



## **SELF-STUDY COURSE 3010-G**

# **Solid Waste Management**



*Environmental Health Sciences*

**Environmental Health Sciences  
Self-Study Course SS3010**

**Lesson 4: Solid Waste Management**

**I. Lesson Consists of**

- A. Part I: 25 multiple choice questions
- B. Part II: 25 multiple choice questions
- C. Part III: 25 multiple choice questions
- D. Part IV: 10 multiple choice questions

**II. Reference**

Salvato, J. A., *Environmental Engineering and Sanitation*. 4th ed. New York: John Wiley & Sons, 1992.

**III. Topics and Reading Assignments**

Chapter 5 - Solid Waste Management	
A. Composition, Storage and Collection	(Page No.) 662 to 679
B. Treatment and Disposal of Solid Wastes	679 to 684
C. Special Wastes	684 to 689
D. Resource Recovery	689 to 696
E. Hazardous Wastes	696 to 716
F. Incineration	716 to 728
G. Sanitary Landfill	729 to 760
H. Composting	760 to 766

**IV. Suggested Supplementary Readings**

*Characterization of Municipal Solid Waste in the United States*. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency: EPA/S30-E-019, 1992.

Kharbanda, O. P., Stallworthy, E. A., *Waste Management*. Auburn House Publishers, 1990, ISBN: 0-86569-000-6

**References of Historical Significance:**

Ehlers, V. M. and Steele, E. W. *Municipal and Rural Sanitation*. New York: McGraw-Hill, 1965.

**V. Objectives**

Upon successful completion of Lesson 4, students should be able to correctly:

- identify and study available disposal techniques and facilities with an understanding of the importance of recycling and resource conservation.
- demonstrate an understanding of the sources and characteristics of present day solid wastes
- examine the economics of solid waste collection, storage, and disposal in order to develop fiscal policies
- demonstrate an understanding of new developments in the collection and disposal technology and interpret predictions of future trends in solid waste generation and characteristics
- identify major sources of hazardous wastes and make correct decisions concerning proper disposal methods
- define and explain selected terms and acronyms associated with solid waste management
- demonstrate an understanding of the importance of solid waste management and its relationship to Federal, State, and local regulations
- demonstrate an understanding of the technology associated with sanitary landfills and incineration operations
- develop an understanding of the opportunities and limitations of composting.

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**Lesson 4: *Solid Waste Management***

**Part I: Multiple Choice**

1. The average amount of solid waste generated, collected, and disposed of from a particular area is dependent on many local factors such as
  - a. time of the year
  - b. education and economic status of the people
  - c. whether the area is urban or rural
  - d. all of the above.
2. The weight and shape of temporary waste storage containers must be kept within the limits that can be easily and conveniently handled by the collection crew, with the weight preferably not exceeding
  - a. 50 pounds
  - b. 3 pounds
  - c. 70 pounds
  - d. 25 pounds.
3. According to the United States Environmental Protection Agency, solid waste **does not** include
  - a. manures and crop residues that can be returned to the soil as fertilizer or soil conditioners
  - b. mining or milling wastes intended for return to the mine
  - c. solid or dissolved material in domestic sewage
  - d. all of the above.
4. Which of the following is not recommended for a refuse storage room?
  - a. a drained concrete floor
  - b. ample natural or artificial light and ventilation
  - c. temperature kept below 50°F
  - d. uncovered base.

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5. Which of the following is **true** about garbage stands?
- a. garbage stands should be screened to keep out birds and rodents.
  - b. garbage cans should be painted for easy detection by collection crews.
  - c. garbage stands should be convenient to the kitchen, in an airy shaded location
  - d. built-in garbage or trash boxes, bins, or sheds are recommended.
6. Bulk containers or refuse bins are recommended where large volumes of refuse are generated, such as at
- a. hotels and motels
  - b. shopping centers and restaurants
  - c. apartment houses
  - d. all of the above.
7. The Consumer Product Safety Commission requires that refuse bins or containers must be able to withstand a hanging weight or force of \_\_\_\_ pounds and a horizontal force of \_\_\_\_ without overturning, with the force applied where tipping of the bin is ~~not~~ <sup>most</sup> likely.
- a. 191; 70
  - b. shopping centers and restaurants
  - c. 200; 100
  - d. 50; 100.
8. The wastewater generated from washing out refuse bins and containers
- a. can be disposed of with the garbage
  - b. must pass through a grease trap before entering a sewerage system
  - c. should not be allowed to run onto the surface of the ground
  - d. all of the above.
9. Added moisture used in maceration \_\_\_\_\_ the handling and haul costs of solid waste
- a. increases
  - b. decreases
  - c. does not change
  - d. sometimes increases or sometimes doesn't change.

