

KLS's
Vishwanathrao Deshpande Rural Institute of Technology, Haliyal-58139
Department of Civil Engineering
SOLID WASTE MANAGEMENT (18CV642)
MODEL QUESTION PAPER - 2

SEM: VI

Max.Marks:100

- Q1. a)** Describe the physical properties of MSW. **(10Marks)**
b) Estimate the Energy content of a solid waste sample with the following composition based on 100kg sample on discarded and on dry basis if the moisture content is 21% . **(10 Marks)**

Component	% by mass in %	Energy content in %
Food waste	15	4650
Paper	45	16750
Cardboard	10	16300
Plastics	10	32600
Garden trimmings	10	6500
Wood	05	18600
Tin cans	05	700

- Q2. a)** Briefly explain the collection services used in SWM. **(10Marks)**
b) Briefly explain Heuristic Guidelines for Laying out Collection Routes solid wastes **(10Marks)**
- Q3. a)** What is chemical volume reduction? Write purposes of incineration **(10Marks)**
b) Explain the advantages and disadvantages of incineration process. **(10Marks)**
- Q4. a)** Briefly explain compaction with advantages and disadvantages **(10Marks)**
b) Briefly explain the equipment's used in size reduction **(10Marks)**
- Q5. a)** Discuss the design considerations of aerobic composting process. **(10Marks)**
b) Determine the amount of air required to oxidize completely 1 tonne of waste having the chemical equation $C_{50}H_{100}O_{40}N$. **(10Marks)**
- Q6. a)** What is sanitary landfilling? Briefly explain advantages of landfilling **(10Marks)**
b) A landfill area of (150 m x 100 m) is available for handling one year' municipal solid waste (MSW) for a town of 5,00,000 people. Out of the total landfill area only 80% is actually available for land fill and other is used for auxiliary services. Given: 1. Average per capita MSW discard per year in town = 0.05 tonne, 2.Landfill density = 500 kg/m³, 3.15 percent of the actual landfill cell volume is used for soil cover, estimate the following, (a) the landfill lift in one year. (b) number of years for which the land fill can be used if the landfill can't be increased beyond 25 m. **(10Marks)**
- Q7.a)** What is biomedical waste? Briefly explain effects of BMW on environment. **(10Marks)**
b) Briefly explain the collection and transportation of biomedical waste. **(10Marks)**
- Q8.a)** Briefly explain the sources and types of E-wastes. **(10Marks)**
b) Briefly explain options for the management of C&D debris **(10Marks)**
- Q9.a)** Briefly explain types of incinerations **(10Marks)**
b) Briefly explain any two by products of process of Pyrolysis. **(10Marks)**
- Q10.a)** What is WTE in SWM? Briefly explain its benefits **(10Marks)**
b) List and explain the sources of hazardous wastes. **(10 Marks)**

SOLUTION FOR MCHM1 QUIZ 09/01/2024

Name of Subject: Solid Waste Management (1207042)

Staff Incharge: Prof. S. G. Hegde

Q.No. 14) Describe the physical properties of MSW. (10 marks)

-Ans:

Information and data on the physical properties of municipal solid wastes are important for the selection and operation of equipment and for the analysis & design of disposal facilities. — 01M

Following are the physical characteristics of municipal solid wastes (MSW).

(i) Density: Density of wastes i.e. its mass per unit volume (kg/m^3), is a critical factor in the design of SWM system. Density is very important in the design of sanitary landfill, storage, & types of collection & transport vehicles. — 02M

(ii) Moisture content: Moisture content is defined as the ratio of the weight of water to the total weight of the waste. It is a critical determinant in the economic feasibility of waste treatment by incineration, pyrolysis etc.

Mathematically,

$$\text{Moisture Content (\%)} = \left(\frac{w_0 - d}{w_0} \right) \times 100$$

where w_0 - initial wt of waste as delivered in kg
 d - weight of sample after drying

— 03M

iii) Size of waste constituents: The size distribution of waste constituents in the waste stream is important because of its significance in the design of mechanical separator and shredder and waste treatment process.

