Biomedical Waste Management (BMW)

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What is BMW?

Any waste generated during

- Diagnosis
- Treatment
- Immunization
- Research activities
- Biological test

Examples (solid/liquid)

- Anatomical waste
- Microbiology and biotechnology wastes
- Veterinary hospitals waste
- Needles, syringes, scalpels and broken glass
- Discarded medicines and cytotoxic drugs

BMW real problem for

MAN, COMMUNITY,& ENVIRONMENT

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

Biomedical Waste Sources

- Hospitals and other health facilities
- Laboratories and research centers
- Mortuary and autopsy centers
- Animal research and testing laboratories
- Blood banks and collection services
- Nursing homes for the elderly

Biomedical Waste Characterization

WHO Categories

Infectious waste: waste contaminated with blood and other bodily fluids, cultures and stocks of infectious agents from laboratory work or waste from patients with infections

Pathological waste: human tissues, organs or fluids, body parts

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

Chemical waste: solvents and reagents used for laboratory preparations, disinfectants, sterilants and heavy metals contained in medical devices, batteries

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

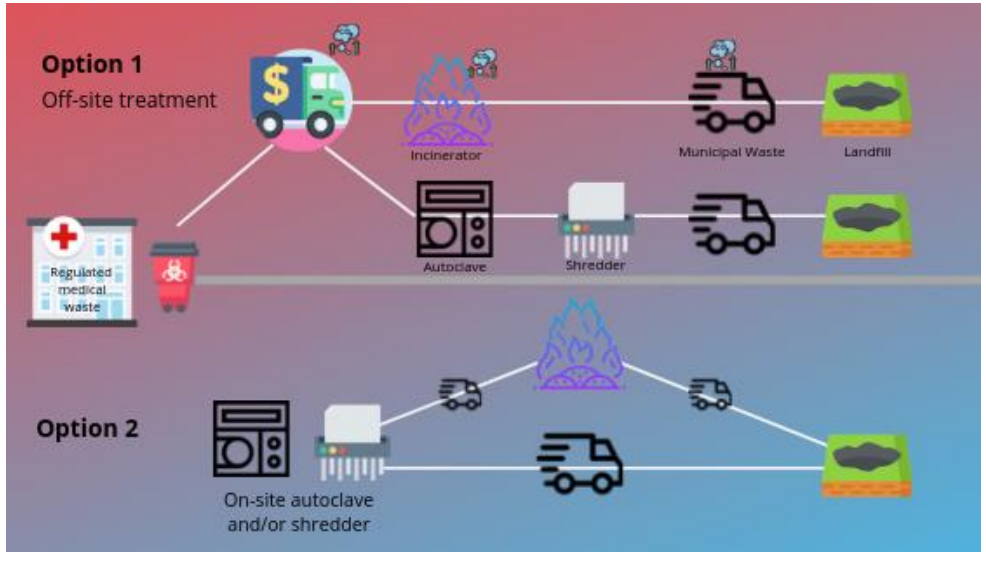
Cytotoxic waste: waste containing substances with genotoxic properties,

Radioactive waste: such as products contaminated by radioactive material

Non-hazardous or general waste: waste that does not pose any particular biological, chemical, radioactive or physical hazard.

