Introduction to E-Waste, Biomedical waste and Solid waste.

Introduction about Waste

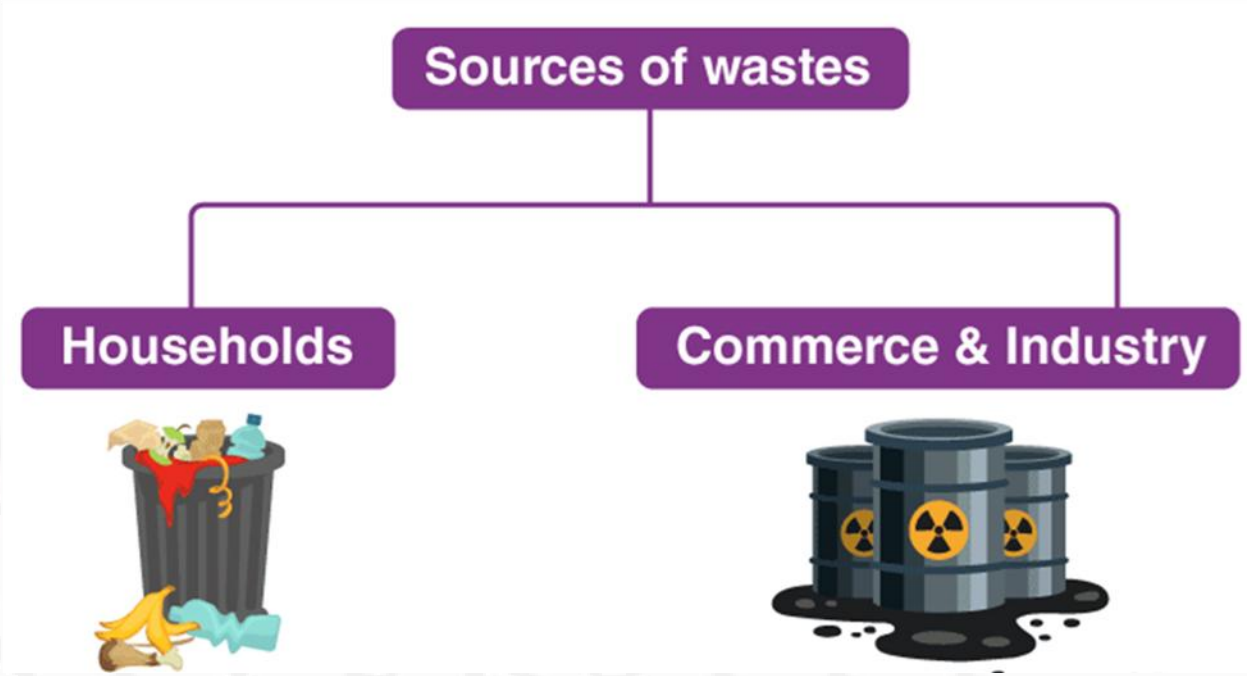
What are Wastes?

Wastes (also known as **rubbish**, **trash**, **refuse**, **garbage**, **junk**, **litter**) is unwanted or useless materials. In biology, waste is any unwanted substances or toxins that are expelled from living organisms and metabolic waste such as urea and sweat.

Waste is generated from human activity mostly. Rapid and unplanned development and modification of livelihood all over the world put complexity in the generated waste. Overall biosphere is degraded rapidly due to continuous release of hazardous pollutants from different industries throughout the world. Rapid expension of health-care facilities and modernization of agricultural practices generate large quantity of biomedical and agricultural wastes which brings adverse effect on environmental health. There are three kinds of wastes mainly such as solid waste, liquid waste and gaseous waste.

Waste is defined as **unwanted and unusable materials** and is regarded as a substance which is of no use. Waste that we see in our surroundings is also known as garbage. Garbage is mainly considered as a solid waste that includes wastes from our houses (domestic waste), wastes from schools, offices, etc. (municipal wastes) and wastes from industries and factories (industrial wastes).