Other physical characteristics considered in solid waste management are calorific value, field capacity, permeability of compacted wastes and compressibility.

02
Total 10 Marks.

Q.No. 16) Numerical on energy content: (10 Marks)

Ans: Consider the following table.

S. No.	Components.	% by mass	Mass for 100kg sample in kg.	Energy content in KJ/kg.	Total energy content in KJ/kg.
1)	Food wastes	15	15	4650	69750
2)	Paper	45	45	16750	753750
3)	Card board	10	10	16300	163000
4)	plastics	10	10	32600	326000
5)	Garden Trimmings	10	10	6500	65000
6)	Wood	05	05	18600	93000
7)	Tin cans	05	05	700	3500.
Total EC					1474000

(2)

06 Marks.

* Compute the unit energy content on discarded basis.

$$\begin{aligned}\text{Unit Energy content for } 100\text{kg} &= \frac{1474000}{100} \\ &= 14740 \text{ KJ/Kg.}\end{aligned}$$

_____ 02M)

* Energy content on dry basis.

Given: Moisture content = 21%.

Assume: Ash content = 5%.

$$\begin{aligned}\therefore \text{Unit energy content on ash free} \\ \text{dry basis} &= \frac{14740 \times 100}{100 - 21 - 5} \\ &= 19919 \text{ KJ/Kg.}\end{aligned}$$

_____ 02M)

Total 10 Marks.

Q.No. 2a) Briefly explain the Collection Services Used in SKM. (10 marks)

Ans:

The term "Collection" includes not only the collection of solid wastes from the various sources, but also the hauling these wastes to the locations where the contents of the collection vehicles are emptied & the unloading of the collection vehicles.

_____ 02M)

Following are the collection services used in solid waste management.

Curb Service: In the curb service, the home owner is responsible for placing the containers

to be emptied at the curb on the collection day
(c) for returning the empty containers to their
storage location until the next collection event.

ii) Alley Service: Alleys are the part of basic layouts
of a city or a given residential area. This service
is usually used in solid waste management.

iii) Set out & set back: In set-out-set-back
service, containers are set-out from the homeowners
property and set-back after being emptied by
additional crews that work in conjunction with
the collection crew responsible for loading the
collection vehicles.

iv) Setout Service: It is same as setout-setback
service, except that the home owner is responsible
for returning the containers to their
storage location

$$(0.2 \times 0.4 = 0.08M)$$

Total: 10 Marks

Q.No. 26)

Briefly explain heuristic guidelines for
laying out collection routes for solid wastes (10M)

Ans:

Some heuristic guidelines for laying out routes
for solid waste collection are as follows.

i) Existing policies & regulations related to such items
as the point of collection and frequency of collection
must be identified.

ii) Existing systems, such as crew size & vehicle types

must be coordinated.

ii) Whenever possible, routes should be laid out so that they begin and end near arterial streets, using topographical & physical boundaries as barriers.

iii) In hilly areas, routes should start at the top of the grades and proceed downhill as the vehicle becomes loaded.

iv) Routes should be laid out so that the last containers to be collected on the route are located nearest to the disposal site.

v) Wastes generated at traffic congested areas should be collected as early in day as possible.

vi) Sources at which extremely large quantities of wastes are generated should be serviced during the first part of the day.

vii) Scattered pick up points where small quantities of solid waste are generated that requires the same collection frequency should, if possible, be serviced during one trip or on the same day.

viii) Electronic data processing equipments and its appropriate software are being used to assist in the planning and evaluation of collection routes.

ix) Preparation of location maps showing data & information concerning the waste generation sources.

Q.No. 3a)

What is chemical volume reduction? Write purposes of incineration. (10 Marks)

Ans:

Chemical volume reduction is a method, where volume reduction occurs through chemical changes brought ~~in~~ within the waste either through addition of chemicals or changes in temperature.

Incineration is a most common method used to reduce the volume of waste chemically and is used both for volume reduction & power production. The other chemical methods used to reduce volume of waste chemically include pyrolysis, hydrolysis & chemical conversions. — 05M.

