Unit-V

Solid and Health care Waste

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- Waste and health risks

Waste

Also known as rubbish, trash, refuse, garbage, junk) is an unwanted or useless materials.

OR,

Any materials unused and rejected as worthless or unwanted and "A useless or profitless activity using or expanding on consuming thoughtlessly or carelessly.

Types of waste

On the basis of source, broadly there are 3 types of waste

1. Household waste (municipal waste)
2. Industrial waste (hazardous waste)
3. Biomedical waste or hospital waste (infectious waste)

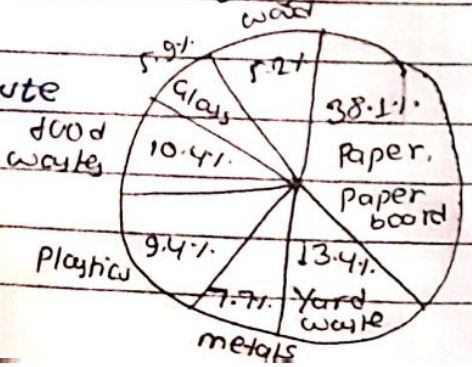
1 Household waste (municipal waste)

Municipal solid waste consist of:

- household waste
- construction and demolition debris
- sanitation residue
- waste from streets

with rising urbanization and change in life
- style and food habits, the amount of
- municipal solid waste has been increasing
- rapidly and its composition changing

Contents of municipal waste



2. Industrial waste (hazardous waste)

- Industrial and hospital waste is considered hazardous as they may contain toxic substances.
- Hazardous waste could be highly toxic to humans, animals and plants.
- In the industrial sector the major generators of hazardous waste are the metals' chemicals', paper, pesticide, dye and rubber goods industries.
- Direct exposure to chemicals in hazardous waste such as mercury and cyanide can be fatal.

Type of waste (Based on nature)

- Solid waste
- Liquid waste
- Gaseous waste
- Animal by products (ABPs)
- Biodegradable waste
- Chemical waste
- Commercial waste / Business waste
- Biomedical waste
- Bulky waste

Impacts of waste on health

i) Chemical poisoning through chemical inhalation
ii) Uncollected waste can obstruct the storm water runoff resulting in flood
iii) Low birth weight
iv) Cancer
v) Congenital malformations

vi) Neurological disease

vii) Nausea and vomiting

viii) Increase in hospitalization of diabetic residents living near hazard waste sites.

ix) Mercury toxicity from eating dish with high level of mercury.

- Solid Waste

It is defined as

"non-liquid, non soluble materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances."

Solid waste also include

- Garbage
- Rubbish
- Demolition products
- Sewage treatment residue
- Dead animals
- Manure and other discarded materials

Per capita solid waste output 0.25-2.5kg/d

Source (Generation of solid waste)

- Agriculture
- Fisheries
- Household
- Commercial and industry

Effects of solid waste

- Health hazards
  - This may lead to epidemic outbreaks.
  - Many diseases like cholera, Diarrhoea, dysentery, plague, Jaundice, or gastro intestinal diseases may spread and cause loss of human lives

- In addition improper handling of the solid wastes, a health hazards for the workers who come in direct contact with the waste.

Environmental impact

If the solid wastes are not treated properly decomposition and putrefaction (decay) may not take place.

- The organic solid waste during decomposition may generate obnozious (intoleroble odour).

- Integrated Management of solid waste

Waste Management concept

3Rs (Reduce, Reuse, Recycle) to be followed by waste management.

i) Reduce

Disposable goods:- paper plate, paper bowl, styrofoam cup, plastic spoon, roll of paper towels, paper napkin; Durable goods: ceramic/plastic plate, metal spoon, glass/plastic drinking cup, dish towel, cloth napkin).

Recovery of 1 tonne paper can save 17 trees.

ii) Reuse

Instead of buying new containers from the market, use the ones that are in house.

iii) Recycle

Use shopping bags made of cloth or jute which can be used over and over.

Integrated solid waste management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program.

- An effective ISWM system considers how to prevent, recycle and manage solid waste in ways that most effectively protect human health and the environment.