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10. Frequency of collection depends on
- quantity of waste
  - time of year
  - socioeconomic status of the area served
  - all of the above.
11. The transfer station should be located \_\_\_\_\_ of the collection service area.
- on the perimeter
  - at the busiest location
  - in the center
  - none of the above.
12. \_\_\_\_\_ reduces the final volume of wastes.
- compaction
  - maceration
  - pneumatic transport
  - a and b above.
13. According to the reference as of 1992, collection cost is \_\_\_\_\_ of the total cost of disposal for landfilled waste. (Please note that the costs of landfill and incineration have greatly increased in recent years, thereby changing these cost ratios.)
- more than 50%
  - less than 50%
  - equal to 50%
  - none of the above.
14. In business districts, refuse, including garbage from hotels and restaurants, should be collected daily, except on
- Sundays
  - Saturdays (usually the busiest days)
  - Mondays
  - Saturdays and Sundays.

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15. The National Safety council reported that solid waste collection workers have an injury frequency approximately \_\_\_\_\_ times the national average for all industry.
- a. ten
  - b. two
  - c. three
  - d. five.
16. The commonly acceptable refuse disposal and treatment methods are
- a. wet oxidation, sanitary landfilling and compaction
  - b. incineration, pyrolization, and anaerobic digestion
  - c. composting, incineration, and sanitary landfilling
  - d. burial at sea, incineration, and sanitary landfilling.
17. Open dumps should be considered
- a. a cause of water pollution
  - b. an odor and smoke nuisance
  - c. a fire hazard
  - d. all of the above.
18. It is recommended that all garbage fed to hogs be properly boiled for
- a. 1 hour
  - b. 30 minutes
  - c. 15 minutes
  - d. 2 hours.
19. The spread of \_\_\_\_\_ is (are) encouraged when uncooked garbage is fed to hogs.
- a. trichinosis to humans
  - b. hog cholera
  - c. vesicular exanthema in swine
  - d. all of the above.

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20. For hog feeding to be satisfactory, in addition to cooking of garbage, it is necessary to accomplish all of the following **except**
- a. rat-proof concrete feeding platforms and structures
  - b. allow garbage to cool down by adding 20% water
  - c. remove manure and leftover waste daily
  - d. clean the hog pens and flush the feeding platforms and troughs frequently.
21. The grinding of garbage is an acceptable method of
- a. garbage disposal
  - b. volume reduction
  - c. wet oxidation
  - d. energy recovery.
22. The home grinding system shreds garbage into small particles while being mixed with water and is discharged to the
- a. ocean
  - b. sanitary landfill
  - c. house sewer
  - d. high-temperature incinerator.
23. The dumping of garbage and other refuse at sea in the united States is
- a. permitted at depths greater than 100 feet
  - b. considered a sanitary practice if weather conditions, distance from shore, and depth of water requirements are met
  - c. prohibited
  - d. not very cost-effective.
24. Various garbage reduction processes extract biological fats that are then used in the manufacturing of
- a. soaps and glycerines
  - b. glue and cement
  - c. grouting and calk
  - d. fertilizer and cattle feed.



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25. Which of the following is (are) true about composting?

- a. it has been a great success in the United States
- b. it may come from municipal solid waste
- c. it results in a poor fertilizer
- d. both b and c above.

**Part II: Multiple Choice**

1. Composting is the controlled decay of organic matter that may come from
  - a. sewage sludge
  - b. agricultural waste
  - c. organic industrial waste
  - d. all of the above.
2. Which of the following composting methods will require limited land space?
  - a. beccari method
  - b. bangalore process
  - c. fairfield-hardy process
  - d. none of the above.
3. \_\_\_\_\_ is a thermochemical process for the conversion of complex organic solids in the absence of added oxygen, to water, combustible gases, tarry liquids, and stable residue.
  - a. composting
  - b. incineration
  - c. wet oxidation
  - d. pyrolysis.
4. Which of the following allows for 95 percent or more volume reduction of municipal solid wastes?
  - a. incineration
  - b. pyrolysis
  - c. high-temperature incineration
  - d. both b and c above.
5. Volume reduction can be achieved by
  - a. baling
  - b. landfill equipment
  - c. pulping
  - d. all of the above.