The purposes of incineration are

- i) Making inert and hazardous waste residues while minimizing the emission into the air, water & soil.
- ii) Destroying organic contaminants and concentrating inorganic contaminants.
- iii) Minimizing the quantity of waste, requiring disposal, especially its volume.
- iv) Recovering the waste's heat value by burning as energy resource and power generation.
- v) Transforming the residues into usable secondary products.

05M

Total 10 Marks.

must be coordinated.

iii) wherever possible, routes should be laid out so that they begin and end near arterial streets, using topographical & and physical boundaries as barriers.

iv) In hilly areas, routes should start at the top of the grades and proceed downhill as the vehicle becomes loaded.

v) Routes should be laid out so that the last containers to be collected on the route are located nearest to the disposal site.

vi) Wastes generated at traffic congested areas should be collected as early in day as possible.

vii) Sources at which extremely large quantities of wastes are generated should be serviced during the first part of the day.

viii) Scattered pick up points where small quantities of solid waste are generated that requires the same collection frequency should, if possible, be serviced during one trip or on the same day.

ix) Electronic data processing equipments and its appropriate software are being used to assist in the planning and evaluation of collection routes.

x) preparation of location maps showing data & information concerning the waste generation sources.

(01 x 10 = 10 marks)

Q.No.36) Explain the advantages & disadvantages of incineration process. (10 Marks)

Ans: Advantages of incineration process:

i) Incineration decreases the quantity of waste.

Incineration can decrease the quantity of waste by 95% and reduce the quantity of solid waste by 80-85% depending on the components that were in solid waste.

ii) Efficient waste management:

Incineration plays a vital role in making waste management easier and more efficient.

Incineration can burn up to 90% waste generated and sometimes even more.

iii) Production of heat & power:

Incineration plants generate energy from waste that can be used to generate electricity or heat. The electricity can be generated using steam turbines.

iv) Reduction of pollution:

Researches have shown that the incineration is less likely to pollute the environment than landfills.

v) Saves on transportation of waste

Incineration plants can be near cities or towns which reduces the cost towards the transportation of wastes which reduces the harmful gases released during transportation.

— 05M.

Disadvantages of Incineration:

i) Incineration is expensive:

The installation of incineration plant is an expensive process, particularly cost of construction & operation are very high.

ii) Pollutes the environment:

Incinerator smoke consists acid gases, carcinogenic dioxins, particulate, heavy metals etc which is poisonous to environment.

iii) Damaging public health.

According to research, the communities where incinerator plants are built are responsible for health hazards such as cancer, birth defects, & reproductive dysfunction etc.

iv) Ash waste can potentially harm people and the environment.

The ash consist of several poisons & heavy metals which can cause serious harm to the human health an environment.

v) The possibility of long term problems.

Incineration does not encourage recycling & waste reduction.

— 05M
Total 10M.

Q. No 4 a)

Briefly explain compaction with advantages & disadvantages. (10 Marks)

"Waste Compaction" is the process of compacting wastes to reduce its volume & densify the waste.

Compaction is done at three levels, namely in Collection vehicles, transfer station and disposal site. Garbage compactors and waste collection vehicles compress waste so that more waste can be loaded within the provided space. At the transfer station they are compacted into bales of cubes or pellets. Waste is also compacted again, more thoroughly, at the landfill to conserve valuable airspace and to extend the landfill's life span.

— O.M.

Advantages of Compaction:

- i) Compaction results in the reduction in the amount of materials to be handled at the disposal site.
- ii) Improved efficiency of collection & disposal of solid wastes.
- iii) Compaction is very important in the feasibility analysis of Solid Waste Management.

— O.M.

Disadvantages of Compaction:

- i) Recyclable material quality will be poor, when solid wastes get compacted.
- ii) Once the solid waste get compacted, the separation or sorting process is too difficult.
- iii) Food wastes & organic biodegradable matters when compacted along with other wastes will reduce the recycling value of paper & plastics.

— O.M.

9.10.10 Masaka

Q.No. 46

Briefly explain the equipments used in size reduction. (10 Marks)

Ans:

"Size reduction" is required to convert the large sized wastes into smaller pieces. Size reduction helps in obtaining the final product in a reasonably uniform and considerably reduced size in comparison to the original form.