Sources of Waste



Classification of Waste

- Waste can be solid, liquid and gas or waste heat. Waste is classified by its source and by its characteristics. Waste products can be differentiated according to their source and types.
- Generally there are four sources from where waste can be generated such as **industrial, municipal, biomedical and electronic**. Waste can be classified on the basis of different criteria such as based on matter, based on degradation feature, based on environmental impact and based on the source. Each category may be of different types which are shown on Fig. 1.

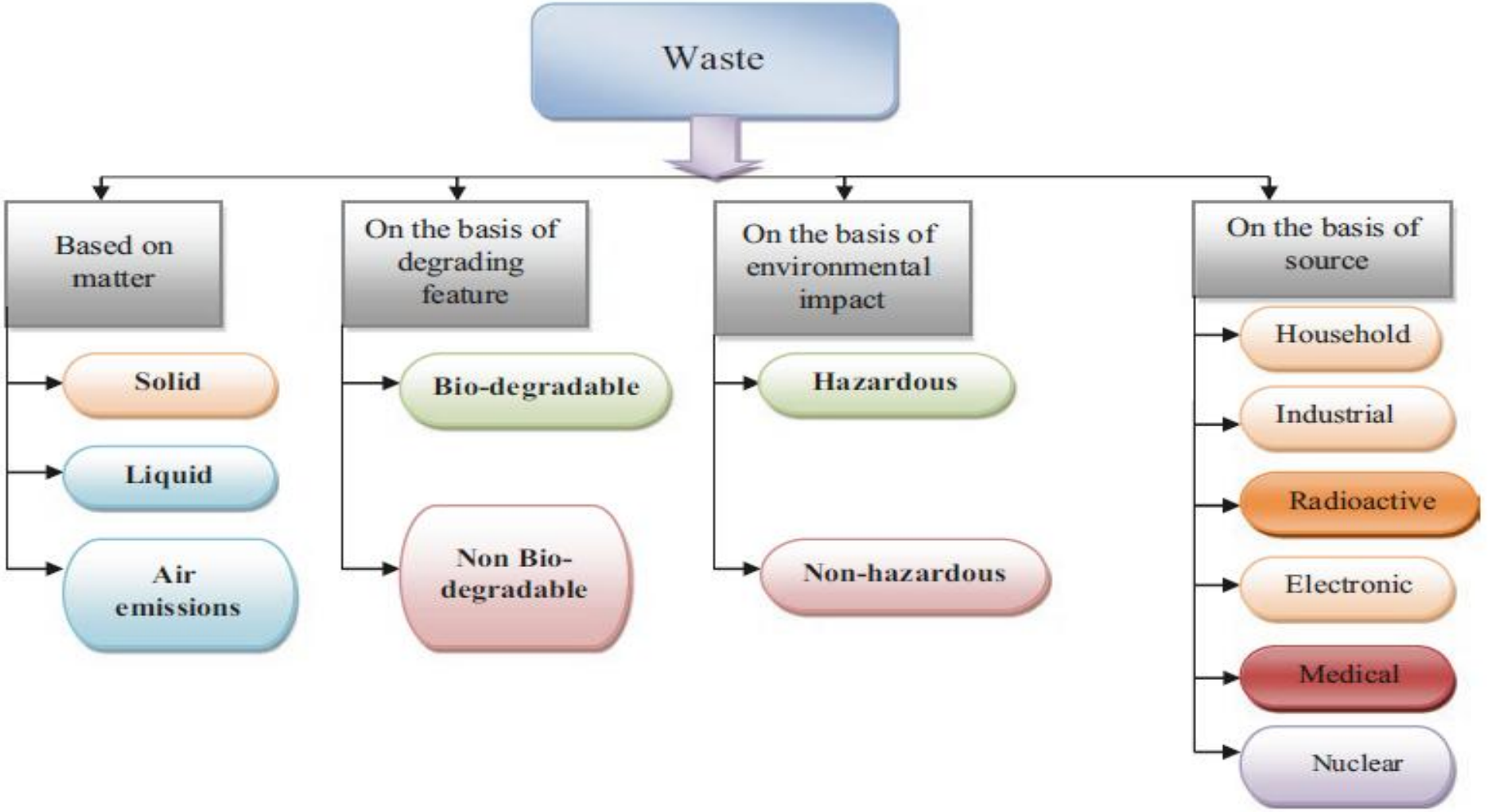


Fig. 1 Different types of waste

Classification of Wastes according to their Properties

Bio-degradable

can be degraded (paper, wood, fruits and others)

Non-biodegradable

cannot be degraded (plastics, bottles, old machines,cans, styrofoam containers and others)

Classification of Wastes according to their Effects on Human Health and the Environment

- **Hazardous wastes**
- Substances unsafe to use commercially, industrially, agriculturally, or economically and have any of the following properties- ignitability, corrosivity, reactivity & toxicity.
- **Non-hazardous**
- Substances safe to use commercially, industrially, agriculturally, or economically and do not have any of those properties mentioned above. These substances usually create disposal problems.

Classification of wastes according to their origin and type

- **Municipal Solid wastes:** Solid wastes that include household garbage, rubbish, construction & demolition debris, sanitation residues, packaging materials, trade refuges etc. are managed by any municipality.
- **Bio-medical wastes:** Solid or liquid wastes including containers, intermediate or end products generated during diagnosis, treatment & research activities of medical sciences.
- **Industrial wastes:** Liquid and solid wastes that are generated by manufacturing & processing units of various industries like chemical, petroleum, coal, metal gas, sanitary & paper etc.
- **Agricultural wastes:** Wastes generated from farming activities. These substances are mostly biodegradable.
- **Fishery wastes:** Wastes generated due to fishery activities. These are extensively found in coastal & estuarine areas.
- **Radioactive wastes:** Waste containing radioactive materials. Usually these are byproducts of nuclear processes. Sometimes industries that are not directly involved in nuclear activities, may also produce some radioactive wastes, e.g. radio-isotopes, chemical sludge etc.
- **E-wastes:** Electronic wastes generated from any modern establishments. They may be described as discarded electrical or electronic devices. Some electronic scrap components, such as CRTs, may contain contaminants such as Pb, Cd, Be or brominated flame retardants.