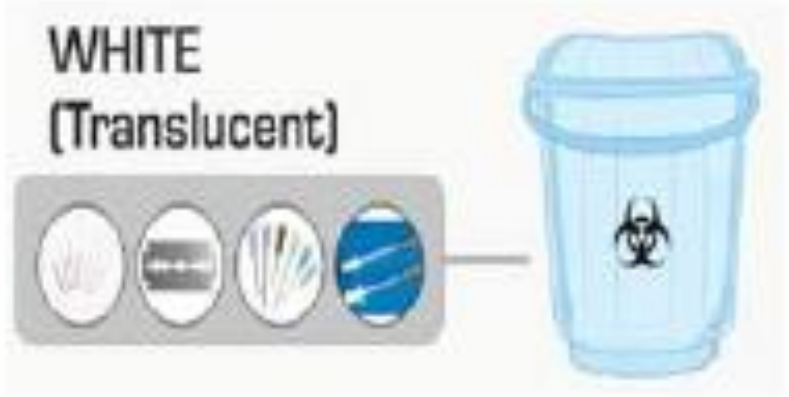
Steps for BMW management

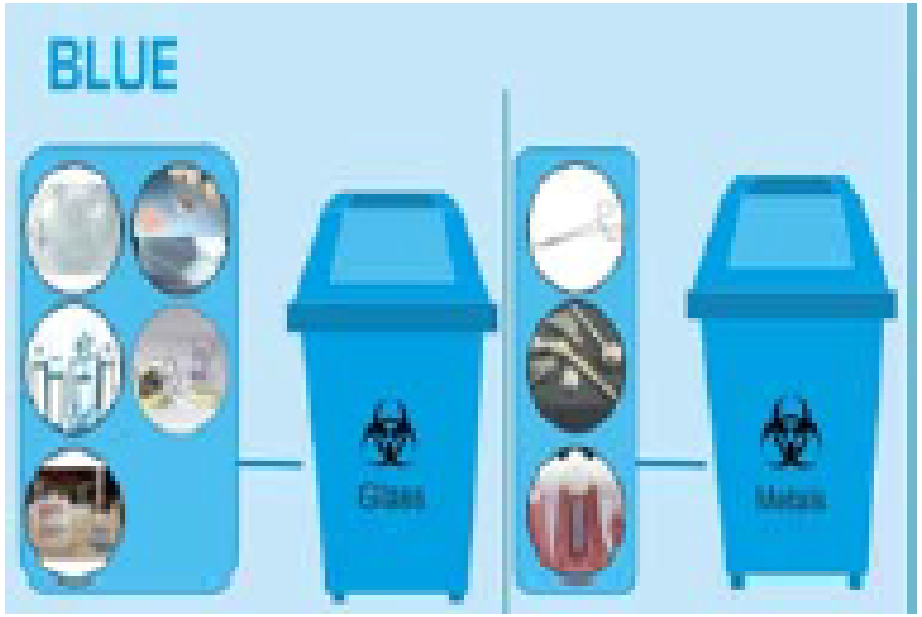
1. Generation
2. Segregation
3. Collection
4. Storage
5. Transport
6. Treatment
7. Disposal



Segregation of Bio medical waste in colour coded Bags

Category	Type of bag / container used	Type of waste	Treatment/ disposal options
	Non-chlorinated plastic bags Separate collection system leading to effluent treatment system	a) Human Anatomical Waste b) Animal Anatomical Waste c) Soiled Waste d) Expired or Discarded Medicines & Cytotoxic drugs along with glass or plastic ampoules, vials etc. e) Chemical Waste f) Micro, Bio-t and other clinical lab waste g) Chemical Liquid Waste h) Discarded linen, mattresses, beddings contaminated with blood or body fluids. **Also routine mask & gown as per BMW rules, 2018.**	Incineration or Plasma pyrolysis or deep burial*

	Non-chlorinated plastic bags or containers	**Contaminated Waste (Recyclable)** Vacutainers, tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles) and gloves	Autoclaving/ microwaving/ hydroclaving and then sent for recycling, not sent to landfill
	(Translucent) Puncture, Leak, tamper proof containers	**Waste sharps including Metal sharps**-Needles, Syringes with fixed needles, Needles from needle tip cutter/burner, Scalpels, Blades	Auto or Dry Heat Sterilization followed by shredding or mutilation or encapsulation

	Cardboard boxes with blue colored Marking. **Puncture proof and leak proof boxes or containers with blue colored marking, as per BMW rules, 2018**	**Broken/ discarded glass-** Medicine vials & ampoules except those contaminated with cytotoxic wastes. **Metallic Body Implants**	Disinfection or autoclaving, microwaving, hydroclaving and then sent for recycling

TREATMENT AND DISPOSAL METHODS OF BIOMEDICAL WASTE

- Treatment and disposal of the biomedical waste shall be done by the following methods

  - Incineration.
  - Autoclaving.
  - Shredding.
  - Disposal option.
  - **Pyrolysis**

INCINERATION

- 85% to 90% of the total BMW is treated by Incineration.
- Incineration systems uses high temperature combustion under controlled conditions to convert wastes containing infectious and pathological material to inert mineral residues and gases.
- Incineration is a process where the combustible waste is reduced to exhaust gaseous products and the incombustible waste is reduced to ash
- The key parameter in an incinerator are
    - Temperature should be 900-1000*C .
    - The waste be exposed for at least two seconds
    - Incinerator should have the air pollution control equipment.

AUTOCLAVING

- The autoclave process is technology for the treatment of microbiology laboratory waste, human blood any body fluid waste, waste sharps and anatomical waste.
- Autoclaving is a time-tested process of sterilization of medical waste using high temperature and high pressure steam.
- Typical operating conditions for an autoclave are a temperature of at least 121^0C at a pressure of 105 kPa for a period of atleast 1hour.
- Effective sterilization results in the destruction of bacteria, virus, spores, fungi and other pathogenic microorganisms.

➢ SHREDDING

- Shredders are used to destroy plastic and paper waste to prevent their reuse.

- After autoclaving the plastic waste is sent to the shredder. The shredded waste is sold out to authorized plastic molding units.