This process not necessarily imply to volume reduction. The wastes once shredded will increase in volume but if compacted then can further be reduced in volume.

— O2M.

The most frequently used shredding equipments are.

Hammer Mills: These are used most often in large commercial operations for reducing the size of the wastes. Hammer mill is an impact device consisting of a number of hammers, fastened flexibly to an inner disk which rotates at high speed. Solid wastes, as they enter the mill, are hit by sufficient force, which crush or tear them with a velocity so that they do not adhere to the hammers. Wastes are further reduced in size by being struck between breaker plates or cutting bars fixed around the periphery of the inner chamber. This process of cutting and striking action continues, until

The required size of the material is achieved and after that it falls out of the bottom of the mill.

Key Shredder:

The shredder is also known as chipper / grinder / shredder / Jaw crusher as per its requirement. The waste is shredded as per the required size for treatment technology.

Other shredding equipment used is hydro-pulper.

- 02 x 04 = 08M

Total: 10 Marks.

Q.No. 5a) Discuss the design considerations of aerobic Composting process. (10 Marks)

Following are the design considerations for effective aerobic Composting process.

i) Size of the material shredded: Wastes to be digested should be shredded to a size that will not interfere with the efficient functioning of Pumping & mixing operations.

ii) Mixing equipment: To achieve optimum results and to avoid scum build up, mechanical mixing is recommended.

iii) Loading rate: 0.6 to 1.6 kg/m³.d. Not well defined at present time. Significantly higher

Rates have been reported.

v) %age of solid wastes mixed with sludge:

Although amounts of waste varying from 50 to 90+ percent have been used, 60% appears to be a reasonable compromise.

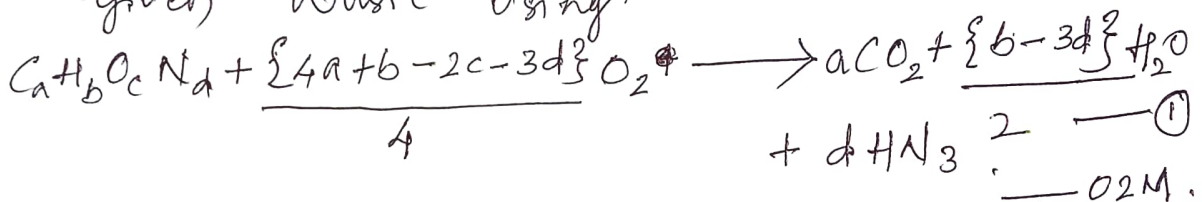
v) Total Solids destroyed: varies from 40 to 60% depending on inert material percent originally.
(0.2 x 0.5 — 10M.)

Q.No. 5b)

Determine the amount of air required to oxidize completely 1 tonne of waste having the chemical equation $C_{50}H_{100}O_{40}N$ (10 Marks)

Solⁿ

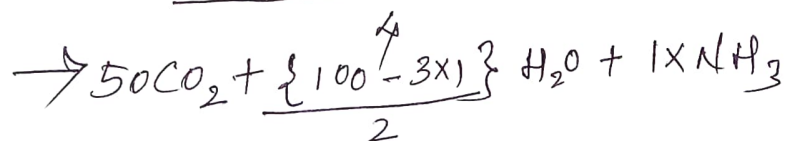
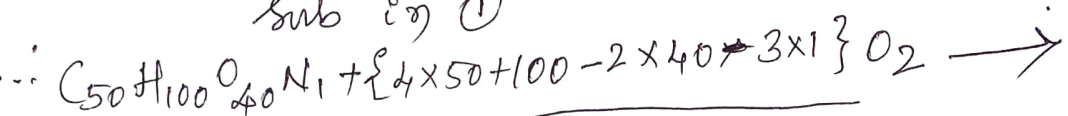
Step 1: Determine the oxygen requirement for the given waste using



Step 2: Now Given

$$a = 50, b = 100, c = 40 \text{ \& } d = 1$$

Sub in (1)