Process of solid waste management include following steps:

1. Storage
2. Collection
3. Transport and handling
4. Recycling
5. Disposal and monitoring of waste materials

1 Storage

- Galvanized steel dustbin
- Paper sack
- ~~Pape~~Public bins

2. Collection

- house-to-house collection
- collection from public bins

3 Waste handling and transport

waste handling and separation involves activities associated with waste management until the waste is placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection.

- Waste is transferred from a smaller collection vehicle to larger transport equipment.

4. Recycling
The materials from which the items are made can be processed into new products.

5 Methods of Disposal
a. Dumping
b Controlled Tipping or sanitary Landfill
c. Incineration
d. composting
e. Manure pits
f. Burial

Objective of waste disposal
- Public hygiene and health
- Reuse, Recover and recycle
- Energy generation
- Sustainable development
- Aesthetics

a. Dumping
- Low lying areas
- Mainly for dry refuses
- Kolkata disposes by using this method
- Method and reclaimed land given for cultivation
- Unsanitary method
  - Exposed to flies and rodents
  - Nuisance
  - Dispersed by wind

- Pollution of surface water

b Controlled Tipping or Sanitary Landfill

- Satisfactory method
- Material placed in a trench
- Compacted with earth at the end of the working day.

- Modified sanitary landfill - where compaction and covering are accomplished once or twice a week.

3 methods

i) Trench methods
ii) Ramp methods
iii) Area methods

i) Trench method

- Long trench of 6-10 feet deep and 12-36 feet wide
- Refuse is compacted and covered with excavated earth.
- Refuse is filled upto 6 feet.
- It is estimated one acre of land per year for 10,000 population.

ii) Ramp method

It is suited where the terrain is moderately slopping.

iii) Area method

- Used for filling land depressions, disused quarries and clay pits.
- Sealing prevents infestation by flies and rodents
- Prevents nuisance of smell and dust.

c Incinaratory

- It is a disposal method in which solid organic wastes are subjected to combustion so as to convert them into residue and gaseous products.

- This process reduces the volumes of solid waste to 20-30% of the original volume.
- Also described as thermal treatment.

d Compositoring

- Method of combined disposal of refuse and night soil/sludge
- Principal by products are CO_2, water and heat
- End product - compost
- Methods

a. Bangalore method
b Mechanical composting
c. Vermicomposting

e Manure pits

- Mostly used in rural areas
- "Digging 'manure pits' is to prevent the refuses thrown around the houses.
- Two pits will be needed.
- In the garbage, cattle dung, straw, and leaves should be dumped into manure pits and covered with earth.

- In 5-6 months time the refuse is converted into manure which can be returned to the field.

f Burial

- Suitable for small camp
- A trench 1.5m wide & 2 m deep is excavated
- The refuse is coveted with 20-30cm of earth
- When the level in the trench is 40cm from ground level, the trench is filled with earth & compacted

Sewage / Liquid waste management

Sewage is waste water from a community containing solid and liquid excreta.

The avg amount of sewage which flows through the sewerage system in 24 hours is called dry weather flow

The total waste water is divided into two parts:

Dry weather flow

Storm weather flow

Dry weather flow

- It refers to the waste water flow in a sewer system during periods of dry weather with minimum infiltration. The consequences of the lower flow apply to both combined sewer system and to separate sanitary sewer systems.

- It consists mainly of
  - Domestic sewage
  - Industrial waste water

- The dry weather flow is also sometimes called as "sanitary sewage"

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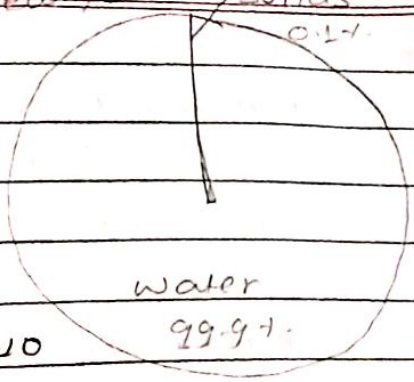
Composition of sewage



- water: 99.9%
- organic and inorganic solid - 0.1%.
- one gram faeces may contain about 1000 million E.coli, 10-100 million faecal streptococci and 1-10 million spores of Cl. perfringes.