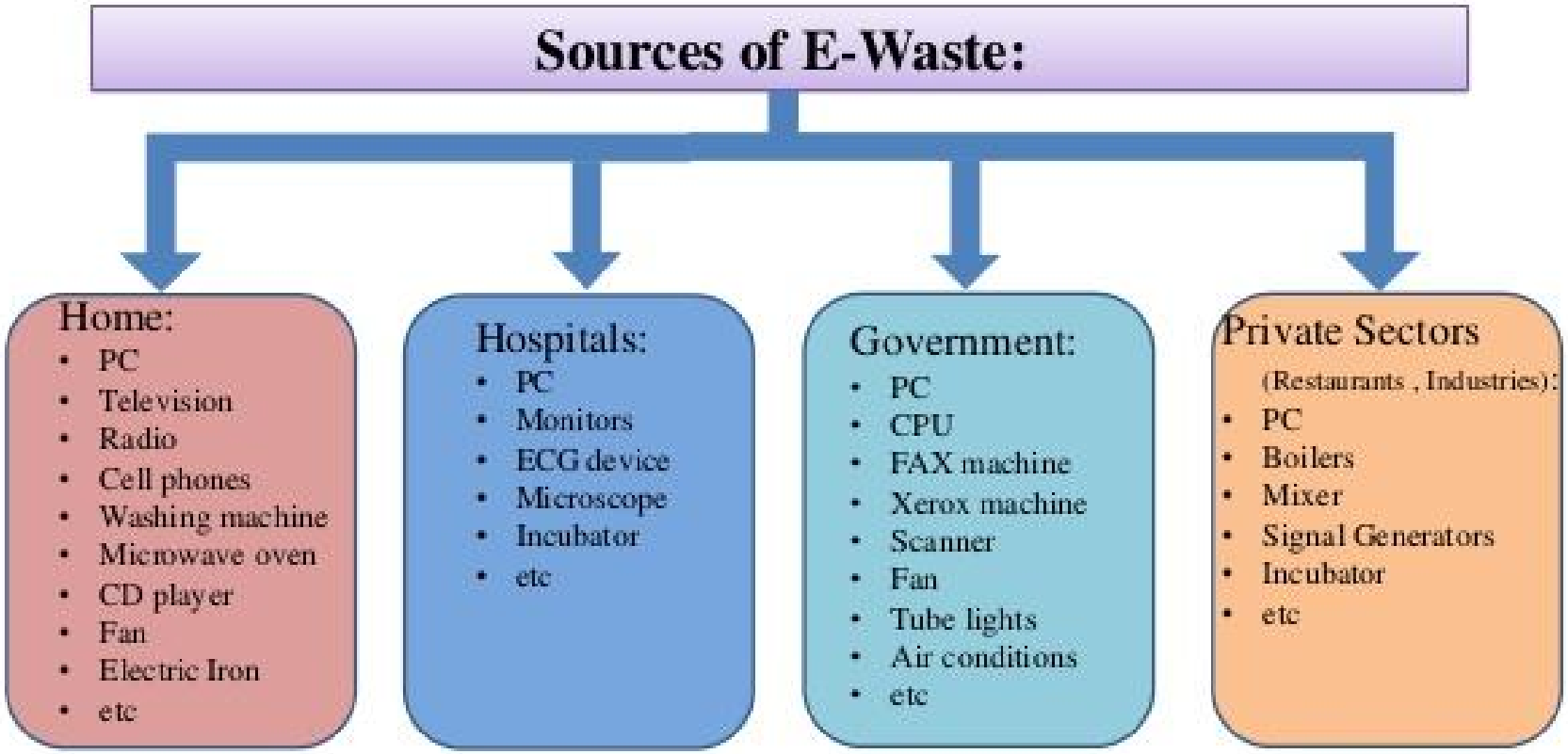
Electronic Wastes: e-Wastes

What is E-waste?

Electronic Waste (e-Waste) comprises of waste electronic/electrical goods which are not fit for their originally intended use. These include items such as computers, cellular phones, stereos, refrigerators, air conditioners, other consumer durables, etc.

Is e-Waste Hazardous?

E-waste is not hazardous waste per-se. However, the hazardous constituents present in the e-waste render it hazardous when such wastes are dismantled and processed, since it is only at this stage that they pose hazard to health and environment.


Sources of E-Waste:
Home:
PC
Television
Radio
Cell phones
Washing machine
Microwave oven
CD player
Fan
Electric Iron
etc
Hospitals:
PC
Monitors
ECG device
Microscope
Incubator
etc
Government:
PC
CPU
FAX machine
Xerox machine
Scanner
Fan
Tube lights
Air conditions
etc
Private Sectors
(Restaurants , Industries):
PC
Boilers
Mixer
Signal Generators
Incubator
etc

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How these become E-Waste?

Reasons:

- Advancement in technology
- Changes in Style, Fashion & Status
- Nearing the end of their useful life
- Not taking precautions while handling them

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Constituents of E-Waste:

E-Waste Source	E-Waste Component	Environmental Hazard	Effects on Human
CRTs (used in TVs, Monitors, ATM, Video Camera, etc), Batteries, PVC cables, Paints	Lead, barium & other heavy metals	These metals leaching into the ground water and release of toxic phosphor	Anemia, Renal Toxicity, Insomnia
Batteries, Housing & Medical Equipment	Mercury	Air emissions as well as discharge into rivers of glass dust	Renal Toxicity, Muscle tumors, Mental retardation, Cerebral palsy
Plastics from printers, keyboards, monitors, etc	plasticizer bisephenol-A(or BPA), as well DEHP and DBP, plastic compounds known as phthalates	Chlorinated plastics release harmful chemicals into the surrounding soil, which seep into ground water or other surrounding water sources which cause serious harm to the species that drink this water.	Risk in developing heart problems, obesity, reproductive disease
PVC & polymer, Paints, Printing inks, Electrical transformers & capacitors	Polychlorinated Biphenyls (PCBs)	include extreme pollution from production, toxic chemical exposure during use, hazards from fires	Suppression of immune system; Damage to the liver, nervous and reproductive systems

Why disposal of e-waste is necessary?

- Landfill disposal allows heavy metals to leach into ground water
- Incineration makes hazardous material airborne
- Acid baths are dangerous and cause water and soil contamination
- Exported materials need to be handled carefully

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E-Waste Disposal

Methods of treatment & disposal:

- *Landfill*
- *Incineration*
- *Pyrolysis*
- *Recycle & Reuse*

Existing E-Waste Management Practices in India :-

- *Plastic Waste :*

Products made from plastics such as keyboards, casing, front or real panel. Miscellaneous parts encased in plastics

Management Practice - The shredding & melting

- *Printed Circuit Board Waste:*

Used in electronic parts such as motherboard, TV internal circuits, etc

Management Practice – De soldering & open burning to remove metals.

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Continue…

- *Miscellaneous Waste:*

  Chips, electronic wires, broken glass waste, copper containing waste.

Management Practice- Chemical stripping & open burning & some of the waste is mixed with the municipal solid waste

- *Liquid Waste:*

  It contains internal chemicals, general waste, acid stripping waste.

Management Practice – Sewerage system

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Recycling of E-Waste

- ***Disassembly/dismantling*** :

Disassembly is the systematic removal of components, parts, a group of parts or a subassembly from a product which is in E-Waste

- ***Upgrading :***

It includes comminuting and separation of materials using mechanical / physical and/or metallurgical processing. Methods to recover materials include incineration and refining.

- ***Materials Recovery*** :

The material are recovered by recycling facilities. The plastic, glass, metals can be recovered by sorting them before mixing with other waste.

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WHAT IS BIO-MEDICAL WASTE ??

Definition

Waste generated during the diagnosis, testing, treatment, research or production of biological products for humans or animals (WHO)

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SOURCES OF BIO-MEDICAL WASTE

Major Sources

- Hospitals
- Labs
- Research centers
- Animal research
- Blood banks
- Nursing homes
- Mortuaries
- Autopsy centers

Minor sources

- Clinics
- Dental clinics
- Home care
- Cosmetic clinics
- Paramedics
- Funeral services
- Institutions

CATEGORIES OF BMW & DISPOSAL

OPTIONS	TYPE OF WASTE	TREATMENT & DISPOSAL
Cat No. 1	***Human Anatomical Waste*** (Human tissues, organs, body parts)	Incineration/ deep burial
Cat No. 2	***Animal Waste*** (Animal tissues, organs, body parts, carcasses, bleeding parts, fluid, blood etc)	Incineration/ deep burial
Cat No. 3	***Microbiology & Biotechnology Waste*** (Wastes from laboratory cultures, toxins and devices used for transfer of cultures etc)	Local autoclaving/ microwaving / incineration

Cat No. 4	***Waste Sharps*** (Needles, syringes, scalpels, blades, glass, etc.)	Disinfection
Cat No. 5	***Discarded Medicine and Cytotoxic drugs*** (outdated, contaminated, discarded medicines)	Incineration / landfills
Cat No. 6	***Soiled Waste*** (Items contaminated with body fluids, other materials contaminated with blood.)	Incineration / autoclaving / microwaving
Cat No. 7	***Solid Waste*** (Waste generated from disposable items other than the waste sharps.)	Disinfection