Now the atomic weights of

$$C = 12, H = 1, O = 16 \text{ and } N = 14$$

Therefore, molecular weight is given by

$$C_{50}H_{100}O_{40}N_1 = 12 \times 50 + 1 \times 100 + 16 \times 40 = 1354$$

$$54.25O_2 = 2 \times 54.25 \times 16 = 1736$$

$$50CO_2 = (50 \times 12 + 2 \times 50 \times 16) = 2200$$

$$48.5H_2O = 48.5 \times 2 \times 1 + 48.5 \times 16 = 873$$

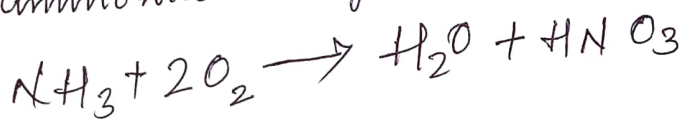
$$NH_3 = 14 + 3 \times 1 = 17$$

_____ 04 Marks.

∴ The oxygen required per tonne of waste is

$$O_2 = \left(\frac{1736}{1354} \right) \times 1000 = 1.282 \times 10^3 \text{ kg/tonne.}$$

Now determine the oxygen required to stabilize the ammonia using the equation



∴ Oxygen required for 1 tonne of waste is

$$O_2 = \left(\frac{17}{1354} \times \frac{64}{17} \right) \times 1000 = 47.3 \text{ kg/tonne}$$

Now determine the amount of air required assuming air contains 23.15% oxygen by weight and that the density of air is 1.2928 kg/m^3

$$a) O_2(\text{total}) = (1.282 + 47.3) \text{ kg/tonne} = 1329 \text{ kg/tonne}$$

$$b) \text{Air (mass)} = 1329 / 0.2315 = 5742 \text{ kg/tonne}$$

c) ∴ the volume of air required is

$$V_{\text{air}} = 5742 / 1.2928 = 4442 \text{ m}^3/\text{tonne.}$$

_____ 04M

Total 10 Marks.

Q.No.6a)

What is sanitary landfilling? Briefly explain the advantages of landfilling: (10 Marks)

Ans:

"Sanitary landfilling" is the method of controlled disposal of municipal solid waste (refuse) on land. In this method the waste is deposited in thin layers up to 1m or 3ft and promptly compacted by heavy machinery & several layers are placed and compacted on top of each other to form refuse cell of thickness 3m. At the end of each day the compacted refuse cell is covered with a layer of compacted soil to prevent odors and windblown debris. — 04 Marks.

Following are the advantages of landfilling

i) Landfills are an excellent energy source when trash accumulates and begins to break down, CO_2 & CH_4 are produced. These gases can be taken out, filtered out & used for energy production.

ii) Keep cities, towns, and districts clean with properly maintained landfill facilities, local trash will be dealt with locally instead of shifting them to other countries.

iii) Landfilling helps in keeping hazardous waste segregated.

iii) Landfills are cheap:

Garbage transport costs will be reduced, as our waste will only have to travel a short distance to landfills. This will also reduce the amount of pollution caused by transporting rubbish.

iv) Landfill support jobs & local business.

v) Modern landfills maintained technically are proved to be eco friendly.

06 Marks.

Total 10 Marks.

Q.No.66)

Numerical on design of Landfilling. (10 Marks)

Given:

* Total area available = $150 \times 100 = 15000 \text{ sq. m}$

* Area available for landfilling = $0.8 \times 15000 = 12000 \text{ sq. m}$.

* Avg. per capita MSW discarded per year in town = $0.05 \text{ tonne} = 50 \text{ kg}$.

* Landfill density = 500 kg/m^3 .

* Total height of landfill = 25 m

02 Marks.

Now

Volume of MSW generated by town per year = $\frac{50 \times 500000}{500} = 50000 \text{ m}^3$.

Assume depth of cell as 0.85 m

$$\therefore \text{Area required} = \frac{50000}{0.85}$$

$$= 58824 \text{ Sq. m.} \quad \text{--- 03M}$$

Then for

$$\text{a) Landfill lift per year} = \frac{58824}{12000}$$

$$= 4.902 \text{ m}$$

$$\text{b) No of years for which the land fill can be used} = 25/4.902$$

$$= 5.1 \text{ years.}$$

--- 02M

Total 10 Marks.

