



Management of Hazardous Wastes

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Hazardous wastes have been defined by the United States Environmental Protection Agency (EPA) as; Wastes or combinations of wastes that pose a substantial present or potential hazard to human health or living organisms, because either they are (a) non degradable, or persistent in nature, (b) they may otherwise cause or tend to cause detrimental cumulative effects”.

A further definition by the government of the U.K. is poisonous, noxious or polluting matter, which relates to the creation of an environmental hazard; itself define as causing material risk of death, injury or impairment of health to persons or animals, or as threatening pollution or contamination of surface or underground water supplies”.

In many developed countries there is now legislation attempting to control the disposal of hazardous waste, in order to reduce the potential hazard to man, other

animals and plants. But these controls have only been introduced relatively recently, and there are a significant number of instances where potentially dangerous levels of toxic materials have been discovered. Toxic chemical wastes have polluted groundwater supplies, surface water and surface environs even though large quantities of waste do not migrate from the site. The waste may be toxic and concentrated that relatively minor leaching can lead to problems. An old toxic waste fill, whose existence is unknown to new property owner, may pollute groundwater that is used by the unsuspecting owner. Gases arising from the decomposition of cellulosic solid waste can kill vegetation and pose an explosion hazard. Some toxic wastes are volatile. After they are buried, they migrate through the soil and pollute groundwater, soil, vegetation and grazing animals.

There are many types of wastes which are “special” or “hazardous” but five general categories can be used to “group”, such wastes:-

- I. Radioactive Substances.
- II. Chemicals.
- III. Biological wastes.
- IV. Flammable waste.
- V. Explosives.

1. Radioactive Substances:

Substances which emit ionizing radiation are said to be radioactive. They are hazardous because of their ability to damage living plants and animals after exposure, and because they decay slowly, thus increasing the risk.

The disposal of radioactive materials is controlled by federal agencies and is highly specialized. Long term storage and disposal of radioactive waste is carried out at special disposal sites, which are not used for other solid wastes.

2. Chemicals:

Many chemicals are classified as hazardous and the list devised and adopted by the Environment Protection Agencies is extensive. Of course, some of these chemicals may also be flammable, or have explosive properties, and if so, then additional or different controls on storage and disposal may be necessary. Storage of such wastes may be in lined metal drums, or tanks, made from various materials, for example glass lined, or fiber glass.

3. Biological wastes:

In this group are clinical or medical wastes, and also waste from biological research facilities. They will include surgical swabs and dressings, syringes, human tissue, animal carcasses, and date expired drugs.

While some of these wastes are toxic, or otherwise present a risk to those involved with their disposal, it is the offensive nature of clinical wastes which is most likely to cause problems, and great care is required in handling and disposal.

Storage may be sealed in waxed paper bags, plastic sacks, or lined metal drums.

4. Flammable wastes.

There are usually chemicals either liquids, gases or solids, but usually liquids which are identified separately from "chemicals" in 2 above due to the hazard in storing, collecting and disposing of flammable wastes. They include oils, solvents, plasticizers and some types of sludge, storage can be by metal drums or tanks.

5. Explosives.

Explosive hazardous wastes are mainly from artillery, armament or military type sources, but also some industrial gases come within this category. Shock absorbing containers, often with strict temperature control are used to contain such wastes.

Treatment and Disposal Options

It is important to distinguish between treatment and disposal. Treatment is used either to make the waste harmless, or to change its physical characteristics to facilitate subsequent disposal. The actual option chosen will depend on the type of waste, its hazardous properties, and the quantity.

The options available are:

1. Recycling and recovery.
2. Chemical or physical change including;
 - A. Incineration
 - B. Paralysis
 - C. Biological treatment
 - D. Chemical treatment
 - E. Physical treatment
 - F. Encapsulation
3. Dilution, delay and disposal. .
 - A. Landfill
 - B. Disposal
4. Storage

Permanent stores in mines, silo's or purpose built bunkers according to its hazardous and toxicity. Environmental Health and Safety Authorities must have to adopt systems to control hazardous waste before deposit it. There are applicants must complete a form indicating the type and quantity of waste and specific other information. This data is used to determine the applicant methods of storage, treatment and final disposal.

In this article we will focus on the group of "Biological Wastes" which include hazardous medical or clinical wastes, and also waste from biological research facilities, special hazardous medical waste.

Medical Wastes Disposal

Failures in the management of hospital wastes have led to a number of incidents involving waste disposal operation and to members of the public exposed to these wastes. Medical wastes are offensive and incidents involving them give rise to considerable concern. Sharp material has been responsible for numerous injuries to waste disposal operators and aesthetic considerations arising from the offensive nature of the wastes are a cause of public concern.

Medical wastes may be defined as “all wastes arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research which by nature of its toxic, infectious or dangerous content may prove a hazard or give offence unless previously rendered safe and inoffensive”. Such wastes include human or animal tissue or excretions, drugs and medical products, swabs and dressings, instruments or similar substances and materials, as well as radioactive material used in hospitals.

Components of medical wastes are classified in five groups, as following:

Group A

1. Solid surgical dressings, swabs and all other contaminated waste from treatment areas.
2. Material other than linen from cases of infectious disease.
3. All human tissue (whether infected or not) animal carcasses and tissues from laboratories and all related swabs and dressings.

Group B

Discarded syringes, needles, cartridges, broken glass, and any other sharp instruments.

Group C

Laboratory and post-mortem room waste (other than in A).

Group D

Certain pharmaceutical, and chemical wastes (such as mercury wastes which should be treated with special care).

