**Vision of the institute**

Development of academically excellent, culturally vibrant, socially responsible and globally competent human resources.

**Mission of the institute**

To keep pace with advancements in knowledge and make the students competitive and capable at the global level.

To create an environment for the students to acquire the right physical, intellectual, emotional and moral foundations to shine as torch bearer of tomorrow’s society.

To strive to attain ever-higher benchmarks of educational excellence.

**Vision of the Department**

The department will be recognised for its value based teaching, associated activities pertaining to research and entrepreneurship.

**Mission of the Department**

* To provide quality education through faculty and state of art infrastructure
* To identify the current problems in society pertaining to Civil Engineering disciplines and to address them effectively and efficiently
* To inculcate the habit of research and entrepreneurship in our graduates to address current infrastructure needs of society

**PEO’s**

**Graduates who complete their UG through our institute will be,**

**PEO 1**- Engaged in professional practices, such as construction, environmental, geotechnical, structural, transportation, water resource engineering by using technical, communication and management skills.

**PEO 2**- Engaged in higher studies and research activities in various civil engineering fields and life time commitment to learn ever changing technologies to satisfy increasing demand of sustainable infrastructural facilities.

**PEO 3**- Serve in a leadership position in any professional or community organization or local or state engineering board

**PEO 4**- Registered as professional engineer or developed a strong ability leading to professional licensure being an entrepreneur.

**PSO’s**

**PSO 1** – To apply science, mathematics and mechanics to solve problems in engineering realm

**PSO 2** – To analyse the techniques, skills and modern engineering tools necessary for engineering practices

**PSO 3** – To develop ability to function as a leader and a team player in multidisciplinary teams

**PSO 4** – To recognize of the need for and an ability to engage in research and life-long learning for developing sustainable construction practices

**PSO 5** – To design and conduct experiments as well as to analyse and interpret data

**Unit – 7**

**Disposal Methods**

**Structure**

7.0 Introduction

7.1 Objectives

7.2 Open Dumping

7.3 Ocean disposal

7.4 Feeding to hogs

7.5 Sanitary landfill

7.6 Incineration

7.7 Pyrolsis

7.8 Composting

7.9 Biomedical wastes and disposal

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7.11 Outcomes

7.12 Further Reading

**7.01 Introduction**

With the help of proper frameworks and sub-frameworks, we can assess the effectiveness of each of the waste disposal options. While a framework represents an aid to decision-making and helps to ensure the key issues are considered, a sub-framework explains how and why the necessary information should be obtained

* Technical
* Institutional
* Financial
* Social
* Environmental

**7.1 Objectives**

1. Identify its advantages and disadvantages
2. Assess the environmental effects of disposal methods

**7.2 Open Dumping**

Open dumping is the simplest and inexpensive method on trash disposal which only needs a large scale of area to dump trashes. Usually, low swampy areas are chosen for it.

Open dumping method is very simple, any solid trashes that have been gathered only need to be piled up into two or four meters dumped in the available area before it is recycled or destroyed. It would be easy if any trashes that were gathered had already been separated based on its material, so it could be process to the next step rapidly. But usually, especially in the development countries, people mix all of trashes together since the beginning, so it needs more time to separate it. As a result, the amount of trash that has been recycled cannot match with the amount which is come, so the pile is continuously getting bigger and bigger. That is way even though open dumping doesn’t waste too much money in the beginning; after a several period, it needs much cost to enlarge or open for a new area.

Despite of its simple and inexpensive way, open dumping actually has many disadvantageous. There are:

* Open dumping spreading foul odours.
* Open dumping provides the area for germs, viruses, and vermin to breed; so, it becomes the source of many diseases.
* Open dumping can contaminates the ground water and run-off pollution.
* Open dumping damage due to air pollution.
* Open dumping wastes and occupies an unnecessarily large area.

According on the facts above, open dumping has more disadvantages instead of its advantages. Even, its disadvantages tend to become dangers; therefore, it is better to avoid this method in trash disposal.

**Factors affecting the selection of site for open dumping:**

* The site should be away from the residential site.
* The site should be in a low lying area.
* The source of water supply should not be near the open dumping pit.
* The site should be easily accessible by road.
* The site should not be located in an aquifer.