Q.No.7a) What is biomedical waste? Briefly explain effects of BMW on environment. (10 Marks)

Ans: "Bio-medical waste" means any waste generated during diagnosis, treatment or immunization of human beings or animals. --- 02M.

Effects of BMW are as follows.

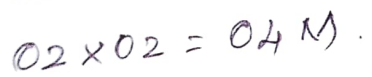
i) Air Pollution:

Air pollution can be caused in both indoors and outdoors atmosphere. As per KSPCB, BMW that generated by air pollution are been classified in three types namely, biological, chemical & radioactive. In doors air pollution pathogens present in the waste can enter & remain in the air for a long period in the form of

Spores or as pathogens.

ii) Water pollution:

The liquid waste generated when let into sewers can also lead into water pollution if not treated properly. Water pollution can alter parameters such as pH, BOD, DO, COD etc. There are instances where dioxins reported from water bodies near incineration plants. Dioxins enter the water bodies from the air.



iii) Land pollution:

Soil pollution from BAW is caused due to infectious waste, discarded medicines, chemicals used in treatment processes. Heavy metals such as Cadmium, lead, ~~and~~ mercury etc, which are present in the waste will get absorbed by the plants can then enter the food chain. Nitrates & phosphates present in leachate from landfills are also pollutants. Excessive amounts of trace nutrients elements and other elements including heavy metals in soil are harmful to crops and are also harmful to animals & human beings.

04 Marks

Total 10 Marks

Q.No.76) Briefly explain collection & transportation of biomedical wastes. (10 Marks)

Ans: * Collection of BMW:

The following table shows the Category, waste class, types of containers & colour of the bag/container used in the collection of BMW.

Category	Waste class	Type of Containers	Colour.
1)	Human anatomical waste	plastic	Yellow
2)	Animal waste	- do -	- do -
3)	Microbiology & bio technology waste	- do -	Yellow/red.
4)	Waste sharp	Puncture proof containers	Blue
5)	Discarded medicines & cytotoxic wastes	plastic bags	Black.

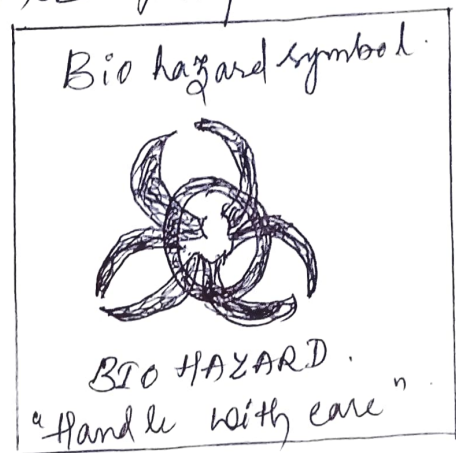
0.5M.

* Transportation of BMW

Waste bags & containers should be removed daily from wards/OPDs, Operation theatres, ICUs etc. Waste bags should be transported in a covered wheel containers or large bins in covered trolleys.

BMW transportation from healthcare establishments to the site of final disposal should be done in a closed motor vehicles such as truck, tractor-trolley to prevent the spillage of waste on the way.

Vehicles used for transport of BMW must have the "Bio-Hazard" symbol as shown below and these vehicles should not be used for any other purpose.



— 05M

Total 10Marks.

Q.No. 8ay Briefly explain the sources & types of E-wastes. (10Marks)

Ans:

Sources of E-wastes:

i) Households:

Electronic appliances which are used personally and in households are the most common sources of e-wastes. Such appliances are usually personal computers, DVD players, laptops, televisions, mobile phones etc.

ii) Electrical industries: Lighting fixtures and appliances such as sodium lamps, fluorescent-

tubes, sewing machines, lawn mowers, coil slot machines etc. These items are broadly categorized as WEEE or Waste Electrical & Electronic Equipments.

ii) Electronic Industries:

The scrap generated by such industries usually consists of toxic materials. Such materials, when improperly discarded, lead to environmental pollution.

iii) Flame Retardent Chemicals:

The flame retardent chemicals, which are present in cables, circuit boards, plastic casing are hazardous to health. The other materials like, switches, & flat screens contain Cadmium, barium, etc which are very harmful to environment.

iv) Imports: Imports from developed countries, to developing countries can also be considered as source of e-waste. There will be generation of e-waste after recycling, ~~the~~ process in the countries which import the e-wastes.