Cat No. 8	***Liquid Waste*** (Waste generated from the laboratory and washing, cleaning, house keeping and disinfecting activities)	Disinfection
Cat No. 9	***Incineration Ash*** (Ash from incineration of any biomedical waste)	Disposal in municipal landfill
Cat No.10	***Chemical Waste*** (Chemicals used in production of biologicals, chemicals used in disinfecting, as insecticides, etc.)	Chemical treatment

Waste Sharps eg: Needles

Discarded medicines

Human anatomical waste

Solid waste eg: cotton swabs

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HAZARDOUS HEALTH CARE WASTE CAN RESULT IN

1. Infection
2. Genotoxicity and Cytotoxicity
3. Chemical toxicity
4. Radioactivity hazards.
5. Physical injuries
6. Public sensitivity.

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COLOUR CODING & TYPE OF CONTAINER FOR DISPOSAL OF BIO-MEDICAL WASTES

COLOR CODE	TYPE OF CONTAINER	WASTE CATEGORY	TREATMENT OPTIONS
Yellow 	plastic bags	1, 2, 3 and 6	Incineration/ Deep burial
Red 	plastic bags/disinfected container	3, 6 & 7	Autoclave/ Microwave/ Chem Tmt
Blue/White 	plastic bags/puncture proof containers	4,7	Autoclave/ Microwave/ Chem Tmt
Black 	plastic bags	5,9,10	Land fill

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DISPOSAL METHODS OF BIO-MEDICAL WASTES

1. Incineration
2. Chemical disinfection
3. Wet & Dry thermal process
4. Microwave irradiation
5. Land disposal
6. Inertization

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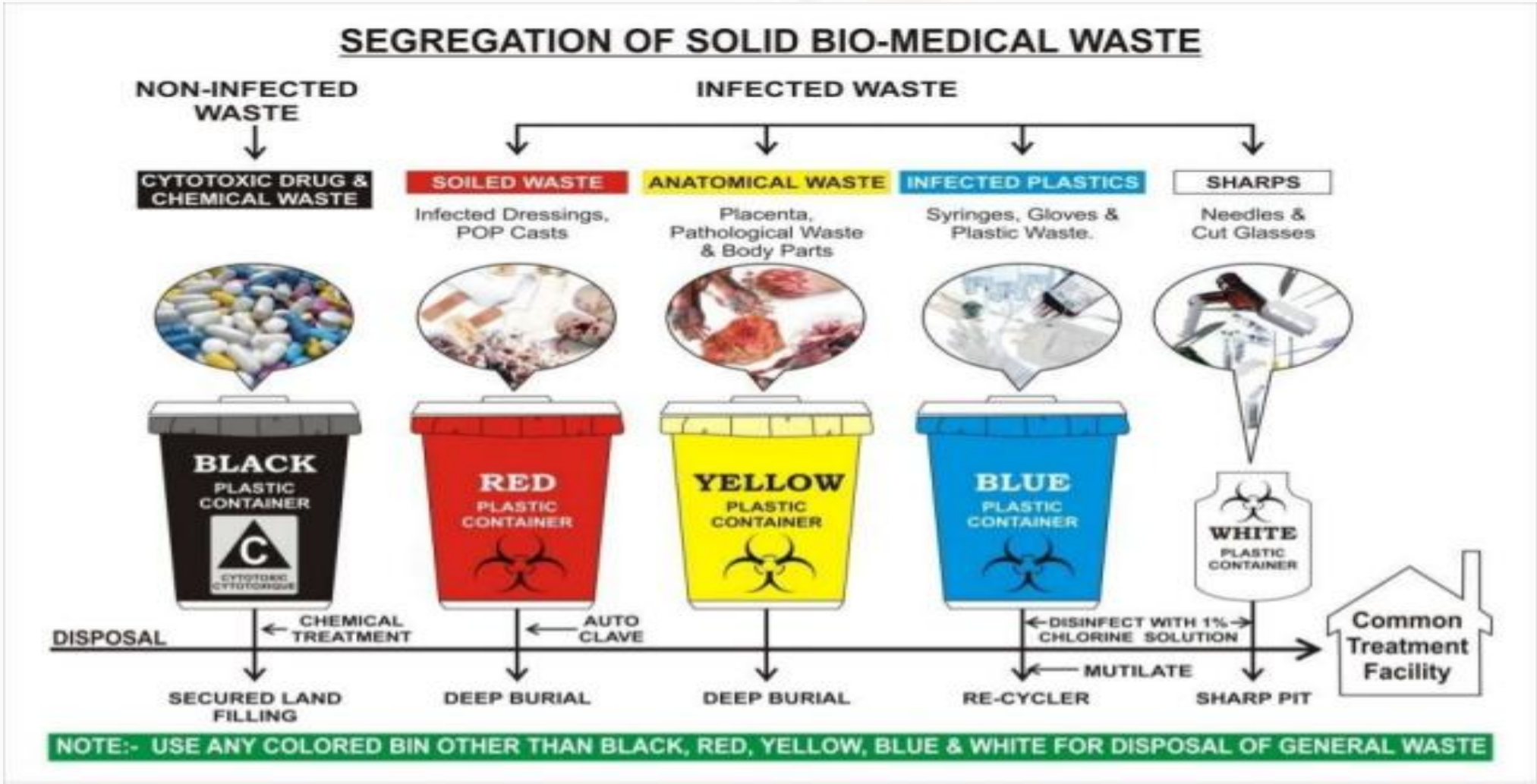
- **Incineration**
  - High temp. dry oxidation process
  - Combustible organic matter → inorganic, incombustible matter