**7.3 Ocean disposal:**

The method may be used to dispose of refuse by throwing it away into the sea, after carrying it to a reasonable distance from the coast (say 16-20km). The sea depth at such disposal point should not be less than 30 m and the direction of currents should be such as not brings it back towards the shore. The method may have a limited use in a few coastal towns.

**Advantages:**

* The method is quite cheap and simple
* By the use of simple management technique, the method can be made as an environmental friendly disposal method of solid waste.
* Large quantities of solid waste can be dumped into the oceans without use of costly equipments and skilled persons.

**Disadvantages:**

* The bulk and lighter parts of the refuse do not settle down, remain floating and tend to the shores especially during high tides
* This requires ships and barrages to take the refuse into the interior of the sea, the movement of which may be difficult during monsoons and storm weather. During such periods the refuse will either have to be collected or disposed of by some other methods.
* Even in spite of the best care and effects some refuse returns to the shores spoiling their beauty and hence this method is now a day’s generally no used and has become obsolete.

**7.4 Feeding to hogs:**

In this method the garbage is fed to the animals like hogs, swine etc. In western countries and America this method is common. Garbage is the main element of refuse which is difficult to handle in sanitary conditions. In foreign countries the health authorities recommended heating of garbage up to 1000 C up to 30 minutes as a precaution to kill all the disease causing organisms.

**Advantages:**

* It is most simple and economical
* With proper precautions the swine and hogs can be feed at a cheaper rate.
* The method is suitable for under developed countries, since it does not require any costly vehicles, equipments and also technically qualified man power.

**Disadvantages:**

* The raw feeding of garbage to animals is responsible for diseases of vesicular exanthema in swines and cholera among hogs
* Animal feeding forms are the source of nuisance due to bad odours, flies and health hazards
* It does requires separation of different kinds of refuse

**7.5 Sanitary landfill:**

**Advantages**

1. The initial capital investment is lower than that required to establish incineration plants or composting facilities for waste treatment.

2. It has lower operating and maintenance expenses than treatment methods.

3. A sanitary landfill is a complete and definitive method, given its capacity to receive every kind of MSW.

4. It creates employment for unskilled labour, which is available in abundance in developing countries.

5. Methane gas can be collected in sanitary landfills that receive more than 500 t/day, and this gas can be an alternative source of energy for some cities.

6. Its location can be as close to the urban area as the existence of available sites permits, which reduces hauling costs and facilitates supervision by the community.

7. It allows lands considered unproductive, making them useful for constructing parks, recreational facilities, green areas, etc.

8. A sanitary landfill can start operating in a short time as a waste elimination method.

9. It is considered flexible because it can receive greater additional quantities of waste with a small increase in personnel.

**Disadvantages**

1. The acquisition of the terrain is often a problem due to local inhabitants’ opposition to the selected site

· Lack of knowledge of the sanitary landfill technique.

· The term sanitary landfill is associated with the open dump.

· Citizens’ evident distrust of local administrations that do not guarantee the quality or the sustainability of the work.

· Legal problems regarding land registration.

2. The rapid process of urban growth that limits the amount of land available and makes it more expensive, the sanitary landfill to be located at a distance from the town.

3. The vulnerability of the quality of operation of the landfill and the high risk of its becoming an open dump, mainly because of a lack of political decision on the part of local governments to invest the necessary funds for its correct operation and maintenance.

4. The finished landfill is not recommended for building homes, schools, etc.

5. The restriction against building heavy infrastructure because of settling and sinking after the landfill is finished.

6. It is necessary to monitor the site after closure of the sanitary landfill, not only to check for negative environmental impacts, but also to prevent undue use of the site by the inhabitants.

7. It can cause a long term environmental impact if the necessary precautions are not taken in the selection of the site and if mitigation measures are not applied. In the case of large sanitary landfills, it is advisable to analyze the effects of vehicular traffic, in particular the trucks carrying the waste on the roads that converge on the site and that produce dust, noise and windblown litter. In the immediate neighbourhood the impact is produced by the liquids, gases and bad odours that can emanate from the landfill.