— OSM.

* Types of e-waste:

i) Temperature exchange equipment

These are more commonly referred as cooling freezing equipment. Typical equipments

includes refrigerators, freezers, air coolers etc.

ii) Screens, Monitors: Typical equipments includes televisions, monitors, laptops, tablets etc.

iii) Lamps: Typical equipments includes, fluorescent lamps, high density discharge lamps and LED lamps.

iv) Large equipments:

Typical equipments includes water washing machines, clothes dryers, dish washing machines, electric stoves, photovoltaic panels etc.

v) Small equipments:

Typical equipments includes, vacuum cleaners, microwaves, ventilation equipments, toasters, electric shavers, Calculators etc.

— 05M

Total 10 Marks.

Q.No. 8b) Briefly explain the options for the management of C&D debris. (10 Marks)

Ans:

There are four options for the management of C&D debris as follows.

i) Source reduction ii) Reuse

iii) Recycling iv) Landfilling

In recent times, the primary focus of C&D debris management programs throughout the country is on the first three i.e. source reduction, reuse & recycling. — 02M.

ix) Source Reduction:

Source reduction involves, reducing the amount of material used through more careful estimating to eliminate waste. Increasing cost for the disposal of C&D debris by landfilling, as a result of new regulations, continues to provide a stimulus for reducing the quantity of waste.

x) Reuse:

In any construction or demolition project, a wide variety of reusable & unused items will be found, including number of sizes, plywood, insulation, paint, heating duct and piping. In addition, other wastes such as broken concrete blocks & bricks can be used ~~for~~ as filler material.

xi) Recycling:

Recycling opportunities for C&D debris depends on the market's for the individual materials comprising the wastes and the ability to process the commingled waste or separate the individual materials. The principal materials that are now recovered from C&D debris for recycling include concrete, wood, asphalt shingles, drywall, metal etc.

xii) Land filling:

This is another option for managing the C&D debris used by US. Much of the

C&D debris generated in United States now ends up in separate C&D landfills. It is estimated that 35 to 45% of the building related C&D debris is disposed in C&D landfills. An additional 20 to 40% of C&D debris is disposed of in MSWLFs i.e. Municipal Solid Waste Landfills.

$$\frac{0.2 \times 0.4 = 0.08}{\text{Total: } 10 \text{ Marks}}$$

Q.No. 99 Briefly explain the types of incinerations. (10 Marks)

Ans: "Incineration" is the burning of waste in a specially designed combustion chamber. Following are the principle types of incinerations.

- i) Municipal waste incineration
- ii) Medical waste incineration
- iii) Waste to energy schemes.
- iv) Refuse Derived fuel (RDF) incineration
- v) Pyrolysis/Thermal gasification
- vi) Cement-Kilns. ——— 02M.

ii) Municipal Waste Incineration:

This is the still number one dioxin source, according to 1999 UNEP study. In many countries over the past few years, older incinerator plants have been updated & new incinerators have been built using improved technologies for air pollution control. This has led to

Substantial reduction of emissions of toxic substances to air.

ii) Waste to Energy incineration:

The generation of energy from waste has increased recently and in fact is used extensively by government & industry to green incineration and make it more acceptable to the general public. But all of the negative impacts from incineration do also apply to waste to energy facilities.

iii) Pyrolysis/Thermal gasification:

Pyrolysis and thermal gasification are related technologies. Pyrolysis is the thermal decomposition of organic materials at elevated temperatures in the absence of gases such as air or oxygen. This process, produces a mixture of combustible gases like CH_4 , CO & H_2 , liquids & solid residues.

iv) Cement Kilns:

Cement kilns are designed to make cement and not to dispose of waste. According to study by the US Center for the biology & natural systems, emissions of dioxins are eight times higher from cement kilns burning of hazardous waste, than from those that do not burn it.

$$0.2 \times 0.4 = 0.08$$

Total: 10 Marks.

