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**UNIT IV – OFF-SITE PROCESSING**  
**PART – A (2 MARKS)**

**1. Differentiate between aerobic and anaerobic composting of MSW**

Aerobic composting process is a single stage process in which aerobic micro-organisms oxidize organic compounds to CO<sub>2</sub>, nitrate and nitriles.

Anaerobic composting process is a two stage process in which break down of organic compounds by reduction is carried out by anaerobic micro-organisms.

**2. Enlist the probable composition of gases in the pyrolysis of MSW**

- CO<sub>2</sub>
- CO
- O<sub>2</sub>
- N<sub>2</sub>O & H<sub>2</sub>O
- SO<sub>2</sub> and ash

**3. What is the need for processing of solid wastes?**

- To segregate Biodegradable and non-biodegradable materials
- To segregate reuse and recyclable materials
- To reduce the quantity of disposable wastes
- To produce manure from wastes

**4. What is the purpose of using landfill for waste disposal?**

- Filling up low lying area and level the surface
- Reclamation of land
- Land use for future development after proper treatment

**5. Write the significance of C/N ratio in composting**

The organisms for stabilization of organic matter use 30 parts of carbon for each part of nitrogen so C/N=30 is good or a range of 26 to 31.

- If C/N < 30, carbon sources such as straw, saw dust, paper are added to increase carbon amount.
- If C/N > 30, indicates nitrogen deficiency, sewage sludge, slaughter house waste, blood are added as a source of nitrogen.

**6. Define pyrolysis.**

Pyrolysis is an ir-reversible chemical change brought by action of heat in an atmosphere, devoid of O<sub>2</sub>. This is also referred to as destructive distillation or carbonization. It is carried out at 900°C by external supply of heat at the end, produce a mixture of

combustible carbon monoxide, methane, hydrogen, ethane and non-combustible liquid, chemicals and charcoal.

### **7. What are the off-processes?**

Before safe disposal of solid wastes, it is required to reduce their quantity and also it is advisable to apply 3R concept towards some beneficial activities to the human society.

Off site processing involves 3 most important significant processes. They are:

- Biological processes
- Mechanical processes
- Thermal processes

### **8. List out any four recoverable products from off-site processing of solid wastes.**

- Methane
- Manure
- Reuse products
- Filling materials
- Mention the process parameters of composting
- Temperature
- Moisture content of wastes
- Use of cultures
- Organisms involved
- Aeration
- Carbon-Nitrogen Ratio
- Addition of sewage

### **9. Define in-vessel composting**

In-vessel composting is defined as a composting method in which the composting materials are confined within a building, container or vessel.

In-vessel composting systems can consist of metal or plastic tanks or concrete bunkers in which air flow and temperature can be controlled, using the principles of a bioreactor.

### **10. Define energy recovering facility**

Energy recovery facility means facility for the recovery of energy or energy producing materials from the controlled processing of solid waste and the production of energy from said solid waste and other materials including coal for a heating and cooling system and for the production of electricity and process steam.

### **11. Define electrostatic precipitators**

It is a system to reduce air pollution during incineration. Sanitary land filling, refuse is carried and dumped into low lying area under an engineered operation.

**12. Define incinerator**

Incinerator is a enclosed device using controlled flame combustion, the primary purpose of which is to thermally break down solid waste. Examples of incinerators are rotary kiln, fluidized bed and liquid injection incinerators.

**13. What is called Composting?**

Composting is an effective method of solid waste disposal. In composting, biodegradable materials break down through natural processes and produce humus. The metabolism of micro-organisms breaks down the waste aerobically or anaerobically.

**14. What are the reasons for modern compost systems are aerobic rather than Anaerobic compost systems?**

Most modern compost systems are aerobic rather than anaerobic for several reasons:

1. Aerobic processes are not accompanied by the foul stench present at an unsealed anaerobic composting operation.
2. In crop production industries, composting is safer because temperatures do not reach that of pasteurization temperatures which exceed the thermal death point of most plants, animals and parasites.
3. Aerobic composting is more rapid than anaerobic composting.

**15. Write down the carbon:nitrogen ratio favorable for decomposition?**

An aerobic compost operation ideally is an optimal environment for the growth of aerobic organisms. The material to be composted is food. Therefore the “food” should have a carbon:nitrogen ratio favorable for decomposition. The microbes require a C: N of 25:1 to 30:1.

**16. If the C: N is too low what will happen in the composting.**

If the C: N is too low(120:1), the ammonium compounds will volatilize into the air, causing an unpleasant odor. Various groups of organisms have different optimum temperatures (some prefer 25 °C, some 37 °C, and others 55 °C), though the optimal temperature for a process as a whole integrates the optimums of the various microbes.