8. The properties or lands surrounding the sanitary landfill may be devalued.

9. Usually it cannot receive hazardous waste.

**7.6 Incineration:**

**Advantages:**

* Reduction of weight (up to 75%) and volume (up to 90%) of solid waste, which can be valuable if land space id scarce
* Generation of revenues from energy production, known as waste-to-energy incineration
* Break down of some hazardous, non-metallic organic wastes and destroys bacteria and viruses.
* Requires minimum land
* Can be operated in any weather

**Disadvantages:**

* Potential emission of contaminates into the air through exhaust stacks and into water through ash leachate.
* Expensive to build and operate
* High energy requirement
* Requires skilled personnel and continuous maintenance

**7.7 Pyrolsis**

**Advantages:**

* Recovering much more value from waste compared to mass burn incineration.
* More flexible than mass burn incinerators
* Syngas, a by product of can be used to generate energy much more efficiently than mass burn incineration. Syngas can be converted into energy through use of a gas engine.
* Easy to build.
* Reduce the biodegradable content of residual waste reducing the production of landfill gases when sent to landfill.

**Disadvantages:**

* Need to use pre-sorted or processed waste as feedstock.
* Much higher capital and operational costs compared to mass burn incineration.
* Increased technical experience is required to operate.

**7.8 Composting**

**Advantages:**

* Reduced the original volume of waste thus, reduce landfill space requirement.
* Produce a final product that can be used to support plant growth as a soil conditioner then minimise the use of chemical fertilizer.
* Conversion of available bio-mass into compost providing economic returns
* Low energy consumption.
* Reduced cost of disposal.
* The waste gets recycled.

**Disadvantages:**

* Releases greenhouse gases
* Need to control rainfall runoff from the composting area.
* Waste needs separation into degradable and non-degradable. Some wastes are not suitable for composting because they contain significant quantities of heavy metals, ceramics and plastics.
* Some plants are complex and difficult to maintain. If mechanised then involves relatively high capital investment and operating costs.
* In some cases, the markets for compost is inadequate in the immediately vicinity, thereby increasing transportation cost.

**7.9 Biomedical wastes and disposal**

Bio-medical waste means “any solid and/or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals.

**Biological processes**

**Incineration**

* Incinerators should be suitably designed to achieve the emission limits.
* Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.
* Toxic metals in the incineration ash shall be limited within the regulatory quantities
* Only low sulphur fuel like Diesel shall be used as fuel in the incinerator.

**Autoclaving**

* A temperature of not less than 121 o C and pressure of about 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or
* A temperature of not less than 135 o C and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or
* A temperature of not less than 149 o C and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.

**Microwaving**

* Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal carcasses, body parts and large metal items.
* The microwave system shall comply with the efficacy tests/routine tests
* The microwave should completely and consistently kill bacteria and other pathogenic organism that is ensured by the approved biological indicator at the maximum design capacity of each microwave unit.

**Deep Burial**

* A pit or trench should be dug about 2 m deep. It should be half filled with waste, and then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.
* It must be ensured that animals do not have access to burial sites.
* Covers of galvanised iron/wire meshes may be used.
* On each occasion, when wastes are added to the pit, a layer of 10cm of soil be added to cover the wastes.
* Burial must be performed under close and dedicated supervision.
* The site should be relatively impermeable and no shallow well should be close to the site.
* The pits should be distant from habitation, and sited so as to ensure that no contamination occurs of any surface water or ground water.
* The area should not be prone to flooding or erosion.
* The location of the site will be authorized by the prescribed authority.
* The institution shall maintain a record of all pits for deep burial.

**Disposal of Sharps**

* Blades and needles waste after disinfection should be disposed in circular or rectangular pits.
* Such pits can be dug and lined with brick, masonry, or concrete rings.
* The pit should be covered with a heavy concrete slab, which is penetrated by a galvanized steel pipe projecting about 1.5 m above the slab, within internal diameter of up to 20 mm.
* When the pipe is full it can be sealed completely after another has been prepared.

**7.10 Recommended Questions**

1. Briefly explain the advantages and disadvantages of the disposal method of open dumping
2. Explain briefly the various methods of solid waste disposal

**7.11 Outcomes**

* + - 1. Identify waste disposal or transformation techniques
      2. Understand health and environmental issues related to solid waste management

**7.12 Further Reading**

1. http://www.sciencedirect.com/science/article/pii/S1018364713000517
2. http://www.pollutionissues.com/Na-Ph/Ocean-Dumping.html
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1362169/
4. http://web.mit.edu/urbanupgrading/urbanenvironment/resources/references/pdfs/DecisionMakers.pdf