Q.No: 965

Briefly explain any two by products of pyrolysis.
(10 Marks)

Ans:

"Pyrolysis" is the destructive distillation of the solid wastes, carbonaceous material in the presence of heat & in the absence of stoichiometric oxygen. Following are the by products of pyrolysis.

i) Biochar ii) Syngas

iii) Bio oil

— O2M.

i) Bio Char:

"Bio Char" is a solid amorphous carbonaceous material obtained from thermal degradation of lignin and hemicellulose polymer during the pyrolysis process.

Biochar predominantly contains larger portion of fixed carbon along with moisture, volatile materials, hydrogen etc. The aromatic portion of biochar contains, H, O, N, P & S. The %age of these constituents depend on the type of biomass & the process of pyrolysis. Biochar can be utilized as fuel in boilers. After catalytic treatment, it can be used to produce activated carbon, carbon nanotubes etc. — O4M

ii) Syngas: Based on biomass composition and process parameters of pyrolysis, the

The composition of syngas varies. Usually gaseous products obtained after pyrolysis process mostly comprise of H_2 & CO . It also contain negligible fractions of CO_2 , N_2 , CH_4 etc. The syngas comparatively elevated flame speed and temperature which produce greater temperature in engines to increase the speed of production of CO_2 & NO_x . At higher temperature flash pyrolysis gives more syngas. Calcinated dolomite was used at 750 to $900^\circ C$ as a catalyst using fixed bed reactor to produce syngas.

(04M)
Total: 10 Marks.

Q.No. 10 ay

What is KITE in SKIM? Briefly explain its benefits. (10 Marks)

Ans:

Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolysis, anaerobic digestion and landfill gas recovery. This process often called "Waste to Energy" (KITE) in Solid waste management (SKIM).

Municipal solid waste (MSW) contains organic as well as inorganic matter. The latent energy present in its organic fraction

Can be recovered for gainfull utilization through adoption of suitable waste processing & treatment technologies. — 05 Marks.

Following are the benefits of KITE.

i) The total quantity of waste get-reduced by nearly 60% to over 90% depending upon the waste composition and the adopted technology.

ii) Demand for land which is already scarce in cities, for landfilling is reduced.

iii) The cost of transportation of waste to faraway land filling is reduced.

iv) Net reduction in environmental pollution.

v) Whenever feasible, recovery from wastes is examined & is incorporated in the overall scheme of waste management. — 05M

Total 10 Marks.

Q.No-106) List and explain the sources of hazardous wastes (10 Marks)

Ans: "Hazardous wastes" are those that may contain toxic substances generated from industrial, hospitals, some types of household wastes. Some hazardous wastes are highly toxic to environment including humans, animals & plants. 01 Marks

Following are the sources of hazardous wastes.


- iv) Industries iv) Petroleum Refineries
- iv) Transportation iv) Coke ovens
- v) Blast furnace sludge v) Scrubbing Sludges
- v) Biomedical waste v) Households. ——— OSM.

Industries. Waste generated from industries can have non hazardous & hazardous components, with non hazardous wastes usually representing the greater part of the volume. This type of waste was identified as hazardous by carrying out tests like, corrosivity test, ignitability test, toxicity tests etc.

Biomedical waste: There are some medical & dental wastes that, when disposed improperly, could cause harm to the environment. Health care waste that is capable of producing injury or disease are infectious wastes, pathological wastes, sharps, pharmaceutical wastes, Genotoxic wastes etc.

Household wastes: Households generate small quantities of hazardous wastes such as oil based paints, wood preservatives, insecticides, used motor oil, antifreeze, batteries etc.

Higemath
(Prof. S. G. Higemath)
Staff Incharge


HEAD
Dept. of Civil Engg.
KLS V.D.I.T., Haliyal


Dean, Academics.