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6. High-density compaction of solid wastes is accomplished by compression to a density of more than \_\_\_\_\_.
- a. 75.5/lb ft<sup>3</sup>
  - b. 60.5/lb ft<sup>3</sup>
  - c. 66.5/lb ft<sup>3</sup>
  - d. none of the above.
7. Which of the following is true about disposal of animal wastes?
- a. If wet manure is plowed under, fly eggs present will not hatch.
  - b. Composting of manure takes advantage of the inclination that larvae have to move out and away from moist manure in search of a dry place to pupate.
  - c. Where a small number of animals are kept, the manure should be collected once a week.
  - d. Odors associated with the handling and disposal of these wastes do not determine the disposal method or its location.
8. Shredding reduces the volume of wastes to about \_\_\_\_ or less of the original bulk.
- a. 60 percent
  - b. 50 percent
  - c. 40 percent
  - d. 30 percent
9. Systems used for treatment and disposal of animal wastes include
- a. field spreading, oxidation ditch, and incineration
  - b. plow-furrow cover, aerated lagoon, and wet oxidation
  - c. irrigation, anaerobic digestion, and drying
  - d. all of the above.
10. Dead animals are best disposed in
- a. an incinerator or rendering plant
  - b. a separate area of sanitary landfill
  - c. a composting bed
  - d. either a or b above.

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11. The EPA believes that only \_\_\_\_ of the waste stream can be recovered economically.
- a. 26 percent
  - b. 36 percent
  - c. 56 percent
  - d. 76 percent.
12. The disposal of used tires presents a problem, but shredded tires may be used as
- a. a source of heat for homes
  - b. fuel for industries
  - c. an asphalt additive to reduce pavement cracking
  - d. a supplemental fuel for incinerators.
13. Resource recovery and reduction of solid wastes should start
- a. at the point of generation
  - b. at the sanitary landfill
  - c. in the home
  - d. at the transfer station.
14. \_\_\_\_ can be recovered from refuse by burning it in a refractory lined incinerator or water-wall incinerator.
- a. glass
  - b. aluminum
  - c. ferrous metal
  - d. energy.
15. Acidic conditions \_\_\_\_ the growth of methane-producing bacteria.
- a. increase
  - b. inhibit
  - c. do not affect
  - d. none of the above.

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16. Methane in the presence of air is explosive at concentrations between
- a. 5 and 15 percent
  - b. 3 and 5 percent
  - c. 20 and 25 percent
  - d. 50 and 60 percent.
17. Oil that has had a physical and chemical impurities removed and that by itself or when blended with new oil or additives, is substantially equivalent or superior to new oil intended for the same purposes, is called
- a. re-refined oil
  - b. substandard oil
  - c. terrestrial oil
  - d. subsurface oil.
18. What does RCRA stand for?
- a. Recovery, Conservation, and Refuse Administration
  - b. Radioactive Chemical Recovery Administration
  - c. Radioactive Chemical Recovery Act
  - d. Resource Conservation and Recovery Act.
19. Hazardous wastes include which of the following types of substances?
- a. chemical and biological
  - b. radioactive
  - c. explosive
  - d. all of the above.
20. Which of the following is **not** one of the four characteristics of hazardous wastes as defined by the Environmental Protection Agency?
- a. radioactivity
  - b. toxicity
  - c. explosive
  - d. ignitability.



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### 21. The Toxic Substances Control Act (TSCA) of 1976

- a. mandates government (Federal and State) control of hazardous wastes from their point of generation to their point of ultimate disposal
- b. regulates the production and use of chemical substances that may present an unreasonable risk of injury to health or environment
- c. requires that all toxic substances transported from one point to another by air, land, or sea be properly documented through an approved manifest system
- d. regulates all hazardous wastes generated at health care facilities through Federal and State governments.

### 22. The goal for management of hazardous waste should be

- a. "safe disposal methods"
- b. "minimal impact on the environment"
- c. "zero discharge"
- d. all of the above.

### 23. The most common problems associated with the disposal of hazardous waste are

- a. public opposition and spills
- b. groundwater pollution from lagoons and unauthorized dumping
- c. leachate from landfills, dumps, sludge disposal, and other land disposal systems
- d. all of the above.

### 24. A properly designed and controlled incinerator is satisfactory for burning combustible refuse as long as

- a. the incinerator is not located in the downtown area
- b. sufficient quantities of refuse can be provided
- c. air pollution standards can be met
- d. the furnace is cooled regularly.