Group E

Used disposable bed-ban liners, urine containers, incontinence pads and stoma bags.

Sources of Medical Waste

Some of the principal sources of medical waste are:

- a. Hospitals and clinics operated by the public sector.
- b. Private hospitals and clinics.
- c. Medical, dental and veterinary teaching establishments.
- d. Immunization and vaccination clinics.
- e. Public health laboratories.
- f. Medical research establishments.
- g. Blood transfusion centers.
- h. General Practitioner surgeries.
- i. Dental surgeries.
- j. Veterinary surgeries, laboratories, pet shops and boarding kennels.
- k. Home or factory where treatment occurs.

Segregation, Transportation and Collection of Medical Waste

The key to the correct management of all wastes arising from the medical sector is the segregation of non-medical from medical wastes. Segregated, non-medical waste is efficiently and economically dealt with by the domestic refuse collection and disposal system. By keeping medical wastes separate, their “special” nature is recognized and appropriate methods for their optimal disposal may be adopted. It is almost always a failure in this segregation which leads to incidents involving the public and waste disposal operator. Hospitals in both public and private sectors should employ a segregation system based preferably on color-coded bags and sacks. A unified system would prevent errors at the source of the waste causing them to enter the wrong stream. Such a system has been recommended, as follows:

- A. Black bags for normal household waste.
- B. Yellow bags for all wastes destined for incineration.
- C. Yellow bags with a black band for wastes preferably disposed of by incineration but which may go to landfill after separate collection and disposal arrangements are made.
- D. Light blue or transparent bags with light blue inscriptions for waste which is to be autoclaved.



Collection and Transportation of Medical Wastes

Medical wastes need to be transported to their places of final disposal. The journey involved may vary from relatively short and straightforward movement to on-site incinerators to lengthy and complex movements for waste destined for distant landfills or central incinerators. The integrity and sealing of the packaging used to contain the wastes is important. For example, where thinner bags are used or where there is likelihood of spillage, double bagging should be employed.

Preferably containers and vehicles reserved solely for the transportation of medical waste should be used. Containers can be either single-use or re-usable and should be fitted with a self-sealing lid and be robust enough to withstand being spilled from the vehicle. Their design should be such that they may be easily and safely stacked in the vehicle. The containers should be easy to clean and offer no harborage to insects or waste.

The vehicles used to transport waste to off-site disposal facilities should be of high standard and conform to the following criteria:

- a. Totally enclosed car body.
- b. Segregation of medical waste from non-medical.
- c. Easy to clean.
- d. Able to survive impact with another vehicle without unacceptable loss of integrity.

The frequency of collection is important. Storage should be for as short a time as possible and specialist storage may be considered, such as refrigeration.

Disposal of Medical Wastes

Incineration is the usual disposal route for medical wastes. This may take place on-site, at a group hospital, private waste disposal incinerator under contract or, less commonly, at a local authority domestic waste incinerator. The latter causes considerable problems as a result of their storage and operating procedures that there is a general relocation to use this option.

It is suggested that incineration should be the preferred route for the following types of medical wastes:

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| Group A : | All tissues, limbs, placenta, infected carcasses and dialysis wastes. |
| Group B : | All sharps. |
| Group C : | All pathology wastes unless autoclaved. |
| Group D : | Some solid medicines and indictable. |

Also in group A the following might be considered for incineration; Soiled surgical dressings, swabs and other contaminated wastes.

There are designed problems associated with incineration of hospital waste, notably the variable composition of the waste, therefore a number of design and operating factors should be considered among them are the following:

a: Reception:

- Disposable, coloured coded plastic bags.
- Secure vehicle.
- Secure container.
- Sharp proof containers.

b: Storage:

- Near Incinerator.
- Well-ventilated room.
- Tissue etc.
- Burnt immediately.
- Short storage time (< 2 days).
- Locked and secure.

c: Operation:

- Wide calorific value burn.
- Mechanical or automatic feed if $> 0.25 \text{ T / hr}$.
- Operation at 900o c.
- After burn at 800o c.
- Residence time > 10 seconds.
- Dust extraction necessary.
- Properly designed flue at $> 150\text{o c}$.
- Flue gas scrubber (especially for PVC).
- Fail-safe controls.

d: Residual disposal:

- Safe.
- Landfill.
- Access.

e: Costs:

The cost depends on the efficiency of treatment and the continuance of operation, and should be calculated according to the quantity of the waste.

Disposal to Landfill

Landfill is a satisfactory disposal route for a large amount, but not all of clinical wastes. Correct packaging and handling is essential, especially contaminated material and sharps.

Antibiotics may in some cases upset the biological activity within a landfill and their acceptability must be given careful consideration.

Special attention must be given to the transport of such wastes to the landfill site. Standards should be laid down and maintained for containers and vehicles. Problems are most likely to arise when the collection system used by the municipality incorporates a transfer station, especially when pulverization and baling are an integral part of the process. It must therefore be recommended that medical wastes should bypass any transfer systems and go directly to the landfill site and arrive in undamaged bags or containers. Static compactors located at the hospital may be used for transporting clinical wastes to landfill sites since accidental exposure would be unlikely.

At the site (which should be fenced and preferably screened) the waste should be deposited in specially constructed cells and immediately covered with at least 0.5 m of suitable cover material. This apart from aesthetic considerations would protect the clinical waste from the action of machinery operating on the landfill site. Compaction should take place after covering. Not more than 10% of the average daily domestic and non-hazardous industrial waste should be clinical waste.