacity flush in toilets.

7. **Increasing block pricing:** The consumer has to pay a proportionately higher bill with higher use of water. This helps in economic use of water by the consumer

3.4.1 RAIN WATER HARVESTING

Introduction:

The term rainwater harvesting is being frequently used these days, however, the concept of water harvesting is not new for India. Water harvesting techniques had been evolved and developed centuries ago.

Ground water resource gets naturally recharged through percolation. But due to indiscriminate development and rapid urbanization, exposed surface for soil has been reduced drastically with resultant reduction in percolation of rainwater, thereby depleting ground water resource. Rainwater harvesting is the process of augmenting the natural filtration of rainwater in to the underground formation by some artificial methods. "Conscious collection and storage of rainwater to cater to demands of water, for drinking, domestic purpose & irrigation is termed as Rainwater Harvesting.

Why to harvest rain water?

- To arrest ground water decline and augment ground water table
- To beneficiate water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

Rainwater harvesting can be harvested from the following surfaces:

Rooftops: If buildings with impervious roofs are already in place, the catchment area is effectively available free of charge and they provide a supply at the point of consumption.

Paved and unpaved areas i.e., landscapes, open fields, parks, storm water drains, roads and pavements and other open areas can be effectively used to harvest the runoff. The main advantage in using ground as collecting surface is that water can be collected from a larger area. This is particularly advantageous in areas of low rainfall.

Water bodies: The potential of lakes, tanks and ponds to store rainwater is immense. The harvested rainwater can not only be used to meet water requirements of the city, it also recharges groundwater aquifers.

Storm water drains: Most of the residential colonies have proper network of storm water drains. If maintained neatly, these offer a simple and cost effective means for harvesting rainwater.

Types of Harvesting System

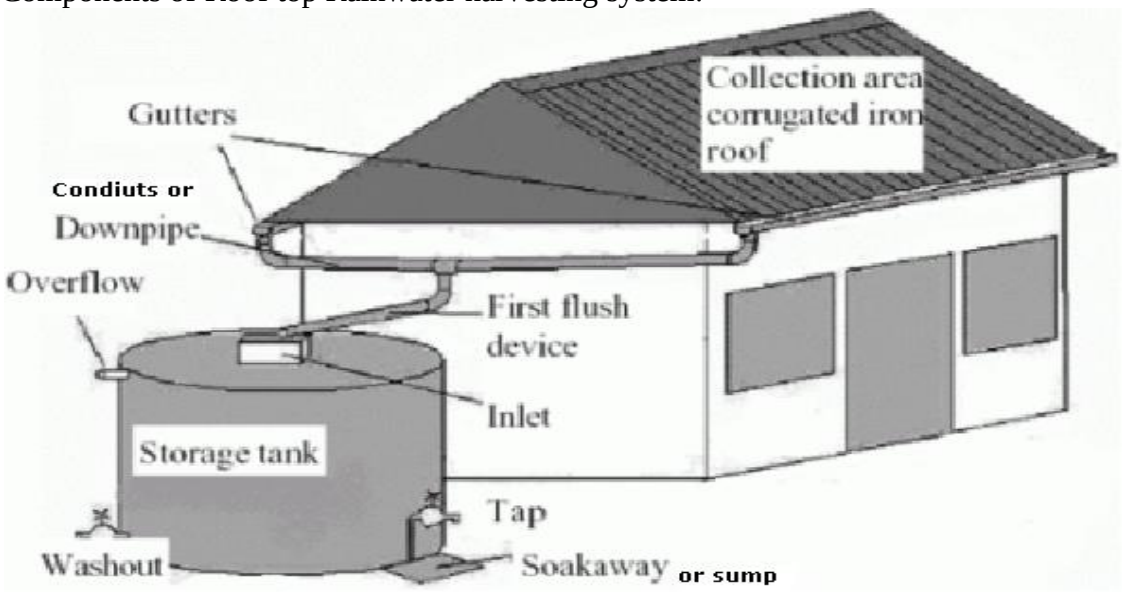
Broadly rainwater can be harvested for two purposes

A. Roof top rain water harvesting (RTRWH)
B. Charged into the soil for withdrawal later (groundwater recharging)

A. Roof top rain water harvesting (RTRWH)

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

Components of Roof top Rainwater harvesting system:



Roof top rain water harvesting system

The system mainly constitutes of following sub components**:**

- Catchment, Coarse mesh, Gutters, Conduits or Conveyance
- Transportation
- First flush
- Filter
- Storage
- Supply unit

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1. **Catchments:** The catchment of a water harvesting system is the surface which directly receives the rainfall and provides water to the system. It can be a paved area like a terrace or courtyard of a building, or an unpaved area like a lawn or open ground. A roof made of reinforced cement concrete (RCC), galvanized iron or corrugated sheets can also be used for water harvesting.