### 25. The batch feeding of incinerators

- a. helps maintain even temperatures
- b. helps maintain high temperatures
- c. promotes spalling and loosening of tiles
- d. both a and b above.

**Part III: Multiple Choice**

1. Additional fuel is needed to incinerate refuse
  - a. with 30 percent or less rubbish
  - b. with 50 percent or more moisture
  - c. with 10 percent or more metals
  - d. both a and b above.
2. The amount of residue left after incineration is approximately
  - a. 10 to 20 percent of the original volume
  - b. 25 to 50 percent of the original volume
  - c. 55 to 65 percent of the original volume
  - d. none of the above.
3. Incinerators are rated in terms of
  - a. percent fuel capacity per day
  - b. BTU's per day
  - c. tons of burnable waste per day
  - d. cubic feet of solid waste per day.
4. To provide enough refuse for an incinerator to continuously operate, a refuse storage pit/bin must hold approximately
  - a. 1 day of refuse
  - b. 2 days of refuse
  - c. 3 days of refuse
  - d. 4 days of refuse.
5. In the rectangular furnace, the grates are arranged in
  - a. arches
  - b. rectangles
  - c. tiers
  - d. circles.

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6. The three essentials for combustion in an incinerator are
  - a. temperature, time, and heat
  - b. time, temperature, and moisture
  - c. temperature, heat and fuel
  - d. time, temperature, and turbulence.
7. Modern furnace walls are usually lined with
  - a. tile or have water walls
  - b. plastic and molten slag
  - c. brick with fire-rods
  - d. steel.
8. The second step of the combustion process in an incinerator requires a high temperature of at least
  - a. 1500° to 1600°F
  - b. 1500° to 1800°F
  - c. 1900° to 2000°F
  - d. 1800° to 1900°F.
9. The furnace temperature of an incinerator can be controlled by adjusting
  - a. The amount of overfire air
  - b. the amount of under fire air
  - c. the induced draft fan
  - d. both a and b above.
10. The temperature of the gases leaving the furnace is reduced by
  - a. spraying with water
  - b. dilution with cool air
  - c. passing through heat exchanges
  - d. all of the above.



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11. When considering a site for a sanitary landfill, both county and regional-wide planning and administration of the site should be considered because
  - a. it could result in shorter travel distances and a lower unit of cost for operation
  - b. the results could be more efficient and a lower unit cost for operation
  - c. the results could be more efficient and there will be less citizen opposition
  - d. there will be less citizen opposition and shorter travel distances.
12. The normal economical hauling distance to a refuse disposal site is usually between
  - a. 5 to 10 miles
  - b. 10 to 15 miles
  - c. 15 to 20 miles
  - d. 20 to 25 miles.
13. When trying to establish economical hauling, what is most important?
  - a. hauling time
  - b. hauling distance
  - c. means of hauling
  - d. what is being hauled.
14. A landfill site should **not**.
  - a. be located near a major highway
  - b. be given an attractive entrance and approach road
  - c. house equipment on site
  - d. be inaccessible during bad weather conditions.
15. A county or regional landfill should provide enough area for a \_\_\_\_ period of operation.
  - a. 5- to 10-year
  - b. 10- to 15-year
  - c. 15- to 25-year
  - d. 20- to 40-year.

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16. In order to determine the depth at which a sanitary landfill can be operated, which of the following must be determined?
- a. location of bedrock
  - b. groundwater table
  - c. finished grade
  - d. all of the above.
17. In good soil and with appropriate geology, landfill sites should be at least \_\_\_\_ from streams, lakes, or other surface bodies of water.
- a. 200 feet
  - b. 500 feet
  - c. 700 yards
  - d. 1000 feet.
18. After a landfill site is closed, it should be covered with at least \_\_\_\_ of compacted soil having a low permeability, graded to shed rainwater, melting snow, and surface water.
- a. 5 feet
  - b. 36 inches
  - c. 2 feet
  - d. 28 inches.
19. Leachates containing primarily low molecular weight organic compounds are best treated by
- a. biological methods
  - b. physical-chemical methods
  - c. physical methods
  - d. both a and b above.
20. A relatively porous landfill earth cover will permit
- a. the escape of gases
  - b. greater infiltration and leachate production
  - c. both a and b above
  - d. none of the above.