Sources of liquid waste

- Municipalities (houses, business, institutions etc. from sinks, tubs, showers, toilets
- Agricultural activities: rainfall and irrigation runoff from farms contains fertilizer, pesticides, manure and soils; runoff from ranches and feedlots contains nutrients, organic matter, bacteria, growth hormones and drugs.
- Industry. Industrial wastewater may contain petroleum products metal, acids and other chemicals, nutrients and sediments

Wastewater generation

It may be defined from the standpoint of sources of generation as a combination of the liquid or water-carried wastes removed from institution, commercial and industrial establishments.

The immediate and nuisance free removal of waste water from its sources of generation followed by treatment, reuse or disposal into the environment is necessary to protect public health and the environment.

Health aspects

- Creation of nuisance, unsightliness and pleasant odours.
- Breeding of flies and mosquitoes
- Pollution of soil and water supplies
- contamination of food
- Increased incidence of disease

Sewage purification

aims

- To stabilize the organic matters so that it can be disposed of safely.
- To convert the sewage water into an effluent of an acceptable standard of purity which can be disposed of into land, rivers or sea.

Decomposition of organic matter < aerobic process / anaerobic process

3 Types of treatment

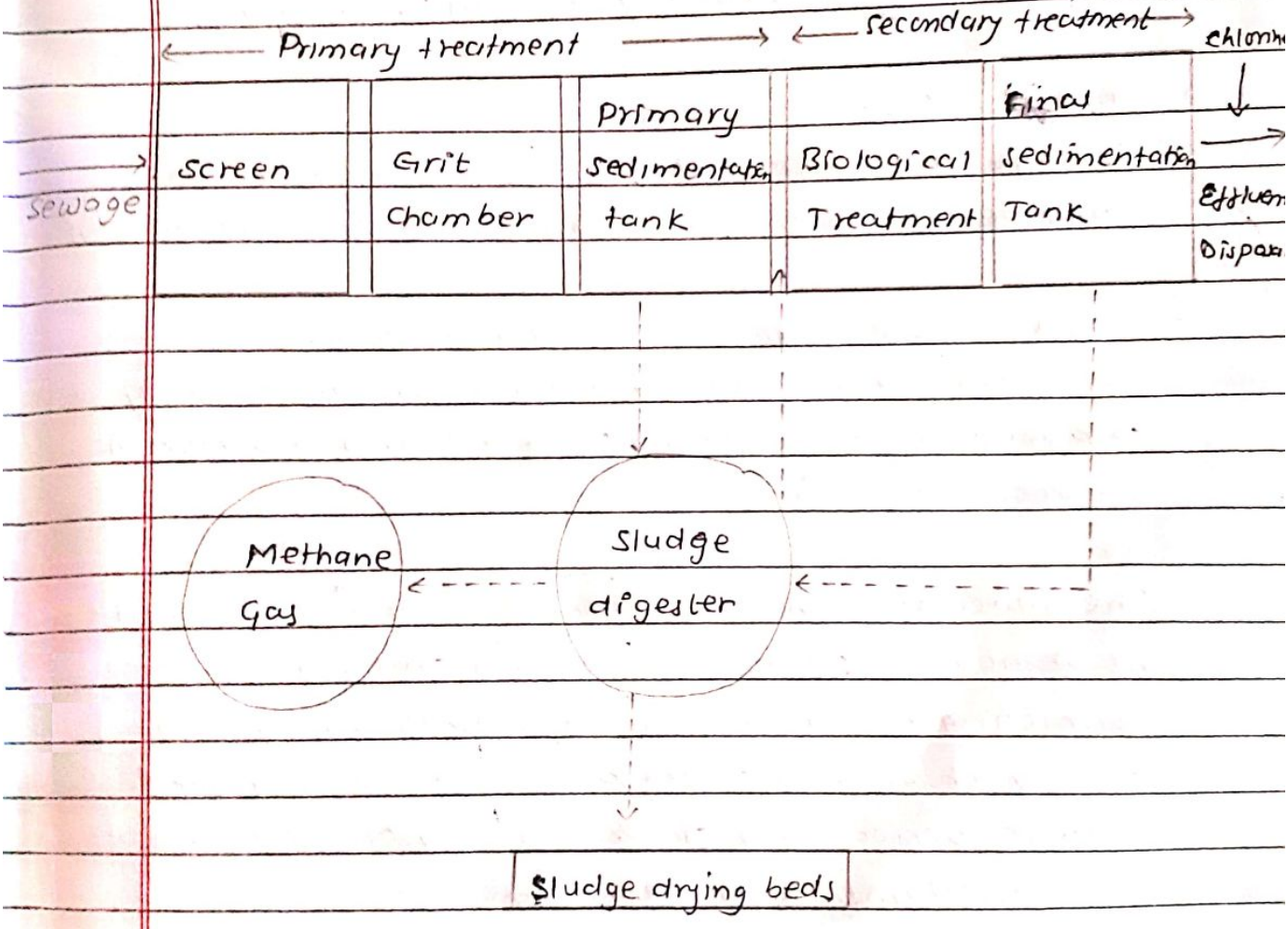
a) Mechanical Treatment
   - Influx (Influent)
   - Removal of large objects
   - Removal of sand and grit
   - Primary sedimentation