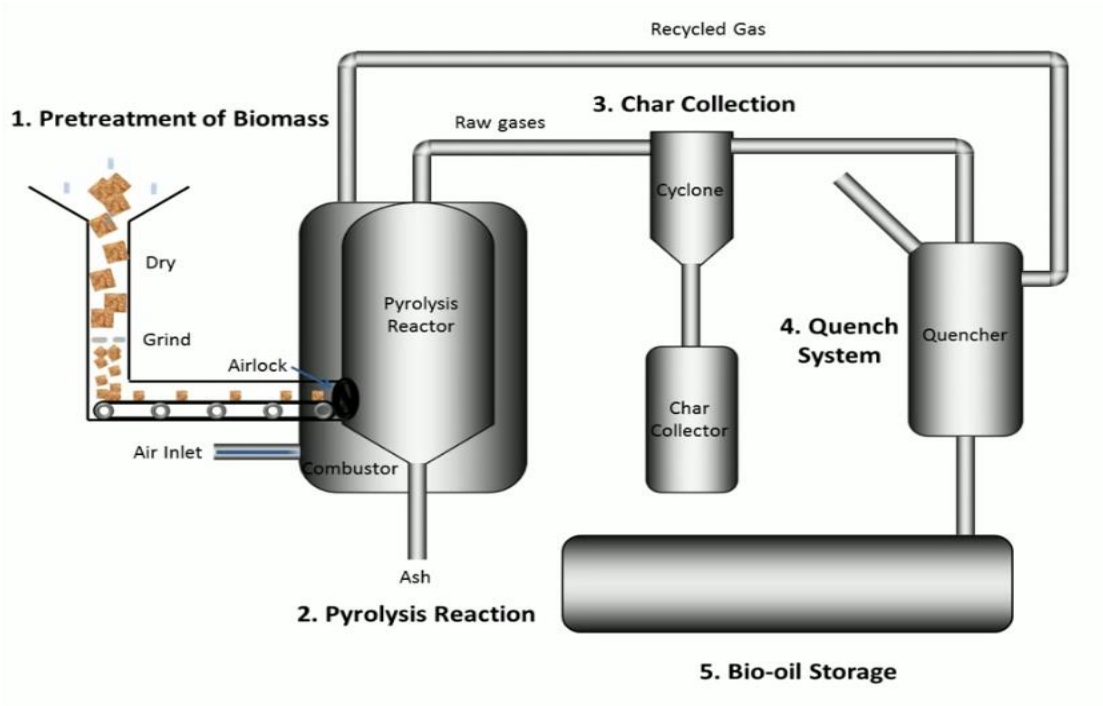
- Only waste that is disinfected should be used in a shredder.
- This reduces the bulk of waste making transportation easy.
- Shredder have a set of revolving blades/shafts, which cut the waste into small pieces.
- Maintainance costs is high.

MICROWAVING

- Used for the sterilization of biomedical waste products before being disposed off.

PYROLYSIS:-

- Pyrolysis is defined as thermal degradation of waste in the absence of air to produce char, pyrolysis oil and syngas, e.g. the conversion of wood to charcoal also it is defined as destructive distillation of waste in the absence of oxygen. External source of heat is employed in this process.



PYROLYSIS

- It is the thermal decomposition of organic material at high temperatures in the absence of oxygen.

Biomedical Waste Treatment

Incineration: a common treatment process to destroy biomedical waste using an enclosed device and **controlled flame combustion**. It is used to eliminate all forms of combustible materials, while sterilizing inorganic portions. It has a negative **perception because of human health concerns, environmental issues and financial impact**.

Autoclave: the disinfection of medical waste by an autoclave consists of exposing the materials to saturated steam under pressure in an enclosed environment. It is a popular method of disinfection in hospitals. Commonly, autoclaves are used in conjunction with physical treatment processes such as shredding or grinding.

Biomedical Waste Treatment

Microwave irradiation: A volumetric heating process to reduce and disinfect medical waste volumes. High energy electromagnetic field (**microwave range**) rapidly heats liquids contained in the refuse, resulting in the destruction of infectious components.

Chemical treatment: The disinfection by application of chemicals to contaminated materials. The disinfectant is usually accompanied by shredding or grinding of the medical waste to ensure maximum contact with the material. Chemical treatment can be considered most suited for treating liquids like blood, urine, stool and hospital sewage. Example, **alcohols, phenol, bleach, formaldehyde, chlorine, oxygen, $KMnO_4$, H_2O_2** etc.

Biomedical Waste Treatment

Shredders are used to destroy plastic and paper waste to **prevent their reuse**. Only waste that is **disinfected** should be used in a shredder. The function of a shredder is to mutilate the already disinfected waste.

Pyrolysis is defined as thermal degradation of waste in the absence of air. The intense heat (1200 °C) generated by the plasma enables it to dispose all types of waste including municipal solid waste, biomedical waste and hazardous waste in a safe and reliable manner. Medical waste is pyrolyzed into **CO, H_2**, and **hydrocarbons**, also known as **Syngas**.