21. The most suitable soil for cover material at a landfill site is one that is
- easily worked and minimizes infiltration
  - relatively porous and rich in nitrogen
  - most convenient to the site and always available
  - dug from the trenches where the waste will be deposited.
22. Which of the following is **not** considered an advantage to using shredded solid waste landfill?
- it does not cause odors
  - it may not require daily earth cover
  - it will readily absorb precipitation
  - it reduces insect breeding.
23. The best way to control deep fires in a sanitary landfill is to
- inject water under the cover material at strategic points throughout the landfill
  - separate the burning refuse and dig a fire brake around the burning refuse
  - smother the burning area with landfill liner made of polymeric or asphaltic materials
  - let the area burn itself out.
24. Before trying to convert an "open dump" into a sanitary landfill, you must first
- remove all previous waste to another site
  - institute a rat-poisoning program 2 weeks before conversion
  - develop a plan of operation, supervision, maintenance, and a drawing showing your proposed plans
  - both b and c above.
25. The best sanitary landfill method for an area with rolling terrain is the
- low-area method
  - valley or ravine area method
  - trench method
  - area or ramp method.

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### **Part IV: Multiple Choice**

1. The life of a tractor at a landfill is figured to be about
  - a. 6,000 hours
  - b. 8,500 hours
  - c. 10,000 hours
  - d. 12,500 hours.
2. The valley or ravine landfill method utilizes "lifts" from the bottom up with depths usually of
  - a. 6 to 8 feet
  - b. 8 to 10 feet
  - c. 10 to 12 feet
  - d. 12 to 14 feet.
3. One piece of refuse-compaction and earth-moving equipment is needed at the landfill site for approximately each
  - a. 40 loads per day
  - b. 60 loads per day
  - c. 80 loads per day
  - d. 100 loads per day.
4. The size and type of machinery needed at the sanitary landfill is dependent on
  - a. the amount of solid waste handled
  - b. the availability of cover material
  - c. the compaction to be achieved
  - d. all of the above.
5. A dragline may be used at a landfill site for
  - a. digging trenches
  - b. stockpiling cover material
  - c. placing cover material over refuse
  - d. all of the above.

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6. The direction of operation of a sanitary landfill should be
  - a. against the prevailing wind
  - b. with the prevailing wind
  - c. perpendicular to the prevailing wind
  - d. changed daily to be perpendicular to the prevailing wind.
7. Compression or shredding of bulky objects before landfilling them will
  - a. improve compaction of the fill
  - b. reduce land volume requirements
  - c. allow for more uniform settlement
  - d. all of the above.
8. Determining what a landfill can be used for when completed should be planned.
  - a. when the landfill is half full
  - b. before you build the landfill
  - c. when the landfill is full
  - d. any time during the operation of the landfill.
9. Large items that are not salvaged should be
  - a. set directly into the landfill
  - b. placed in an alternative location
  - c. compressed or shredded
  - d. any of the above.
10. Depending on the size of the community, there should be a minimum of one worker at a landfill site and \_\_\_\_\_ workers per 1000 yd<sup>3</sup> of waste dumped per day that the site is open.
  - a. six
  - b. four
  - c. three
  - d. two.

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# **Answer Keys**





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**Answer Keys (Page No.)**

**Lesson 4: Part I**

1. D (666)	6. D (672)	11. C (676)	16. C (679)	21. A (680)
2. C (672)	7. A (672)	12. D (676)	17. D (679)	22. C (680)
3. D (665)	8. D (674)	13. C (675)	18. B (679)	23. C (680)
4. D (672)	9. A (674)	14. A (675)	19. D (679)	24. A (681)
5. C (672)	10. D (675)	15. A (676)	20. B (680)	25. D (760)

**Part II**

1. D (760)	6. C (683)	11. C (690)	16. A (696)	21. B (702)
2. D (762)	7. B (687)	12. B (688)	17. A (688)	22. C (706)
3. D (681)	8. C (683)	13. A (689)	18. D (696)	23. D (701)
4. D (682)	9. D (687)	14. D (694)	19. D (697)	24. C (717)
5. D (683)	10. D (686)	15. B (695)	20. A (699)	25. D (717)

**Part III**

1. D (719)	6. D (723)	11. B (730)	16. D (735)	21. A (746)
2. D (720)	7. A (723)	12. B (732)	17. A (743)	22. C (747)
3. C (722)	8. B (723)	13. A (732)	18. C (743)	23. B (748)
4. D (719)	9. D (726)	14. D (735)	19. A (744)	24. D (758)
5. C (723)	10. D (726)	15. D (735)	20. C (744)	25. D (749)

**Part IV**

1. C (750)	3. C (750)	5. D (753)	7. D (754)	9. D (754)
2. B (749)	4. D (750)	6. B (754)	8. B (759)	10. A (755)