Type of incinerators

a) Double chamber pyrolytic incinerator
b) Single chamber furnace with static gate
c) Rotary kilns

- **Chemical Disinfection**
  - Chemicals are added to waste to kill/ inactivate the pathogens
- **Wet thermal treatment/ steam disinfection**
  - Shredded waste exposed to high temperature, high pressure steam
- **Dry thermal treatment/ Screw feed technology**
  - Dry thermal disinfection process
  - Heated in a rotating auger

- **Microwave irradiation**
  - Micro organisms are destroyed by heat conduction
- **Land disposal**
  - Sanitary land fills are preferrable
- **Inertization**
  - Mixing waste with cement and other substances ➔ minimizes the migration of toxic substances to surface/ ground water


SEGREGATION OF SOLID BIO-MEDICAL WASTE
NON-INFECTED WASTE
INFECTED WASTE
CYTOTOXIC DRUG & CHEMICAL WASTE
SOILED WASTE
ANATOMICAL WASTE
INFECTED PLASTICS
SHARPS
Infected Dressings, POP Casts
Placenta, Pathological Waste & Body Parts
Syringes, Gloves & Plastic Waste.
Needles & Cut Glasses
BLACK PLASTIC CONTAINER
RED PLASTIC CONTAINER
YELLOW PLASTIC CONTAINER
BLUE PLASTIC CONTAINER
WHITE PLASTIC CONTAINER
DISPOSAL
CHEMICAL TREATMENT
AUTO CLAVE
DISINFECT WITH 1% CHLORINE SOLUTION
MUTILATE
Common Treatment Facility
SECURED LAND FILLING
DEEP BURIAL
DEEP BURIAL
RE-CYCLER
SHARP PIT
NOTE:- USE ANY COLORED BIN OTHER THAN BLACK, RED, YELLOW, BLUE & WHITE FOR DISPOSAL OF GENERAL WASTE

Industrial Waste

These are the wastes created in factories and industries. Most industries dump their wastes in rivers and seas which cause a lot of pollution.

Example: plastic, glass, etc.

Commercial Waste

Commercial wastes are produced in schools, colleges, shops, and offices.