**17. What are the Types of Composting?**

Types of Composting The three main types of composting are: windrow, static pile, and in-vessel.

1. Windrow: A sludge/refuse mixture configured in long rows (windrows) that are aerated by convection air movement and diffusion, or by turning periodically through mechanical means to expose the organic matter to ambient oxygen.

2. Static pile: A stationary mixture is aerated by a forced aeration system installed under the pile.

3. In-vessel composting: Composting takes place in enclosed containers in which environmental conditions can be controlled. The waste decomposes into a harmless organic material that can be used as a soil conditioner and enhancer for agricultural applications.

### **18. Which Factors in Composting Operation?**

The most important factors in composting operations are:

1. segregation of refuse and salvage
2. grinding or shredding of the material
3. carbon-nitrogen ratio
4. blending or proportioning of wastes
5. moisture content

### **19. What are the most important purposes for composting organic Wastes?**

The two most important purposes for composting organic wastes are:

- a. reclamation or conservation of the nutrient and fertilizer values of the waste,
- b. sanitary treatment and disposal to prevent the spread of disease.

### **20. What is called humus?**

Compost is a brown material, the main constituents of which are humus. It has the following physical properties when applied to the soil:

- the lightening of heavy soil
- improvement of the texture of light sandy soil
- increased water retention
- enlarging root systems of plants.

### **21. What are the Character and Value of the Compost?**

Character and Value of the Compost Compost material is stable. It may undergo little or no further decomposition. It has a slightly musty or earthy odor. Colorwise, it must be grayish or blackish. Its value is to serve as soil conditioner, lightness to the soil, promotes aeration and helps retain moisture by adding humus.

**22. What is called composting pit?**

Compost Pit: It can be designed for individual houses or institutions. It is the easiest method of— solid waste management system, if it is well managed. It is the most ideal method of dealing with wastes in homes and institutions like schools. Waste is normally deposited in the pit and covered within 24— hours with a thin layer of earth.

**23. What is called incineration?**

Incineration is a process of burning the combustible components of garbage and refuse. Disposal of solid waste by incineration can be effectively carried out on a small scale in food service establishments as well as in institutions such as hospitals, schools etc.

**24. What is called on-site incineration?**

On-site Incineration This term applies to incineration of refuse at home, office, apartment house, commercial building, hospital or industrial site. Refuse collection and disposal could be reduced satisfactorily by using on-site incineration. Generally, airpollution can be expected.

**25. Give the Advantages of an incinerator?**

Advantages of an incinerator

1. Less land is required for landfills
2. A central location is possible, allowing short hauling for the collection service.
3. Ash and other residue produced are free of organic matter, nuisance- free, and acceptable as fill material.
4. Many kinds of refuse can be burned. Even noncombustible materials will be reduced in bulk.
5. Climate or unusual weather does not affect it.

**26. Give the disadvantages of an incinerator?**

Disadvantages of an incinerator

1. Initial cost is high during construction.
2. Operating cost is relatively high.
3. Skilled employees are required for operation and maintenance.
4. There may be difficulty in getting a site.

**UNIT IV – OFF-SITE PROCESSING**  
**PART – B (16 MARKS)**

1. Draw a flow chart showing the steps involved in the aerobic composting process. Explain the factors affecting composting process.
2. Discuss the major types of gaseous emissions from a mass burn incinerator and how each may be effectively removed from flue?
3. Explain the classifications of compensating technologies and discuss briefly the basic steps involved in the compensating process.
4. How does incineration help in the management of solid waste? Describe the incineration technologies and air emissions and its control in detail.
5. Explain the various options for the disposal of solid wastes and the relative merits of disposal options
6. Describe the incineration technologies and air emissions and its control in detail
7. Explain composting process of bio degradable MSW
8. Draw schematic diagram of a in-line multiplier chamber incinerator and specify the parts.
9. Write short notes on
  - i) Composting micro biology
  - ii) Gases in sanitary landfill
  - iii) Air pollution problems in incineration process
10. Explain the components and operations of a window composting facility
11. Discuss the factors affecting waste composting and the methods of its control.
12. What are the objectives of waste processing?
13. i) Describe the factors to be considered in the selection of waste processing equipments.  
ii) What are the important factors affecting composting? How they are controlled during composting?
14. i) Briefly outline the different waste to energy options for management of solid and hazardous waste.  
ii) What are the important factors affecting composting? How they are controlled during composting?
15. Explain briefly about various magnetic separators with neat sketches. Explain with neat sketches about the pyrolysis and incineration – pyrolysis process?