b. Biological treatment
- Trickling bed filter
- Activated sludge

c. chemical treatment
- Divingection

• Waste water treatment process/technique

Modern sewage Treatment



1. Primary treatment

- Screening

Sewage is first passed through a metal screen which intercepts large floating objects such as pieces of wood, rags, masses of garbage and dead animals.

Their removal is necessary to prevent clogging of the treatment plant. The screen consists of vertical or inclined steel bars usually set 5cm (2 in) apart.

- Grit chamber

- Sewage is then passed ~~in~~through a long narrow chamber called the grit chamber or detritus chamber.

- This chamber is approx 10 to 20 m in length.
- It is also designed to maintain a constant velocity of about 1 foot per second with a detention period of 30 seconds to 1 minute.

The function of the grit chamber is to allow the settlement of heavier solids such as sand and gravel, while permitting the organic matter to pass through. The grit which collects at the bottom of the chamber is removed periodically or continuously, and disposed of by plain dumping or trenching.

- Primary sedimentation

Sewage is now admitted into huge tank called primary sedimentation tank. It is a very large tank, holding from ¼ to ½ the dry weather flow. There are various designs in primary sedimentation tank.

- Sewage is made to flow very slowly across the tank at a velocity of 1 to 2ft per minute.

- The sewage spends about 6 to 8 hours in the tank.

- A reduction of between 30 to 40 percent in the number of coliform organisms is obtained.

2 Secondary treatment

- The effluent from the primary sedimentation tank still contains a portion of organic matter in solution or colloidal state, and numerous living organism.

It is subjected for further treatment, aerobic oxidation, by one of the following methods:

a. Trickling filter method
b. Activated sludge process

a. Trickling filter method

The effluent from the primary sedimentation tank is sprinkled uniformly on the surface of the bed by a revolving device.

The device consists of hollow pipes each of which have a row of holes. The pipes keep rotating, sprinkling

the effluent in a thin film on the surface of the filter.

- Over the surface and down through the filter, a very complex biological growth consisting of algae, fungi, protozoa and bacteria of many kinds occurs. This is known as the "zoogleal layer."

- The effluent percolates through the filter bed, it gets oxidized by the bacterial flora in the zoogleal layer.

5. Activated sludge process

It is the modern method of purifying sewage, in place of the trickling filter. The "heart of the activated sludge process is the aeration tank."

The mixture is subjected to aeration in the aeration chamber for 6 to 8 hours.

- During the process of aeration, the organic matter of the sewage get oxidized into carbon dioxide, nitrates and water with the help of the aerobic bacteria in the activated sludge.

- Secondary sedimentation

It differs from the sludge in the primary sedimentation tank in that it is practically inoffensive and is rich in bacteria, nitrogen and phosphates.

3. Disposal of effluent

Disposal by dilution: Disposal into water courses such as rivers and streams is called 'disposal by dilution'.

Since people use rivers water for drinking purpose, the effluent must be rendered free from pathogenic organisms by adequate chlorination.

4. Sludge digestion

- Sludge is a thick, black mass containing 95% of water and it has revolting odour.
- If sludge is incubated under favorable condition of temperature and pH, it undergoes aneerobic auto-digestion in which complex solids are broken down into water, carbon dioxide, methane and ammonia. The volume of sludge is also considerably reduced.