Example: plastic, paper, etc.

Domestic Waste

The different household wastes which are collected during household activities like cooking, cleaning, etc. are known as domestic wastes.

Example: leaves, vegetable peels, excreta, etc.

Agricultural Waste

Various wastes produced in the agricultural field are known as agricultural wastes.

Example: cattle waste, weed, husk, etc.

Solid Waste

What is Solid Waste?

Solid waste comprises of all the wastes arising from human and animal activities that are typically solid and that are discarded as useless or unwanted.

Some of the commonly used synonyms in solid wastes are:

Re-use: This is a more appropriate term for solid waste as most waste can be utilized as a raw material for some other purpose.
Garbage: It consist of kitchen/wet waste.
Rubbish: Those wastes with high ash content.
Scrap: Wastes that have high metal content.
Debris: Bulky wastes such as construction waste.

Impacts Of Solid Wastes

Chemical poisoning through chemical inhalation

Uncollected waste can obstruct the storm water runoff resulting in flood

Soil Contamination

Cancer

Neurological disease

Nausea and vomiting

Increase in hospitalization of residents living near hazard waste sites.

Mercury toxicity from eating fish with high levels of mercury.

Impacts Of Solid Wastes On Aqualtic Life

Increase in mercury level in fish due to disposal of mercury in the rivers.

Plastic found in oceans ingested by birds.

Resulted in high algal population in rivers and sea.

Degrades water and soil quality.

Change in climate and destruction of ozone layer due to waste biodegradable- Green house gas -**Methane**

Leaching: is a process by which solid waste enter soil and ground water and contaminating them.

Solid waste Reduction

WHAT SHOULD BE DONE ??

Reduce Waste

Improve product design to use less materials.

- Redesign packaging to eliminate excess toxic materials while maintaining the quality.

- Work with customers to design and implement a packaging.

- Switch to reusable transport containers.

- Purchase products in bulk.

Reuse

Reuse office furniture and supplies, such as envelopes, file folders, and paper.

- Use durable towels, tablecloths, napkins, dishes, cups, and glasses.

- Use reusable packaging materials for outgoing shipments.

- Encourage employees to reuse office materials rather than purchase new ones.

Solid waste Reduction

Conduct outreach program adopting an ecologically sound waste management system which includes:

- waste reduction
- segregation at source
- Composting
- recycling and re-use
- more efficient collection
- more environmentally sound disposal

IMPACTS OF WASTE IF NOT MANAGED WISELY

- Affects our health
- Affects our socio-economic conditions
- Affects our coastal and marine environment
- Affects our climate

- GHGs are accumulating in Earth's atmosphere as a result of human activities, causing global mean surface air temperature and subsurface ocean temperature to rise.

- Rising global temperatures are expected to raise sea levels and change precipitation and other local climate conditions.

- Changing regional climates could alter forests, crop yields, and water supplies.

- This could also affect human health, animals, and many types of ecosystems.

- Deserts might expand into existing rangelands, and features of some of our national parks might be permanently altered.

IMPACTS OF WASTE…

- Some countries are expected to become warmer, although sulfates might limit warming in some areas.

- Scientists are unable to determine which parts of those countries will become wetter or drier, but there is likely to be an overall trend toward increased precipitation and evaporation, more intense rainstorms, and drier soils.

- Whether rainfall increases or decreases cannot be reliably projected for specific areas.

Impacts of waste….

- Activities that have altered the chemical composition of the atmosphere:

- Buildup of GHGs primarily carbon dioxide (CO_2) methane (CH_4), and nitrous oxide (N_20).

- CO_2 is released to the atmosphere by the burning of fossil fuels, wood and wood products, and solid waste.

- CH_4 is emitted from the decomposition of organic wastes in landfills, the raising of livestock, and the production and transport of coal, natural gas, and oil.

- $N0_2$ is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels. In 1977, the US emitted about one-fifth of total global GHGs.

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IMAGES

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