- It takes 3-4 weeks or longer for complete sludge digestion.

Other method of sewage Disposal

a. Sea outfall
b. River outfall
c. Land treatment
d. Oxidation ponds
e. Oxidation ditches

Explaination in KPark P.g. no. 85g

- Nature and Types of health care waste (Bio-medical waste)

Nature

Biomedical waste means "Any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological."

It may includes wastes like sharp waste, pathological waste, pharmaceutical waste, genotoxic waste, chemical waste and radioactive waste, etc.

- Of the total amount of waste generated by health-care activities, about
  85% is general, non-hazardous waste.
  remaining 15% is considered hazardous material that may be infectious, toxic or radioactive.

- Open burning and incineration of health care wastes can under some circumstances, result in the emission of doxins, furans and particulate matter.

- Measures to ensure the safe and environmentally sound management of health care wastes can prevent adverse health and environmental impacts

Types

a. Infectious waste- waste contaminated with blood and other bodily fluids (eg. from discarded diagnostic samples), cultures and stocks of infectious agents from laboratory work. (eg. waste from autopsies and infected animals from laboratories), or waste from patients with infections (eg. swabs, bandages and disposable medical devices).

b. Pathological waste- human tissues, organs or fluids, body parts and contaminated animal carcasses;

c. Sharps waste: syringes, needles, disposable scalpels and blades,

d. Chemical waste: for example solvents and reagents used for laboratory preparations, disinfections, sterilants and heavy metals contained in medical devices (eg. mercury in broken thermometers) and batteries;

e. Pharmaceutical waste: expired, unused and contaminated drugs and vaccines;

f. Cytotoxic waste: waste containing substances with genotoxic properties (ie. highly hazardous substances that are mutagenic, teratogenic or carcinogenic), such as cytotoxic drugs used in cancer treatment and their metabolites;

g. Radioactive waste: such as products contaminated by radio nuclides including radioactive diagnostic material or radiotherapeutic materials; and

4. Non-hazardous or general waste- Waste that doesnot pose any particular biological, chemical, radioactive or physical hazard.

- Major source of health care waste (generation)
- Hospital and other health facilities
- Laboratories and research centres
- Mortuary and autopsy centres
- Animal research and testing laboratories
- Blood banks and collection services
- Nursing homes for the elderly

High income countries generate on avg upto 0.5kg of hazardous waste per hospital bed perday; while low income countries generate on average 0.2kg.

Principle of management of health care waste

1. Duty of care principle
2. Polluter pays principle
3. Precautionary principle
4. Proximity principle.

1. Duty of care principle

The principle stipulates that any organization that generates waste has a duty to dispose of the waste safely. Therefore it is the health care facilities that has ultimate responsibility for how waste is containerized, handled on-site and offsite and finally disposed of.

2. Polluter pays principle

Acc to this principle, all waste produced are legally and financially responsible for the safe handling and environmentally sound disposal of waste they produce.

3. Precautionary principle

Following this principle one must always assume that waste is hazardous until shown to be safe. This mean that where it is unknown what the hazard may be, it is important to take all the necessary precautions.

4. Proximity principle

This principle recommends that treatment and disposal of hazardous waste take place at the closest possible location to its source in order to minimize the risks involved in its transport. Acc to similar principle, any community should recycle or dispose of the waste it produces, inside its own territorial limits.

- Management of health care waste

Steps in Health care waste disposal

1. Identification
2. Handling (collection, measurement, storage and transport)
3. Treatment
4. Disposal

1. Identification

colour coding & types of container for disposal of Bio medical waste

colour coding	Description	Type of waste
Yellow (Incineration)	Infectious, Pathological, sharps, Chemical	• placenta, cotton waste • Pathological waste, discarded cap, post operation body parts, dressing materials, etc
~~Red~~ Red	sharp, chemical, waste with high contains heavy metals	• syringes without needles I.V set catheters, dialysis kit Gloves, IV bottles Urine bag
White	Pharmaceutical waste,	needles, blades, scalpels
Blue/white translucents	waste with	syringes with fixed needles
Blue	high contain of heavy metals	• Glass - Broken glass - ampoules - Lab slides • Metals - nails - metallic body implants
Black	Genotoxic, radioactive solid waste	- scissors

2. Handling

a. collection of waste.

Waste are generally collected in bins or bags.

Black: General or non-hazardous waste

Yellow: Hazardous waste & sharps

For sharp objects

- must be collected at a point of generation, in a leak proof and puncture-resistant container
- Containers should never be completelely filled

- Only one staff for collection for hazardous waste and incineration
- hazardous waste collected in incinerator room and immediately burn.

b Measurement

It is done to record about amount of waste generation.

c Storage of waste

waste should be storage with respect to temperature and climate. eg. 72 hours in winter & 48 hours in summer.

d. Transportation of Waste

By means of wheeled trolleys, containers, or carts that are not used for any other purpose.

- Yellow bagged hazardous waste and black bagged general waste shall be collected on separate trolleys.

- All yellow-bagged waste is collected at least once daily.
- The collection route shall be the most direct one from the final collection point to central storage facilities designed in waste management plan.

- All concerned staff members should properly trained in handling, loading and uploading transportation and disposal.
- All vehicles should be decontaminated, cleaned, and disinfected after use.

3. Treatment and Disposal technique for health care waste / ~~Management of health care waste~~

i) Incineration
ii) Chemical disinfection
iii) Wet & dry thermal treatment
iv) Microwave irradiation
v) Land disposal
vi) Inertization

i) Incineration
- It is a high temperature dry oxidation process.
- Reduces organic and combustible waste to inorganic and incombustible waste.
- For most hazardous waste.
- Result in significant reduction of waste volume & weight.

Not to be incinerated
- wastes like high mercury, cadmium eg. broken thermometer, used batteries
- Ampules containing heavy metals
- Photographic / radiographic wastes

ii) Chemical disinfection

- To kill or inactive pathogens it contained.
- Disinfection rather than sterilization.
- Most suitable for liquid waste eg. urine, blood, stool, hospital sewage, microbiological cultures.

iii) Wet and Dry thermal treatment

	wet thermal treatment	screwfeed / Dry thermal treatment
i)	similar suitable to autoclave sterilization process.	suitable for infectious waste & sharps.
ii)	Inappropriate for the treatment of anatomical waste and animal carasses.	Not used for pathological, cytotoxic or radioactive waste.
		Non burn, this process in which waste is shredded & heated in a rotating auger.

iv) Microwave irradiation

- Most organism destroyed by the microwave of frequency of 2450 MHz & a wavelength (λ) of 12.24 nm.
- The efficiency of microwave disinfection checked routinely through bacteriological and virological test.

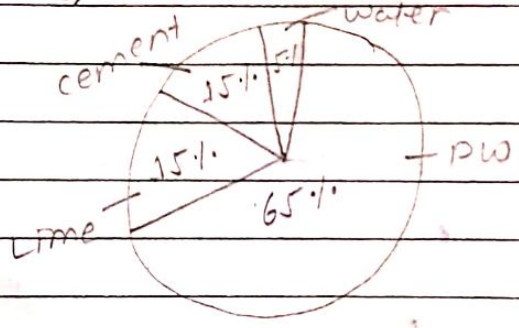
v) Land Disposal

If hazardous health-care waste cannot be treated or disposed

- Investigate more suitable treatment methods. disposal sites:
- Land open dumps
- sanitary landfills.

vi) Inertization

- mixing waste with cement & other substances before disposal.
- Inhibits the waste migrating into the surface & ground water
- Proportion of mixture is 65% pharmaceutical waste, 15% lime, 15% cement & 5% water.



~~Health~~

- Health hazard of health care waste

i) sharp-inflicted injuries

ii) toxic exposures to pharmaceutical products, in particular, antibiotics and cytotoxic drugs released into the surrounding environment, and to substances such as mercury or dioxins, during the handlings or incineration of health care wastes.

iii) chemical burns arising in the context of disinfection, sterilization or waste treatment activities

iv) air pollution arising as a result of the release of particulate matter during medical waste incineration;

v) thermal injuries occurring in conjunction with open burning and the operation of medical waste incinerators; and

vi) Radiation burns